Game Theory

Honoring Abraham Neyman's Scientific Achievements:

June 16-19, 2015

PROGRAM

TUESDAY June 16, 2015

09:00 - 09:30	Welcome
	Session I
	Chair: Eilon Solan (Tel-Aviv University)
09:30 - 09:50	Eilon Solan (Tel-Aviv University) Stopping Games with Termination Rates
09:50 - 10:10	Fabien Gensbittel (Toulouse School of Economics) Zero-Sum Stopping Games with Asymmetric Information (joint with Christine Grün)
10:10 - 10:30	Miquel Oliu-Barton (Université Paris-Dauphine) The Asymptotic Value in Stochastic Games
10:30 - 10:50	Xiaoxi Li (University of Paris VI) Limit Value in Optimal Control with General Means (joint with Marc Quincampoix and Jérome Renault)
10:50 - 11:10	Break
	Session II
	Chair: Dov Samet (Tel-Aviv University)
11:10 - 11:30	Ehud Lehrer (Tel-Aviv University) No Folk Theorem in Repeated Games with Costly Monitoring
11:30 - 11:50	Antoine Salomon (Université Paris-Dauphine) Bayesian Repeated Games and Reputation
11:50 - 12:10	John Hillas (University of Auckland) Correlated Equilibria of Two Person Repeated Games with Random Signals (joint with Min Liu)
12:10 - 12:30	Gilad Bavly (Bar-Ilan University) How to Gamble Against All Odds
12:30 - 14:00	Lunch
	Session III
	Chair: John Hillas (University of Auckland)
14:00 - 14:20	Yoav Shoham (Stanford University) Intention, or, why the Formal Study of Rationality is Relevant to Software Engineering
14:20 - 14:40	Rene Levinsky (Max Planck Institute) Should I Remember More than You?: Best Response to Factor-Based Strategies
14:40 - 15:00	Dov Samet (Tel-Aviv University) Weak Dominance
15:00 - 15:20	János Flesch (Maastricht University) Subgame-Perfect Epsilon-Equilibrium in Perfect Information Games with Infinitely Many Players

15:20 - 15:40 Break

Session IV

Chair: Ori Haimanko (Ben-Gurion University)

15:40 - 16:00 Omer Edhan (Manchester University)
Cost Sharing: The Effect of Individual Demand

16:00 - 16:20 Benyamin Shitovitz (Haifa University)
A Comparison between Asymptotic Nucleolus and Kernel of Smooth Oligopoly with a Continuum of Players: An Example of a Duopoly (joint with Avishay Aiche)

16:20 - 16:40 Elchanan Ben-Porat (The Hebrew University of Jerusalem)
Optimal Allocation with Certifiable Information

16:40 - 17:00 Amparo Urbano (University of Valencia)
Network Performance under Attacks (joint with Iván Arribas and Víctor Tárrega)

17:00 - 17:20 Break

17:20 - 18:00 Chair: Ehud Lehrer (Tel-Aviv University) Ehud
Kalai (Northwestern University)
Stability Cycles in Big Games (joint with Eran Shmaya)

WEDNESDAY June 17, 2015

Session I

Chair: János Flesch (Maastricht University)

09:30 - 09:50 Reiko Aoki (Hitotsubashi University)
Feasible Patent Pools for Standards

09:50 - 10:10 Chang Zhao (Stony Brook University)
Bargaining on the Sale of a New Innovation in the Presence of Potential Entry

10:10 - 10:30 Amrita Dhillon (King's College London)
Overcoming Moral Hazard with Social Networks: An Experimental Approach (joint with Ronald Peeters and Ayşe Müge Yüksel)

10:30 - 10:50 Jinpeng Ma (Rutgers University)
Markovian Alpha Double Auctions

10:50 - 11:10 Break

Session II

Chair: Penelope Hernandez (University of Valencia)

11:10 - 11:30 Bruno Ziliotto (University of Toulouse)
A Tauberian Theorem for Non-Expansive Operators and Applications to Zero-Sum Stochastic Games

11:30 - 11:50 Xavier Venel (Université Paris 1)
Stochastic Games with Partial Observation and Borel Evaluation

11:50 - 12:10 Hari Govindan (University of Rochester) Homotopy
Methods for Stochastic Games

12:10 - 12:30 Johannes Horner (Yale University)
Implementation in Markovian Environments

12:30 - 14:00 Lunch

Session III

Chair: Hari Govindan (University of Rochester)

14:00 - 14:20 Yair Tauman (IDC Herzlyia and Stony Brook University)
Attacking the Unknown Weapons of a Possible Provocateur: How Intelligence Affects the Strategic Interaction (joint with Artyom Jelnov and Richard Zeckhauser)

14:20 - 14:40 Frank Page (Indiana University)
Endogenous Correlated Network Dynamics (joint with Rui Gong and Myrna Wooders)

14:40 - 15:00 Break

Chair: Ehud Kalai (Northwestern University)

15:00 - 15:40 Abraham Neyman (The Hebrew University of Jerusalem)
Stochastic Games

15:40 - 15:50 Break

Chair: Shmuel Zamir (The Hebrew University of Jerusalem)

15:50 - 16:30 Robert J. Aumann (The Hebrew University of Jerusalem)
My Merale

17:00 Reception (by invitation)

THURSDAY June 18, 2015

Session I

Chair: Frank Thuijsman (Maastricht University)

09:30 - 09:50 Penelope Hernandez (University of Valencia)
The Complexity of Interacting Automata
(joint with Olivier Gossner and Ron Peretz)

09:50 - 10:10 Igor Evstigneev (University of Manchester)
Evolutionary Behavioral Finance (joint with Rabah Amir, Thorsten Hens and Klaus Reiner Schenk-Hoppé)

