6TH SPAIN, ITALY, AND NETHERLANDS MEETING ON GAME THEORY

JULY 7-9, 2010, PALERMO, ITALY

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A Message from the General Chair

On behalf of the organizing committee I would like to express my warmest welcome to all attendees of the 6th Spain, Italy and Netherlands meeting on Game Theory (SING 6). The meeting will be held at the University of Palermo, from July 7 to 9, 2010. The meeting is under the auspices of Institute of Electrical and Electronics Engineers (IEEE) - Italian Chapter, Control Systems Society (CSS) and Systems Man and Cybernetics (SMC), Società Italiana Docenti e Ricercatori in Automatica (SIDRA), Associazione Italiana Ricerca Operativa (AIRO), Associazione per la Matematica Applicata alle Scienze Economiche e Sociali (AMASES), Dipartimento di Matematica, Statistica, Informatica e Applicazioni “Lorenzo Mascheroni”, Università di Bergamo, Dipartimento di Matematica Applicata, Università “Cà Foscari” Venezia, Dipartimento di Ingegneria Informatica, Università di Palermo. The technical program includes 4 parallel tracks of sessions with about 130 contributions and 5 plenary talks. SING6 is being made possible because of the contributions of a great number of individuals. First, my sincere thanks go out to all authors and plenary speakers. I thank all the members of the organizing committee and the administrative staff of the “Dipartimento di Ingegneria Informatica”. I also want to thank the University of Palermo central administration and the “Assemblea Regionale Siciliana” for providing funds. I look forward to seeing you at the SING6 and encourage you to consider spending a few days to enjoy the many opportunities for outdoor and cultural activities.

Dario Bauso
General Chair

A Message from the Local Organizing Chairs

It is our great pleasure to welcome you to SING6 2010, in the historical city of Palermo, Italy. In addition to a program of 32 technical sessions consisting of about 130 papers, SING6 this year will include 5 outstanding plenary talks. The technical program covers a broad spectrum of research topics in game theory, such as cooperative/non cooperative games, bargaining, auction, learning, economics and cost sharing, repeated games, oligopoly games, distributed optimization and control games, mechanism design and social networks, game theory in logistics and supply chain, operational research games, evolutionary games and signaling. We are pleased about the broad variety of topics in the technical program. For the first time the meeting will be attended by scientists of multi-disciplinary interests, such as control and communication engineers, operational researchers, economists and mathematicians. We believe that the presented papers will offer exciting new perspectives that will foster innovative future research. We thank the members of the program committee for their work. We thank Dario Bauso, the General Chair of SING6 2010, for his enormous effort in taking care of the most part of the organization. We hope that you will find this program interesting and thought-provoking and that the conference will provide you with a valuable opportunity to network with other researchers and practitioners from institutions around the world.

Local Organizing Committee:

- Laura Giarrè (vice-chair)
- Fabio Bagagiolo
- Antonio Chella
- Salvatore Gaglio
- Raffaele Pesenti
- Ilenia Tinnirello
Conference Venue

SING6 will be held at the “Complesso Polididattico”, in front of the Aula Magna of the Faculty of Engineering, Università di Palermo. The “Complesso Polididattico” is located in the Campus of the University, in viale delle Scienze, Palermo. The campus is close to the subway station “Orleans”, to “Parco d’Orleans” and at walking distance (about 15 minutes) from the Cattedrale (Cathedral) and from the Palazzo dei Normanni (Norman Palace, site of Sicilian Goverment).

Registration

All conference attendees must be registered. The provided personal badges must be worn to identify registered participants. All registration categories include access to technical sessions, coffee breaks, and welcome party. All registered participants will receive a pen drive containing the book of abstracts. Full rate registration also includes the Conference Banquet on Thursday, July 8th. The registration packages will be available at the registration desk starting from Wednesday at 8.00 am.

Light Lunches

Light lunches will be served at the "Mensa-cafeteria". Mensa is inside the campus; to get there, exit the complesso, turn right and walk for about 200 meters and you will see the entrance on your right (after some external stairs). Once inside, you will be asked to show the ticket lunch provided with the package to the cashier. Try to get to the mensa before 1 pm to avoid long queues.
Conference Banquet

The conference banquet will be at the Castello Utveggio, a castle in liberty style located upon Monte Pellegrino at 346 m above sea level. Castello Utveggio was built in 1928-1933 and was site of a luxury grand hotel first and a casinò after some years. In 1984, the sicilian regional government bought it and destined it to a school on management studies called “CERISDI”. Buses will leave at 7 pm from Complesso Polididattico. Welcome ceremony and a brief speech of Prof. Aumann (15 min) will precede the banquet.

Welcome Party

Welcome party will take place at Palazzo Steri (site of University Administrative Bureau). Palazzo Steri is in piazza Marina n. 61 and 2,5 km far from the Complesso Polididattico (see the route below).

Instructions for Speakers

For lecture/oral presentations each room will have the following equipment: i) Laptop with PDF or PowerPoint software ii) LCD projector, and iii) Screen. Please note that conference rooms “WILL NOT PROVIDE OVERHEAD PROJECTORS FOR PRESENTATIONS”. So, in case you intended to use transparencies, please, scan and convert them into an electronic PDF file.
History

Italy

The first occasion in which Italian researchers joined together for a meeting on Game Theory dates back to 1983, thanks to the initiative of Gianfranco Gambarelli and Michele Grillo. On the 12th of October in Bergamo, a working day was held about: “A discussion between economists and mathematicians: recent contributions from Game Theory to Economics”. One year later, Pierangelo Mori and Fioravante Patrone organised, in Pavia (December 14 and 15) the first meeting under the name that would last for a long time: “Convegno di Teoria dei Giochi ed Applicazioni” (which was called the “second meeting” to acknowledge the relevance of the “working day” held in Bergamo). Invited speakers were Gerhard Schwodiauer and Stef Tijjs. Then came Firenze, in 1986: the meeting was on 23rd and 24th May, and it was organised by Andrea Battinelli and Guidi. The invited speakers were Michael Bacharach and Reinhard Selten. Next, it was again the turn of Bergamo, in 1987 (main organiser: Gambarelli), followed by Cagliari 1988 (Andrea Battinelli), Modena 1989 (Gianni Ricci), Pisa 1992 (Giacomo Costa), Genova 1993 (Fausto Mignanego and Fioravante Patrone), Siena 1995 (Stefano Vannucci), Bergamo (the 10th, edition, again Gambarelli) 1996, Milano 1997 (Michele Polo and Gilli), Genova 1998 (jointly with Game Practice I, Fioravante Patrone), Bologna 1999 (Elettro Agliardi).

During this period the “CITG” (Centro Interuniversitario per la Teoria dei Giochi e le sue Applicazioni - Interuniversity Centre for Game Theory and Applications) was created, under the initiative of the researchers in Pavia, Bergamo and Firenze. It was born in Firenze (official birth date: December 31, 1990) with the participation of a dozen of Universities. The first director was, for six years, Piero Tani, followed by Marco Dardi and Fioravante Patrone. A new form of this Center is forthcoming. The CITG organised the “International Conference on Game Theory” in Firenze, from 25 to 27 of June, 1991. The meeting of Ischia 2001 was organised by Jaqueline Morgan having in mind the alternation agreement with Spain, and luckily saw a very good participation of Spanish researchers. Gian Italo Bischi organised the 2003 Meeting in Urbino, where a lot of special sections were organised by Gambarelli in honour of the 65th birthday of Guillermo Owen. Andrea di Liddo was the organiser of the 2006 edition at Foggia.

Spain

The first occasion in which Spanish researchers joined for a meeting on Game Theory dates back to 1994. In those days, the number of Spanish game theorists was increasing considerably and the growing Spanish Game Theory community decided to organise a conference every two years. The first Spanish Game Theory Meeting, organised in Bilbao by Federico Valenciano and Jose Zarzuelo, was a great success. Since then, the meetings in Santiago de Compostela (1996), organised by Ignacio Garcia Jurado, Barcelona (1998), organised by Carles Rafels, and Valencia (2000), organised by Amparo Urbano, were great successes, with more than 100 presentations in each of them, showing the good health of the many Spanish research groups in Game Theory and their growing international links. The meetings in Sevilla (2002), organised by Mario Bilbao and Paco Ramón Fernández, and Elche (2004), organised by Joaquín Sánchez Soriano, continued the “joint venture” between Italy and Spain started in 2000. In 2005, a new partner, The Netherlands, joined the club.

The Netherlands

There is no tradition of organising Dutch game theory conferences. There is a monthly game theory seminar (afternoon or day) in Tilburg, first established in Nijmegen in 1982 by Stef Tijjs, and now under the responsibility of Peter Borm. There is also, since the middle of the eighties, a monthly seminar on the closely related area of social choice in Tilburg, organised by Ton Storcken, Ad van Deemen, and Harrie de Swart. In 1996, the Third International Meeting of the Society for Social Choice and Welfare was organised (in Maastricht) by Hans Peters and Ton Storcken. The first conference on Logic, Game Theory and Social Choice (LGS1) was organised by Harrie de Swart in 1999 (Tilburg-Oisterwijk). In 2002, Peter Borm organised a game theory conference on the occasion of the 65th birthday of Stef Tijjs (Tilburg). Several workshops on (cooperative) game theory were and are organised by Gerard van der Laan and René van den Brink (Amsterdam) and Theo Driessen (Enschede). The 8-th International Symposium on Dynamic Games and Applications was organised by Frank Thuijsman and Koos Vrieze (Maastricht-Vaalsbroek, 1998).

SING: The joint venture

In 2000 Federico Valenciano organised in Bilbao GAMES 2000, the first Meeting of the Game Theory Society. During this conference Fioravante Patrone, director of the Italian CITG, took the initiative of looking for a “joint venture” between Italy and Spain, suggesting the alternation of Italian and Spanish meetings. The agreement of this idea by the involved researchers lead to the meetings of Ischia (2001), Sevilla (2002), Urbino (2003) and Elche (2004). During the Meeting of Urbino the idea of The Netherlands as a new entry into the Italian-Spanish alternation, proposed by Patrone, was eagerly approved. The first edition of SING (Spanish-Italian-Netherlands Game Theory Meeting) was organised by Hans Peters in Maastricht from 24 to 26 June 2005. Andrea di Liddo organised the second edition, SING2, in Foggia. Juan Tejada organized SING3 in Madrid in 2007. In 2008 the conference was organized outside one of the three SING countries for the first time. Jacek Mercik organized SING4 in Wroclaw, Poland. In 2009 SING5 was held in Amsterdam, The Netherlands. In 2010 Italy will be host again when Dario Bauso will organize SING6 in Palermo. In 2011 the conference will again go outside the SING countries when Michel Grabisch will organize SING7 in Paris.
Program at a Glance

Program for Wednesday July 7, 2010

8.00 - 9.00  Registration
9.00 - 9.20  Opening, Aula Magna
9.20 - 10.10 Plenary I, Aula Magna
10.10 - 11.00 Plenary II, Aula Magna
11.00 - 11.30 Coffee break
11.30 - 12.30 WeA1, Cooperative Games I - WeA2, Bargaining I
WeA3, Algorithmic Game Theory - WeA4, Bargaining II
12.30 - 14.00 Lunch
14.00 - 15.20 WeB1, Cooperative Games II - WeB2, Auctions
WeB3, Coop. Models & Game Pract. - WeB4, Learning
15.20 - 15.40 Coffee break
15.40 - 17.00 WeC1, Economics and Cost Sharing - WeC2, OR games I
WeC3, OR Games II - WeC4, Non Cooperative Games
17.00 - 17.45 SING Country Representatives’ Meeting
18.30 - 20.30 Welcome party at “Palazzo Steri”

Program for Thursday July 8, 2010

9.10 - 10.00  Plenary I, Aula Magna
10.00 - 10.30  Coffee break
10.30 - 12.30  ThA1, Distr. Opt. & Control via Games
ThA2, Cooperative games I - ThA3, Cooperative games II
ThA4, GT in Logistics & Supply Chain
12.30 - 14.00  Lunch
14.00 - 15.20  ThB1, Repeated Games I - ThB2, Voting and Power Indices
ThB3, Oligopoly Games - ThB4, Non cooperative games I
15.20 - 15.40  Coffee break
15.40 - 17.00  ThC1, Repeated Games II - ThC2, Cooperative Games III
ThC3, Mechanism Design and Social Networks
ThC4, Cooperative Games IV
20.00 - 23.00  Banquet

Program for Friday July 9, 2010

9.20 - 10.10  Plenary I, Aula Magna
10.10 - 11.00  Plenary II, Aula Magna
11.00 - 11.30  Coffee break
11.30 - 12.50  FrA1, Non Cooperative Games I - FrA2, Cooperative Games I
FrA3, Voting and Power Indices
FrA4, Evolutionary games and signaling
12.50 - 14.00  Lunch
14.00 - 15.20  FrB1, Non Cooperative Games II - FrB2, Cooperative Games II
FrB3, Games and Economics
FrB4, Cost Sharing
15.20 - 15.50  Coffee break
15.50 - 16.40  Assembly of SING Members
16.40 - 17.00  Closing
17.00 - 21.00  Visit of Palermo
Program for **Wednesday July 7, 2010**

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<td>9.00 - 9.20</td>
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<td>9.20 - 10.10</td>
<td>Plenary I, Aula Magna</td>
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<td>Dynamic Teams, Games, and Non-Classical Information</td>
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<td>Bajar, Tamer* - Univ. of Illinois, Urbana-Champaign</td>
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<td>10.10 - 11.00</td>
<td>Plenary II, Aula Magna</td>
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<td>Feedback solutions of non-cooperative differential games</td>
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<td>Bressan, Alberto* - Pennstate Univ.</td>
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<td>11.00 - 11.30</td>
<td>Coffee break</td>
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<td>11.30 - 12.30</td>
<td>WeA1, Cooperative Games I - Chair: Lorenzo</td>
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<td>11.30 - 11.50</td>
<td>Games on fuzzy communication structures with Choquet players</td>
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<td>Jiménez-Losada, André* - Univ. de Sevilla</td>
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<td>Fernández, J. R. - Univ. de Sevilla</td>
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<td>Grabisch, Michel - Univ. of Paris I, CES</td>
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<td>Ordóñez, Manuel - Univ. de Sevilla</td>
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<td>11.50 - 12.10</td>
<td>A Non-cooperative and an Axiomatic Characterization of the AL - values</td>
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<td>Kongo, Takumi* - Waseda Univ.</td>
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<td>Funaki, Yukihiro - Waseda Univ.</td>
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<td>Branzei, Rodica - Al I. Cuza* Univ.</td>
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<td>Tij, Stef - Tilburg Univ.</td>
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<td>12.10 - 12.30</td>
<td>Mixed rules in multi issue allocation situations</td>
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<td>Bergantiños, Gustavo - Univ. de Vigo</td>
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<td>Lorenzo, Leticia* - Univ. de Vigo</td>
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<td>Lorenzo-Freire, Silvia - Univ de Coruña</td>
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<td>11.30 - 12.30</td>
<td>WeA2, Bargaining I - Chair: Mazalov</td>
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<td>11.30 - 11.50</td>
<td>Emergence of nested coalition structures in a pure bargaining game</td>
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<td>Imai, Haruo* - Kyoto Univ.</td>
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<td>11.50 - 12.10</td>
<td>Bargaining one-dimensional policies and the efficiency of super majority rules</td>
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<td>Cardona, Daniel - Univ. de les Illes Balears</td>
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<td>Ponsati, Clara* - Institut d'Anàlisi Econòmica (CSIC), Barcelona</td>
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<td>12.10 - 12.30</td>
<td>Effect of correlation in bargaining model with Juri</td>
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<td>Mazalov, Vladimir* - Karelia Research Center</td>
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<td>Tokarevay, Yulia - Zabaikalsky State Humanitarian Pedagogical Univ.</td>
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<td>11.30 - 12.30</td>
<td>WeA3, Algorithmic Game Theory - Chair: Markakis</td>
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<td>11.30 - 11.50</td>
<td>Algorithmic explorations of a well known wargame</td>
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<td>Ciancarini, Paolo* - Univ. Bologna</td>
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<td>Favini, Gian Piero - Univ. Bologna</td>
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<td>11.50 - 12.10</td>
<td>Experimenting with Game-Theoretical Computer Models</td>
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<td>Hrube, Martin* - Brno Univ. of Technology</td>
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<td>12.10 - 12.30</td>
<td>Algorithmic Aspects of the Core in Cooperative Games over Graphs</td>
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<td>Chalkiadakis, George - Univ. of Southampton</td>
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<td>Markakis, Evangelios* - Athens Univ. of Economics and Business</td>
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<td>Jennings, Nick R. - Univ. of Southampton</td>
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<td>11.30 - 12.30</td>
<td>WeA4, Bargaining II - Chair: Ju</td>
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<td>11.30 - 11.50</td>
<td>The relationship of the bargaining set of Davis and Maschler</td>
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<td>Getán, Jesús* - Univ. of Barcelona</td>
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<td>Montes, Jesús - Univ. Abad Oliba</td>
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<td>11.50 - 12.10</td>
<td>Market Games and the Bargaining Set</td>
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<td>Ziros, Nicholas* - Univ. of Cyprus</td>
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<td>12.10 - 12.30</td>
<td>On the Robustness of the Shapley Value in Bargaining with Renegotiation</td>
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<td>Ju, Yuan* - Univ. of York</td>
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<td>12.30 - 14.00</td>
<td>Lunch</td>
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<td>14.00 - 15.20</td>
<td>WeB1, Cooperative Games II - Chair: Skoda</td>
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<td>14.00 - 14.20</td>
<td>Compensations in the Shapley value and the compensation solutions for graph games</td>
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<td>Béal, Sylvain* - Univ. de Saint-Etienne</td>
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<td>Rémiia, Eric - Univ. de Lyon</td>
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<td>Solal, Philippe - Univ. de Saint-Etienne</td>
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14.20 - 14.40  
The monolcus of an airport game  
Gulick, Gerwald van - Tilburg Univ.  
Norde, Henk* - Tilburg Univ.  
Reijnierse, Hans - Tilburg Univ.  
Slikker, Marco - Eindhoven Univ. of Technology

14.40 - 15.00  
Multi-sided Böhm-Bawerk assignment games: point solutions  
Tejada, Orio* - Univ. de Barcelona

15.00 - 15.20  
Coalition structures induced by the strength of a graph  
Grabisch, Michel - Univ. of Paris I, CES  
Skoda, Alexandre* - Univ. de Paris I

14.00 - 15.20  
WeB2, Auctions - Chair: Drabik  
The Value at Risk of the Revenue in Some Auction Models  
Alonso-Pérez, Estrella* - Univ. Pontificia Comillas de Madrid  
Tejada-Cazorla, Juan - Univ. Complutense de Madrid

14.20 - 14.40  
Application of auction rules on the Polish Power Exchange  
Drabik, Ewa* - Warsaw Univ. of Technology

14.40 - 15.00  
Multi-attribute Procurement Auction With no Prior Scoring  
Nielsen, Kurt* - Univ. of Copenhagen

15.00 - 15.20  
Competing for Free-Riding: Strategic Non-Bidding in an Ascending Package Auction  
Sano, Ryuji* - Univ. of Tokyo

14.00 - 15.20  
WeB3, Cooperative Models and Game Practice (Invited) - Chair: Mallozzi  
How to handle interval solutions for cooperative interval games  
Alparslan Gök, S. Zeynep - Suleyman Demirel Univ., Isparta  
Branzei, Rodica* - "Al. I. Cuza" Univ.  
Tij, Stef - Tilburg Univ.

14.20 - 14.40  
A class of solutions for river games with multiple springs and externalities  
vanden Brink, René - Free Univ. of Amsterdam  
van der Laan, Gerard* - Free Univ. of Amsterdam  
Moes, Nigel - Free Univ. of Amsterdam

14.40 - 15.00  
Bankruptcy in a fuzzy framework and new solution concepts  
Mallozzi, Lina - Univ. of Naples "Federico II"  
Scalzo, Vincenzo* - Univ. of Naples  
Tij, Stef - Tilburg Univ.

15.00 - 15.20  
The cost sharing problem for a facility location situation with regional fixed costs  
Mallozzi, Lina* - Univ. of Naples "Federico II"

14.00 - 15.20  
WeB4, Learning - Chair: Sopher  
Job Market Signaling and Employer Learning  
Aílos-Ferrer, Carlos* - Univ. of Konstanz  
Prat, Julien - (IAE-CSIC), Barcelona

14.20 - 14.40  
Local Conventions and Social Planners  
Shi, Fei* - Univ. of Konstanz

14.40 - 15.00  
Network games and genes centrality  
Moretti, Stefano - Univ. of Paris Dauphine  
Fragnelli, Vito - Univ. of Eastern Piedmont  
Patrone, Fioravante* - Univ. of Genoa  
Bonassi, Stefano - IRCCS San Raffaele Pisana

15.00 - 15.20  
Information Aggregation and Communication in Group Decision Making  
Sopher, Barry* - Rutgers Univ.  
Lau, Richard - Rutgers Univ.  
Birchby, Jeffrey - Rutgers Univ.  
Andersen, David - Rutgers Univ.