10:10 - 10:30 Yuval Heller (Oxford University)
Stable Observable Behavior (joint with Erik Mohlin)

10:30 - 10:50 Rabah Amir (The University of Iowa)
Nash Equilibrium in Games with Quasi-Monotonic Best-Responses

10:50 - 11:10 Break

Session II

Chair: Johannes Horner (Yale University)

11:10 - 11:30 T. Parthasarathy (Osmania University)
Completely Mixed Stochastic Games

11:30 - 11:50 Jerome Renault (University Toulouse 1 Capitole)
Hidden Stochastic Games and Limit Equilibrium Payoffs

11:50 - 12:10 Yeneng Sun (National University of Singapore)
Stationary Markov Perfect Equilibria in Discounted Stochastic Games
(joint with Wei He)

12:10 - 12:30 Frank Thuijsman (Maastricht University)
Evolutionary Stochastic Games

12:30 - 14:00 Lunch

Session III

Chair: Francoise Forges (Université Paris-Dauphine)

14:00 - 14:20 Daniel Granot (Sauder School of Business)
A Game Theoretic Approach for the Allocation of Greenhouse Gas Emissions in Supply Chains (joint with Frieda Granot)

14:20 - 14:40 Nahum Shimkin (Technion)
An Online Convex Optimization Approach to Blackwell's Approachability

14:40 - 15:00 Eran Shmaya (Tel-Aviv University)
Learning the Ergodic Decomposition

15:00 - 15:20 Marco Scarsini (LUISS Guido Carli)
Dynamic Atomic Congestion Games with Seasonal Flows

15:20 - 15:40 Break

Session IV

Chair: Marco Scarcini (LUISS Guido Carli)

15:40 - 16:00 Ezra Einy (Ben-Gurion University)
The Value of Public Information in Common-Value Tullock Contests

16:00 - 16:20 Ori Haimanko (Ben-Gurion University)
Approximate Robustness of Equilibrium to Incomplete Information

16:20 - 16:40 John Levy (Oxford University)
Projections and Functions of Nash Equilibria

16:40 - 17:00 Bezalel Peleg (The Hebrew University of Jerusalem)
Choosing k from m: Feasible Elimination Procedures Reconsidered
(joint with Hans Peters)

17:00 - 17:20 Break

Chair: Pradeep Dubey (Stony Brook University)

17:20 - 18:00 John Nash (Princeton University) The
Method of Acceptances

FRIDAY June 19, 2015

Session I

Chair: Myrna Wooders (Vanderbilt University)

09:30 - 09:50 Jonathan Berk (Stanford University and NBER)
Matching Capital and Labor
(joint with Jules H. van Binsbergen and Binying Liu)

09:50 - 10:10 Pradeep Dubey (Stony Brook University)
Money as Minimal Complexity

10:10 - 10:30 Larry Samuelson (Yale University)
Favor Exchanges (joint with Ennio Stacchetti)

10:30 - 10:50 Break

Session II

Chair: Peyton Young (Oxford University)

10:50 - 11:10 John Geanakoplos (Yale University)
TBA

11:10 - 11:30	Myrna Wooders (Vanderbilt University) Elementary Conditions for Existence of Equilibrium with Unbounded Short Sales
11:30 - 11:50	Break
	Chair: Yair Taumann (IDC Herzliya and Stony Brook University)
11:50 - 12:30	Roger Myerson (Chicago University) Sequential Equilibria of Infinite Games (joint with Phil Reny)

ABSTRACTS

Eilon Solan (Tel-Aviv University)
Stopping Games with Termination Rates

Multiplayer stopping game with termination rates are continuous-time stopping games in which when some players stop at the time interval [t,t+dt), the game does not terminate with probability 1, but rather stops with some probability, which is of the order of dt and may depend on time and on the set of players who stop at that time. We prove that every multiplayer stopping game with termination rates admits an epsilon-equilibrium, for every positive epsilon.

Fabien Gensbittel (Toulouse School of Economics)
Zero-Sum Stopping Games with Asymmetric Information (joint with Christine Grün)

We study a model of two-player, zero-sum, stopping games with asymmetric information. We assume that the payoff depends on two continuous-time Markov chains (X, Y), where X is only observed by player 1 and Y only by player 2, implying that the players have access to stopping times with respect to different filtrations. We show the existence of a value in mixed stopping times and provide a variational characterization for the value as a function of the initial distribution of the Markov chains. We also prove a verification theorem for optimal stopping rules in the case where only one player has information.

Miquel Oliu-Barton (Université Paris-Dauphine) The
Asymptotic Value in Stochastic Games

We provide a direct, elementary proof for the existence of $\lim_{\lambda \to 0} v_\lambda$, where v_λ is the value of a λdiscounted finite two-person zero-sum stochastic game.

Xiaoxi Li (University of Paris VI)
Limit Value in Optimal Control with General Means
(joint with Marc Quincampoix and Jérome Renault)

We consider optimal control problems with an integral cost, where the integral of a running cost function is taken with respect to a Borel probability measure on R+ . As a particular case, the cost concerned is the Cesàro average over a fixed horizon. The limit of the value with Cesàro average when the horizon tends to in finity is widely studied in the literature. We address the more general question of the existence of a limit for values de fined by general means satisfying certain long-term condition.

For this aim, we introduce an asymptotic regularity condtion for Borel probability measures on R+. Our main result is that, for any sequence of Borel probability measures on R+ satisfying this condition, the associated value functions converge uniformly if and only if they are totally bounded for the uniform norm.

As a byproduct, we obtain the existence of a limit value (for general means) for control systems having a compact invariant set and satisfying suitable nonexpansive property.