15.20 - 15.40  
Coffee break

15.40 - 16.00  
WeC1, Economics and Cost Sharing - Chair: Grilli  
Tax Evasion as a Global Game (TEGG) in the laboratory  
Sanchez-Villalba, Miguel* - Univ. of Alicante

16.00 - 16.20  
Sharing a polluted river network through environmental taxes  
Gómez-Rúa, María* - Univ. de Vigo

16.20 - 16.40  
A Game Theoretical Study of the Wheat Market in South Italy  
Grilli, Luca* - Univ. degli Studi di Foggia  
Sfrecola, Angelo - Univ. degli Studi di Foggia
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<td><strong>WeC2, OR games I - Chair: Hougaard</strong></td>
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<td>15.40 - 16.00</td>
<td><strong>An extension of Owen allocations in Linear Production Games</strong></td>
<td>Fernández, Francisco R. - Univ. of Seville</td>
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<td>Perea, Federico* - Univ. of Saragossa</td>
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<td>Puerto, Justo - Univ. of Seville</td>
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<td>16.00 - 16.20</td>
<td><strong>Linear Production Games with a Common - Pool Resource</strong></td>
<td>Llorca, Natividad - Miguel Hernández Univ. of Elche</td>
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<td>Mosquera, Manuel Alfredo - Vigo Univ.</td>
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<td>Sánchez-Soriano, Joaquin* - Miguel Hernández Univ. of Elche</td>
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<td>16.20 - 16.40</td>
<td><strong>Strategyproof Nash Equilibria in Minimum</strong></td>
<td>Hougaard, Jens Leth* - Univ. of Copenhagen</td>
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<td>Tvede, Mich - Univ. of Copenhagen</td>
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<td>16.40 - 17.00</td>
<td><strong>A solution concept in two-sided market models</strong></td>
<td>Llorca, Natividad* - CIO, Miguel Hernández Univ.</td>
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<td>Sánchez-Soriano, Joaquin - CIO, Miguel Hernández Univ.</td>
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<td>15.40 - 17.00</td>
<td><strong>WeC3, OR games II - Chair: Ghintran</strong></td>
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<td>15.40 - 16.00</td>
<td><strong>How flow can you go? An application of an OR game in practice</strong></td>
<td>Heeschen, Remco - Tilburg Univ.</td>
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<td>Hamers, Herbert* - Tilburg Univ.</td>
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<td>Huisman, Kuno - Tilburg Univ.</td>
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<td>16.00 - 16.20</td>
<td><strong>Cooperative Situations: Games and Cost Allocations</strong></td>
<td>Kleepe, John* - Tilburg Univ.</td>
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<td>Borm, Peter - Tilburg Univ.</td>
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<td>Hendrickx, Ruud - Tilburg Univ.</td>
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<td>Reijnierse, Hans - Tilburg Univ.</td>
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<td>16.20 - 16.40</td>
<td><strong>Egalitarian Tree Solutions for Graph Games</strong></td>
<td>Béal, Sylvain - Univ. de Saint-Etienne</td>
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<td>Ghintran, Amandine* - Ôbuda Univ.</td>
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<td>Rémiel, Eric - Univ. de Lyon</td>
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<td>Solal, Philippe - Univ. de Saint-Etienne</td>
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<td>Allocating slacks in stochastic PERT network</td>
<td>Gomez, Daniel* - Univ. Complutense Madrid</td>
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<td>Castro, Javier - Univ. Complutense Madrid</td>
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<td>Tejada, Juan - Univ. Complutense Madrid</td>
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<td>15.40 - 16.40</td>
<td><strong>WeC4, Non cooperative Games - Chair: Vyrastekova</strong></td>
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<td><strong>Non-cooperative approaches to claims or bankruptcy problems</strong></td>
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<td>Berden, Caroline - SEO Economic Research</td>
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<td>Palvölgőyi, Denes - Univ. of Maastricht</td>
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<td>Peters, Hans* - Univ. of Maastricht</td>
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<td>Vermeulen, Dries - Univ. of Maastricht</td>
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<td><strong>Expectations of altruistic punishment in a public goods game</strong></td>
<td>Vyrastekova, Yana* - Radboud Univ.</td>
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<td>Funaki, Yukihiro - Waseda Univ.</td>
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<td><strong>Evolutionary Reputation Model for Distributed</strong></td>
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<td>Service Oriented Architectures</td>
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<td>De Paola, Alessandra* - Univ. Palermo</td>
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<td>Milazzo, Fabrizio - Univ. Palermo</td>
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<td>17.00 - 17.45</td>
<td><strong>SING Country Representatives’ Meeting</strong></td>
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<td>18.30 - 20.30</td>
<td><strong>Welcome party at “Palazzo Steri”</strong></td>
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Program for Thursday July 8, 2010

9.10 - 10.00  Plenary I Aula Magna
Engineering cooperation in two-player strategic games
Kalai, Ehud* - Northwestern Univ.

10.00 - 10.30  Coffee break

10.30 - 12.30  ThA1, Distributed optimization and control via games - Chair: Blanchini
10.30 - 10.50  A Distributed Scheme for Network Localization from Relative Distance Measurements
Calafiore, Giuseppe C.* - Politecnico di Torino
Carbone, Luca - Politecnico di Torino
Weix, Mingzhu - Politecnico di Torino

10.50 - 11.10  On Ergodicity, Infinite Flow and Consensus in Random Models
Touri, Behrouz - Univ. of Illinois
Nedić Angelia* - Univ. of Illinois

11.10 - 11.30  A Distributed coordination-by-constraints approach for set-point management of Interconnected Multi-Agent System
Casavola, Alessandro - Univ. of Calabria
Garone, Emanuele* - Univ. of Calabria
Tedesco, Francesco - Univ. of Calabria

11.30 - 11.50  A Game Theoretic Approach to Resources Management in Home Automation Systems
Conte, Giuseppe - Univ. Politecnica delle Marche
Pecori, Anna Maria - Univ. Politecnica delle Marche
Scardozzi, David* - Univ. Politecnica delle Marche
Rosettani, Matteo - Univ. Politecnica delle Marche

11.50 - 12.10  Control of Multi Inventory Systems with Constrained Average Uncertain Demand
Blanchini, Franco* - Univ. Udine
Collini, Valeria - Univ. Udine

12.10 - 12.30  A generalized MAC protocol for contention- based infrastructure networks
Tinnirello, Ilenia* - Univ. Palermo
Giarré, Laura - Univ. Palermo

10.30 - 12.30  ThA2, Cooperative games I - Chair: Østerdal
10.30 - 10.50  On the Nucleolus for 2-Convex TU Games
Driessen, T.S.H.* - Univ. of Twente
Hou, Dongshuang - Univ. of Twente

10.50 - 11.10  On the axiomatisation of the balanced solution for cooperative TU-games
van den Brink, René - Free Univ. of Amsterdam
Levínský, René* - Max Planck Institute of Economics
Zelený, Miroslav - Charles Univ, Prague

11.10 - 11.30  An extension of Shapley's value to multivariate games
Hernández-Lamoneda, Luis* - Centro de Investigación en Matemáticas
Sánchez-Sánchez, Francisco - Centro de Investigación en Matemáticas

11.30 - 11.50  Forming and dissolving partnerships in cooperative game situations
Platz, Trine Tornæ - Univ. Copenhagen
Tvede, Mich - Univ. Copenhagen
Østerdal, Lars Peter* - Univ. Copenhagen

11.50 - 12.10  An approach to values based on sub-coalition
Bertini, Cesarino - Univ. Bergamo
Gambarelli, Gianfranco - Univ. Bergamo
Stach, Izabella* - AGH Univ. of Science and Technology

12.10 - 12.30  Individual Incentives and Network Security
Larson, Nathan* - Univ. of Virginia

10.30 - 12.30  ThA3, Cooperative games II - Chair: Álvarez-Mozas
10.30 - 10.50  The tree and web values for games with cycle- free directed communication structures
Khmelnitskaya, Anna* - Russian Academy of Sciences
Talman, Adolphus Johannes Jan - Tilburg Univ.

10.50 - 11.10  Polyhedral Results on the Core of the Shortest Path Tree Games
Horozoglu, Nayat* - London School of Economics
Papadaki, Katerina P. - London School of Economics
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<td>The Shapley value for games with restricted cooperation</td>
<td>Katsev, Ilya* - Russian Academy of Sciences</td>
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<td>11.30 - 11.50</td>
<td>Young's axiomatization of the Shapley value - a new proof</td>
<td>Pintér, Miklós* - Univ. of Budapest</td>
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<td>11.50 - 12.10</td>
<td>On Semivalue for TU games on matroids</td>
<td>Dragon, Irinel* - Univ. of Texas</td>
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<td>12.10 - 12.30</td>
<td>A Banzhaf value for games with levels structure of cooperation</td>
<td>Álvarez-Mozos, Mikel* - Univ. of Santiago de Compostela</td>
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<td>New, Oriol - Univ. of Barcelona</td>
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<td>10.30 - 12.30</td>
<td>ThA4, Game Theory in Logistics and Supply Chain (Invited) - Chair: Meca</td>
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<td>10.30 - 10.50</td>
<td>Cooperation in a multi-client distribution network</td>
<td>Fiestras-Janeiro, M. Gloria - Vigo Univ.</td>
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<td>Garcia-Jurado, Ignacio - Coruña Univ.</td>
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<td>Meca, Ana - Miguel Hernández Univ. of Elche</td>
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<td>Mosquera, Manuel Alfredo* - Vigo Univ.</td>
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<td>10.50 - 11.10</td>
<td>Cooperation in multisuppliers distribution chains with stochastic and bounded demand</td>
<td>Meca, Ana - Miguel Hernández Univ. of Elche</td>
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<td>Puerto, Justo* - Univ. de Sevilla</td>
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<td>Guardiola, Luis - Miguel Hernández Univ. of Elche</td>
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<td>11.10 - 11.30</td>
<td>Cooperation in Tandem Lines</td>
<td>Timmer, Judith* - Univ. of Twente</td>
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<td>Scheinhardt, Werner - Univ. of Twente</td>
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<td>11.30 - 11.50</td>
<td>Nucleolus Based Revenue Sharing in Airline Alliances</td>
<td>Kimms, Alf* - Univ. of Duisburg-Essen</td>
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<td>11.50 - 12.10</td>
<td>Stable Group Purchasing Organizations</td>
<td>Nagarajan, Mahesh - Sauder School of Business</td>
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<td>Sošić, Greys* - Mashall School of Business</td>
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<td>Zhang, Hao - Mashall - School of Business</td>
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<td>12.10 - 12.30</td>
<td>Cost sharing in distribution problems for franchises operations</td>
<td>Fiestras-Janeiro, M. Gloria - Vigo Univ.</td>
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<td>Garcia Jurado, Ignacio - Coruña Univ.</td>
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<td>12.30 - 14.00</td>
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<td>14.00 - 14.20</td>
<td>Quality Unilateral Commitments</td>
<td>Briata, Federica* - G. D'Annunzio* Univ., Chieti-Pescara</td>
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<td>Patrone, Fioravante - Univ. of Genoa</td>
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<td>Kittis, Mitri* - Aalto Univ. School of Economics</td>
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<td>14.40 - 15.00</td>
<td>Belief Distorted Nash Equilibria - introduction of a new kind of equilibrium</td>
<td>Wiszniewska Matyszkiel, Agnieszka* - Warsaw Univ.</td>
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<td>The Determinants of Collusion under Exogenous Demand Fluctuations</td>
<td>Pot, Erik - Maastricht Univ.</td>
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<td>Peeters, Ronald - Maastricht Univ.</td>
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<td>Peters, Hans - Maastricht Univ.</td>
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<td>Vermeulen, Dries* - Maastricht Univ.</td>
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<td>14.00 - 15.20</td>
<td>ThB2, Voting and Power Indices - Chair: Molina</td>
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<td>14.00 - 14.20</td>
<td>Measuring Power and Satisfaction in Societies with Opinion Leaders: An Axiomatization</td>
<td>van den Brink, Rene - Free Univ. of Amsterdam</td>
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<td>Rusinowska, Agnieszka - GATE, CNRS</td>
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<td>Steffen, Frank* - Univ. of Liverpool Managment School</td>
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<td>14.20 - 14.40</td>
<td>Power and Centrality of Groups</td>
<td>Flores, Ramón - Univ. Carlos III de Madrid</td>
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<td>Molina, Elisenda* - Univ. Carlos III de Madrid</td>
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<td>Tejada, Juan - Univ. Complutense de Madrid</td>
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<td>14.40 - 15.00</td>
<td>Fuzzy weighted voting games and power indices</td>
<td>Lange, Fabien* - Óbuda Univ.</td>
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<td>15.00 - 15.20</td>
<td>Indirect Control of Corporations. Some applications</td>
<td>Prati, Nando* - Univ. Udine</td>
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14.00 - 15.20  ThB3, Oligopoly games - Chair: Lamantia

14.00 - 14.20
Bertrand-Edgeworth games under oligopoly with a complete
colorization for the triopoly
De Francesco, Massimo A. - Univ. di Siena
Salvadori, Neri* - Univ. di Pisa

14.20 - 14.40
An Existence Theorem for Cournot-Walras Equilibria in a
Monopolistically Competitive Economy
Shirai, Koji* - Waseda Univ.

14.40 - 15.00
Oligopolistic Equilibrium and Bankruptcy
Beviá, Carmen* - UAB
Corchón, Luis C - Univ. Carlos III de Madrid
Yasuda, Yosuke - GRIPS

15.00 - 15.20
Dynamic models of fisheries with alternative
fishing strategy choices in discrete time
Bischi, Gian Italo - Univ. of Urbino
Lamantia, Fabio* - Univ. di Calabria

14.00 - 15.00  ThB4, Non cooperative games I - Chair: Novac

14.00 - 14.20
Slightly Altruistic Correlated Equilibrium
De Marco, Giuseppe - Univ. di Napoli Parthenope
Morgan, Jacqueline* - Univ. di Napoli "Federico II"

14.20 - 14.40
Existence of Equilibrium Points in Infinite Extensive Games
Hernández-Castaneda, S.* - Univ. Autónoma de México
Zapata-Lillo, Paloma - Univ. Autónoma de México

14.40 - 15.00
About the noncooperative informational
extended games
Novac, Ludmila* - State Univ. of Moldova

15.00 - 15.20  Investment portfolio management base on the theory
of differential games
Nikonov, Oleg* - Ural State Tech. University-UPI
Medvedeva, Marina - Ural State Tech. University-UPI

15.20 - 15.40  Coffee break

15.40 - 16.40  ThC1, Repeated games II - Chair: Peeters

15.40 - 16.00
On the existence of Markov equilibria in perfect
information games
Salonen, Hannu* - Univ. of Turku
Vartiainen, Hannu - Univ. of Turku

16.00 - 16.20
Dynamic Competition with Consumer Inertia
Pot, Erik - Maastricht Univ.
Fiesch, Janos - Maastricht Univ.
Peeters, Ronald* - Maastricht Univ
Vermeulen, Dries - Maastricht Univ

16.20 - 16.40
Career Concerns and Contingent Compensation
Caruana, Guillermo - CEMFI, Madrid
Celentani, Marco* - Univ. Carlos III de Madrid

15.40 - 17.00  ThC2, Cooperative games III - Chair: Kamijo

15.40 - 16.00
A New Solution for Cooperative Games with
Communication Structure
Huseyinov, Tural* - Tilburg Univ.
Talman, Adolphus Johannes Jan - Tilburg Univ.

16.00 - 16.20
The Dutta-Ray solution for games with restricted cooperation
Yanovskaya, Elena* - Russian Academy of Sciences

16.20 - 16.40
Characterisations of the β- and the
Degree Network Power Measure
van den Brink, René - Free Univ. of Amsterdam
Borm, Peter - Tilburg Univ.
Hendrickx, Ruud* - Tilburg Univ.
Owen, Guillermo - Naval Postgraduate School, Monterey

16.40 - 17.00
Whose deletion does not affect your payoff? The difference
between the Shapley value, the egalitarian value, and the
solidarity value
Kamijo, Yoshio* - Waseda Univ.
Kongo, Takumi - Waseda Univ.
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<td>On the Optimality of a Duty-to-Rescue Rule and the Bystander Effect</td>
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<td>Optimal Influenza Vaccination Mechanism</td>
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<td>Ruys, Pieter H.M.* - Tilburg Univ.</td>
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<td>Bednay, Dezsö* - Corvinus Univ. of Budapest</td>
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<td>Values for Games on the Cycles of a Digraph</td>
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<td>16.20 - 16.40</td>
<td>Axiomatizations of Two Types of Shapley</td>
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<td>Dahleh, Munther* - Massachusetts Inst. Tech.</td>
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<td>Beyond Nash: rational expectations in games</td>
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<td>Aumann, Robert* - The Hebrew Univ.</td>
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<td>Linear Bid in Asymmetric First-Price Auctions</td>
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<td>Pareto-optimal security strategies in matrix games with fuzzy payoffs</td>
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<td>Puerto, Justo - Seville Univ.</td>
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<td>Incentive Game Among Two Retailers in Liberated Electricity Market</td>
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<td>Oruc, Sertac* - Delft Univ. of Technology</td>
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<td>Pandharipande, Ashish - Philips Research, Eindhoven</td>
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<td>Cunningham, Scott - Delft Univ. of Technology</td>
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<td>On the definition of perfect equilibrium in games with compact action spaces</td>
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<td>Bajoorian, Elnaz* - Maastricht Univ.</td>
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<td>Vermeulen, Dries - Maastricht Univ.</td>
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<td>Curiel, Imma* - Univ. of the Netherlands Antilles</td>
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<td>New characterizations for largeness of the core</td>
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<td>The k-additive core and its relation to other solution concepts</td>
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<td>Li, Tong - Beijing Inst. of Technology</td>
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<td>Minimal exactly balanced collections</td>
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<td>Lohmann, Edwin* - Tilburg Univ.</td>
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<td>Herings, Jean-Jacques - Maastricht Univ.</td>
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<td>11.30 - 12.50</td>
<td>FrA3, Voting and Power Indices - Chair: Mercik</td>
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<td>11.30 - 11.50</td>
<td>The men who were not even there: Legislative</td>
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<td>voting with absenteeees</td>
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<td>Kóczy, Laszlo Á. - Óbuda Univ. Budapest</td>
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<td>Pintér, Miklós* - Univ. of Budapest</td>
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<td>11.50 - 12.10</td>
<td>Voting Power and Social Interaction</td>
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<td>Koster, Maurice* - Univ. of Amsterdam</td>
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<td>Lindner, Ines* - Free Univ. of Amsterdam</td>
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<td>Napel, Stefan - Univ. Bayreuth</td>
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<td>12.10 - 12.30</td>
<td>Embedding classical indices in the FP family</td>
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<td>Chessa, Michela - Univ. Milano</td>
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<td>Fragnelli, Vito* - Univ. of Eastern Piedmont</td>
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<td>12.30 - 12.50</td>
<td>On an estimation of power of veto</td>
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<td>Mercik, Jacek* - Wroclaw Univ. of Technology</td>
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<td>11.30 - 12.50</td>
<td>FrA4, Evolutionary games and signaling - Chair: Martínez</td>
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<td>11.30 - 11.50</td>
<td>Altruism in defence against a predator</td>
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<td>Garay, Joszef* - Ótvós Loránd Univ. Budapest</td>
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<td>11.50 - 12.10</td>
<td>Quality Signals, Competition and Consumer Fraud</td>
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<td>Martínez-Gorricho, Silvia* - Univ. of Alicante</td>
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<td>12.10 - 12.30</td>
<td>Innovation and bargaining</td>
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<td>Ramsza, Michal* - Warsaw School of Economics</td>
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<td>12.30 - 12.50</td>
<td>Evolutionary Stability and Correspondences</td>
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<td>De Michielis, Stefano* - Univ. Pavia</td>
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<td>12.50 - 14.00</td>
<td>Lunch</td>
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<td>14.00 - 15.20</td>
<td>FrB1, Non cooperative games II - Chair: Berga</td>
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<td>14.00 - 14.20</td>
<td>Terrorist Targeting, Information, and Secret Coalitions</td>
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<td>Koster, Maurice - Univ. of Amsterdam</td>
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<td>Lindner, Ines* - Free Univ. of Amsterdam</td>
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<td>McCormick, Gordon - Naval Postgraduate School, Monterey</td>
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<td>Owen, Guillermo - Naval Postgraduate School, Monterey</td>
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<td>14.20 - 14.40</td>
<td>Indices of Collusion among Judges and an Anti-collusion Average</td>
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<td>Gambarelli, Gianfranco* - Univ. of Bergamo</td>
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<td>Bertini, Cesarino - Univ. of Bergamo</td>
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<td>Uristani, Angelo - Univ. of Bergamo</td>
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<td>15.00 - 15.20</td>
<td>Single-dipped preferences</td>
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<td>Barberá, Salvador - Univ. Autónoma de Barcelona</td>
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<td>Berga, Dolors* - Univ. de Gironda</td>
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<td>Moreno Bernardo - Campus de El Ejido, Malaga</td>
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<td>14.00 - 15.20</td>
<td>FrB2, Cooperative Games II - Chair: Marco-Gil</td>
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<td>14.00 - 14.20</td>
<td>The division problem with maximal capacity constraints</td>
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<td>Bergantíños, Gustavo* - Univ. de Vigo</td>
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<td>Massó, Jordi - UAB, Barcelona</td>
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<td>Neme, Alejandro - Conicet, San Luis, Argentina</td>
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<td>14.20 - 14.40</td>
<td>On the Myerson value in communication structures</td>
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<td>Algaba, Encarnación* - Univ. of Sevilla Bilbao,</td>
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<td>J. Mario - Univ. of Sevilla</td>
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<td>van den Brink, René - Free Univ. of Amsterdam</td>
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<td>López, Jorge J. - Univ. of Sevilla</td>
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<td>14.40 - 15.00</td>
<td>Some game-theoretic grounds for meeting people half-way</td>
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<td>Gadea-Blanco, Pedro - Polytechnic Univ. of Cartagena</td>
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<td>Jimenez-Gomez, José Manuel - Univ. of Cartagena</td>
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**Plenary Lectures**

Dynamic Teams, Games, and Non-Classical Information

Başar, Tamer*, Univ. of Illinois, Urbana-Champaign, basar1@beckman.illinois.edu

**Abstract.** Interaction between information/communication and control (with control interpreted in a broader context, including strategic decision making in multi-agent teams and games) has been a dominating research topic for several decades. This interaction is in general a complex one because different decision units (agents) linked through their interactions over a network could affect each others performance through also the information content of their actions. In team problems, for example, with an overall common objective, the more information the agents share on the uncertain environment (through transmission of messages) the better is the performance (global as well as local), and a judicious construction of local actions or decisions could improve the relevant information content of transmitted messages. One critical question that arises in this context is for each sending agent how to reshape (for example, encode) the locally received information and embed it into its action, and for each receiving agent how to process it (decode or filter) so that it will be of utmost value in the construction of its action—with each agent actually playing both roles, leading sometimes to a conflict between these dual roles and/or forcing the agents to tradeoffs. A further question is how agents should use the limited resources they have in the most efficient way, which may occasionally lead to no action as a possible decision, so that resources can be saved for future actions. These issues become more pronounced and complex in game situations, where it could even happen that enhancement of the quality of information through decisions or actions would be detrimental to a player. The phenomenon of the quality of the information exchanged over channels being affected by decisions or actions (generally referred to as non-classical information) brings in inherent difficulties to stochastic team and game problems in the construction of team-optimal policies for the former and (Nash) equilibrium policies in the latter. Even though the underlying subtleties have been recognized for quite some time, the question of how to cope with the tradeoffs that arise in this context is still in search of a universally applicable satisfactory answer. This talk will provide an overview of the issues as described above underlying the interplay between communication and decision making in multi-agent dynamic teams and non-cooperative dynamic games, and discuss results not only on what to send, how to shape, and how to process, but also on when to send, with non-classical information being the centerpiece.

**Biography.** Tamer Başar is with the University of Illinois at Urbana-Champaign (UIUC), where he holds the academic positions of Swanlund Endowed Chair, Center for Advanced Study Professor of Electrical and Computer Engineering, Research Professor at the Coordinated...
Feedback solutions of non-cooperative differential games

Bressan, Alberto*, Pennstate Univ., bressan@math.psu.edu

Abstract. For a non-cooperative differential game, Nash equilibrium solutions in feedback form can be determined by solving a (highly nonlinear) system of Hamilton-Jacobi equations for the value functions. After a general overview, the talk will present an analytical approach to the study of these PDEs, based on a homotopy method.

Biography. Alberto Bressan is with Penn State University, University Park, Pa., 16802, and the Ph.D. degree in Mathematics from University of Colorado, Boulder. He joined Penn State University in 2003 after holding positions at Mathematics Research Center Madison, Wisconsin, University of Colorado, and S.I.S.S.A. (Italy). He has current research interests in hyperbolic systems of conservation laws and nonlinear wave equations, control of Lagrangian system, systems of Hamilton-Jacobi equations related to non-cooperative differential games, Nash equilibrium solutions in feedback form for infinite-horizon discounted differential games, applications to games of optimal inventory and pricing, in economics, dynamic blocking problems (mathematical models of wild fire confinement), existence of blocking strategies, optimization problems, optimization problems for elliptic equations, with measure-valued control strategies, applications to optimal fishery management.

Dr. Bressan is currently the Editor-in-Chief of the AIMS book series on Applied Mathematics and member of editorial boards of several international journals in mathematics, applied mathematics, optimization and control. He has received several awards and recognitions over the years, among which are “A. Feltrinelli” prize for Mathematics, Mechanics and Applications, Accademia Nazionale dei Lincei, Rome, 2006; “Analysis of Partial Differential Equations” prize, Society for Industrial and Applied Mathematics, Phoenix, 2007; “M. Böcher” prize, American Mathematical Society, San Diego, 2008, “L. Amerio” prize, Accademia di Scienze e Lettere, Istituto Lombardo, Milan, 2010. He is a member of Unione Matematica Italiana, American Mathematical Society, Society for Industrial and Applied Mathematics.
Engineering cooperation in two-player strategic games

Kalai, Adam T., Microsoft Research New England, adum@microsoft.com
Kalai, Ehud*, Northwestern Univ., kalai@kellogg.northwestern.edu

Abstract. Selfish, strategic players may benefit from cooperation, provided they reach an agreement. It is therefore important to construct mechanisms that enable such cooperation, especially in the case of asymmetric private information. There are two major issues:

(1) the determination of a fair and efficient outcome among the many compromises possible in a strategic game, and

(2) the establishment of a play protocol under which strategic players will agree to the selected compromise. The paper presents a general solution for an important class of two person Bayesian games with monetary payoffs.

The proposed solution builds on earlier concepts in game theory. It coincides with the von Neumann minmax value on the class of zero sum games and with the major solution concepts to the Nash Bargaining Problem. Moreover, the solution is based on a simple decomposition of every game into cooperative and competitive components, which is easy to compute.

Biography. Ehud Kalai is the James J. O'Connor Distinguished Professor of Decision and Game Sciences at Northwestern University. He holds an AB from University of California at Berkeley (1967), and an MS (1971) and a PhD (1972) from Cornell University, all in mathematics. Kalai is the founding Editor of Games and Economic Behavior, a past president and cofounder of the Game Theory Society, and a Fellow of the Econometric Society. The Kalai-Smorodinsky solution to the bargaining problem and the egalitarian solution to cooperative games are among Kalai's major contributions to cooperative games. Among his contributions to noncooperative games are the Kalai-Lehrer model of learning, which shows that rational players converge to play Nash equilibria of repeated games, and his models of large robust games, which show that the equilibria of games with many players are structurally robust. Kalai is also known for seminal collaborative research on flow games and totally-balanced games; strategic complexity and its implications in economics and political systems; arbitration, strategic delegation and commitments; extensions of Arrows Impossibility Theorem in social choice; competitive service in queuing games; and on strategic polarization in group decision making.

Learning over complex social networks

Dahleh, Munther*, Massachusetts Inst. Tech., dahleh@mit.edu

Abstract. We study the (perfect Bayesian) equilibrium of a model of learning over a general social network. Each individual receives a signal about the underlying state of the world, observes the past actions of a stochastically-generated neighborhood of individuals, and chooses one of two possible actions. The stochastic process generating the neighborhoods defines the network topology (social network). We characterize pure-strategy equilibria for arbitrary stochastic and deterministic social networks and characterize the conditions under which there will be asymptotic learning-convergence (in probability) to the right action as the social network becomes large. We show that when private beliefs are unbounded (meaning that the implied likelihood ratios are unbounded), there will be asymptotic learning as long as there is some minimal amount of "expansion in observations." We present examples showing that "herding" can occur in the absence of such conditions. We also characterize conditions under which there will be asymptotic learning when private beliefs are bounded. Finally, we discuss various robustness issues pertaining to this model.

Biography. Munther A. Dahleh was born in 1962. He received the B.S. degree from Texas A & M university, College Station, Texas in 1983, and his Ph.D. degree from Rice University, Houston, TX, in 1987, all in Electrical Engineering. Since then, he has been with the Department of Electrical Engineering and Computer Science, MIT, Cambridge, MA, where he is now a full Professor. He is currently the associate director of the Laboratory for Information and Decision Systems. He has been a visiting Professor at the Department of Electrical Engineering, California Institute of Technology, Pasadena, CA, for the Spring of 1993. He has held consulting positions with several companies in the US and abroad.

Dr. Dahleh has been the recipient of the Ralph Budd award in 1987 for the best thesis at Rice University, George Axelby outstanding paper award (paper coauthored with J.B. Pearson in 1987), an NSF presidential young investigator award (1991), the Finmeccanica career development chair (1992) and the Donald P. Eckman award from the American Control Council in 1993, the Graduate Students Council teaching award in 1995, the George Axelby outstanding paper award (paper coauthored with Bamieh and Paganini in 2004), and the Hugo Schuck Award for Theory (for the paper coauthored with Martins). He became a fellow of IEEE in year 2000. He was a plenary speaker at the 1994 American Control Conference, at the Mediterranean Conference on Control and Automation in 2003, at the MTNS in 2006, at SYSD in 2009, and at Asian Control Conference in 2009. He was an Associate Editor for IEEE Transactions On Automatic Control and for Systems and Control Letters. He is the co-author (with Ignacio Diaz-Bobillo) of the book Control of Uncertain Systems: A Linear Programming Approach, published by Prentice-Hall, and the co-author (with Nicola Elia) of the book Computational Methods for Controller Design published by Springer. Dr. Dahleh
is interested in problems at the interface of robust control, filtering, information theory, and computation which include control problems with communication constraints and distributed mobile agents with local decision capabilities. He is also interested in various problems in network science including distributed computation over noisy network as well as information propagation over complex engineering and social networks. He is also interested in model reduction problems for discrete-alphabet hidden Markov models and universal learning approaches for systems with both continuous and discrete alphabets. He is also interested in the interface between systems theory and neurobiology, and in particular, in providing an anatomically consistent model of the motor control system.

Beyond Nash: rational expectations in games

Aumann, Robert*, The Hebrew Univ., nobel@heui.ac.il
Dreze, Jacques*, CORE Univ. Catholique de Louvain, jacques.dreze@uclouvain.be

Abstract. In games, as in all decision situations, players should take those actions that maximize their expected payoff, given their beliefs about what the other players do. Nevertheless, each player should take into account the interactive nature of games: that the other players are also maximizing in the same way. We explore where this reasoning leads, and fully characterize the resulting outcomes; contrary to what might be thought, they are in general NOT Nash Equilibria.

Biography. Robert Aumann was born in Frankfurt am Main, Germany, in 1930, to a well-to-do orthodox Jewish family. Fleeing Nazi persecution, he emigrated to the United States with his family in 1938, settling in New York. In the process, his parents lost everything, but nevertheless gave their two children an excellent Jewish and general education. Aumann attended Yeshiva elementary and high schools, got a bachelor’s degree from the City College of New York in 1950, and a Ph.D. in mathematics from MIT in 1955. He joined the mathematics department at the Hebrew University of Jerusalem in 1956, and has been there ever since. In 1990, he was among the founders of the Center for Rationality at the Hebrew University, an interdisciplinary research center, centered on Game Theory, with members from over a dozen different departments, including Business, Economics, Psychology, Computer Science, Law, Mathematics, Ecology, Philosophy, and others. Aumann is the author of over ninety scientific papers and six books, and has held visiting positions at Princeton, Yale, Berkeley, Louvain, Stanford, Stony Brook, and NYU. He is a member of the American Academy of Arts and Sciences, the National Academy of Sciences (USA), the British Academy, and the Israel Academy of Sciences; holds honorary doctorates from the Universities of Chicago, Bonn, Louvain, City University of New York, and Bar Ilan University; and has received numerous prizes, including the Nobel Memorial Prize in Economic Sciences for 2005. Aumann is married and has five children (the oldest was killed in Lebanon in 1982). Also, he has twenty-one grandchildren, and eight great-grandchildren. When not working, he likes to hike, ski, cook, and study the Talmud.

Book of Abstracts

On the Myerson value in communication structures

Algaba, Encarnación*, Univ. de Sevilla, ealgaba@us.es
Bibbo, J. Mario, Univ. of Sevilla, mbibbo@us.es
van den Brink, René, Free Univ. of Amsterdam, jbrink@feweb.vu.nl
López, Jorge J.*, Univ. of Sevilla, jarlopvaz@us.es

Abstract. This paper deals with cooperative games in which partial cooperation is based on union stable systems. These systems have the communication situations, permission structures and augmenting systems as particular cases. We analyze the relation between the restricted game and the conference game to establish later which effects a union stable system has on certain desirable properties of these games. Basing on the properties of the position value two new characterizations are given for the Myerson value in this context.

Keywords: cooperative games, conference game, restricted game, union stable system, position value, Myerson value.

The Value at Risk of the Revenues in some Auction Models

Alonso-Pérez, Estrella*, Univ. Pontificia Comillas de Madrid, ealonso@upcomillas.es
Tejada-Cazorla, Juan, Univ. Complutense de Madrid, jtejada@mat.ucm.es

Abstract. It is well known that when a single object is auctioned, the two classical auction models, First-Price auction and Second-Price auction, generate the same expected payoff to the bidders and, therefore, the same expected revenue to the auctioneer (Vickrey 1961). In fact, the Revenue Equivalence Theorem (Myerson 1981) is verified if two auction models have the same allocation rule and give the same payment to a bidder with valuation 0. If the auctioneer takes into account only the expected revenue, i.e. he is a risk neutral auctioneer, every auction model verifying the Revenue Equivalence Theorem is equivalent for him. However, every risk averse auctioneer could prefer the lowest variance auction model (assuming, of course, that the bidders are risk neutral). For this, in some works, and in order to establish a preference between the classical models, their variability (usually their variance) is compared. Beltrán and Santamaría (2006) use a simulator to analyze how large around the mean the variations of running several auctions with the same expected revenue are. Krishna (2002) proves that the distribution of prices in Second-Price auction is a mean-preserving spread of the distribution of prices in First-Price auction. The main problem with variance is that it does not indicate the sign of the deviations from the revenue: the revenue can be volatile because it suddenly takes high values. The auctioneer is not affected if his revenue is higher than expected, however, much lower than expected revenues could leave him bankrupt. Hence, we are interested in obtaining a measure of the risk of losses for each auction model.

Keywords: auctions.
Job market signaling and employer learning

Alós-Ferrer, Carlos*, Univ. of Konstanz, carlos.alonso-ferrer@uni-konstanz.de
Prat, Julien, IAE-CSIC, Barcelona, julien.prat@iae.csic.es

Abstract. We consider a signaling model where the receiver is able to update his belief about the sender type after the signaling stage. We introduce Bayesian learning in a variety of environments ranging from simple two-period to continuous time models with stochastic production. Signaling equilibria present two major departures from those obtained in models without learning. First, new mixed strategy equilibria involving multiple pooling are possible. Second, pooling equilibria can survive the Intuitive Criterion when learning is fast enough.

keywords: learning.

A Banzhaf value for games with levels structure of cooperation

Álvarez-Mozos, Mikel*, Univ. of Santiago de Compostela, mikel.alvarez@usc.es
Tejada, Oriol, Univ. of Barcelona, oriol.tejada@ub.edu

Abstract. Winter (1989) introduced the cooperative games with levels structure of cooperation and proposed an extension of the Shapley value for such games. The model of games with levels structure of cooperation is a generalization of the model of games with coalition structure studied in Owen (1977). A levels structure is composed by a sequence of coalition structures, each obtained from the previous by unification of coalitions and each describing the way the cooperation between coalitions of the previous level happens. In this work, we propose an extension of the Banzhaf value (Owen, 1975) for such situations, the proposal is also a generalization of the Banzhaf-Owen value (Owen, 1982) for games with coalition structure. We study the properties that the new solution concept satisfies and provide parallel characterizations of this new value and Winter’s extension of the Shapley value.

keywords: TU games, Banzhaf value, levels structure.

On the definition of perfect equilibrium in games with compact action spaces

Bajoori, Eliaz*, Maastricht Univ., e.bajoori@maastrichtuniversity.nl
Flesch, János, Maastricht Univ., j.jflesch@maastrichtuniversity.nl
Vermeulen, Dries, Maastricht Univ., d.vermeulen@maastrichtuniversity.nl

Abstract. In 1995 Simon and Stinchcombe defined perfect equilibrium for games with an infinite compact set of pure action profiles. They distinguished two main lines of definitions, one based on the notion of a completely mixed strategy, and the other based on the notion of an “ε-perfect equilibrium in finite approximations of the original game. They showed that the first type of perfect equilibrium only admits limit-admissible strategies. Furthermore, they conjectured that the two approaches are incomparable. In this paper we investigate the relations between these various types of perfect equilibrium that exist for strategic form games with compact pure action spaces. We verify the conjecture of Simon and Stinchcombe. We provide an example of a completely mixed, and hence perfect in the first sense, equilibrium, that is not the limit of “ε-perfect equilibria for any sequence of finite approximations. Furthermore, we also define a strengthened version of the second type of perfection that relates better to the notion of perfection in the first sense. We show that these results remain true, even when we restrict to pure action spaces that are compact intervals on the real line.

keywords: non-cooperative games, perfect equilibrium, infinite action spaces.

Compensations in the Shapley value and the compensation solutions for graph games

Béal, Sylvain*, Univ. de Saint-Etienne, sylvain.beal@univ-reims.fr
Rémi, Éric, Univ. de Lyon, eric.remi@ens-lyon.fr
Solal, Philippe, Univ. de Saint-Etienne, philippe.solal@univ-reims.fr

Abstract. We consider an alternative expression of the Shapley value that reveals a system of compensations: each player receives an equal share of the worth of each coalition he belongs to, and has to compensate an equal share of the worth of any coalition he does not belong to. We give an interpretation in terms of formation of the grand coalition according to an ordering of the players and define the corresponding compensation vector. Then, we generalize this idea to cooperative games with a communication graph. Firstly, we consider forest graphs and extend the compensation vector by considering all rooted spanning trees of the graph (Demange, 2004) instead of orderings of the players. The associated allocation rule, called the compensation solution, is characterized by component efficiency and relative fairness. The latter axiom takes into account the relative position of a player with respect to his component. Secondly, we consider arbitrary graphs and construct rooted spanning trees by using the classical algorithms DFS and BFS. If the graph is complete, we show that the compensation solutions associated with DFS and BFS coincide with the Shapley value and the equal surplus division respectively.

keywords: cooperative games, Shapley value, compensations, relative fairness, compensation solution, DFS, BFS, equal surplus division solution.
Abstract. For a level $z$ not greater than the value of the grand coalition, we introduce the set of $z$-imputations which is the set of the individually rational payoff vectors with sum of payoffs equal to $z$. A $z$-stable set is a set of $z$-imputations that is stable (in the standard von Neumann–Morgenstern sense) on the set of $z$-imputations. We show that a $z$-stable set in an assignment game is a lattice and every two points of this set are connected through a monotonic curve. We also give a sufficient condition for stability of a set of $z$-imputations. By applying it to a generalization of the set proposed by Shapley and Shubik, we provide a proof of their conjecture.

Keywords: cooperative games, assignment game, stable set.

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Generalized stable sets in assignment games

Solymosi, Tamas, Corvinus Univ. of Budapest, tamas.solymosi@uni-corvinus.hu
Bednay, Deszö*, Corvinus Univ. of Budapest, bednay@gmail.com

Abstract. Single-dipped preferences naturally arise in the presence of a public bad. Consider, for example, the decision on where to locate a facility whose neighborhood is undesirable, like a prison, a dumping site or an incineration plant. It is natural to assume that the worse allocation for each agent is the one that places the facility right by their home, and that locations become better as they place it further away. When location can be identified with a point on a line, this gives rise to single-dipped preferences. We concentrate on this case, though we can also think of natural extensions to two-dimensional spaces, or even $k$-dimensional ones, under alternative interpretations. The purpose of this paper is to define and to partially characterize strategy-proof rules on the domain of single-dipped preferences, and also on its subdomains. The set of all strategy-proof rules whose domain includes all single-peaked preferences was characterized by Moulin (1980). These rules, called generalized median voter schemes, constitute a rich class and contain many alternative procedures. One feature that is common to both domains is that all rules that are strategy-proof on them or on any of their subdomains are also group strategy-proof. This is because both satisfy a condition called sequential inclusion (see Barberà, Berga, and Moreno, 2009a) that guarantees the equivalence of these two otherwise different incentive-compatibility requirements. However, this coincidence regarding the equivalence of individual and group strategy-proofness does not carry over other characteristics of our rules on these two domains. In particular, they dramatically differ regarding the characteristics of their ranges. In the case of single-peaked preferences and their subdomains, the range of strategy-proof functions can often consist of the whole set of alternatives. By contrast, we will show that in domains where all single-dipped preferences are feasible, the range of strategy-proof rules contain at most two alternatives. This striking limitation is only one instance of a more general fact: that the size of the maximal ranges for strategy-proof rules on families of single-dipped preferences is endogenously predetermined by the nature of the domains that it must be defined on. This leads us to consider different subdomains of single-dipped preferences, to establish the maximal sizes that the range of strategy-proof rules over them, and to exhibit examples of rules where these sizes, that can certainly be larger than two, are effectively attained. The work of Peremans and Storcken (1999) is an important predecessor of ours. They started a systematic study of restrictions imposed by strategy-proofness on the ranges of rules defined for special subdomains of single-dipped preferences. We improve on the bound that they propose and we analyze several new cases for which we can also provide tight results. However, there is no denial that theirs is a pioneer study of the subject. A recent paper by Manjunath (2009) provides a result that is very similar to the one we obtain for the domain of all single-dipped preferences, in that it also shows that the range of rules must be of size two, and also provides a characterization of all strategy-proof rules in that case. The main differences are that, unlike Manjunath, we do not impose the requirement that rules are unanimous and we do not concentrate on a bounded interval in the real line, and this allows us to be slightly more general on those

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Single-dipped preferences

Barberà, Salvador, Univ. Autònoma de Barcelona, salvador.barbera@uab.cat
Berga, Dolors,* Univ. de Girona, dolors.berga@udg.edu
Moreno, Bernardo, Campus de El Ejido, Malaga, bernardo@uma.es

Abstract. Single-dipped preferences naturally arise in the presence of a public bad. Consider, for example, the decision on where to locate a facility whose neighborhood is undesirable, like a prison, a dumping site or an incineration plant. It is natural to assume that the worst allocation for each agent is the one that places the facility right by their home, and that locations become better as they place it further away. When location can be identified with a point on a line, this gives rise to single-dipped preferences. We concentrate on this case, though we can also think of natural extensions to two-dimensional spaces, or even $k$-dimensional ones, under alternative interpretations. The purpose of this paper is to define and to partially characterize strategy-proof rules on the domain of single-dipped preferences, and also on its subdomains. The set of all strategy-proof rules whose domain includes all single-peaked preferences was characterized by Moulin (1980). These rules, called generalized median voter schemes, constitute a rich class and contain many alternative procedures. One feature that is common to both domains is that all rules that are strategy-proof on them or on any of their subdomains are also group strategy-proof. This is because both satisfy a condition called sequential inclusion (see Barberà, Berga, and Moreno, 2009a) that guarantees the equivalence of these two otherwise different incentive-compatibility requirements. However, this coincidence regarding the equivalence of individual and group strategy-proofness does not carry over other characteristics of our rules on these two domains. In particular, they dramatically differ regarding the characteristics of their ranges. In the case of single-peaked preferences and their subdomains, the range of strategy-proof functions can often consist of the whole set of alternatives. By contrast, we will show that in domains where all single-dipped preferences are feasible, the range of strategy-proof rules contain at most two alternatives. This striking limitation is only one instance of a more general fact: that the size of the maximal ranges for strategy-proof rules on families of single-dipped preferences is endogenously predetermined by the nature of the domains that it must be defined on. This leads us to consider different subdomains of single-dipped preferences, to establish the maximal sizes that the range of strategy-proof rules over them, and to exhibit examples of rules where these sizes, that can certainly be larger than two, are effectively attained. The work of Peremans and Storcken (1999) is an important predecessor of ours. They started a systematic study of restrictions imposed by strategy-proofness on the ranges of rules defined for special subdomains of single-dipped preferences. We improve on the bound that they propose and we analyze several new cases for which we can also provide tight results. However, there is no denial that theirs is a pioneer study of the subject. A recent paper by Manjunath (2009) provides a result that is very similar to the one we obtain for the domain of all single-dipped preferences, in that it also shows that the range of rules must be of size two, and also provides a characterization of all strategy-proof rules in that case. The main differences are that, unlike Manjunath, we do not impose the requirement that rules are unanimous and we do not concentrate on a bounded interval in the real line, and this allows us to be slightly more general on those
points. Another difference is that we use a result of our own in the characterization of the rules (see Barberá, Berga, and Moreno, 2009b), while he appeals to a previous result by Larsson and Svensson (2006). In that specific aspect, our paper and Manjunath’s seem to be nicely complementary. After that our contribution, as already explained, takes the direction of exploring new subdomains and to provide additional results on the maximal sizes of ranges allowed by the strategy-proofness requirement.

**keywords:** game theory, (group) strategy-proof, binary range rules.

### The division problem with maximal capacity constraints

**Bergantños, Gustavo*, Univ. de Vigo, gbergant@uvigo.es**  
**Massó, Jordi, UAB, Barcelona, jordi.masso@uab.es**  
**Neme, Alejandro, Conicet, San Luis, aneme@unsl.edu.ar**

**Abstract.** The division problem consists of allocating a given amount of an homogeneous and perfectly divisible good (or task) among a group of agents with single-peaked preferences on the set of their potential shares. A rule proposes a vector of shares for each division problem. The literature has implicitly assumed that all divisions are feasible. In this paper we consider the division problem when each agent has a maximal capacity due to an objective and verifiable feasibility constraint which imposes an upper bound on his share. Each agent has a feasible interval of shares where his preferences are single-peaked. A rule has to propose to each agent a feasible share. We study strategy-proof, efficient and consistent rules and provide alternative characterizations of the extension of the uniform rule that deal explicitly with agents’ maximal capacity constraints.

**keywords:** cooperative games, division problem, axiomatic.

### Oligopolistic equilibrium and bankruptcy

**Beviá, Carmen*, Univ. Autonoma de Barcelona, carmen.bevia@uab.cat**  
**Corchón, Luis C., Univ. Carlos III de Madrid, lcorcho@eco.uc3m.es**  
**Yasuda, Yosuke, GRIPS, yyasuda@grips.ac.jp**

**Abstract.** The theory of Industrial Organization is one of the main applications of game theory. Concepts like Cournot equilibrium, Bertrand equilibrium or Stackelberg equilibrium are usually presented as an illustration of game-theoretical concept like Nash equilibrium or subgame perfection. These concepts, though, apply strictly speaking to one shot situations so a little bit of interpretation is needed because oligopolistic competition is seldom a once-for-all interaction. An interpretation is that the one shot game is repeated a finite number of times. If the one shot game has a unique Nash equilibrium, the subgame perfect Nash equilibrium of the repeated game is to play in each period the actions corresponding to the Nash equilibrium of the one shot game. Another interpretation is that the one shot equilibrium is a good approximation to the equilibrium of the infinite repetition of the one shot game when the discount rate is very close to zero. Unfortunately, the repetition, finite or infinite, of the one shot game opens new possibilities that are not considered in the equilibrium concepts mentioned above. Suppose that a firm, say 1, takes in the first period an action that produces negative profits for all other firms but positive profits for firm 1: if firms do not posses liquid assets to face these losses, all firms but 1 become bankrupt. And, it is not likely that these firms will ever produce again. Thus firm 1 may become a monopolist, at least for some time. The profitability of such move cannot be studied in the static concepts mentioned above. Rather, this kind of behavior is an example of predatory pricing. Standard explanations of this behavior are based on incomplete information (Milgrom and Roberts [1982]), the learning curve (Cabral and Riordan [1994]) or firms playing an attrition game (Roth [1996]). In this paper we present a model where firms may become bankrupt as a consequence of the actions of other firms without resorting to any of these explanations: Information is complete, the technology is fixed and firms play standard quantity-setting games. Our first step is to define the set of actions that are Bankruptcy-Free (BF in the sequel). This is the set of actions that yield profits in excess of a certain, exogenously given, value to any firm (i.e. no firm is bankrupted) and such that no firm, say i, can be pushed below this value (i.e. i is bankrupted) by an action of another firm, say j, which obtains profits in excess of this value with this action (i.e. j is not bankrupted as a consequence of its own action). The concept of BF captures the opportunities for ruining other players that are not captured by concepts like Cournot equilibrium. Our second step consists in characterizing the set of BF actions under alternative assumptions. In the case where average cost are non-decreasing we show that a large number of output vectors are BF. For instance when all firms have constant average costs any output vector in which profits of the firm with the smaller average cost are non-negative, is BF. In contrast, when average costs are decreasing, BF output vectors are either such that all firms have zero profits and further increases in output produce negative profits or those in which only one firm is active. Our final step is to consider a dynamic game where BF actions emerge as an equilibrium. We first notice that if the Nash equilibrium corresponding to the static game is BF, this allocation can be supported as a Subgame Perfect Nash equilibrium. We also show that not all BF allocations can be supported as Nash equilibria. Next, we show that when the discount rate is sufficiently close to one, any Nash equilibrium must yield BF allocations. Finally we show that the latter result cannot extended to three players by showing that in this case some actions which are not BF can be supported as a Subgame Perfect Nash equilibrium.