Ehud Lehrer (Tel-Aviv University)
No Folk Theorem in Repeated Games with Costly Monitoring

We study two-player discounted repeated games in which players cannot automatically monitor each other nor do they observe their own stage payoff. Rather, after every stage each player can pay a fixed amount c and monitor the action just played by the other player. We analyse games in which the time lap between two stages and the cost c are small. We prove that, as both tend to 0, the limit set of Nash equilibrium payoffs, is equal to the set of public perfect equilibrium payoffs. We provide a full characterization of this limit set, and show that, it is typically a strict subset of the set of feasible and individually rational payoffs.

Antoine Salomon (Université Paris-Dauphine)
Bayesian Repeated Games and Reputation

The folk theorem characterizes the (subgame perfect) Nash equilibrium payoffs of an undiscounted or discounted infinitely repeated game - with fully informed, patient players - as the feasible individually rational payoffs of the one-shot game. To which extent does the result still hold when every player privately knows his own payoffs? Under appropriate assumptions (private values and uniform punishments), the Nash equilibria of the Bayesian infinitely repeated game without discounting are payoff equivalent to tractable, completely revealing, equilibria and can be achieved as interim cooperative solutions of the initial Bayesian game. This characterization does not apply to discounted games with sufficiently patient players. In a class of public good games, the set of Nash equilibrium payoffs of the undiscounted game can be empty, while limit (perfect Bayesian) Nash equilibrium payoffs of the discounted game, as players become infinitely patient, do exist. These equilibria share some features with the ones of multi-sided reputation models.

John Hillas (University of Auckland)
Correlated Equilibria of Two Person Repeated Games with Random Signals
(joint with Min Liu)

In this work we extend a result of Lehrer characterizing the correlated equilibrium payoffs in undiscounted two player repeated games with partial monitoring to the case in which the signals are permitted to be stochastic. In particular we develop appropriate versions of Lehrer's concepts of "indistinguishable" and "more informative." We also show that any payoff associated with a (correlated) distribution on strategy vectors in the stage game such that neither player can profitably

deviate from one of his strategies to another that is indistinguishable and more informative is the payoff of a correlated equilibrium of the supergame.

Gilad Bavly (Bar-Ilan University)
How to Gamble Against All Odds

A decision maker observes the evolving state of the world while constantly trying to predict the next state given the history of past states. The ability to benefit from such predictions depends not only on the ability to recognize patters in history, but also on the range of actions available to the decision maker. We assume there are two possible states of the world. The decision maker is a gambler who has to bet a certain amount of money on the bits of an announced binary sequence of states. If he makes a correct prediction he wins his wager, otherwise he loses it. We compare the power of betting strategies (aka martingales) whose wagers take values in different sets of reals. A martingale whose wagers take values in a set A is called an A-martingale. A set of reals B anticipates a set A, if for every A-martingale there is a countable set of B-martingales, such that on every binary sequence on which the A-martingale gains an infinite amount at least one of the B-martingales gains an infinite amount, too. We show that for two important classes of pairs of sets A and B, B anticipates A if and only if the closure of B contains r A, for some positive r. One class is when A is bounded and B is bounded away from zero; the other class is when B is well ordered (has no left-accumulation points). Our results generalize several recent results in algorithmic randomness and answer a question posed by Chalcraft et al. (2012).

Yoav Shoham (Stanford University)
Intention, or, why the Formal Study of Rationality is Relevant to Software Engineering

Why is the formal model of intention? Why is my calendar essentially the same as that of my late grandfather? And what do the two questions have to do with each other?

Rene Levinsky (Max Planck Institute)
Should I Remember More than You?: Best Response to Factor-Based Strategies

In this paper we offer a new approach to modeling strategies of bounded complexity, the so-called factor-based strategies. In our model, the strategy of a player in the multi-stage game does not directly map the set of histories H to the set of her actions. Instead, the player's perception of H is represented by a factor $\varphi : H \to X$, where X reflects the "cognitive complexity" of the player. Formally, mapping φ sends each history to an element of a factor space X that represents its equivalence class. The play of the player can then be conditioned just on the elements of the set X. From the perspective of the original multi-stage game we say that a function φ from H to X is a factor of a strategy σ if there exists a function ω from X to the set of actions of the player such that $\sigma = \omega \circ \varphi$. In this case we say that the strategy σ is φ-factor based. Stationary strategies and strategies played by finite automata and strategies with bounded recall are the most prominent examples of factor-based strategies. In the discounted infinitely repeated game with perfect monitoring, a best reply to a profile of φfactor-based strategies need not be a φ-factor-based strategy. However, if the factor φ is recursive, namely, its value $\varphi(a1, \ldots, at)$ on a finite string of action profiles)a1, . . . , at) is a function of $\varphi(a1, \ldots, at-1)$ and at, then for every profile of factor-based strategies there is a best reply that is a pure factor-based strategy. We also study factor-based strategies in the more general case of stochastic games.

Dov Samet (Tel-Aviv University)
Weak Dominance

What strategy profiles can be played when it is common knowledge that weakly dominated strategies are not played? A comparison to the case of strongly dominated strategy is in order. A common informal argument shows that if it is common knowledge that players do not play strongly dominated strategies

then players can play only profiles that survive the iterative elimination of strongly dominated strategies. We formalize and prove this claim. However, the analogous claim for the case of weak dominance does not hold. We show that common knowledge that players do not play weakly dominated strategies implies that they must play profiles that survive an iterative elimination of profiles, called flaws of weakly dominated strategies, a process described by Stalnaker (1994). The iterative elimination of flaws of strongly dominated strategies results in the same set of profiles as the iterative elimination of strongly dominated strategies. Thus, the case of weak dominance and strong dominance are completely analogous: Common knowledge that players do not play weakly, or strongly dominated strategies implies iterative elimination of flaws of weakly, or strongly dominated strategies, correspondingly. These processes, for both weak and strong dominance, are independent of the order of elimination.