**keywords:** Oligopoly games.
Control of multi inventory systems with constrained average uncertain demand

Blanchini, Franco*, Univ. of Udine, blanchini@uniud.it
Collini, Valeria, Univ. of Udine

Abstract. We consider continuous-time robust network flows with capacity constraints and unknown but bounded time-varying demand. In previous work the demand is assumed pointwise bounded in a convex set. We relax the assumption considering a quite larger family of demand, in which constraints are imposed on the average value of the demand which are constrained in a given set. In this way we include several interesting patterns which have not been taken into account, including demands having high peaks and even impulses. The main result shows that previous necessary and sufficient solvability conditions valid for pointwiseconstrained demand remain valid. We investigate on the existence of static control strategies.

keywords: flow control, uncertain demand, average constraints.

How to handle interval solutions for cooperative interval games

Alparslan Gök, S. Zeynep, Suleyman Demirel Univ., Isparta, sirmagok@sfd.sdu.edu.tr
Branzei, Rodica*, “Al. I. Cuza” Univ., branzei@info.uaic.ro
Tijs, Stef, Univ. of Tilburg, S.H.Tijs@utw.tn

Abstract. Uncertainty accompanies almost every situation in our lives and it influences our decisions. On many occasions uncertainty is so severe that we can only predict some upper and lower bounds for the outcome of our (collaborative) actions, i.e. payoffs lie in some intervals. Cooperative interval games have been proved useful for solving reward/cost sharing problems in situations with interval data in a cooperative environment. We present two procedures for cooperative interval games. Both transform an interval solution, i.e. a payoff vector whose components are compact intervals of real numbers, into a payoff vector (whose components are real numbers) when the value of the grand coalition becomes known (at once or in multiple stages). The research question addressed here is: How to determine for each player his/her/its payoff generated by cooperation within the grand coalition - in the promised range of payoffs to establish such cooperation - after the uncertainty on the payoff for the grand coalition is resolved? This question is an important one that deserves attention both in the literature and in game practice.

keywords: cooperative Games, interval uncertainty, interval solutions.

Quality unilateral commitments

Briata, Federica*, “G. D’Annunzio” Univ., Chieti-Pescara, briata@sci.unich.it
Patrone, Fioravante, Univ. of Genoa, patrone@diptem.unige.it

Abstract. Given a game with Nash equilibria, we embed it in a non cooperative two-stages game in order to make a Nash equilibrium self-enforcing, without having to recur to the finitely repeated games tool. In the first stage, each player declares that he will pay a penalty if he will not play, in the second stage, the restricted strategies. This simple sequential game structure, assuming a self-punishing scheme, makes self-enforcing the Nash equilibria of the constituent game, if any. The structure of the QUC model is traced out from UC model, but here the commitments are assumed to be not binding, since in the second stage a player can play a strategy not belonging to his restricted set declared in the first stage. The role, played in UC by binding commitments, is in the QUC performed by penalty. In fact, we must interpret in a positive way the penalty of a player, as guarantee towards the others of his perfect, unobjectionable and fair behavior, and not in a negative way, as a punishment for his (possible) deviation. The choice of each player to make quality commitments is not only in order to build a reputation, but also because, when the relations climate has been so positive and harmonious, the players will behave properly and make commitments. Since a commitment is a binding of an individual to the others, it measures an attitude to the sense of altruism, compliance, identification and loyalty towards the group.

keywords: non-cooperative games.

Axiomatizations of two types of Shapley values for games on union closed systems

van den Brink, Rene*, Free Univ. of Amsterdam, jbrink@feweb.vu.nl
Katsev, Ilya, Russian Academy of Sciences, katsev@yandex.ru
van der Laan, Gerard, Free Univ. of Amsterdam, glaan@feweb.vu.nl

Abstract. A cooperative game with transferable utility, or simply a TU-game, is a finite set of players and for any subset (coalition) of players a worth representing the total payoff that the coalition can obtain by cooperating. In its classical interpretation, a TU-game describes a situation in which the players in every coalition S of N can cooperate to form a feasible coalition and earn its worth. In the literature various restrictions on coalition formation are developed. In this paper we consider games in which the collection of feasible coalitions is closed under union, meaning that for any pair of feasible coalitions also their union is feasible. Examples of union closed systems are antimatroids and sets of feasible coalitions arising from permission structures where players need permission from (some of) their superiors in a hierarchical structure when they want cooperate with others. We define and axiomatize two solutions for games on union closed systems. To define the first solution, we first associate to every union closed system its corresponding superior graph. This is the directed graph that is obtained by putting an arc from player i to player j if every
feasible coalition containing player $j$ also contains player $i$. We then consider the game with permission structure induced by this superior graph, and define the superior rule as its conjunctive permission value (being one of the solutions developed for games with a permission structure). The second solution, called the union rule, directly applies the Shapley value to some restricted game that assigns to every coalition the worth of its largest feasible subset. (By union closedness this largest feasible subset is unique.) Both solutions generalize the Shapley value in the sense that they are equal to the Shapley value when the union closed system is the power set of player set $N$. We provide axiomatizations of these two solutions such that each axiomatization uses only one axiom that is not satisfied by the other solution.

**Keywords:** cooperative games, restricted cooperation, union closed system, Shapley value, conjunctive permission value, superior graph, superior rule, union rule.

**Abstract.** Information on the geometrical position of agents in a formation, or more generally of nodes in a networked system, is of crucial importance in many technological applications, ranging from mobile robotics, autonomous vehicles navigation, and sensor networks. GPS is a well-known and robust solution to localization, but it requires an expensive and power consuming equipment at each node, hence it is often unsuitable for low-cost or large-size systems. As a consequence, research effort has been recently oriented towards the estimation of positions from relative and partial measurements among nodes. A common setup, referred to as range localization, arises when nodes are capable of measuring distances with respect to a subset of mates (neighbor nodes) and need to retrieve their location in a common reference frame. The structure of the problem can be naturally described using graph formalism: nodes represent the vertices of a graph, and pairs of nodes between which the internodal distance is given represent graph edges. Therefore the localization problem can be formulated as the minimization of a cost function that has the meaning of accumulated quadratic distance mismatch error over the graph edges. Range localization has quite a long history, dating at least back to the eighties, and the literature encompasses several recent contributions. The renewed research interest on the topic stems from the possibility to derive decentralized schemes to solve the optimization problem. Approaching such problems in a centralized way, in fact, would require that each agent sends its information to the central elaboration unit, who solves the (usually large-scale) problem and transmits back the results to each agent. This may of course be highly undesirable for networked systems due to intensive communication load over the central units and the agents. Moreover, since all the computation is performed by a single unit, for large networks the computational effort can be just too intensive. Also, the system is fragile, since failure in the central elaboration unit or in communication would compromise the functioning of the whole network. According to these considerations, distributed approaches are desirable for solving network localization. In a distributed setup each node communicates only with its neighbors, and performs local computations in order to obtain an estimate of its own position. As a consequence, the communication burden is equally spread among the network, the computation is decentralized and entrusted to each agent, improving both efficiency and robustness of the estimation process. In this paper, we investigate the problem of distributed network localization from pairwise distance measurements, and we develop a decentralized gradient algorithm with Barzilai-Borwein stepsizes, based on a distributed averaging technique. The algorithm is composed by two phases: a consensus phase and an update phase. In the consensus phase each node iteratively consults and exchanges information with its neighbors in order to converge to some parameter value that must be common and available to all nodes for an update step to be possible. In the update phase, this common parameter is used to actually update the current position estimate, according to gradient algorithm. The technique is proved to converge, under an hypothesis of network connectivity, to the same solution as its centralized counterpart, while providing the benefits of fully decentralized schemes that can be implemented autonomously by the networked agents. The described approach is also illustrated through numerical experiments. We first test a setup that exemplifies the case of a team of autonomous vehicles or mobile robots moving in formation where few agents are equipped with GPS, in order to evaluate computational effort and localization performance. Then we discuss the scalability of the proposed technique, considering a sensor network in which a large number of nodes has to perform localization. The distributed gradient method is shown to be suitable for large networked systems with limited bandwidth and reduced computational resources.

**Keywords:** distributed optimization, consensus, network localization.
A model for coopetitive games

Carfi, David, Univ. of Messina, davidcarfi71@yahoo.it

Abstract. In this paper we introduce a mathematical model for the coopetitive games, such a type of game is used in a more or less intuitive way in Business Administration and some related fields. A two-player coopetitive game should be a game in which two or more players can interact simultaneously both cooperatively and non-cooperatively, but in a not well defined way. The problem is how this two possibilities of interaction can live together. Indeed, if \( G = (f, >) \) is a classic two-person normal-form game gain game, that is a pair in which \( f \) is a real function defined on a Cartesian product \( E \times C \) with values in the Euclidean plane and \( > \) is the natural order of this plane, and if \( f \) and \( F \) are the strategy sets of the two players, the two players of the game can choose the respective strategies \( x \in E \) and \( y \in F \) cooperatively or not cooperatively, there are no middle positions, in this model: there is no room, in this classic model, for other convex mixtures of the two end-points cooperation and competition. In this paper we propose a manner to pass this stop, the idea is simple: the players of the game have their respective strategy-sets (in which they can choose cooperatively or not) and a common strategy set \( C \) containing other strategies (possibly of different type with respect to the previous one) that must be chosen cooperatively. This strategy set \( C \) can be also structured as a Cartesian product, but in any case the strategies in this new set \( C \) must be chosen cooperatively.

A particular aspect of the question of coopetitive games is that when we consider a coopetitive game we necessarily build up a family of classic normal-form games. Indeed,

- we define a \( n \)-person coopetitive gain game as a pair \( (f, >) \), where \( f \) is a function from the Cartesian product \( E \times C \) (\( E \) is the classic strategy-profile space) into the \( n \)-dimensional Euclidean space \( \mathbb{R}^n \),
- we can associate with any coopetitive game \( (f, >) \) the family of classic normal-form games \( \{ G_z \}_{z \in C} \), where, for any cooperative strategy \( z \in C \), the game \( G_z = (f(z), >) \) is the classic normal-form game with payoff function the section \( f(z) : E \rightarrow \mathbb{R}^n \) defined by \( f(z)(x) = f(x, z) \), for every \( x \) in the strategy profile space \( \mathbb{R}^n \),
- the family of normal-form games associated with a coopetitive game uniquely determines the game,
- thus, the study of a coopetitive game is equivalent to the study of a family of normal-form games.

In this paper we suggest how this latter study can be conduct and what are the concepts of solution corresponding to the main concepts of solution present in the literature for the classic normal-form games.

keywords: games and economics, competition, cooperation, coopetition, normal-form games.

A distributed coordination-by-constraints approach for setpoint management of interconnected multi-agent system

Casavola, Alessandro, Univ. of Calabria, casavola@deis.unical.it
Garone, Emanuele*, Univ. of Calabria, egarone@deis.unical.it
Tedesco, Francesco, Univ. of Calabria, ftedesco@deis.unical.it

Abstract. In this paper we introduce a novel distributed supervision strategy for multi-agent linear systems connected via data networks and subject to coordination constraints. Such a coordination-by-constraint paradigm is based on an on-line active set-point management and is characterized by a set of spatially distributed dynamic systems, connected via communication channels, with possibly dynamical coupling amongst them which need to be supervised and coordinated in order to accomplish their overall objective. Interestingly enough, once the dynamical part of the problem is taken into account by means of a Steady-State Command Governor approach, the distributed control problem simplifies into a game theory problem in which the game rules have to be determined so as to allow agents to select their local set-point avoiding conflicts with other agents decisions. Two decentralized strategies will be described and analyzed by means of game theory approach. First, we will propose a “sequential” decentralized strategy in which only one agent at a time is allowed to manipulate its own reference signal. Such a strategy will be instrumental to introduce a more effectice “parallel” distributed strategy, in which all agents are allowed, under certain conditions, to modify their own reference signals simultaneously. Both the strategies will be carefully studied and their convergence to Pareto Optimal Nash equilibria will be proved.

keywords: game theory, distributed control.

Career concerns and contingent compensation

Caruana, Guillermo, CEMFI, Madrid, caruana@cemfi.es
Celentani, Marco*, Univ. Carlos III de Madrid, marco.celentani@uc3m.es

Abstract. This paper considers an environment in which managers have unknown abilities to forecast the consequences of their decisions and in which these decisions are publicly observable. We construct a two-period model in which firms compete for managers by offering short-run contracts contingent on managers’ decisions and their consequences. As salaries depend on managerial reputation, the manager's investment decisions are affected by their concern for their future careers. We analyze the interaction between the implicit incentives created by career concerns and the explicit incentives made possible by contingent compensation. Managers’ career concerns create perverse incentives that can be mitigated by contingent contracting, but this requires payments which are nonmonotonic in performance. Two numerical exercises relate our results to the literature on the link between executive pay and corporate performance. In line with empirical findings, we find that: i) the pay-performance sensitivity is higher in the final period of
managers’ employment; ii) higher pay-performance sensitivities are associated with a lower variance of profits.

**keywords:** games and economics, multi stage and repeated games, reputation, compensation.

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**Algorithmic explorations of a well known wargame**

Ciancarini, Paolo*, Univ. of Bologna, ciancarini@cs.unibo.it.
Favini, Gian Piero, Univ. of Bologna, favini@cs.unibo.it.

**Abstract.** Kriegspiel was a serious game played on three identical boards representing an actual territory. Two (groups of) generals fought a virtual war coordinated by an umpire, the only one knowing the full state of the game. The players would issue orders to their units, and the umpire would carry them out, revealing to each player what their units could see, and no more. He would also resolve combat based on tables, rules and personal experience. Kriegspiel is thought to have been an important training tool for the armies that used it until the XX century. The Japanese navy used Kriegspiel in the Russo-Japanese war (1905), which resulted in the Rising Sun’s unexpected major victory. The modern descendants of Kriegspiel are computer games, especially the real-time and turn-based strategy genres, which owe everything to this original idea. So-called “wargames” are still widespread, mostly fought with toy soldiers and miniatures, though they eschew imperfect information due to practical difficulties in maintaining three boards. Instead, uncertainty derives from a random factor (dice) and estimating distances between units without using tools. This paper is about Kriegspiel, though not the Kriegspiel that the Prussians played for training the officers of their armies. It is about a chess variant of the same name, designed around the same spirit, in hopes of making Chess closer to a modern wargame, including a concept of fog of war. It was described by vonNeumann and Morgestern in their classic book Theory of Games and Economic Behavior under the name blind chess. Players only see their own pieces and submit move attempts to a neutral umpire who can accept or reject them. Kriegspiel is like chess in that it follows the same rules, yet it is very different. For one, computers have a lot of trouble playing Kriegspiel compared to regular chess, whereas human players can adapt fairly quickly to the concept of an invisible opponent. Information is scarce, changes all the time and can be misleading, but every little bit of it can decide the outcome of the game. In a way, many Kriegspiel tactics could be likened to the ever elusive common sense that remains one of the most difficult things for computers to grasp. We study algorithms for playing Kriegspiel because it is a difficult game that does not seem to fall completely into any one category, which makes it very much like a real-world simulation. Playing a game of Kriegspiel forces you to reason about the past, present and future, to reason about your goals and your opponents’ ones, to decide what you know and what you choose to believe. Except in limited endgame scenarios, there is no ultimate perfection that a computer can discover by trying a number of combinations. Poker is a complex game that meets most of these criteria; even so, Texas Hold’em merely requires the player to select one of three strategies (check, fold or raise) through a handful of betting rounds. Imagine a game of poker with 40 options to choose from through 50 betting rounds in which your opponent may keep his strategy secret most of the time. Yet, maybe surprisingly, the best human players can win consistently this game. Computers are only starting to make some progress. Within the context of this work, much of this progress will be discussed and analyzed.

**keywords:** wargames, algorithmic game theory.

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**Exploitation and power in dynamic organizations**

Corchón, Luis C.*, Univ. Carlos III de Madrid, lcorchon@eco.uc3m.es
Romero-Medina, Antonio, Univ. Carlos III de Madrid, aromero@eco.uc3m.es

**Abstract.** This paper wants to contribute to the understanding of how power is maintained (or lost) in organizations and how this power translates in resource distribution. In order to uncover the main insights we consider an extremely simplified model of an organization that lasts for an infinite number of periods. At the beginning of period 0 the organization has a meta rule that fixes how decisions are taken. For the time being we take this meta rule to be majority voting. Agents last for an infinite number of periods. They can be of two types: H (high) or L (low). In each period there is a pool of potential entrants in the organization. Agents outside the organization are called outsiders and those inside the organization are called insiders. In each period the organization takes two decisions in turn. First it decides how the output is shared. Second it decides who joins the organization. Next, the agents who wish, leave the organization and join the pool of agents outside the organization. They receive their reservation utility. Finally production takes place and output is shared among insiders. Decision on hirings and sharing rules are made by majority voting among insiders in each period. Output is distributed by voting between egalitarian and meritocratic rules. In order to be able to solve the model we make some additional assumptions including that the pool of outsiders remains constant through time and that in each period the organization hires one agent only. We will say that type T (= H ; L) is the dominant class at time t if the number of insiders of this type is larger than one half of total agents. We show that when the discount factor is close to one and reservation utilities are low, in any Subgame Perfect Nash Equilibrium if a class is dominant at period, this class is dominant in all subsequent periods. This implies that organizations may opt for inefficient policies in order to maintain political power. But when the discount factor is low or reservation utilities are high, class dominance may pass from one class to the other. In particular the dominance of L may be short-lived. Currently, we are extending the model to consider the possibility of hiring several agents, more general technology and variable effort. We also have some preliminary thoughts on how to make the meta rule endogenous. Finally, we plan to introduce competition among organizations. Our model, focus on small organizations that are subject to competition (i.e. the role of reservation utility) and in which the number of insiders is endogenous. Thus, the kind of questions that we have in mind is, for instance, why not all universities hire talented people despite the abundance of them.

**keywords:** repeated games, games and decisions, cost sharing.
Project management games

Curiel, Imma*, Univ. of the Netherlands Antilles, imma.curiel@una.an

Abstract. Project management games are used to model situations in which several companies can cooperate by pooling their resources, in order to improve the earliest completion time of a project that consists of multiple tasks. This is clearly beneficial to the customer. The customer will pay an amount for the completion of the project that depends on the earliest completion time. The customer will assign the project to the coalition of companies that offers him the best earliest completion time. Precedence constraints among the tasks dictate the order in which they have to be completed. An activity on arc graph is used to model the precedence relations among the jobs. A critical path in this graph determines the earliest completion time. If all companies cooperate and form the grand coalition they can offer the customer the best earliest completion time. For this to happen the payoff that is generated should be distributed in such a way among the companies that it induces them to cooperate. This is possible if the core of the corresponding project management game is non-empty. Conditions that guarantee the non-emptiness of the core are discussed. For a certain class of project management games necessary and sufficient conditions for the game to have a non-empty core are given. It will be shown that the set of balanced games in this class can be partitioned into a class of 1-convex games and a class of big boss games.

keywords: cooperative games, activity on arc network, earliest completion time, 1-convex games, big boss games.

Bertrand-Edgeworth games under oligopoly with a complete characterization for the triopoly

De Francesco, Massimo A., Univ. di Siena, defrancesco@unisi.it
Salvadori, Neri*, Univ. di Pisa, nersal@ec.unipi.it

Abstract. In this paper we extend the analysis of price competition among capacity-constrained sellers beyond the duopoly and symmetric oligopoly cases. We first derive some general results on the mixed strategy equilibrium under oligopoly - among them, the fact that the minimum of the support of the equilibrium strategy is determined for the largest firm as in duopoly and the possibility of an infinite number of equilibria. The mixed strategy equilibrium may look quite different depending on firms’ capacities: supports of the equilibrium strategies may or may not coincide across all firms, the equilibrium need not be fully determined as far as the firms other than the largest one are concerned, and equilibrium payoffs may or may not be proportional to capacities. (The possibility of these features has been discovered also by D. Hirata, 2009). A complete characterization of mixed strategy equilibrium requires a taxonomy, and we provide it for the triopoly. We partition the region of the capacity space where the equilibrium is mixed into several subregions according to the properties of the equilibrium specific to each subregion. Another novel feature - in the context of concave demand, constant and identical unit cost and efficient rationing - revealed by our analysis is the possibility of some support of equilibrium strategies being disconnected, and we show how gaps are actually determined in that event. Having made the taxonomy of mixed strategy equilibria - in terms of the minima and maxima of the supports - having determined the equilibrium payoffs of the firms and the degree of determinateness of the equilibrium, and having seen how any gap is determined, we show how computing the mixed strategy equilibrium becomes an easy task.

keywords: oligopoly games, Bertrand-Edgeworth, triopoly, mixed strategy equilibrium.

On the optimality of a duty-to-rescue rule and the bystander effect

Crettez, Bertrand, Pantheon-Assas Univ.
Deloche, Regis*, Paris Descartes Univ., regis.delolche@gmail.com

Abstract. The majority American rule on omissions is that there is no legal duty to rescue persons in danger. By contrast, the New French Penal Code and most Western European civil laws impose a duty to aid persons in danger. Which system is better? What does “better” mean in that context? To address these issues, we develop a new game-theoretic model that reliably captures both the coordination problem and the “audience inhibition” process faced by bystanders in groups. We rely on the fact that a witness may wish before all to avoid the embarrassment suffered because of a misinterpretation of the situation. We show that a duty-to-rescue rule is more likely to be optimal when the cost of the embarrassment is low.

keywords: law and economics, duty to rescue, good samaritan laws, bystander effect.

Evolutionary stability and correspondences

De Michelis, Stefano*, Univ. Pavia, sdm.golem@gmail.com

Abstract. We argue that differential inclusions provide the sufficient higher degree of flexibility to model evolutionary and social learning. This paper is a first attempt to construct a theory of what we call Nash inclusions. To this aim, standard characterizations of evolutionary dynamics (such as payoff compatibility or monotonicity) are generalized to this novel framework. We give a necessary condition for asymptotic stability of a Nash component, or a set of rest points of the inclusions, under a convex valued upper semicontinuous inclusion. This condition generalizes the one proposed by Demichelis and Ritzberger (2003), namely, the equality of index and Euler characteristic. It is shown, via examples, that this condition is optimal.

keywords: evolutionary games; differential inclusions dynamic stability; index theory.
Evolutionary reputation model for distributed service oriented architectures

De Paola, Alessandra*, Univ. of Palermo, depaola@dinfo.unipa.it
Gaglio, Salvatore, Univ. of Palermo, gaglio@unipa.it
Lo Re, Giuseppe, Univ. of Palermo, lore@unipa.it
Milazzo, Fabrizio, Univ. of Palermo

Abstract. Classical Service Oriented Architectures (SOA) show several drawbacks regarding the information management of available services and their providers. The amount of information may be huge in large-size networks, with consequent limitations on the application scalability. This work presents a Distributed SOA (D-SOA) that overcomes the limits of the classical approach, using a hierarchical network structure. Moreover, the architecture proposes the adoption of an additional parameter of Quality of Service (QoS), with the aim of supporting network users in the selection process of the most suitable service. However, fully distributed approaches present some disadvantages due to the absence of a central authority, which may evaluate the trustworthiness of QoS declarations of service providers. In such a scenario, it is common the presence of antisocial behaviors. Unscrupulous providers could apply a greedy strategy in order to increment their service utilization. For instance, such providers could attribute higher QoS values to their services. Such a kind of behavior can be fully represented if a game theory approach is adopted in order to model the scenario. The players, i.e. the service providers, want to maximize their profits in the game, and the action, which maximizes their rewards, is the attribution of higher QoS values, thus inducing more users to select their services. In order to discourage this untruthful behavior it results useful to introduce a mechanism capable of inducing players to cooperate. Several approaches, presented in literature, exploit the cooperation among nodes, and among these the reputation based systems are the most similar to our approach. In our scenario, the reputation value of a provider indicates the trustworthiness of the QoS information regarding its services. The system can be modeled using the evolutionary game theory. The model is used to analyze the evolution of systems composed by populations of players, which are not perfectly rational, but able to change their strategies on the basis of the resulting gains. Starting from non-optimal strategies (in our case greedy), we note that alternative better strategies are used more likely in the population, until some equilibrium point is achieved. A real world analogy is the Darwinian evolutionary theory. In a sociobiological system, individuals naturally evolve their behaviors by a mechanism of action-selection. Larger the reward of an action, greater is the probability that the same action is selected. The model we propose, affords two kinds of players: i) users: select the best service in terms of QoS and trustworthiness; ii) providers: try to sell their owned services to the maximum number of customers. The system evolution is warranted by the adoption of reinforcement learning schemata. Users learn provider reputations, and exploiting this information, they select services with greater reliability. On the other hand, providers learn how to modify the QoS declarations in order to achieve a best utilization of provided services. Initially, deceitful providers, declaring QoS values higher than the real ones, sell their services with higher probability than reliable nodes. Nevertheless, as the network users experiment the services and rightly evaluate them, the reputation of fraudulent nodes soon will decrease in the network. As a consequence, the users will evolve their behaviors and select services only from reliable providers. From here on out fraudulent nodes can modify QoS declarations to recover the loss of reputation, and more important the loss of service sales. This involves a form of auto-balance system. Only optimal actions will be selected by users and providers and for this reasons the system tends towards an equilibrium point.

keywords: evolutionary games, reputation, distributed systems.

Application of auction rules on the polish power exchange

Drabik, Ewa*, Warsaw Univ. of Technology, ewa.drabik@poczta.fm

Abstract. The Polish energy market gained its competitive character in late 1990s. At that time in the majority of European countries a new law was enacted (in Poland in 1987), which enabled the creation of internal energy markets. The Polish Power Exchange has been functioning since the end of 1999. However, from the very onset it has constituted a vital component of liberalization of electricity market. Since it was created the Polish Power Exchange has served as a market mechanism for setting objective energy market price. Support and control of the Polish Financial Supervision Authority guarantee the security of concluded transactions. The spot energy market was created as the first one and has functioned according to the rule of double auction. Double auction are a form of money and goods exchange, during which the bids are made by purchasers as well as by sellers. Besides the price, each bid discloses the amount of ware which is to be purchased by contracting parties. The rules of double auctions, as well as of other auction types, are comparable to the rules of a game. The double auction is one of the most common exchange institutions, used extensively in stock markets, commodity markets in markets for financial instruments, including options and futures. Research and simulation experiments pertaining to the functioning of double auctions have been conducted on a wide scale. They were initiated in 1960s in the XX century by the Vernon L. Smith. Many authors such as: Wilson (1987), Friedman (1991), Gode and Sunder (1993), Gjerstad and Dickhaut (1998), Sadrieh (1998) attempted to construe models of behavior of double auction participants. Although all these models have deepened understanding of the interaction between individual behavior and institution in the double auction, the model of Sadrieh has been selected in order to describe the auction rules applicable to the spot energy trade on the Polish Power Exchange. Furthermore, an algorithm on the basis of which it is possible to forecast transaction prices is presented. The effectiveness of this algorithm will be compared with other traditional methods of forecasting transaction prices.

keywords: double auction, to forecast transaction price, energy market
On semivalues for TU games on matroids

Dragan, Irinel*, Univ. of Texas, dragan@uta.edu

Abstract. The Semivalues, axiomatically introduced by Dubey, Neyman and Weber (1981), form a family of values depending on some parameters, for TU games; it is well known that the Shapley Value is the unique efficient Semivalue. We give here an algebraic proof for this fact, which follows from the axioms, because this proof can be extended for TU games on matroids. In the case of matroids the efficiency should be redefined, as the grand coalition is not, in general, an independent set. M.Bilbao (1999 and 2000), has given a definition of matroid efficiency, which together with a redefined dummy player concept led him to a concept of Shapley Value for games on matroids. In this paper, we choose an alternative definition of matroid efficiency for Semivalues of games on matroids. This new definition provides a class of efficient Semivalues depending on one parameter, taking values in an interval, which is suggesting a range of efficiencies. For the highest efficiency we get a value which deserves the name of Shapley Value, as for a game on a free matroid it is reduced to the classical Shapley Value. Several examples show that the new Shapley Value is different of the Bilbao’s value, even in the case of equal efficiencies.


keywords: cooperative TU games.

On the nucleolus for 2-convex TU Games

Driessen, T.S.H.*, Univ. of Twente, t.s.h.driessen@ewi.utwente.nl
Hou, Dongshuang, Univ. of Twente, dshhou@126.com

Abstract. For 2-convex n-person cooperative TU games, the nucleolus is determined as some type of constrained equal award rule. Its proof is based on Maschler, Peleg, and Shapleys geometrical characterization for the intersection of the prekernel with the core. Pairwise bargaining ranges within the core are required to be in equilibrium. This system of non-linear equations is solved and its unique solution agrees with the nucleolus.

keywords: cooperative games; 2-convex game, core, nucleolus.

A generalization of the Owen value for games in partition function form

Ekes, Maria*, Warsaw School of Economics, maria.ekes@sgh.waw.pl

Abstract. In the paper we present a generalization of the Owen value for games in partition function form. For any given partition we construct a truncated characteristic function of a cooperative game with a priori unions, defined by this partition, in order to calculate its Owen value. Afterwards we take an average of Owen values for all partitions of the set of players. We examine the properties of the value defined in this way and we compare it to other values proposed for games in partition function form.

keywords: cooperative games, games in partition function form, Owen value.

New characterizations for largeness of the core

Estévez-Fernández, Arantza*, Free Univ. of Amsterdam, mestevez@feweb.vu.nl

Abstract. In this lecture we provide three new characterizations of largeness of the core. The first characterization of largeness of the core is based on the idea that if a base of the grand coalition does not provide a core element of the game, it should not provide a core element of a game which differs from the original one only by an increase of the value of the grand coalition. The second characterization shows the relation between the bases that provide core elements of the game and the bases that provide core elements of the games that are obtained from the original one by increasing the value of the grand coalition. The third characterization of largeness of the core is based on minimal covers of the grand coalition and associated inequalities.

keywords: cooperative games, core, upper core, base, minimal covering collection, largeness of the core.

Pareto-optimal security strategies in matrix games with fuzzy payoffs

Clemente, Moira, Seville Univ., moiraclemente@yahoo.es
Fernández, Francisco R.*, Seville Univ., fernande@us.es
Puerto, Justo, Seville Univ., puerto@us.es

Abstract. We present a new methodology for the analysis of fuzzy payoff matrix games. The main difficulty that appears in the study of these games is the comparison between the payoff values associated to the strategies of the players because these payoffs are fuzzy quantities. Our approach does not transform the fuzzy payoffs to crisp numbers via standard defuzzification but we use standard fuzzy orders which allows us to find solutions within the same space of fuzzy numbers. Moreover, we provide a method to solve these games finding equivalent fuzzy linear programs whose maximal solutions give the solutions of the games.

keywords: cooperative games, two-person games, fuzzy payoffs, Pareto-optimal security strategies.
Embedding classical indices in the FP family

Chessa, Michela, Univ. Milano, michela.chessa@unimi.it
Fragnelli, Vito*, Univ. of Eastern Piedmont, vito.fragnelli@mfn.unipmn.it

Abstract. Recently, a new family of power indices, the FP, was introduced by Fragnelli, Ottone and Sattanino. The different indices in this family depend on some parameters that may be set in order to represent various situations. In this paper we analyze the possibility to select the parameters with the aim of representing well-known power indices when the additional hypothesis that the winning coalitions include contiguous parties holds.

Keywords: power indices, contiguous winning coalitions.

Indices of collusion among judges and an anti-collusion average

Gambarelli, Gianfranco*, Univ. of Bergamo, gianfranco.gambarelli@unibg.it
Bertini, Cesarino, Univ. of Bergamo, cesarino.bertini@unibg.it
Uristani, Angelo, Univ. of Bergamo, angeluri@yahoo.it

Abstract. Certain subjective valuations may be exaggerated by shortcoming or excess, due to incompetence or collusion among judges. In order to avoid taking bad data into account in the synthesis of collective valuations, classical methods give little or no weight to the tails of distributions. This creates problems in the case of asymmetries, because good data may be undervalued while bad data may be overvalued. Methods have been developed as a solution to such cases (see, for instance, Gambarelli, 2008). However, these techniques do not work well in cases in which valuations are supplied by sub-committees whose results must be synthesized in terms of general averages. In order to find a solution to these particular cases, we introduce the Anti-collusion average, based on indices of collusion among judges. In order to prove that this average provides better incentives to judges to make correct evaluations than other averages, we use a game in strategic form that represents the problem faced by the judges. The game is defined as follows:

• the individual strategies of each judge are the possible valuations that he can assign;
• the utility function of each player is a function of the score assigned to the object/event to which he would like to give the highest score. Finally, we provide an algorithm to calculate this average.

Keywords: game theory.

Altruism in defence against a predator

Garay, Joszef*, Eötvös Loránd University Budapest, garayj@ludens.elte.hu

Abstract. The origin and the evolutionary stability of altruism between unrelated individuals is one of the key problems of evolutionary biology. In this paper, an altruistic defence game against a predator is introduced. Altruism means that the individual, which is not the target of the predator, helps the members of the group attacked by the predator and during defensive action the helper individual may also die in an attack. In order to decrease the long term predation risk, this individual has to carry out a high risk action. In a simple stochastic model, I show that this kind of altruistic behaviour can evolve in small groups in the sense that altruism is an invader strategy and also an ESS. For a minimal model, considering an altruistic individual and its group mate, we have two cases:

1. The mate is non-altruistic. The reason for the emergence of altruism is that if the predator does not kill the mate of an altruist individual, then the survival probability of the altruist will increase in the future. Indeed, each individual of the pair will have lower predation risk than a solitary one, since the predator having two targets, will choose one of them with half probability. Moreover, two individuals will observe the approaching predator earlier than a solitary one, so they can flee from attack earlier.

2. The mate is altruistic. Now, an altruistic individual has a further gain, the active help in defence during further predator attacks. Of course, all advantages of living in group remain. Summing up, if an altruistic individual can increase the survival rate of its mate (no matter whether the mate is altruistic or not), then its own predation risk will decrease.

Keywords: evolutionary games, altruism, survival game, cooperation.

Optimal influenza vaccination mechanism

Gaviouis, Arieh*, Ben Gurion Univ., ariehg@bgu.ac.il
Yamin, Dan, Ben Gurion Univ.

Abstract. Influenza (flu) is a contagious respiratory illness caused by influenza virus. It can cause mild to severe illness, and may lead to death. The most efficient way to prevent the disease is through vaccination. Vaccinations are vital for reducing the probability of infection not only for the individual who becomes inoculated, but also for the entire population. Although a fairly efficient vaccine for the disease exists, influenza vaccination coverage in all age groups remains suboptimal. This research analyzes seasonal influenza vaccination efficiency based on self-interests versus social interests. The research has two main objectives. The first is to offer a normative explanation for the small percentage of people taking the vaccine. The second is to offer tools for an optimal vaccination policy based on epidemic theory and economic mechanisms with the goal of benefiting society. We offer a non-atomic game based on epidemic theory to model the decision-making problem of an individual considering whether or not to get the vaccine. The game includes a ‘social
The relationship of the bargaining set of Davis and Maschler and the core for almost convex games

Getán, Jesús*, Univ. of Barcelona, jesus.getan@ub.edu
Montes, Jesús, Univ. Abad Oliva, montes3@uao.es

Abstract. For convex games, Maschler, Peleg and Shapley (1972) proved that the core and the Davis and Maschler's bargaining set are equal. Later, the concept of almost convex games was introduced by Nuñez and Rafels (1998). In this work, we prove the equality between these two sets for all almost convex balanced games. In particular, we obtain that the kernel is contained in the core for this class of games.

keywords: cooperative TU games, bargaining.

Egalitarian Tree Solutions for Graph Games

Béal, Sylvain, Univ. de Saint-Etienne, sylvain.beal@univ-st-etienne.fr
Ghintran, Amandine*, Obuda Univ., amandine.ghintran@kkg.uni-obuda.hu
Rémi, Eric, Univ. de Lyon, eric.remi@ens-lyon.fr
Solal, Philippe, Univ. de Saint-Etienne, philippe.solal@univ-st-etienne.fr

Abstract. To generalize the equal surplus division for n-person TU games into n-person graph games, this article introduces a recursive negotiation process to establish cooperation between all players. This procedure can be regarded as a generalization of the negotiation process introduced by Ju, Borm and Ruys (2007) from orderings of the player to rooted spanning trees of a communication graph (Demange, 2004). The associated payoff vector can be characterized by component efficiency and component fairness for subordinates. The latter axiom says that if a player deletes all his links, then the changes in payoff for this player and the resulting components among his subordinates should be the same. Then, for each nonempty set of rooted spanning trees, we define the egalitarian tree solutions as the average over this set of the associated payoff vectors. For the class of forest graph games, we provide two axiomatic characterizations of the egalitarian tree solution. A further extension to arbitrary graph games is studied in which rooted spanning trees are constructed by classical algorithm DFS and BFS. When the graph is complete, we show that the associated egalitarian tree solutions coincide with the consensus value (Ju, Borm and Ruys, 2007) and the equal surplus division respectively. As such, the egalitarian tree solution can be seen as a generalization of the consensus value for graph games.

keywords: consensus value, average tree solution, DFS, BFS.

Allocating slacks in stochastic PERT network

Gomez, Daniel*, Univ. Complutense Madrid, dagomez@estad.ucm.es
Castro, Javier, Univ. Complutense Madrid, jcastro@estad.ucm.es
Tejada-Cazorla, Juan, Univ. Complutense Madrid, jtejada@mat.ucm.es

Abstract. The problem of allocating slacks in PERT networks (SPERT problem) was initially defined in a deterministic framework. In this work, we extend the problem in a stochastic framework defining a new rule that presents a similar performance of other rules that were defined only for deterministic PERT networks. Finally, we show how this new rule permits us to tackle with classical project scheduling problems.

keywords: project scheduling, PERT network, slack allocation, game theory.
Sharing a polluted river network through environmental taxes

Gómez-Rúa, Maria*, Univ. de Vigo, mariarua@uvigo.es

Abstract. Dong et al. (2007) consider a river network divided into n segments. In each segment there is exactly one agent, who throw some kind of residue into the water. An environmental authority must share the total cost of cleaning the river network among all the agents. In this paper we propose several rules to distribute the total cleaning-cost among the agents. Moreover, we provide axiomatic characterizations for them using properties based in water taxes. Both, the rules and the characterizations are generalizations of the ones given in Gomez-Rúa (2008).

Keywords: cost sharing, pollutant-cleaning cost, water taxes.

The k-additive core and its relation to other solution concepts

Grabisch, Michel*, Univ. de Paris, michel.grabisch@univ-paris1.fr
Li, Tong, Beijing Inst. of Technology, tltitong@163.com

Abstract. In a cooperative game, the core is the set of pre-imputation vectors (which can be assimilated to additive games having the same value on the grand coalition) being coalitionally rational, and is therefore an important solution concept ensuring stability. However, it is well known that the core is often empty, so that other solution concepts have to be found. The concept of k-additive core, proposed by Miranda and Grabisch, can be helpful when the core is empty. It is the set of k-additive games (i.e., whose dividends vanish for subsets of more than k elements) ensuring coalitional rationality, and is therefore a natural generalization of the notion of core, keeping its attractive feature of stability. It can be shown that the k-additive core is never empty for any k greater or equal to 2. However, the k-additive core being a set of generalized imputations (in the sense that imputations are not only defined for individual players but also for groups of players up to size k), it remains the problem of defining a rational sharing among players from generalized imputations. A given sharing procedure is in fact an element of the selectope of a generalized imputation. We study the set of pre-imputations obtained when a particular sharing procedure is chosen for the set of generalized imputations in the k-additive core. In particular, we show that for a large class of sharing procedures (including the Shapley value), the whole set of pre-imputations is obtained. On the other hand, when the sharing procedure is a marginal worth vector, a proper subset of the set of pre-imputations is obtained, which is a pointed unbounded polyhedron having the considered marginal vector as unique vertex. Other results concern the lower envelope (as proposed by Schmeidler, and also known as the min game) of a set of pre-imputations obtained from the k-additive core.

Keywords: cooperative games, k-additive core, selectope.

A game theoretical study of the wheat market in south Italy

Grilli, Luca*, Univ. degli Studi di Foggia, I.grilli@unifg.it
Sfrecola, Angela, Univ. degli Studi di Foggia, a.sfrecola@unifg.it

Abstract. In this paper we investigate, in a game theoretical context, the wheat market in South Italy. In particular we consider the “Tavoliere” area in the Region Puglia, this area is also known as “granaio d’Italia”. The “Tavoliere” economy is based on agriculture and in particular wheat-growing. Typically the farmer is also the owner of the land. The farmer has to choose the wheat variety to raise and consequently the quantity to be produced according to land availability. The selection of wheat variety is crucial since the European Community provides incentives only if the wheat produced satisfies specific characteristics in terms of protein, gluten and others. Once the wheat has been harvested the farm could sell it in the market at the current price which is determined in a specific Exchange. Nevertheless, the farmer uses to sell the wheat produced to an intermediate trader that will sell it, later, in the market. This is due to impossibility, for the farmer, to stock the harvested wheat and wait for selling it since small farmers, in this area, do not have grain bins. In this paper we consider a model in which there are two agents: the trader and the farmer. We suppose that they interact following a Leader-Follower structure, where the trader is the Leader and the farmer is the Follower. The farmer has to decide the quantity to sell considering also the Communitarian incentives, as a best reply to the announced price asked by the trader.

Keywords: wheat market, leader-follower, public incentives.

How flow can you go? An application of an OR game in practice

Heesen, Remco, Tilburg Univ., R.D.Heesen@lse.ac.uk
Hamer, Herbert*, Tilburg Univ., h.j.m.hamer@uvt.nl
Huisman, Kuno, Tilburg Univ., k.j.m.huisman@uvt.nl

Abstract. In this paper we introduce a management game for an international logistics provider. The game aims to show the strength of mathematical programming and cooperative game theory. First, it is shown that for individual business units is profitable to develop route planning using a mixed integer programming (MIP). Indeed, it turns out that the MIP planning outperforms the regular planning by increasing the profit of each individual business unit substantially. Second, we show that profit can be increased even more if the individual business units cooperate. Obviously, this extra profit has to be shared in a fair way. The latter will be tackled using cooperative game theory. The latter will be tackled using cooperative game theory.

Keywords: OR Games, game practice
Characterisations of the $\beta$- and the degree network power measure

van den Brink, René, Free Univ. of Amsterdam, jbrink@feweb.vu.nl
Borm, Peter, Tilburg Univ., P.E.M.Borm@uvt.nl
Hendrickx, Ruud*, Tilburg Univ., r.l.p.hendrickxx@uvt.nl
Owen, Guillermo, Naval Postgraduate School, Monterey, gowen@nps.edu

Abstract. A symmetric network consists of a set of positions and a set of bilateral links between these positions. For every symmetric network we define a cooperative transferable utility game that measures the “power” of each coalition of positions in the network. Applying the Shapley value to this game yields a network power measure, the $\beta$-measure, which reflects the power of the individual positions in the network. Applying this power distribution method iteratively yields a limit distribution, which turns out to equal the well-known degree measure. We compare the $\beta$-measure and degree measure by providing characterisations, which differ only in the normalisation that is used.

keywords: cooperative TU games.

Existence of equilibrium points in infinite extensive games

Hernández-Castaneda, S.*, Univ. Autónoma de México, pzl@ciencias.unam.mx
Zapata, R., Univ. Autónoma de México, zapatalillo@yahoo.com.mx

Abstract. We start from the infinite $n$-personal extensive games defined by Kuhn, with the restriction that for every vertex the set of successors is finite. We intend to find enough conditions which have to cope $\pi$, the payoff functions of the extensive game to grant the existence of at least one equilibrium point in the game. Our search consists of proceeding as usual in the finite extensive games. That is, reducing the extensive game to its normal form, building the sets of mixed strategies plays, and the building of the normal form is immediate. However, in the infinite case, we need to establish a semi ring in the set of plays and to show that every $\sigma$ determines a measurement in the Borel’s algebra of that semi ring. And, the expected payoff functions, to finally apply a Parthasaraty’s fixed point theorem. In the finite extensive games it is easy to show that every $m$ profile of pure strategies determines a probability distribution in the set of plays, and the building of the normal form is immediate. However, in the infinite case, we need to establish a semi ring in the set of plays and to show that every $\sigma$ determines a measurement in the Borel’s algebra of that semi ring, and, through this, get a probability distribution in the set of plays. Besides, we need that the $k_i$ functions have integrating properties with respect to those probability distributions, so as to define the normal form of the game. Thus, and for the necessity of discussing properties of the $\pi_i$ functions which imply continuity properties of the normal form of the game, we will introduce topologies in the sets of plays and of pure strategies. The fundamental result we reached is the following: If for every $i$ player and every $\sigma$ profile of strategies we get: 1. $\pi_i$ is integrable with respect to $u_i$, the determined distribution from $\sigma$; 2. the $u_i$-measurement of the discontinuities set of $\pi_i$ is zero and 3. $\pi_i$ has a local mayorant, then, the extensive game has at least one equilibrium point. Finally, we present some examples of interest in the infinite extensive games which $\pi_i$ payoff function fills the previous properties. We specially study, with the help of our theorem, the Shapley’s stochastic games, thus, we build an infinite extensive game equivalent to the stochastic game and demonstrate that the payoff function of the extensive game has the three previously exposed properties.

keywords: non-cooperative games, infinite extensive games, normal form, Nash equilibrium, existence of equilibrium in infinite extensive games.