János Flesch (Maastricht University)

Subgame-Perfect Epsilon-Equilibrium in Perfect Information Games with Infinitely Many Players

We consider multi-player perfect information games that are played on a tree of infinite depth. In the tree, each node is controlled by one of the players. Play of the game starts at the root. At every node that play visits, the player who controls this node has to choose one of the outgoing arcs. This induces an infinite sequence of nodes, and depending on this sequence, each player receives a payoff .

A strategy profile is called a subgame-perfect epsilon-equilibrium if in any subgame (i.e., starting at any node), no player can gain more than epsilon by a unilateral deviation. We discuss existence results for subgame-perfect epsilon-equilibria in games that are played by an arbitrary number of players.

Omer Edhan (Manchester University)

Cost Sharing: The Effect of Individual Demand

We study cost sharing problems in which demand can vary considerably across markets and services, but costs are determined at the aggregate level. We examine the effect of individual demand on the pricing mechanism under a list of axioms akin to the Mirman-Tauman framework. For differentiable costs, we prove that only the total aggregate demand affects the unique solution, which coincides with the Aumann-Shapley price mechanism. Contrasting that, for non-differentiable costs the unique solution heavily depends on individual demand.

Benyamin Shitovitz (Haifa University)

A Comparison between Asymptotic Nucleolus and Kernel of Smooth Oligopoly with a Continuum of Players: An Example of a Duopoly (joint with Avishay Aiche)

We compare the asymptotic nucleolus and kernel in differentiable oligopoly games with a continuum of players where there is a… finite number of traders' types. In the monopolistic case both asymptotic solution concepts coincide with the center of symmetry of the subset of the core in which all the monopolists receive the same payoff, (see Einy et al. JET 1999). In contrast, we analyze a smooth and symmetric oligopoly market game with an atomless sector (introduced in Aiche et al. IJGT 2014) where the asymptotic kernel strictly contains the nucleolus, which coincides with the unique t.u.c.e. In this general set-up, the homogeneous ocean's exploitation in the asymptotic kernel is similar to that in the core, that is its least upper bound is (for the ocean) the t.u.c.e. payoff. Moreover, in a symmetric duopoly with two big players, the asymptotic kernel coincides with the closed interval whose end points

are from above the t.u.c.e. payoff and from below the t.u.c.e. payoff in the submarket with all the ocean and one big player.

Elchanan Ben-Porat (The Hebrew University of Jerusalem)
Optimal Allocation with Certifiable Information

TBA

Amparo Urbano (University of Valencia)
Network Performance under Attacks
(joint with Iván Arribas and Víctor Tárrega)

Infrastructure, information transmission and traffic networks play an important role in current Economy. Communication networks, transports and interbank connections are only a few examples of this vital and crucial importance. This paper develops a sequential model of network defense where a Network Defender chooses a set of network nodes to costly protect and a Network Attacker observes the defended network and decides whether to costly attack a set of network nodes. The network consists of N nodes, each of them could be interpreted as an economic agent (for instance: a bank, a firm, a transport station, etc.). The network together with the choice of defense and attack define a residual network. The value of the residual network depends on the performance of the surviving nodes. The goal of the Network Defender is to maximize the net value of the residual network, while the objective of the Network Attacker is to minimize this value. We study the subgame perfect Nash equilibrium of this game.

Instead of centering on network connectivity, we focus on network performance that evaluates the system behavior. Performance is a measure of the maximum flow or traffic among nodes. To evaluate network performance, we use a gravity model with node capacity constraints. The value of the residual network will be the maximum flow of the surviving nodes. To evaluate our model we offer two polar network examples: Scale free networks and Poisson networks.

Ehud Kalai (Northwestern University)
Stability Cycles in Big Games (joint with Eran Shmaya)

A big game is one played repeatedly by a large population of players. The game changes as fundamentals of nature change and player type distribution depends on the changing fundamentals. The population of players may change, but information about the outcomes of plays is passed from one generation to the next. Differential incomplete information and imperfect monitoring are present.

Big games give rise to a *stability cycles* that consists of well-defined segments that start after fundamental changes. Each segment consists of a bounded number of chaotic learning periods, followed by hindsight-stable periods with predictable outcomes.

The lecture presents illustrative examples; a game theoretic analysis of one segment of such a cycle; and a discussion of how to tractably model equilibrium, the definition of predictability and stability, and basic findings in simple versions of such games.

<u>WEDNESDAY June 17, 2015</u>

Reiko Aoki (Hitotsubashi University)
Feasible Patent Pools for Standards

We present two alternative interpretations of reasonable and non-discriminatory (RAND) policy for licensing essential patents for implementing a standard: (1) reasonable royalty is the royalty rate hypothetically negotiated ex-ante i.e., before standard adoption, and (2) reasonableness introduces renegotiation possibility, leading to favored customer treatment effect. We show that there is no incentive to resort to injunctions with (1). Rule (2) prevents the usual unraveling of sequential coalition formation and again a grand coalition can form in equilibrium.

Chang Zhao (Stony Brook University)

Bargaining on the Sale of a New Innovation in the Presence of Potential Entry

We consider an industry with one incumbent and many potential entrants. Initially the high entry cost does not enable a pro table entry. Suppose an outside innovator holds a patent on a technology that eliminates the entry cost but has a marginal cost at least as high as the current one. The innovator wishes to sell his intellectual property (IP) to the incumbent, through bargaining. Even though the technology itself is useless for the incumbent, he may purchase the IP to limit or exclude further entry. The innovator may sell a few licenses to new entrants before approaching the incumbent.