Polyhedral results on the core of the shortest path tree games

Horozoglu, Nayat*, London School of Economics, n.horozoglu@lse.ac.uk
Papadaki, Katerina P., London School of Economics, k.p.papadaki@lse.ac.uk

Abstract. We introduce the Shortest Path Tree Games (SPTGs), which are cooperative linear programming games where the set of players are the nodes on a graph. The aim of the players is to connect to a root node at minimum cost either directly or via other players who are willing to cooperate. The optimal solution is obtained when all the players collaborate and form a shortest path tree. The SPTGs are shown to be subadditive, non-monotone, non-convex and population monotonic. In the current study, we present polyhedral results on the core of the SPTGs, which we show is nonempty. Furthermore, we reduce the number of inequalities needed to describe the core using dominance. The core, a fundamental notion in cooperative games, constitutes a polytope of stable solutions since no coalition of players has an incentive to break away from the grand coalition if they are given an allocation that belongs to the core. Thus, it can be considered as a very appealing solution concept. However, since there is an exponential number of linear inequalities (exponential in the problem size) that need to be taken into account, finding cost allocations that lie in the core becomes computationally hard for games with large number of players. In this paper, we show that the SPTGs have nonempty cores since the solution where each player is allocated their shortest path cost to the root node belongs to the core. We call this point the altruistic solution. We start the analysis of the core by identifying a special coalition structure, which we call primary coalitions. The primary coalitions are shown to be sufficient to characterise the core of the SPTGs, that is, they dominate all non-primary coalitions. Naturally arising sets of nodes to consider are the branches of the shortest path tree formed by the players. On a given shortest path tree, a hub node is defined to be a node whose predecessor is the root node. The set of nodes that depend on a hub node forthat the SPTGs have nonempty cores since the solution where each player is allocated their shortest path cost to the root node belongs to the core. We call this point the altruistic solution. We start the analysis of the core by identifying a special coalition structure, which we call primary coalitions. The primary coalitions are shown to be sufficient to characterise the core of the SPTGs, that is, they dominate all non-primary coalitions. Naturally arising sets of nodes to consider are the branches of the shortest path tree formed by the players. On a given shortest path tree, a hub node is defined to be a node whose predecessor is
the root node. The set of nodes that depend on a hub node for their shortest path form a branch. We show that the cost that each branch has to pay is fixed for points in the core and is independent of other branches. Upon analysing the polyhedral structure of the core we first distinguish between SPTGs where players form a unique tree, that is, no node has an alternative shortest path and SPTGs where there exists a node, which has an alternative shortest path. For the latter case, the alternative shortest path can either be through nodes, which belong to the same branch or through nodes, which belong to a different branch. Taking all of the aforementioned cases into consideration, we find the dimension of the core of the SPTGs. For cases where there does not exist a node, which has an alternative shortest path through the nodes of a different branch, the dimension of the core is equal to the number of players minus the number of branches; for every such node, the dimension is further reduced by one. We call a coalition a subtree coalition if it contains all the nodes that lie on the shortest path of each of its nodes. Using the second shortest path costs, we show that the subtree coalitions are facet-inducing for the core of the SPTGs where the players form a unique tree. When alternative shortest paths exist, we identify a subset of the subtree coalitions that are facets and we show that the rest are faces of the core. We show that the altruistic point is an extreme point of the core defined by the subtree facets. Further, we identify a class of extreme points of the core based on marginal contributions of the players and investigate the facets that define them.

**keywords:** Cooperative Games; Linear Programming Games; Shortest Path Trees; Core.

### Strategyproof Nash equilibria in minimum cost spanning tree models

**Hougaard, Jens Leth**, Univ. of Copenhagen, jlh@foi.dk  
**Tvede, Mich**, Univ. of Copenhagen, mich.tvede@econ.ku.dk

**Abstract.** In this paper we consider the Minimum Cost Spanning Tree model. We assume that a central planner aims at implementing the minimum cost spanning tree not knowing the true link costs. The central planner sets up a game where agents announce the link costs, a tree is chosen and costs are allocated according to the rules of the game. We characterize ways of allocating costs such that true announcements constitute Nash equilibria. In particular, we find that the Shapley rule with respect to the irreducible cost matrix is consistent with truthful announcements while a series of other well-known rules (such as the Bird-rule, Serial Equal Split, the Proportional rule etc.) are not.

**keywords:** minimum cost spanning tree, strategyproof implementation, Nash equilibrium, Shapley value.

### Experimenting with game-theoretical computer models

**Hrubý, Martin**, Brno Univ. of Technology, hrubym@fit.vutbr.cz

**Abstract.** The paper presents algorithms and methods of simulation experimenting with computer models based on game theory. These approaches were developed during author’s work on computer models of commodity markets which are now practically employed in professional forecasts of the markets evolution. Thus, the paper combines theoretical results with practical experimental experience. Generally, these models are interesting for their large number of modelled players and their strategies. The strategies model various actions which the players may adopt in the multi-criteria decisional situation (price of the commodity, activities on various markets, usage of resources etc.). The computer model itself is composed of a general structure of a static game (players, strategies) and an internal model (also called an “oracle”) computing the players’ payoffs for given strategy profiles. Computing a response for a given profile takes the oracle a certain machine time which is significant in the context of the whole simulation. For these reasons, it is highly wanted to minimize a number of invocations of the oracle to keep the simulation time in reasonable limits. In the previous work, the author developed an algorithm reducing a given static game to its strategic equivalent in polynomial number of invocations of the oracle, i.e. in polynomial time in general. This particular paper is more concentrated on experimenting with the models, i.e. on computer aided interactive process of examination of the models and predicting the players’ probable behaviour. The experimenting starts with a formulation of a single large original static game modeling the target problem. Having this original game, the experimenter asks for particular predictions within sub-games in the context of the original game. The presented simulation algorithm stores the sub-results of the sub-games and uses them for its further reasoning during the experiments. As the main theoretical contribution, the paper presents an algorithm of efficient determination of equilibrium points in extremely large static games combining a machine computing with a human supervision.

**keywords:** algorithmic game theory, computer modeling and simulation, reduction of dominated strategies.

### A new solution for cooperative games with communication structure

**Huseynov, Tural**, Tilburg Univ., T.Huseynov@uvt.nl  
**Talman, Adolphus Johannes Jan**, Tilburg Univ., talman@uvt.nl

**Abstract.** In this paper we introduce a new solution concept for cooperative games, with communication structure, which generalizes the well known Shapley value. Cooperative games with communication structure were first introduced and analyzed by Myerson. Myerson models the communication structure by means of graph where vertices represent players and edges represent communication links between the players. Moreover, it is assumed that the coalitions which induce a connected subgraph are able to communicate.
Furthermore, the worth of a coalition is simply the worth of it under standard cooperative game, i.e. with full communication. Myerson defined a new value for this class of games which generalizes the Shapley value in certain sense. Another solution which is introduced for this class of games is the average tree solution studied by Herings et al., (2009). In the latter, only the tree orders are extracted from a graph and marginal payoff vectors with respect to these orders are considered. This generalizes the notion of a linear (total) order in the definition of Shapley value for games with restricted communication. In this study, we go one step further and extract not only the so called tree orders but also other partial orders (with exactly one maximal element) which preserve the connectivity assumption on a graph. We notice that this solution coincides with the Shapley value when the underlying communication graph is full and coincides with the average tree solution for the class of cycle free graph games. As for the stability, we notice that this solution is in the core if the game is convex. However, this convexity condition is too strong. For average tree solution the link convexity condition is introduced and it is shown that under this condition the average tree solution lies in the core. Link convexity, however, is a weak condition to assure that our new solution is in the core. We expect a weaker condition than convexity but stronger than link convexity for our new solution to be a core element. Finally, we make some connections between these partial orders and partial orders of a graph induced by minors and topological minors.

**Keywords:** cooperative games, graph games, average tree solution.

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**Emergence of nested coalition structures in a pure bargaining game**

Imai, Haruo*, Kyoto Univ., imai@kier.kyoto-u.ac.jp

**Abstract.** We consider a coalition formation game a la Bloch and Ray and Vohra, in a pure and sequential bargaining game. Under the bargaining protocol which does not favor a player who rejected an offer, and coalition members cannot commit not to renegotiate the distribution within it, the solution yields a de facto delegation to the toughest player. We show under an order independent equilibrium, the softest player tend to get a relatively favorable deal. Then we consider the possibility to form a sub-coalition at each level of coalitional bargaining, with the same assumption that redistributive agreement is incomplete and subject to renegotiation. We show that it is possible to have a nested coalition structure to emerge, by means of an example consisting of two types of players, tough and soft, measured by RRA. In one simple example with one toughest player, this toughest player always belong to the coalition. A relatively tough player among the soft players is excluded, and then next tough player in the soft players is kicked out and so on. Finally, a coalition consisting of the toughest and the softest player remain, at the end.

**Keywords:** nested coalition structure, bargaining game, coalition formation, renegotiation.

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**Games on fuzzy communication structures with Choquet players**

Jiménez-Losada, André*, Univ. de Sevilla, hispan@esi.us.es
Fernández, J. R., Univ. de Sevilla, julio@us.es
Grabisch, Michel, Univ. of Paris I, CES, michel.grabisch@univ-paris1.fr
Ordóñez, Manuel, Univ. de Sevilla, morionez@us.es

**Abstract.** Myerson (Graphs and cooperation in games, Mathematics of Operation Research 2 (1977) 225-229) used graph-theoretic ideas to analyze cooperation structures in games. In his model, he considered the players in a cooperative game as vertices of a graph which undirected edges defined their communication possibilities. He modified the initial games taking in account the graph and he established a fair allocation rule based on applying the Shapley value to the modified game. Later, this rule was named the Myerson value. Now, we consider a fuzzy graph to introduce leveled communications. In this paper players play in a cooperative Choquet way, in the sense of Tsurumi et al. (A Shapley function on a class of cooperative fuzzy games. European Journal of Operation Research 129 (2001) 596-618). This means that they are always interested first in the biggest feasible coalition and second in the greatest level. We propose a modified game for this situation and a rule of the Myerson kind. Finally, we analyze the case of a forest and the relationship with the above work of Tsurumi et al.

**Keywords:** cooperative fuzzy games, fuzzy graph, Myerson value, Choquet integral, partial cooperation.

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**On the robustness of the Shapley value in bargaining with renegotiation**

Ju, Yuan* Univ. of York, yj506@york.ac.uk

**Abstract.** Since Gul (1989) the strategic approach to the Shapley value has attracted wide attention. While most such mechanisms proposed in literature suggest the Shapley value as a reasonable outcome, Ju and Wettstein (2009) argued that by introducing renegotiation a bargaining game may generate completely different value allocations in equilibrium. The current paper is to evaluate the robustness of the Shapley value in bargaining with renegotiation. Three distinctive, yet reasonable renegotiation protocols are presented, which lead to the Shapley value in subgame perfect equilibria.

**Keywords:** bargaining, implementation, Shapley value, bidding mechanism, renegotiation.
Whose deletion does not affect your payoff? The difference between the Shapley value, the egalitarian value, and the solidarity value

Kamijo, Yoshio*, Waseda Univ, kami-jo@suou.waseda.jp
Kongo, Takumi, Waseda Univ., kongo.takumi@toki.waseda.jp

Abstract. Consider a situation that is well described by a standard notion of a cooperative game with a transferable utility (or, simply a TU game) and consider some one-point solution concept that prescribes how players divide their worth of total cooperation among them. We deal with the setting of variable player sets and our concern is how the payoff of a player in some TU game is related to his payoff in another TU game (especially for the subgame of the former game). More specifically, we explore the problem of when the payoff of a player is not affected by the elimination of some player from the original TU game. In this paper, we explore three types of the invariance property in the payoff before and after the elimination of some player. One is the invariance in the payoffs of the other players before and after the elimination of a null player who makes zero contribution to any other coalition and this is called the invariance from the null player deletion property. The other two is the invariance from the eliminations of players who makes contribution to each coalition in the same manner and these are called the invariance from the proportional player deletion property and the invariance from the quasi-proportional player deletion property, respectively. Using the balanced cycle contributions property (BCC) that is weaker condition than the balanced contributions property of Myerson (1980), Kamijo and Kongo (2009) show that

• The Shapley value is a unique solution satisfying efficiency, BCC, and the invariance from the null player deletion property. In this paper, we extend the result of Kamijo and Kongo to other major solutions. We show that

• The egalitarian value is a unique solution satisfying efficiency, BCC, and the invariance from the proportional player deletion property

• The solidarity value introduced by Nowak and Radzik (1994) is a unique solution satisfying efficiency, BCC, and the invariance from the quasi-proportional player deletion property. Thus, we provide new axiomatic foundations of the egalitarian value and the solidarity value, respectively. Moreover, combining with the result of Kamijo and Kongo (2009), the difference among the three major one point solution concepts, the Shapley value, the egalitarian value, and the solidarity value, lie in the selection of a player “whose deletion does not affect your payoff.”

keywords: axiomatization; invariance from players' deletion; balanced cycle contributions property; shapley value; egalitarian value; solidarity value.

The Shapley value for games with restricted cooperation

Katsnev, Ilya*, Russian Academy of Sciences, katsnev@yandex.ru

Abstract. A situation in which a finite set of players can obtain certain payoffs by cooperation can be described by a cooperative game with transferable utility, or simply a TU-game. A (single-valued) solution for TU-games assigns a payoff distribution to every TU-game. A well-known solution is the Shapley value. The cooperative game theory usually deals with problems of a standard type: as a start point we have a set of players and a characteristic function which is defined for each coalition and as a result we get a “fair” distribution of the profit between players. However, in many real life situations not every group of players has the opportunity to cooperate and to collect their own payoff. We say that we deal with cooperative games with restricted cooperation when not all coalitions can form. This talk deals with possible generalizations of the Shapley value for games with restricted cooperation. Three solutions for games with restricted cooperation will be considered. One of them (the Myerson value) is well known. Two others based on the same principle: to construct some restricted game and use the Shapley value for this game. An axiomatic characterization for each possible solution which can be constructed by this way will be given.

keywords: cooperative games, restricted cooperation, the Shapley value, the Myerson value, balanced contribution.

The tree and web values for games with cycle-free directed communication structures

Khmelnitskaya, Anna*, Russian Academy of Sciences, akhmelnitskaya@math.utwente.nl
Talman, Adolphus Johannes Jan, Tilburg Univ, talman@uvt.nl

Abstract. In standard cooperative game theory it is assumed that any coalition of players may form. However, in many practical situations the collection of feasible coalitions is restricted by some social, economical, hierarchical, communicational, or technical structure. The study of TU games with limited cooperation introduced by means of communication graphs was initiated by Myerson (1977). In this paper we restrict our consideration to the class of cycle-free directed graph games in which all players are partially ordered and a possible communication via bilateral agreements between participants is presented by a directed graph (digraph) without directed cycles. A cycle-free digraph cooperation structure allows modeling of various ow situations when some links may merge while others split into several separate ones. Following Myerson, we assume that for a given game with cooperation structure, cooperation is possible only among productive coalitions of players, while in a directed graph not every connected coalition might be productive. We consider tree-type values assuming that each player may be controlled only either by his predecessors or by his successors and we consider web values when every player can be
Nucleolus based revenue sharing in airline alliances

Kimms, Alf*, Univ. of Duisburg-Essen, alf.kimms@uni-due.de

Abstract. A major problem in airline alliance revenue management operations is to construct allocation rules which define how the alliance revenue should be shared among the airline partners. In this paper, we provide fair revenue proportions for airlines based on the nucleolus solution concept. We obtain revenue allocations by incorporating revenue management concepts into a nucleolus computation algorithm. The revenue proportions are found by taking the ratio of the resulting allocations to the expected alliance revenue. Through a computational study on randomly generated alliance networks, we show that the nucleolus revenue proportions provide reasonable allocation rules for airline alliances and may serve as a benchmark for decentralized approaches.

keywords: OR games, nucleolus, revenue management.

Equilibrium paths in discounted supergames

Berg, Kimmo, Aalto Univ. School of Sc. and Tech., kimmo.berg@tkk.fi
Kitti, Mitri*, Aalto Univ. School of Economics, mitri.kitti@hse.fi

Abstract. We give a characterization for subgame perfect equilibrium paths in discounted supergames with perfect monitoring. More specifically, we consider the case where a stage game is repeated infinitely many times, players discount the future payoffs, observe perfectly each others actions, and use pure strategies. Our approach relies on the result by Abreu, Pearce, and Stacchetti (1986,1990) which tells tells that subgame perfect equilibrium payoffs are a fixed-point of a particular iterated function system. It has been observed that the result is analogous to the Bellman equation in dynamic programming. To continue this analogue, our approach is similar to the Euler equation: wethe payoff set is a graph-directed self-affine set. More generally the payoff set is a sub-self-affine seta particular fractal. Consequently, it possible to analyze the Hausdorff dimension of the payoff set using tools developed for this kind of fractals.

keywords: repeated games, subgame perfect equilibrium, equilibrium path, payoff set, multi-graph, fractal.

Cooperative situations: games and cost allocations

Kleppe, John*, Tilburg Univ., J.Kleppe@uvt.nl
Borm, Peter, Tilburg Univ., P.E.M.Borm@uvt.nl
Hendrickx, Ruud, Tilburg Univ., r.l.p.hendrickx@uvt.nl
Reijnierse, Hans, Tilburg Univ., j.h.reijnierse@uvt.nl

Abstract. This paper analyses several classes of cooperative situations, among which sequencing situations without initial order, minimum cost spanning tree situations, travelling salesmen problems and the new class of travelling repairman problems. A cooperative situation consists of a group of players that can choose from a set of alternatives, where each alternative results in a cost for the (group of) players. Such a situation gives rise to two main questions; which alternative should be realised and how should the costs of this alternative be divided? In this paper we introduce a general model to answer the second question. Our approach is based on the idea that a cooperative situation can be represented by an order problem, which consists of the player set of the underlying cooperative situation, the set of orderings of the player set and an individualised cost function. In an order problem players make individual decisions (e.g., which link to build, position to take, machine to use) in a particular order. All decisions together result in an alternative. The costs of this alternative are associated with the individual players via the individualised cost function that describes for each ordering of the player set the corresponding cost for every player (based on the best individual decisions). We focus on two types of order problems; positive and negative externality order problems. In the first type all (groups of) players are best off at the end of an ordering, while for the second type all (groups of) players prefer to be the first to decide. We argue to model the first type by the so called direct cost game where a coalition of players assumes to be the first to make its individual decisions. We model the second type by the marginal cost game, which is the dual of the direct cost game. By the use of this model we find transferable utility games that are a good fit for the underlying cooperative situation. For several classes of cooperative situations we also show that the core of the resulting transferable utility game is non-empty. For this we introduce the generalised Bird solution as a single-valued solution concept.

keywords: OR games, cooperative situation, order problem, alternative problem, generalised Bird solution, direct cost game, marginal cost game, travelling repairman problem.
The men who were not even there: legislative voting with absentees

Koczy, Laszlo A.*, Obuda Univ. Budapest, koczy.laszlo@kgk.uni-obuda.hu
Pinté, Miklós, Univ. of Budapest, miklos.pinter@uni-corvinus.hu

Abstract. Voting power in voting situations is measured by the probability of changing decisions by altering the cast “yes” or “no” votes. Recently this analysis has been extended by strategic abstention. Abstention, just as yes or no votes can change decisions. This theory is often applied to weighted voting situations, where voters can cast multiple votes. Measuring the power of a party in a national assembly seems to fit this model, but in fact its power comprises of votes of individual representatives each having a single vote. These representatives may vote yes or no, or may abstain, but in some cases they are not even there to vote. We look at absentees not due to a conscious decision, but due to illness, for instance. Formally voters will be absent, say, ill, with a certain probability and only present otherwise. As in general not all voters will be present, a thin majority may quickly melt away making a coalition that is winning in theory a losing one in practice. A simple combinatorial model allows us to differentiate between winning and more winning and losing and less losing coalitions reflected by a voting game that is not any more simple. Among other properties this model enables us to verify the intuitively appealing notion that a larger losing coalitions reflected by a voting game that is not any more simple. Among other properties this model enables us to verify the intuitively appealing notion that a larger lost coalition is more democratic using the language of power indices. We use data for selected years in the Hungarian National Assembly both to illustrate the relation of the theoretical and effective power and show our results working in the practice.

Keywords: voting and power indices, being absent from voting, minority, Shapley-Shubik index, Shapley value.

A non-cooperative and an axiomatic characterization of the AL-values

Kongo, Takumi* Waseda Univ., kongo.takumi@toki.waseda.jp
Funaki, Yukihiko, Waseda Univ., funaki@waseda.jp
Branzei, Rodica, “Al. I. Cuza” Univ., branzeir@info.uaic.ro
Tjwa, Stef, Tilburg Univ., S.H.Tjwa@uvt.nl

Abstract. We give a non-cooperative and an axiomatic characterization of the AL-value on the class of balanced games. In both characterizations, a consistency property which we call average consistency plays an important role, and the property is obtained by the consistency property “a la Davis and Maschler of the leximals.

Keywords: cooperative games; AL-value; average consistency

Voting power and social interaction

Koster, Maurice*, Univ. of Amsterdam, mkoster@uva.nl
Lindner, Ines, Free Univ. Amsterdam, ilindner@feweb.vu.nl
Napel, Stefan, Universität Bayreuth, stefan.napel@uni-bayreuth.de

Abstract. Basic notions of classical voting theory are extended to serve the goal of identifying the most influential actors when voters cannot be assumed to act independently of one another. The key idea is to extend the classical concept of power of an actor as a marginal contribution to the probability of the bill’s passing. Feature of the model is that voting power does not only concern actors with institutional voting rights, but also those non-institutional actors influencing them. Examples include insurgency and lobbyists. We illustrate our measure of voting power in absence of independent voting by analyzing it in two different ways. The first approach is a dynamic model in which the agents in a network update their voting behavior over time in a decentralized way by repeatedly taking averages of their neighbors’ opinions from the previous period. This approach is based on a model of network influence largely due to Morris H. de Groot (1974). The second approach is an axiomatic one and extends Dubey and Shapley’s axiomatization of the Banzhaf measure in their classical paper from 1979.

Keywords: voting and power indices.

Dynamic models of fisheries with alternative fishing strategy choices in discrete time

Bischi, Gian Italo, Univ. of Urbino, gian.bischi@uniurb.it
Lamantia, Fabio*, Univ. of Calabria, lamantia@unical.it

Abstract. The problem of a sustainable exploitation of fisheries represents a serious challenge to policy makers, as it involves nonlinear interactions of biological, social, economic and legislative externalities, as well as international agreements. The complexity of time evolutions of natural populations, due to nonlinear biological growth functions and ecological interactions among species, gives rise to several difficulties in implementing suitable regulation policies that are able to combine economically (and socially) efficient exploitation with issues of sustainable exploitation. Moreover, in the exploitation of open access resources by competing agents (individuals, societies or countries) a typical prisoner dilemma arises, often denoted as the “tragedy of the commons” after Hardin. The sustainability of this exploitation is constrained by the natural growth of the resource as well as equilibrium patterns regulated by ecological interactions among species, and overexploitation eventually leads to stock depletion and thus decreasing yields, up to the danger of extinction of some species. For these reasons, central institutions should impose forms of regulation in fisheries, either by imposing fishing restrictions, such as constant fishing efforts or taxation or by limitations in the kinds of species that can be fished, or limitations in the regions where shing is allowed. Different sources of strategic interdependence among competing agents who have access to a public natural resource
are present. First, biological externalities must be taken into account, as overexploitation of the resource by one agent may have important consequences on the capacity of regeneration of the resource, thus giving a negative externality for the whole community of exploiters. Second, market externalities may exist, due to price reduction as a consequence of increasing resource harvesting, and finally cost externalities, due to the increase of fishing costs when fish stock is depleted. Hence, the mathematical modelling of fisheries is an intriguing problem, involving methods from the qualitative theory of nonlinear dynamical systems, game theory and optimal control. The proposed model considers two different fish species, each with its own growth function and, possibly, interacting through competition, prey-predator or symbiotic relations. According to a recent law proposed in Italy, we assume that, during a given time period (typically two years), each fisherman can harvest only one kind of fish, then they can revise their choice in the successive periods.

keywords: multi stage and repeated games, natural resources, oligopoly games.