This on one hand reduces the total industry pro t but enables a better credible threat on the incumbent and hence may increases the innovator's payoff. A licensing contract with an entrant species the license fee together with the maximum number of licenses that can be sold. The contracts are signed sequentially and they are bound by previous commitments. The rms are engaged in Cournot competition in the last stage. It is shown that depending on the marginal cost of the new technology and on the bargaining power of the innovator relative to that of the incumbent, there are three types of subgame perfect Nash equilibrium (SPNE): (i) the innovator sells rst a license to one entrant before selling his IP to the incumbent. The incumbent then put the technology on the shelf to exclude further entry. (ii) the innovator sells one license to an entrant before selling the IP to the incumbent. The incumbent then licenses the new technology to one additional entrant and (iii) the innovator sells the IP directly to the incumbent who then put the technology on the shelf.

Amrita Dhillon (King's College London)

Overcoming Moral Hazard with Social Networks: An Experimental Approach

(joint with Ronald Peeters and Ayşe Müge Yüksel)

The use of social networks in the workplace has been documented by many authors, although the reasons for their widespread prevalence are less well known. In this paper we present evidence based on a lab experiment that suggests quite strongly that social networks are used by employers to reduce worker moral hazard. We capture moral hazard with a dictator game between the referrer and worker. The worker chooses how much to return under different settings of social proximity. Social proximity is captured using Facebook friendship information gleaned anonymously from subjects once they have been recruited. Since employers themselves do not have access to social connections, they delegate the decision to referrers who can select among workers with different degrees of social proximity to themselves. We show that employers choose referrals over anonymous hiring relatively more when they know that the referrer has access to friends, and are willing to delegate more often when the social proximity between referrer and worker is potentially higher. In keeping with this expectation, referrers also choose workers with a greater social proximity to themselves and workers who are closer to referrers indeed pay back more to the referrer. The advantage of the lab setting is that we can isolate directed altruism as the only reason for these results.

Jinpeng Ma (Rutgers University)

Markovian Alpha Double Auctions

This paper studies the $\alpha-$double auction in Xu et al. (2014) and extends their results to the case where α is time-varying in a manner governed by a time non-homogeneous Markov chain specified in Ram et al. (2009) over a set of states defined by $R\equiv\{\alpha_1, \alpha_2, \cdots, \alpha_r\}$, $0\le \alpha_1<\alpha_2<\cdots<\alpha_r\le 1$. The convergence results in Xu et al. (2014) hold, with α replaced with the average $\alpha^*=\frac{1}{r}\sum_{\theta=1}^r \alpha_\theta$. We also identify the conditions under which the price process generated by such a Markovian $\alpha-$double auction converges to a Walrasian equilibrium of the underlying exchange economy. The assignment problem and an exchange economy with indivisible goods (Bikhchandani and Mamer 1997) typified by the noted job matching model in Kelso and Crawford (1982) are two examples covered by our convergence results. A number of simulations are conducted and these simulations show that the excess volatility in equity market may in part come from the use of double auction mechanisms.

Bruno Ziliotto (University of Toulouse)

A Tauberian Theorem for Non-Expansive Operators and Applications to Zero-Sum Stochastic Games

We prove a Tauberian theorem for nonexpansive operators, and apply it to the model of zero-sum stochastic game. Under mild assumptions, we prove that the value of the lambda-discounted game v_{lambda} converges uniformly (with respect to the initial state) when lambda goes to 0 if and only if the value of the n-stage game v_n converges uniformly (with respect to the initial state) when n goes to infinity. This generalizes the Tauberian theorem of Lehrer and Sorin (1992) to the two-player zerosum case. We also provide the first example of a stochastic game with public signals on the state and perfect observation of actions, with finite state space, signal sets and action sets, in which for some initial state k_1 known by both players, (v_{lambda}(k_1)) and (v_n(k_1)) converge to distinct limits.

Xavier Venel (Université Paris 1)

Stochastic Games with Partial Observation and Borel Evaluation

The aim of this presentation is to study two-player zero-sum stochastic games with partial observation. At each stage, both players choose some actions. This generates a stage payoff then a new state and new signals are randomly chosen according to a transition function.

There are several ways to study the long term behaviour of these games. A lot of attention has been given to two of these approaches: the asymptotic behavior of the n-stage game and the uniform value which focuses on what payoff a player can guarantee independently of the length of the game. A recent couterexample of Ziliotto (2013) with symmetric information showed that when the players are not informed of the state, the values of the n-stage games may not converge.

In this presentation, we come back to a point of view coming from the literature of game determinacy (Gale and Stewart 1953) and adopted by Maitra and Sudderth (1992): from the sequence of stage payoff, we can define an evaluation on the set of infinite histories and study the existence of the value in the induced normal form game.

We provide several counterexamples to the existence of the value and several positive results. In particular, there exists a value for any Borelian evaluation in stochastic games with symmetric information.

Hari Govindan (University of Rochester)

Homotopy Methods for Stochastic Games

TBA

Johannes Horner (Yale University)
Implementation in Markovian Environments

The aim of this paper is to provide a characterization of the Markovian decision rules that are implementable via transfers. This generalizes the static analysis of Rochet (1987) to the case in which the agent observes the values of a Markov chain.

Yair Tauman (IDC Herzliya and Stony Brook University)
Attacking the Unknown Weapons of a Possible Provocateur:
How Intelligence Affects the Strategic Interaction
(joint with Artyom Jelnov and Richard Zeckhauser)

We consider the interaction of two enemy nations. Nation 1 wants to develop a nuclear bomb (or other weapons of mass destruction). Nation 2 wants to prevent such a development through the deterrence of a threatened attack, or an actual attack if it thought the bomb was produced. 2 has an intelligence system that imperfectly indicates the presence of a bomb. 1, if lacking the bomb, can open its facilities to prevent an attack. A further uncertainty is that nation 2 does not know nation 1's type. He could be a Deterrer, whose prime goal is to avoid an attack, or he could a Provocateur who prefers an unjustified attack if he does not possess the bomb, so as to build support from inside his nation or the outside world. The game has a unique sequential equilibrium. The qualitative nature of that equilibrium depends on parameters on preferences and information conditions.

A number of initially counterintuitive results emerge. For example, it may sometimes be rational (an equilibrium strategy) for 2 to attack even though 1 does not have a bomb, and even though 2's high quality intelligence system indicates that a bomb is not present. Fortunately, intuitive explanations can be provided for all such results.

Illustrations of the model's implications are provided from the experiences of the West (nation 2) with Saddam Hussein and the Ayatollah Khameini (nation 1). Sometimes be rational (an equilibrium strategy) for 2 to attack even though 1 does not have a bomb, and even though 2's high quality intelligence system indicates that a bomb is not present. Fortunately, intuitive explanations can be provided for all such results.

Illustrations of the model's implications are provided from the experiences of the West (nation 2) with Saddam Hussein and the Ayatollah Khameini (nation 1).

Frank Page (Indiana University)
Endogenous Correlated Network Dynamics (joint with Rui Gong and Myrna Wooders)

We model the structure and strategy of social interactions prevailing at any point in time as a directed network and we address the following open question in the theory of social and economic network formation: given the rules of network and coalition formation, preferences of individuals over networks, strategic behavior of coalitions in forming networks, and the trembles of nature, what network and coalitional dynamics are likely to emergence and persist. Our main contributions are to formulate the problem of network and coalition formation as a dynamic, stochastic game and to show that: (i) the game possesses a correlated stationary Markov equilibrium (in network and coalition formation strategies), (ii) together with the trembles of nature, this correlated stationary equilibrium determines an equilibrium Markov process of network and coalition formation, and (iii) this endogenous Markov process possesses a finite set of ergodic measures, and generates a finite, disjoint collection of nonempty subsets of networks and coalitions, each constituting a basin of attraction. Moreover, we

extend to the setting of endogenous Markov dynamics the notions of pairwise stability (Jackson-Wolinsky, 1996) and the path dominance core (Page-Wooders, 2009a).

We show that in order for any network-coalition pair to emerge and persist, it is necessary that the pair reside in one of finitely many basins of attraction. The results we obtain here for endogenous network dynamics and stochastic basins of attraction are the dynamic analogs of our earlier results on endogenous network formation and strategic basins of attraction in static, abstract games of network formation (Page and Wooders, 2009a), and build on the seminal contributions of Jackson and Watts (2002) Konishi and Ray (2003), and Dutta, Ghosal, and Ray (2005).

Abraham Neyman (The Hebrew University of Jerusalem)
Stochastic Games

TBA

Robert J. Aumann (The Hebrew University of Jerusalem)
My Merale

A review of some of the works of Prof. Neyman with which the speaker is familiar.

THURSDAY June 18, 2015

Penelope Hernandez (University of Valencia)
The Complexity of Interacting Automata
(joint with Olivier Gossner and Ron Peretz)

This paper studies the interaction of two automata of size m and shows that they can be identified as a more complex automaton of size comparable to m log(m). The set of plays generated by two correlated automata is characterised by studying a statistic property of random plays induced by probability measures on the set of pairs of automata with m states each. We provide possibility and impossibility results regarding the empirical distributions of those distributions. Our results have implications on the correlated min-max value of repeated games played under automaton size constraints.

Igor Evstigneev (University of Manchester)
Evolutionary Behavioral Finance
(joint with Rabah Amir, Thorsten Hens and Klaus Reiner Schenk-Hoppé)

The talk introduces to a new research field developing evolutionary and behavioral approaches to the modeling of financial markets. The main objective is to create a plausible alternative to the conventional Walrasian equilibrium theory based on the hypothesis of full rationality of market players. Rather than maximizing (typically unobservable) individual utility functions, traders/investors are admitted to have a whole variety of patterns of strategic behavior depending on their individual psychology. The models considered in this field combine elements of evolutionary game theory (solution concepts) and stochastic dynamic games (strategic frameworks).

Yuval Heller (Oxford University)
Stable Observable Behavior (joint with Erik Mohlin)

We study stable behavior when agents are randomly matched, and before the interaction begins each agent observes partial information about the partner's aggregate behavior. We present a novel modeling approach and characterize when stationary strategies uniquely determine the aggregate behavior. We then show that arbitrarily low levels of observability may destabilize non-strict stable outcomes, while strict Nash equilibria are stable for any level of observability. Next, we apply the model to study the Prisoner's Dilemma. We show that if players only observe past actions, then defection is

the unique stable outcome. However, if players are able to observe past action profiles, then cooperation is also stable. Finally, we extend the model to deal with non-stationary strategies and subjective preferences.

Rabah Amir (The University of Iowa)
Nash Equilibrium in Games with Quasi-Monotonic Best-Responses

This paper develops a new existence result for pure-strategy Nash equilibrium. In succinct form, 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 pseudocomplementarities.

We also prove some extensions to n-player games, at the cost of some further plausible assumptions. Along the way, the paper provides a number of ancillary results of independent interest, including sufficient conditions for a quasiincreasing argmax, comparative statics of equilibria, and new sufficient conditions for uniqueness of fixed points. For maximal accessibility of the results, in addition to a general lattice-theoretic treatment, the main results are presented in a Euclidean setting.

We argue that all these results have broad and elementary applicability by providing simple illustrations with four commonly used models from applied microeconomic fields.