An extension of Shapley’s value to multivariate games

Hernández-Lamoneda, Luis*, Centro de Investigación en Matemáticas, lamoneda@cimat.mx
Sánchez-Sánchez, Francisco, Centro de Investigación en Matemáticas, sanfco@cimat.mx

Abstract. We study TU cooperative games where the set of players is divided by types -in other words, we are given a fixed partition \( \{ N_1, \ldots, N_m \} \) of the set of players \( N \). Games are multivariate functions \( v(S_1, \ldots, S_m) \) where each coalition \( S_i \) is a subset of \( N_i \), and we impose the condition that the game be zero if any of these coalitions is empty. With this we try to model situations where the most important thing is the interaction between groups comprised of different types of players and where it is essential that each type be represented. This kind of games appears in a natural way in some applications. For instance, the two-sided market of houses in Shapley and Shubik (1971) could be model by defining \( v(S, T) \) as the worth of a market with a set \( S \) of houses (or sellers) and a set \( T \) of buyers. Another example is the assignment problem in operation research, in this case, \( v(S, T) \) could be the optimal solution, whatever the objective function be, when there are a set \( S \) of jobs and a set \( T \) of workers. With the point of view adopted here, in particular, the number of coalitions considered is smaller \((2^{n_1} - 1) \ldots (2^{n_m} - 1) \) versus \( 2^{n_1 + \ldots + n_m} - 1 \) and the group symmetry is also smaller: one considers only permutations that preserve the different classes of players. We will start by defining the main objects of study and setting the relevant notation, namely the space of games in this multivariable scenario. After that, we recall a theorem of Ruiz et al characterizing all linear, symmetric and efficient solutions on cooperative games in TU form. This formula defines a payoff vector for the game \( v \) by starting with the egalitarian solution and then perturbing it by splitting zero among the players. Our first result for these multivariable games is a characterization, in the spirit of that of Ruiz et al, of all linear, symmetric and efficient (LSE) solutions. The formula contains three terms. As before, one is the egalitarian contribution, then comes a new term which may be interpreted as a splitting of zero between partition classes, i.e. there is a transference from each type to each other type paying equally to each member of each partition class; finally there is a transference among the players within each partition class much in the same way as for the one variable scenario. Given an exogenous vector \( \alpha = (\alpha_1, \ldots, \alpha_m) \), we say that a solution is locally efficient if it divides the quantity \( \alpha v(N_1, \ldots, N_m) \) among the players in \( N \). The notion of local efficiency turns out to be equivalent to the vanishing of the term giving the transference between partition classes. Thus, linear, symmetric \( \alpha \)-locally efficient (\( \alpha \)-LSE) solutions are very similar to one variable LSE-solutions. This similarity goes further. We show that, for given \( \alpha \), there is a unique value characterized as being \((\alpha \text{-LSE})\) and satisfying the (corresponding multivariate version of the) null player axiom. Moreover, it has a simple expression in terms of Shapley’s value applied to some projection games restricted to the partition classes. This last result points to a possible relation between this value and solutions for games with a coalitional structure. Indeed, we’ll show that for a particular choice of \( \alpha \) this value corresponds to Owen’s value. Yet, we have a continuum of possible values (one for each \( \alpha \)) of which Owen’s but one, and where for certain applications other options might be more suitable. Finally, we look in some detail at the house market problem of Shapley and Shubik. We explain how to model it as a two variable game and we consider three different solutions applied to it: the \((1/2, 1/2)\) -LSE value, the \((1/2, 1/2)\) -LS value given by the same coefficients of the one variable Shapley value, and a perturbation of this by introducing a “natural” transference between the two partition classes.

keywords: cooperative games, cooperative multivariate games, Owen and Shapley’s values.

Fuzzy weighted voting games and power indices

Lange, Fabien*, Óbuda Univ., fabien.lange@kgk.uni-obuda.hu

Abstract. We propose a model of fuzzy voting games, where each member of an assembly of \( n \) players can display a gradual membership in any coalition. This membership may represent the probability or the belief that the player takes part to the coalition. Consequently, a fuzzy coalition is represented by a vector with coordinates in the interval \([0, 1]\), and a fuzzy game is a mapping over all possible fuzzy coalitions. However, for a given bill, such a game has only two possible outputs for every coalition, namely, 1 or 0, depending on whether the coalition passes the bill or not, following the example of classical voting games. In this talk, we take an interest to fuzzy weighted voting games, which are a generalization of classical weighted games. We examine possible definitions of power indices for these games which are consistent regarding the expected power of the voters. In particular, for some given classes of fuzzy weighted voting games, we work out some generalizations of power indices having some rational properties: the coalition passes the bill or not, following the example of classical voting games. In this talk, we take an interest to fuzzy weighted voting games, which are a generalization of classical weighted games. We examine possible definitions of power indices for these games which are consistent regarding the expected power of the voters. In particular, for some given classes of fuzzy weighted voting games, we work out some generalizations of power indices having some rational properties.

keywords: voting and power indices, weighted games, fuzzy games.
Individual incentives and network security

Larson, Nathan*, Univ. of Virginia, larson@virginia.edu

Abstract. We introduce a model of network formation in which individuals can both benefit from and be harmed by their connections. As leading examples, consider epidemiology or computer networks. In the first case, people interact face-to-face in social networks in order to benefit from information passed on by word of mouth, but those same connections can become pathways for disease. Similarly, computer users benefit from information flows along online networks, but pernicious software can co-opt those same networks to spread computer viruses or spam. We use a random graph network model to shed light on the incentives of individual agents in situations like these. In the model, beneficial and harmful items (tips and viruses) are created exogenously and spread costlessly through the graph. Individual agents make two strategic decisions that affect the the structure of the network (and consequently, how tips and viruses spread). First, each agent chooses how many links to form; these links are connected randomly to form the network. While this random graph assumption is extreme; it is meant to capture the notion that in a large population, individuals cannot reasonably condition their connection choices on the fine details of the entire network. Second, each agent chooses a (costly) security level for her links. Security takes the form of an imperfect screening technology that permits tips to pass through, but blocks some viruses before they infect her. Individual security choices generate a wedge between the spread of tips and viruses: the network that the latter have access to is effectively sparser, so viruses spread less widely than tips. Because individuals do not internalize the benefits and harms from spreading tips and viruses to other agents, individual link and security decisions are not socially optimal. An agent who adds an additional link causes both positive (more tips) and negative externalities (more viruses) for the agents connected to her, but we can show that the negative externality dominates. Furthermore, security is underprovided, since an agent who blocks a virus does not account for the protection that she has provided to agents downstream from her. Equilibria of the model suggest a rich set of conclusions. For example, even if links are not explicitly costly, agents will self-limit them for security reasons. The returns to security are necessarily increasing, and this tends to push agents toward extremes: either full security, or no security. As a corollary to this result, there are cases in which agents must behave asymmetrically in equilibrium, even though all agents are ex ante the same. For example, equilibrium can involve a symbiotic relationship between cautious agents (a few, highly secure contacts) and carefree agents (many unsecure contacts). The latter provide connectivity to the latter while enjoying the benefits of their screening. Equilibrium comparative statics suggest that policy interventions may yield unexpected results. For example, an intervention that reduces the cost of security will induce agents to screen more carefully, but it also induces them to form more links. We characterize conditions under which the latter effect dominates, and the pro-security policy actually causes virus outbreaks to increase.

Keywords: social networks, communication networks, network games.

On the axiomatisation of the balanced solution for cooperative TU-games

van den Brink, René, Free Univ. of Amsterdam, jbrink@feweb.vu.nl
Levinski, René*, Max Planck Institute of Economics, levinski@econ.mpg.de
Zelený, Miroslav, Charles Univ. Praha

Abstract. The Shapley value of a cooperative transferable utility game distributes the dividend of each coalition in the game equally among its members. Given exogenous weights for all players, the corresponding weighted Shapley value distributes the dividends proportionally to their weights. The balanced solution assigns weights to players such that the corresponding weighted Shapley value of each player is equal to her weight. We prove its existence for all monotone transferable utility games and discuss properties of this solution. Most importantly, we provide an axiomatization of the balanced solution on monotone games using balanced transformations and component efficiency. For positive two-player games component efficiency and balanced consistency imply proportional standardness for two-player games (Ortmann, 2000). Or, in other words, it establishes the equity principle of Homans (1961) and Selten (1978) for all positive two-player games, i.e., the solution satisfying component efficiency and balanced consistency redistributes the worth of the grand coalition proportionally to the singleton worths for all positive two-person games. Although the proportionality principle is not obvious for general games (with more than two players), it is still clear what the equity principle states for inessential games with non-zero sum of singleton worths: namely that the worth of grand coalition is allocated proportionally to the singleton worths. For inessential games equity principle is established by all the solutions that satisfy component efficiency, thus also by the Shapley value and the balanced solution. Balanced consistency helps us to construct a set of games for which the balanced solution satisfies the equity principle. We define a class of games that consists of games that are obtained by a balanced transformation of an inessential game. We refer to this class of games as proportionally balanced games.

Keywords: cooperative game theory.

Terrorist targeting, information, and secret coalitions

Koster, Maurice, Univ. of Amsterdam, M.A.L.Koster@uva.nl
Lindner, Ines*, Free Univ. of Amsterdam, illindner@feweb.vu.nl
McCormick, Gordon, Naval Postgraduate School, Monterey, McCormick@nps.edu
Owen, Guillermo, Naval Postgraduate School, Monterey, GOwen@nps.edu

Abstract. We consider a game played by a state sponsor of terrorism, a terrorist group, and the target of terrorist attacks. The sponsoring state wishes to see as much damage inflicted on the target of attack as possible, but wishes to avoid retaliation. To do so, his relationship with the terrorist group must remain ambiguous. The target of attack, for his part, wishes to bring these attacks to an end as quickly as possible and will consider the
option of retaliating against the sponsor to do so. There is a penalty, however, for retaliating against a state that is not supporting terrorist operations, and even if the victim is aware of this relationship, it is necessary to convince third parties that this relationship actually exists. We approach the problem by introducing an "evidence" variable in a dynamic setting. We show that the interplay of different strategic and non-strategic effects boils down to three qualitatively different scenarios, determined by key parameters. Based on this result, two alternative instruments to retaliation are identified in order to resist terrorist activities. First, assuming that the target is able to change some parameters by monetary investments, the paper provides an economic analysis of how to invest optimally in order to make the sponsor lose incentives to support the terrorist group. Second, we propose changing the structure of the game. Here, the key insight is that the target country can make a unilateral statement as to his strategy. The sponsor cannot do so as he is in fact claiming that there is no cooperation with terrorist groups. While our discussion, in this article, is motivated by an important problem in contemporary counterterrorism policy, it applies more generally to the study of secret coalitions. 

**Keywords:** non-cooperative games, secret coalitions, security economics.

### Minimal exactly balanced collections

Lohmann, Edwin*, Tilburg Univ, e.r.m.aloehmann@uvt.nl
Borm, Peter, Tilburg Univ, p.e.m.borm@uvt.nl
Herings, Jean-Jacques, Maastricht Univ, p.herings@algec.unimaas.nl

**Abstract.** This paper studies the structure and properties of the class of exactly balanced collections. Comparing the definition of exactly balanced collections with the definition of balanced collections, the weight vector of a balanced collection must be positive where the weight vector for an exactly balanced collection can contain at most one negative weight. Schmeidler (1972) and P. Csóka and Köczy (2007) show that exact balancedness is equivalent with exactness. We investigate minimal exactly balanced collections, and show that only these collections are needed to obtain exactness. Furthermore, we show how the class of minimal exactly balanced collections can be partitioned into three basic types.


**Keywords:** cooperative games, exact games, exactly balanced collections.

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### Mixed rules in multi-issue allocation situations

**Bergantiniños, Gustavo, Univ. de Vigo, gbergantinos@uvigo.es**
**Lorenzo, Letícia*, Univ. de Vigo, leticiaplaz@uvigo.es**
**Lorenzo-Freire, Silvia, Univ de Coruña, s Lorenzo@udc.es**

**Abstract.** Bankruptcy situations study problems where an estate must be divided among several claimants. The problem arises when the estate is not enough to cover all claims. A typical example is when a firm goes bankrupt. The objective is to identify well-behaved rules for dividing the estate among the agents. In bankruptcy situations each agent's claim is a number. In many real situations we have to divide an estate among a group of agents, as in bankruptcy for instance, but the claim of each agent is a vector. In many Spanish Universities, once they have decided on the total annual operating budget for each department, the procedure is as follows. The university decides the money that will be assigned to the departments. The departments then submit a quantified request for each issue, typically research and teaching. Finally, the university decides the amount each department receives. More examples are: The European Community divides the budget among several issues (agriculture, roads, research, ...) and each state (Spain, France, ...) has claims over the different issues. The government of Spain divides the budget among several issues (health, education, ...) and each “Comunidad Autónoma” (Galicia, Madrid, Catalonia, ...) has claims over the different issues. The government of Galicia divides the budget among several issues (roads, education, ...) and each city council, “Concello” (Vigo, Santiago de Compostela, ...) has claims over the different issues. These kind of situations are called multi-issue allocation (MIA) situations. In multi-issue allocation situations, two approaches are possible. In approach 1, as in bankruptcy, an allocation rule is a vector that specifies the amount assigned to each agent. In approach 2 the one followed in this paper -we first divide the budget among the issues. Later, the amount assigned to each issue is divided among the agents. With this approach a rule is a matrix that specifies the amount assigned to each agent on each issue. No agent can give part of the amount assigned to a particular issue to another different issue. This approach is more popular in many situations, for instance, in all the situations mentioned above. If we recall the example of the Spanish universities, usually the university authorities argue that research and teaching are two important issues of the university and no one is more important than the other. In our model this idea can be applied by claiming that the amount devoted to research and teaching should be as equal as possible. However, within each issue (research or teaching) the authorities argue that agents are, in general, different. Then, the amount they receive should recognize these differences. For instance, in the university of Vigo, the amount each department receives for research is proportional to the number of points the department obtains. The points are computed taking into account publications, meetings, books, ... In our model this idea could be applied by claiming that the amount each agent receives in each issue is proportional to his claim on the issue. We then study the two stage rule which divides among the issues following the constrained equal awards bankruptcy rule and inside each issue following the proportional bankruptcy rule. We give two axiomatic characterizations of this rule.

**Keywords:** cooperative games, multi-issue allocation situations, proportional rule, constrained equal awards rule.
New characterizations of the family of obligation rules for minimum cost spanning tree problems

Bergantiños, Gustavo*, Univ. de Vigo, gbergant@uvigo.es
Lorenzo, Leticia, Univ. de Vigo, leticiap@uvigo.es
Lorenzo-Freire, Silvia, Univ da Coruña, sorenzo@udc.es

Abstract. Tijs et al. (EJOR, 2006) introduce the family of obligation rules in the context of cost spanning tree problems. Later on, Lorenzo and Lorenzo-Freire (IJGT, 2009) provide the first characterization of this family. In this paper we provide two new characterizations for the family of obligation rules: the first one by means of strong cost monotonicity, a property of additivity, and a property of separability; and in the second characterization we replace the property of separability with core selection.

keywords: cost sharing, minimum cost spanning tree problems, obligation rules, cost monotonicity, cost additivity, separability, core selection.

The cost sharing problem for a facility location situation with regional fixed costs

Mallozzi, Lina*, Univ. of Naples “Federico II”, mallozzi@unina.it

Abstract. A continuous single-facility location problem is analyzed: the first problem is to locate a new facility minimizing the total transportation costs to reach the demand points plus a fixed cost (location problem). Then the corresponding total cost has to be shared between all the involved agents (allocation problem). The problem is studied in the case where the fixed cost depends on the chosen location. In fact, the opening cost of a facility may depend on the cost of land, on the taxation of different regions, on zone-restrictions, and so on. Some properties of the location problem are discussed and the allocation problem is modelled by using Cooperative Game Theory tools. Core solutions are proposed for the total cost allocation problem. Sufficient conditions are given to guarantee the existence of allocations that belong to the core of the game.

keywords: cooperative games, cost sharing.

Some game-theoretic grounds for meeting people half-way

Gadea-Blanco, Pedro, Polytechnic Univ. of Cartagena, pedro.gadea@upct.es
Jiménez-Gómez, José-Manuel, Univ. of Cartagena,
Marco-Gil, M. del Carmen*, Polytechnic Univ. of Cartagena, carmen.marcogil@upct.es

Abstract. The normative approach to sharing problems rarely leads to a single proposal. In fact, a trade-off can usually be found between properties, interpreted as different equity principles, which are fulfilled by the various solution concepts. This idea was superbly expressed by Young (1994): “Fairness does not boil down to a single formula, but represents a balance between competing principle of need, desert and social utility”. In this context, we have concentrated on transferable utility distribution problems with two different proposals that highlight discrepancy, i.e., problems that involve sharing a given amount of a perfectly divisible good among a group of agents with two focal viewpoints. Firstly, we introduce the bifocal distribution problems by adding, to a generic distribution problem, two solution concepts interpreted as prominent proposals for solving them. We then model these kinds of problems as transferable utility cooperative games as follows. We associate with each coalition the smallest quantity of the good that such a coalition would receive according to the two proposed allocations. The analysis of these games, known as bifocal distribution games, provides solid theoretic grounds in defense of intermediate compromises. Specifically, we provide a necessary condition for sharing to be in the Core of these games: a quantity belonging to the interval defined by the extremes corresponding to the focal proposals must be recommended for each agent. Furthermore, although these games are not convex in general, we find that not only is the Shapley value a Core selection, it also coincides with the Nucleolus. We also show that the recommendation made by these two solution concepts is the average of the two focal distributions. Our modeling is of great interest when applied to some certain problem types in which bipolarity may usually take place. In this regard, the previous general results are then applied to bankruptcy problems: a particular kind of distribution problems in which individuals have different incompatible rights, summarized in a claims vector, so the available amount of the good should be rationed. In bankruptcy problems two significant viewpoints naturally arise as any distribution can be observed by focusing either on gains or on losses. This fact together with the idea that the general desirable social goal is to treat everybody as evenly as possible, captured by the Lorenz criterion, (Lorenz (1905)), provide a new basis for the average of the Constrained Equal Awards and the Constrained Equal Losses bankruptcy solutions, two proposals put forward by Maimonides in the twelfth century.

keywords: cooperative games, distribution problems, bankruptcy, nucleolus, Shapley value, Lorenz criterion.
**Algorithmic aspects of the core in cooperative games over graphs**

Chalkiadakis, George, Univ. of Southampton, gc2@ecs.soton.ac.uk  
Markakis, Evangelios*, Athens Univ of Economics and Business, markakis@gmail.com  
Jennings, Nick R., Univ. of Southampton, nj@ecs.soton.ac.uk

**Abstract.** The vast majority of work in cooperative game theory assumes that, given a set of agents, any coalition among them is allowed to form. In many circumstances, however, the environment might impose restrictions to the formation of coalitions: for reasons that might range from physical limitations and constraints to legal banishments, certain coalitions might not be feasible. The structure of these restrictions can be often captured by an undirected graph with edges that provide links between any two agents that can belong to the same coalition. In other words, a coalition \( S \) is allowed to form only if any pair of agents of \( S \) is connected with a path that uses only agents from \( S \). Sensor networks, telecommunication networks, or transportation networks provide natural settings for cooperative games defined over graphs. We consider various models of cooperative games in structured environments as described above and study the stability of coalition structures in such settings. We focus on the (now modified) concept of the core which is the set of outcomes that are stable against deviations by any feasible subset of agents. Our main interest is in questions regarding the existence of the core and the computational complexity of finding elements of the core. We start with the usual setting of characteristic function games (CFGs), but now defined over graphs. We review recent results from the literature, which establish the non-emptiness of the core in games defined over a tree. Trees form a well-motivated class of graphs as in many applications the underlying graph falls within this class (e.g. hierarchical networks). We then determine the computational complexity of questions related to the core. We show that (a) for a CFG defined over a line, the problems of (i) finding an element in the core, and (ii) checking if a given (coalition structure, payoff allocation) pair is in the core can both be solved in polynomial time; while (b) when the underlying graph is a tree (other than a line), the problems of (i) finding an element in the core and (ii) determining a partition with a lower bound on its social welfare are both NP-hard (i.e., they are computationally hard). Then, we move on to the more general setting of partition function games (PFGs) over graphs, and initiate the study of stability in that setting. In partition function games, the value of a coalition depends on the coalition structure currently in place. Defining the core in PFGs becomes more complicated because potential deviators in PFGs have to consider how non-deviators—the “residual” players—would react to their deviation. Since residual players can form any structure among themselves, the value of any deviation relies on the resulting partition across the space of agents. The standard treatment of this problem in the literature is for the deviators to either pessimistically assume that non-deviators will partition in such a way so as to hurt them the most, or to optimistically assume that the residuals’ partition will be maximizing the deviating structure’s value. Operating under the assumption of pessimism, we define the (pessimistic) core and then show that for any PFG, there is a corresponding CFG, such that the core of the CFG is contained in the core of the PFG (but the opposite is not always true). This correspondence enables us to generalize the CFG-related results, and show that the core is non-empty for PFGs defined over trees. Furthermore, the same process as before can be used to obtain a stable configuration in a PFG defined over a tree (which runs in polynomial time for lines). We are not aware of any other work to date that has tackled the problem of stability in PFGs defined on graphs. As a final contribution, we introduce a Bayesian extension of PFGs, namely Bayesian partition function games: in short, instead of resorting to pessimism or optimism, a coalition of potential deviators assumes that the reaction of the residual players is determined by a probability distribution. We then go on to define the core and initiate its study in this setting as well.

**keywords:** algorithmic game theory, coalition formation, cooperative games.

**Quality signals, competition and consumer fraud**

Martín García, Silvia*, Univ. of Alicante, silviagi@merlin.fae.ua.es

**Abstract.** This paper considers a two-sided private information model. We discuss the signaling role of consumers private but imperfect information together with the effect of competition on the equilibrium level of honesty and incidence of fraud. We assume that two exogenously given qualities, which are represented by sellers types, are offered in the market. Prices are fixed. Low quality sellers choose to be either honest (by charging the lower market price) or dishonest (by charging the higher price). We demonstrate that in equilibrium, the amount of fraud might increase when the precision of the buyers private information increases. Furthermore, we show that the level of dishonesty is non-decreasing in the level of market competition in equilibrium.