T. Parthasarathy (Osmania University)
Completely Mixed Stochastic Games

In this talk we consider finite discounted and undiscounted stochastic games. Suppose stochastic game is completely mixed. Does it imply the individual matrix game in each state completely mixed? Under some conditions on the reward function and the transition probabilities it is answered in the affirmative. Otherwise we can produce a counter example. Suppose individual matrices in every state are 2x2 matrices. Then the stochastic game is completely mixed if and only if 2x2 matrices are completely mixed under the following conditions namely 2x2 matrices are symmetric and transition probabilities are controlled by one player. This result fails to hold in higher dimension. Finally some open problems will be mentioned. This is a joint work with Sujatha Babu and Krishnamurthy Nagarajan and it is in progress.

Jerome Renault (University Toulouse 1 Capitole)
Hidden Stochastic Games and Limit Equilibrium Payoffs

We consider 2-player stochastic games with perfectly observed actions, and study the limit, as the discount factor goes to one, of the equilibrium payoffs set. In the usual setup where current states are observed by the players, we show that the set of stationary equilibrium payoffs always converges, and provide a simple example where the set of equilibrium payoffs has no limit. We then introduce the more general model of hidden stochastic game, where the players publicly receive imperfect signals over current states. In this setup we present an example where not only the limit set of equilibrium payoffs does not exist, but there is no converging selection of equilibrium payoffs. This second example is robust in many aspects, in particular to perturbations of the payoffs and to the introduction of correlation or communication devices.

Yeneng Sun (National University of Singapore)
Stationary Markov Perfect Equilibria in Discounted Stochastic Games

(joint with Wei He)

The existence of stationary Markov perfect equilibria in stochastic games is shown in several contexts under a general condition called "coarser transition kernels". These results include various earlier existence results on correlated equilibria, noisy stochastic games, stochastic games with mixtures of constant transition kernels as special cases. The minimality of the condition is illustrated. The results here also shed some new light on a recent example on the nonexistence of stationary equilibrium. The proofs are remarkably simple via establishing a new connection between stochastic games and conditional expectations of correspondences.

Frank Thuijsman (Maastricht University)
Evolutionary Stochastic Games

We extend the notion of Evolutionarily Stable Strategies introduced by Maynard Smith and Price (Nature 246:15–18, 1973) for models ruled by a single fitness matrix A, to the framework of stochastic games developed by Lloyd Shapley (Proc. Natl. Acad. Sci. USA 39:1095–1100, 1953) where, at discrete stages in time, players play one of finitely many matrix games, while the transitions from one matrix game to the next follow a jointly controlled Markov chain. We show that this extension from a singlestate model to a multistate model can be done on the assumption of having an irreducible transition law. In a similar way, we extend the notion of Replicator Dynamics introduced by Taylor and Jonker (Math. Biosci. 40:145–156, 1978) to the multistate model. These extensions facilitate the analysis of evolutionary interactions that are richer than the ones that can be handled by the original, singlestate, evolutionary game model. Several examples are provided.

Daniel Granot (Sauder School of Business)
A Game Theoretic Approach for the Allocation of Greenhouse Gas Emissions in Supply Chains (joint with Frieda Granot)

Globalization, which exports production and jobs from rich countries to poor countries, also exports from rich countries to poor countries the greenhouse gas (GHG) emissions created from the production of the goods consumed by rich countries. But whose responsibility are the GHG emissions? Are they exclusively the responsibility of the producing countries, or exclusively the responsibility of the consuming countries? Or, perhaps, the responsibility for the GHG emissions should be shared by both the producers and the consumers?

Our approach to the GHG emission responsibility (GGER) problem is to formulate it as a cooperative game, referred to as the GGER game, and use cooperative game theory methodology to suggest allocations of GHG responsibility among the various parties in the supply chain. We prove that the GGER game is convex, and thus has a non-empty core, and we identify some allocation methods which are extreme core points and are used in practice. We derive an explicit expression for the Shapley value of the GGER game, which is shown to have a very simple and intuitive interpretation, and we provide an axiomatic characterization of the Shapley value in the family of GGER games. Further, we develop an efficient algorithm to compute the nucleolus in some instances of the GGER game, and we illustrate our approach by allocating GHG emissions in a newspaper publishing supply chain.

*Joint work with Greys Sosic and Hailong Cui, Marshall School of Business, USC, and with Sanjith Gopalakrishnan, Sauder School of Business, UBC.

Nahum Shimkin (Technion)
An Online Convex Optimization Approach to Blackwell's Approachability

The notion of approachability in repeated games with vector payoffs was introduced by Blackwell in the 1950s, along with geometric conditions for approachability and corresponding strategies that rely on computing steering directions as projections from the current average payoff vector to the (convex) target set. Recently, Abernethy, Batlett and Hazan(2011) proposed a class of approachability algorithms that rely on the no-regret properties of Online Linear Programming for computing a suitable sequence of steering directions.

This is first carried out for target sets that are convex cones, and then generalized to any convex set by embedding it in a higher-dimensional convex cone. In this paper we present a more direct formulation that relies on the support function of the set, along with suitable

Online Convex Optimization algorithms, which leads to a general class of approachability algorithms. We further show that Blackwell's original algorithm and its convergence follow as a special case.

Eran Shmaya (Tel-Aviv University)
Learning the Ergodic Decomposition

A Bayesian agent learns about the structure of a stationary process from observing past outcomes. We prove that his predictions about the near future become approximately those he would have made if he knew the long run empirical frequencies of the process.

Marco Scarsini (LUISS Guido Carli)
Dynamic Atomic Congestion Games with Seasonal Flows

We propose a model of discrete time dynamic congestion games with atomic players and single source-destination pair. The latencies of edges are composed of free-flow transit time and possible queuing time due to capacity constraints. This allows to give a precise description of the dynamic induced by individual strategies of players and to study how the steady state is reached, either when players act selfishly, or when the traffic is controlled by a planner. Our contributions are three-fold. First, we establish that socially optimal and equilibrium flows eventually coincide, and according to the max-flow min-cut principle, send players at capacity over the edges of minimum cuts of the network. However, queues created by selfish players in early periods induce equilibrium costs that are higher than optimal costs.
Second, we show some differences between atomic and non-atomic dynamic congestion games. For instance, we compare the equilibrium conditions and several measures of efficiency.
Third, we illustrate a new dynamic version of Braess's paradox that may arise: the presence of initial queues in a network may decrease the long-run equilibrium latency. This paradox arises in networks for which no Braess's paradox was previously known.

Ezra Einy (Ben-Gurion University)
The Value of Public Information in Common-Value Tullock Contests (joint with Moreno and Shitovitz)

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; Rd; determines the effect on equilibrium efforts and payoffs of the increased áexibility/reduced commitment that more information introduces into the contest: If Rd is increasing and the value (cost of effort) is independent of the state, then the equilibrium expected effort increases (decreases) with the level of information. Moreover, if Rd is increasing (decreasing), then the value of public information is non-negative (non-positive).

Ori Haimanko (Ben-Gurion University)
Approximate Robustness of Equilibrium to Incomplete Information

We relax the Kajii and Morris (1997a) notion of equilibrium robustness by allowing approximate equilibria in close incomplete information games. The new notion is termed "approximate robustness.

The approximately robust equilibrium correspondence turns out to be upper hemicontinuous, unlike the (exactly) robust equilibrium correspondence. As a corollary of the upper hemicontinuity, it is shown that approximately robust equilibria exist in all two-player zero-sum games and all two-player two-strategy games, whereas (exactly) robust equilibria may fail to exist for some games in these categories.

John Levy (Oxford University)
Projections and Functions of Nash Equilibria

We show that any compact semi-algebraic subset of mixed action profiles on a fixed player set can be represented as the projection of the set of equilibria of a game in which additional binary players have been added. Even stronger, we show that any semi-algebraic continuous function, or even any semi-algebraic upper-semicontinuous correspondence with non-empty values, from a bounded semialgebraic set to the unit cube can be represented as the projection of an equilibrium correspondence of a game with binary players in which payoffs depend on parameters from domain of the function or correspondence in a multilinear way.

Bezalel Peleg (The Hebrew University of Jerusalem)
Choosing k from m: Feasible Elimination Procedures Reconsidered
(joint Hans Peters)

We show that feasible elimination procedures (Peleg, 1978) can be used to select k from m alternatives. An important advantage of this method is the core property: no coalition can guarantee an outcome that is preferred by all its members. We also provide an axiomatic characterization for the case k = 1, using the conditions of anonymity, Maskin monotonicity, and independent blocking. Finally, we show for any k that outcomes of feasible elimination procedures can be computed in polynomial time, by showing that the problem is computationally equivalent to finding a maximal matching in a bipartite graph.

John Nash (Princeton University)
The Method of Acceptances

TBA

FRIDAY June 19, 2015

Jonathan Berk (Stanford University and NBER)
Matching Capital and Labor
(joint with Jules H. van Binsbergen and Binying Liu)

We establish an important role for the firm by studying capital reallocation decisions of mutual fund firms. At least 30% of the value mutual fund managers add can be attributed to the firm's role in efficiently allocating capital amongst its mutual fund managers. We find no evidence of a similar effect when a firm hires managers from another firm. We conclude that an important reason why firms exist is the private information that derives from the firm's ability to better assess the skill of its own employees.

Pradeep Dubey (Stony Brook University)
Money as Minimal Complexity (joint with Siddhartha Sahi, and Martin Shubik)

We consider mechanisms that provide traders the *opportunity* to exchange commodity i for commodity j, for certain ordered pairs ij. Given any connected graph G of opportunities, we show that there is a unique mechanism M_G that satisfies some natural conditions of "fairness" and "convenience". Let $\mathfrak{M}(m)$ denote the class of mechanisms $M_G$obtained by varying G on the commodity set $\{1, \dots, m\}$. We define the complexity of a mechanism M in $\mathfrak{M}(m)$ to be a pair of integers $\tau(M), \pi(M)$ which represent the "time" required to exchange i for j and the "information" needed to determine the exchange raio (each in the worst case scenario, across all $i \neq j$. This induces a quasiorder $\preccurlyeq$ on $\mathfrak{M}(m)$ by the rule

$$M \preccurlyeq M' \text{ if } \tau(M) \leq \tau(M') \; aaa \; \pi(M) \leq \pi(M').$$

We show that, for $m > 3$, there are precisely three $\preccurlyeq$- minimal mechanisms $M_G$in $\mathfrak{M}(m)$, where G corresponds to the star, cycle and complete graphs. He star mechanism has a distinguished commodity – the money – that serves as the sole medium of exchange and mediates trade between decentralized markets for the other commodities.
Our mail result is that, for *any* weights $\succ, \mu > 0$, the star mechanism is the *unique* minimizer of $\succ \tau(M) + \mu\pi(M)$ on $\mathfrak{M}(m)$ for large enough m.

Larry Samuelson (Yale University)

Favor Exchanges (joint with Ennio Stacchetti)

We examine repeated interactions between two players, each of whom randomly encounters a "favor" opportunity, in the which the player incurs a cost in order to confer a benefit on the the other player. We examine how, in the absence of transfers, the players use continuation payoffs to create the incentives to confer such favors, and how continuation payoffs and transfers interact when the latter are available. We find that transfers are welfare improving, but nonetheless that transfers may be very rare in equilibrium play. We relate these results to studies of interactions in which people are reported to routinely engage in favor trading, but to seldom make transfers to one another.

John Geanakoplos (Yale University)

TBA

Myrna Wooders (Vanderbilt University)

Elementary Conditions for Existence of Equilibrium with Unbounded Short Sales

TBA

Roger Myerson (Chicago University)

Sequential Equilibria of Infinite Games (joint with Phil Reny)

TBA