**keywords:** quality uncertainty, price signalling, imperfect quality signals, adverse selection, honesty, competition.

**Effect of correlation in bargaining model with Juri**

Mazalov, Vladimir*, Karelia Research Center, vmazalov@krc.karelia.ru  
Tokarevay, Yulia, Zabaikalsky State Humanitarian Pedagogical Univ., jtokareva2@mail.ru

**Abstract.** We consider the arbitration procedure with juri which consists of some arbitrators. The players L and M present their offers \( x \) and \( y \) to this juri. You can think about the players like Labor and Management who discuss about the salary rate. Player L likes to maximize the value and the objective of player M is opposite. Each member of the juri decides after observing the offers \( x \) and \( y \) which offer must be selected. Let the solutions of the arbitrators are presented by correlated random variables with continuous distribution function. Each arbitrator chooses an offer using the final offer arbitration scheme. So the arbitrator prefers the offer which is closer to his solution. After that the committee determines the final solution using the majority rule. The objective of the paper is to find the equilibrium in this arbitration game and estimate the effect of correlation for the final solution. We derive the optimal solution in the procedure with the normal distributed random variables. We show that the interval of optimal offers is increasing if the correlation factor is increasing.

**keywords:** bargaining, arbitration procedure, juri, correlated arbitrators.
Cost sharing in distribution problems for franchises operations

Fiestras-Janiero, M. Gloria, Vigo Univ., fiestras@uvigo.es
Garcia-Jurado, Ignacio, Corunna Univ., igurjado@udc.es
Meca, Ana*, Miguel Hernandez: Univ. of Eche, ana.meca@umh.es
Mosquera, Manuel Alfredo, Vigo Univ., mamrguez@uvigo.es

Abstract. In the context of modern commerce, franchising is the process of expanding a business whereby a company (franchisor) grants a license to an independent business owner (franchisee) to sell its products or render its services. A franchise, therefore, is a legal or party of a franchise agreement gives up some legal rights to gain others. The franchisee increases its number of outlets and gains additional income. The franchisee opens an established business with strong potential for success. Franchise operations, as we know them, are not very old. The boom in franchising took place in the USA around 1929, where General Motors (GM) used to be opposed to the antitrust law, which forbade GM, as supplier, to have its own retailer network. Nowadays, franchising plays a significant role in the world economy. It has proven itself to be a powerful and efficient means of growing a business and of creating employment and wealth both at local and international level. This comes from the distinct but combined roles of the franchisor and of the franchisees whose efforts together leverage the potential of the business concept. A very important issue in product franchises and business opportunity ventures (two of the four major types of franchises) is the distribution of the products from the franchisor to several franchisees following particular transportation routes. Suppose a finite set of retail stores (franchise outlets) that distributes a single product manufactured by a company (franchisor) according to a periodic deterministic demand and a particular order policy. We could see such a situation as an inventory transportation system (cooperative inventory situation) in which the set of retailers are allowed for joint replenishment where part of the ordering cost is shared, and part is the specific transportation cost for each retailer. Then, if a retailer is served (i.e., the one located at the end of the route), all retailers in the distribution route can be served without any additional transportation cost and the total cost can be diminished. In this talk we focus on the distribution problem for franchises operations by using cooperative game theory. We deal with the cost sharing problem in an inventory transportation system with a single item and multiple agents that place joint orderings using an economic order quantity (EOQ) policy. Part of the ordering cost is shared, and part is specific to each agent and depends on its distance from the supplier. It extends the inventory ordering cost game study in Meca et al. (2004) to allow for joint replenishment. Actually, we decompose the ordering cost into a fixed cost, equal for all agents, plus a variable cost which is proportional to the distance between the agent and the supplier (transportation cost). We analyze the situation where each agent is located on the same distribution route. Then, if an agent is served, all agents in the route are served without any additional transportation cost. For this inventory situation, cooperation is not always better than the situation where all agents order separately, so we seek to study when cooperation is profitable and how to divide the total cost in a stable way (no group of agents can improve by deviating from the total group). We use cooperative game theory to provide adequate answers to these two questions. It is well known in cooperative game theory that a cost reduction does not guarantee the existence of stable divisions of cost. A key notion is the core solution. The core of a cooperative game is the set of all cost allocations, or divisions of the total cost among the agents, that assure coalitional stability. Core allocations (i.e., coalitional stable allocations) provide incentives for cooperation. They are also fair in the sense that no subgroup subsidizes any other. The optimization problem associated with the above problem is that of when to place orders by the various agents and what quantities to order each time a replenishment takes place. The goal is to minimize the average total inventory cost. When the fixed part of the ordering cost is zero each agent faces an individual EOQ model. When the transportation cost is zero for all agents, each subset of retailers faces a centralized EOQ model (Meca et al., 2004). Otherwise, the structure of the optimal policy is unknown, except that each retailer places an order when his inventory level is zero. Practitioners consider suboptimal policies which have some guaranteed deviation from the optimal policy and which are computationally efficient. Two of such suboptimal policies are the unsplit fixed partition policy and the power-of-two (POT) policy. The problem with joint ordering cost is known as the joint replenishment problem with first order interaction structure. In the context of the cost allocation problem for the first order interaction joint replenishment model, Annily and Haviv (2007) define the characteristic function assuming that retailers follow the POT policy and the warehouse does not hold any inventory. In their model, when a subset of retailers simultaneously place an order, the total ordering cost is given by the addition of the major setup cost (fixed part of the ordering cost) and the corresponding minor setup costs (part of the ordering cost that is retailer-dependent). They show that the resulting cooperative game is concave. Then, they describe a particular core allocation, which can be expanded to a set of core allocations. Dror and Hartman (2007) also consider this special first order interaction cost structure, but assume, as in Meca et al. (2004), that retailers always place orders together by means of an EOQ policy. They provide conditions for the nonemptiness of the core and analyze the sensitivity of the core with respect to the cost parameters. Later on, Zhang (2009) generalizes the model by Annily and Haviv (2007). He shows that under POT policies, the joint replenishment game with a submodular joint setup cost function has a non-empty core, even when the warehouse is allowed to hold inventory. Here we consider the joint replenishment problem where a number of agents lease the reordering and transportation of their supplies from a provider. Each agent faces a constant demand stream and keeps storage activities. Unlike Annily and Haviv (2007) and Zhang (2009) who consider a POT policy, we will focus on the unsplit fixed partition policy (c.f. Annily and Bramel, 2004). In an unsplit fixed partition policy each retailer must be served on a single route, retailers are partitioned into disjoint and collectively exhaustive sets, and each one of these sets is served independently of the others at its optimal replenishment rate. We consider a specific first-order interaction structure and assume that when a subset of retailers simultaneously places an order the ordering cost is the addition of the fixed part of the ordering cost and the maximum of the individual transportation costs (this is the key difference with the game by Dror and Hartman, 2007). For this subclass of joint replenishment problems we identify the situations for which cooperation is profitable (inventory game is subadditive), then we can always find coalitional stable allocations of the total cost (coalition is non-empty). We further define two kinds of transport-specific cost sharing rules and study their properties. The first one, which turns out to be coalitional stable, is a cost sharing rule à la Shapley. The second one, simpler but not always
On an estimation of power of veto

Mercik, Jacek*, Wroclaw Univ. of Technology, jacek@pwr.wroc.pl

Abstract. The main goal of the paper is an evaluation of power connected with veto attribute of the decision maker. In certain cases, it is possible to estimate a value of power of veto attributed to decision maker and to propose the exact value of the veto power measured by "veto" index as well. In other cases, it is only possible to compare the situation with and without veto attribute. Actually, significant numbers of power indices are in use for evaluation of power of player. The main differences between these indices are the ways in which coalition members share the final outcome of their cooperation, and the kind of coalition players chose to form. The latest started from negation of equiprobability of possible coalition transformation into a winning coalition (as it was for example done in Owen, 1977) and consequently it leads to different assumptions and results. A special kind of action attributed to some players is right to veto, i.e. to stop an action of others permanently or temporarily. There are two types of vetoes: those which can be overruled (like veto of Polish president) and those which can't be overruled (like of permanent members of UN Security Council). In this paper we would like to analyse the power of player (like veto of Polish president) and those which can't be overruled (like of permanent members of UN Security Council). In certain cases, it is possible to estimate a value of power of veto let us to evaluate directly or indirectly the power of veto itself.

keywords: voting and power indices, veto.

Power and Centrality of Groups

Flores, Ramón, Univ. Carlos III de Madrid, rflores@est-econ.uc3m.es
Molina, Elisenda*, Univ. Carlos III de Madrid, elisenda.molina@uc3m.es
Tejada - Cazorla, Juan, Univ. Complutense de Madrid, jtejada@mat.ucm.es

Abstract. We are interested in defining a measure of group centrality in social networks based on a power measure of groups or coalitions in a game. The relevance of defining an appropriate group centrality measure has been pointed out by different authors in different contexts, mainly in the framework of information diffusion models (Kempe, Kleinberg and Tardos (2005), Koster, Lindner and Molina (2006),...), but also in the Social Networks context (Everett and Borgatti (1999), Borgatti (2006)). Our approach is similar to that proposed by Gómez , González-Arangüena, Manuel, Owen, del Pozo and Tejada (2003). They adopt a game theoretical approximation to the problem of measuring the power by considering a cooperative game in characteristic function form to reflect the interests that motivate the interactions among individuals in a network. Then, they define the individual power of an agent as the difference between his/her power in the the game restricted by the graph which captures the social structure and his/her power in the game without any coalition structure. Therefore, in order to extend their approach, we previously need to find a group value for TU-games that give us an appropriate measure of coalitional power, rather than individual power. We have found out that this is not a trivial question with a unique accepted answer. In that sense, the main line of research focuses on studying the behavior of well established individuals values, such as the Shapley value, when some kind of integration among a group of agents is considered (Kalai and Samet (1987), Haller (1994), Carreras (1996), Derks and Tijos (2000), Segal (2003), Knudsen and Østergaard (2005), Carreras, LLongeras and Magaña (2005)). Thus, before trying to achieve our main goal (the definition of a measure of group centrality), a deep study of group values for TU-games must be carried out.

keywords: social networks, TU-games, values.

Slightly altruistic correlated equilibrium

De Marco, Giuseppe, Univ. di Napoli Parthenope, giuseppe.demarco@uniparthenope.it
Morgan, Jacqueline*, Univ. di Napoli Federico II, morgan@unina.it

Abstract. The usual assumption in the economic models is that all people are exclusively pursuing their material self-interest and do not care about social goals. However, recent empirical and theoretical literature has shown that there exists a substantial evidence suggesting that fairness motives affect the behavior of many people. Indeed, on one hand, empirical results show that in some strategic situations altruistic behavior may emerge as it turns out that the economic environment determines whether the fair types or the selfish types dominate equilibrium behavior (see Fehr and Schmidt (1999)). On the other hand, in theoretical papers on normal formal games, reciprocal altruism has been characterized by using concepts of equilibrium in associated games derived from the original one (see Rabin (1993) or Falk and Fischbacher (2003) and references therein). In these models the payoff of each player is modified with a term proportional to the sum of opponents' payoffs or to the weighted sum of opponents' payoffs, where the weight coefficients depend explicitly on the beliefs of players about others' intentions and such approach requires the adoption of psychological game theory (Geanakoplos et al. (1989)). Similar payoff functions have also been used in dynamic games to describe altruistic behavior (for example in Levine (1998), Sethi and Somarathan (2001) or Dufwenberg and Kirchsteiger (2004)). We emphasize that all the models quoted above are not suitable for Nash equilibrium selection since neither, in the static models, the prescribed predictions are necessarily Nash equilibria of the original game, nor, in the dynamic models, strategies necessarily converge to a Nash equilibrium. Therefore, in previous papers, we have investigated the effects of altruistic behaviour in the problematic of Nash equilibrium selection. In particular, in De Marco and Morgan (2008) we introduced the refinement concept of slightly altruistic equilibrium based on a limit process with respect to perturbations on players' payoffs. Our approach captures an idea of reciprocal altruism in the following way: each player cares only about himself but his
choice corresponds to the limit of choices he would have done in equilibrium if he had slightly cared about the others, provided the others had done the same. By definition, this kind of concept is self-enforcing in terms of stability with respect to trembles, where trembles (namely based on altruism) concern preference relations of the players rather than strategies as done by Selten (1975) with the trembling hand perfect equilibrium concept. Indeed in an equilibrium which is not slightly altruistic, there exists at least a player whose equilibrium strategy is not rational whenever he assumes his opponents’ behavior might be perturbed in an altruistic way, whatever is the perturbation. In this talk, as further step, we merge our approach of slightly altruism with the concept of correlated equilibria (Aumann 1974). Since, similarly to what happens with trembling hand perfect correlated equilibria (see Myerson (1986) or Dhillon and Mertens 1996), there might be different ways to embody the idea of slight altruism in the correlated equilibrium case, firstly we look at the connection between the possible different definitions. Then, we analyze the properties and the refinement power of the different concepts.

**keywords**: correlated equilibria, non-cooperative games.

### Cooperation in a multi-client distribution network

**Fiestras-Janeiro, M. Gloria**, Vigo Univ., fiestras@uvigo.es  
**Garcia-Jurado, Ignacio**, Coruña Univ., igjurado@udc.es  
**Meca, Ana**, Miguel Hernández Univ. of Elche, ana.meca@umh.es  
**Mosquera, Manuel Alfredo**, Vigo Univ., mamguez@uvigo.es

**Abstract.** In a multi-client distributions network a common provider serves the products from a central warehouse to intermediate warehouses, from which firms receive their goods as they need them. This situation can be seen as a new pattern of centralized inventory where a group of firms facing EOQ problems decide to coordinate by making joint orders to the big warehouse and by storing all goods in the cheapest intermediate warehouse. In this paper we model this situation as a cooperative TU game. This new class of games is a generalization of the classes of inventory games and holding games defined in Meca et al. (2004). Moreover, we provide a context-specific allocation rule and study its properties. Finally, we give an axiomatization of the allocation rule using axioms related to coalitional manipulation.

**keywords**: OR games, multi-client distributions network, axiomatization.

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### Cost sharing with coalition claims

**Naumova, Natalia**, St. Petersburg State Univ, nataliai.naumova@mail.ru

**Abstract.** A cost sharing problem is a problem of division a positive amount of resources among n agents taking into account nonnegative claims of agents. A share of each agent must be nonnegative. Here we consider a generalized cost sharing problem. For a fixed collection of coalitions of agents A, the claims of agents are replaced by the claims of coalitions of agents from this collection. We assume that A covers the set of agents. A solution of this problem is a set of vectors of agent’s shares. A method is a map that associates to any problem its solution. We may interpret a generalized cost sharing problem as a TU-cooperative game with limited cooperation possibilities and a method as a value on the set of such games. We consider generalizations of two methods: the Proportional method and the Uniform Losses method (also called the Constrained Equal Losses method). In the Proportional solution of cost sharing problem, agent’s shares are proportional to their claims. The proportional nucleolus and the weighted entropy solution give the same result. For generalized cost sharing problem, we suppose that the claims of coalitions are positive and consider the following 3 extensions of proportional solution: a A-proportional solution, where the total shares of coalitions in A are proportional to their claims; a A-proportional nucleolus based on the ratios of total shares of coalitions in A to their claims; a A-weighted entropy solution based on total shares of coalitions in A and their claims. For each A, the A-proportional nucleolus and the A-weighted entropy solution are always nonempty and define uniquely total shares of coalitions in A. The A-proportional solution is nonempty for all possible claims of coalitions in A if A is a minimal covering of the set of agents. The A-proportional nucleolus is contained in the A-proportional solution for all possible claims of coalitions in A if A is a partition of the set of agents. The A-weighted entropy solution is contained in the A-proportional solution for all possible claims of coalitions in A if A is a partition of the set of agents. We also define a A-weakly proportional solution, where the ratios of total shares of coalitions to their claims are equal only for disjoint coalitions in A. Necessary and sufficient condition on A that ensures nonemptiness of the A-weakly proportional solution for all possible claims of coalitions in A is obtained. Necessary and sufficient condition on A that ensures nonemptiness of the intersection of the A-proportional nucleolus with the A-weakly proportional solution for all possible claims of coalitions in A is obtained. In the Uniform losses solution of the cost sharing problem, if an agent’s share is positive, then his excess is not less that the excess of any other agent. This property defines this solution uniquely. The nucleolus and the least square solution on the set of nonnegative sharings of the total amount give the same result. This permits to define 3 extensions of the Uniform losses solution for generalized cost sharing problem: a A-uniform losses solution, a A-nucleolus, and a A-least square solution. We also define a A-weakly uniform losses solution, where we compare only excesses of disjoint coalitions in A. We obtain conditions on A that ensure the nonemptiness of the A-uniform losses solution, the nonemptiness of the A-weakly uniform losses solution, the nonemptiness of intersection of the A-nucleolus with these solutions. The results are similar to the corresponding results for generalizations of proportional solution.

**keywords**: cost sharing, cooperative games, proportional solution, weighted entropy, nucleolus; constrained equal losses solution.
On ergodicity, infinite flow and consensus in random models

Touri, Behrouz, Univ. of Illinois, touri1@illinois.edu
Nedić, Angelia*, Univ. of Illinois, angelia@illinois.edu

Abstract. We consider the ergodicity and consensus problem for a discrete-time linear dynamic model driven by random matrices, which is equivalent to studying these concepts for the product of random matrices. Our focus is on the model where the matrices are “stochastic.” We introduce a new phenomena, the infinite flow, and we study its fundamental properties and relations with the ergodicity and consensus. We start by a comprehensive study of the fundamental relations and 0-1 laws for the infinite flow, ergodicity and consensus for general random models, independent models and i.i.d. random models. We then investigate the random models with a feedback property and the models with a common steady state for the expected matrices. Both of these properties have been used in the analysis of consensus models, but a deeper understanding of their roles has not been observed. We classify feedback property in three basic types from weak to strong and show some relations for them. For the models that have a common steady state in expectation, we provide insights into the geometry of the accumulation points of dynamic systems driven by such models. Finally, we combine all the pieces together and demonstrate the interplay of three characteristics of a random model: infinite flow, feedback property and the existence of a common steady state in expectation. Specifically, these characteristics constitute sufficient conditions for ergodicity of independent random models. The most importantly, using these characteristics, we show that the ergodicity of the model is equivalent to the ergodicity of the expected model for a class of independent random models, as given in infinite flow theorem. The infinite flow property and its equivalent deterministic characterization play the central role in establishing this result. The result provides us with a deterministic characterization of the ergodicity (imposing conditions only on the expected matrices), thus rendering a new tool for studying the consensus over random networks and convergence of random consensus algorithms. The main novelties of this work include: 1) the equivalence of the ergodicity of the model and the expected model for a class of independent random models with a feedback property and a common steady state in expectation; 2) the new insights and understanding of the ergodicity and consensus events over random networks brought to light through a new phenomena of infinite flow event, which to the best of our knowledge has not been known prior to this work; 3) novel comprehensive study of the fundamental properties of the consensus and ergodicity events for general class of independent random models; 4) new insights into the role of feedback property and the role of a common steady state in expectation for the ergodicity and consensus.

keywords: consensus, ergodicity, random stochastic matrices, linear random model.

Multi-attribute procurement auction with no prior scoring

Nielsen, Kurt*, Univ. of Copenhagen, kun@life.ku.dk

Abstract. The suggested multi-attribute procurement auction consists of two bidding rounds. The first bidding round functions as a revelation mechanism to support the Principals articulation of preferences. To facilitate truthful revelation in the first bidding round, the price bids are replaced with yardstick prices defined by a linear envelopment of the other bidders bids. The Principal expresses his preferences by selecting the most preferred among the efficient yardstick bids. The Principals choice is used to construct K or less linear scoring functions spanned by the constructed yardstick bids. The second bidding round is basically a first score auction based on the K or less scoring functions identified in round 1. The bids that span the scoring functions in the first round function as lower bounds in the second round. The Principal selects the most preferred bid among the highest scoring bids from the second bidding round and the winner is compensated with the price stated in the bid. The auction provides incentives to reveal the most competitive bid including a price less than or equal to the true cost in the first bidding round. This strengthens the Principals articulation of preferences and the competition in general. Also the flexible approach makes the suggested auction a closer alternative to a traditional negotiation while ensuring transparent and strong competition. The mechanism requires a trusted third party to compute the applied yardstick prices. We discuss how the system may be implemented based on modern cryptography known as secure multiparty computation. An implementation that can avoids any dissemination of the submitted prices without putting trust in any single person or organization.

keywords: auctions, multi-attribute, yardstick competition, market design.

Investment portfolio management based on the theory of differential games

Nikonov, Oleg*, Ural State Tech. Univ.-UPI, olegnikonov@yahoo.com
Medvedeva, Marina, Ural State Tech. Univ.-UPI, aspr@mail.ustu.ru

Abstract. Problems under consideration are in some way related to the theory of portfolio investment that goes back to the papers [1-2]. The paper deals with dynamic problem of financial portfolio management. In contrast to traditional settings [3] we assume that dynamics of the averaged characteristics of financial assets are described by differential inclusions, whereas in classical approaches stochastic differential equations are usually used for description of prices dynamics. Using approaches of [4-6], we construct a control strategy, which guarantees the efficiency of portfolio in time. Namely, in the framework of formalization proposed in the paper that corresponds to the theory of guaranteed control under uncertainty conditions, a family of dynamic reconstruction problems of investment portfolio can be considered. In particular, assuming that at the initial moment a portfolio is efficient for the initial state, one can formulate a problem of constructing a strategy that
guarantees the efficiency of the investment portfolio and provides the given level of return or the given level of risk throughout a prescribed time interval. If the market is stable, that means that there is no uncertainty in assets' characteristics, and the strategy is trivial, and there is no need of portfolio reconstruction. Solvability conditions of the problem allow us to define an index of stability of financial market. Numerical examples related to the last financial crisis are also presented. The work was partly supported by Russian Fund for Basic Research (project 009-01-00223a) and Russian Fund for Humanities (project 08-02-00315a).

**keywords:** portfolio investment, guaranteed control, differential games.

### The monoclus of an airport game

**Gulick, Gerwald van**, Tilburg Univ., G.VanGulick@uvt.nl  
**Norde, Henk***, Tilburg Univ., H.Norde@uvt.nl  
**Reijniere, Hans**, Tilburg Univ., J.H.Reijniere@uvt.nl  
**Slikker, Marco**, Eindhoven Univ. of Technology, M.Slikker@tue.nl

**Abstract.** Most solution concepts for cooperative games focus on payoff vectors, which assign a number to each player in the grand coalition. The Shapley value and the nucleolus are well-known examples. Sprumont introduced allocation schemes, which assign a number to every player in every coalition. Where generating core elements is a desired property for "standard" solution concepts, generating population monotonic allocation schemes is a similar property for allocation scheme rules. Slikker and Norde introduced the monoclus, an allocation scheme rule yielding a population monotonic allocation scheme whenever one exists. The basic idea underlying the concept of monoclus is similar to the idea underlying the nucleolus. In this paper we apply the monoclus to the class of airport games. We show that the resulting allocation for the grand coalition can be described by a "painting" algorithm, similar to the algorithm presented by Maschler, Potters and Reijniere for the nucleolus of an airport game.

**keywords:** non cooperative games, informational extended game, Nash equilibrium, payoff function, set of strategies, best response mapping, point-to-set mapping, fixed point.

### About the noncooperative informational extended games

**Novac, Ludmila***, State Univ. of Moldova, novac-ludmila@yandex.com

**Abstract.** Using the general concept of the informational extended games for the noncooperative games and using some models of informational extended games (as a particular case of Howards metagames), we extend the study of noncooperative informational extended games. The informational extension concept for games has on its basis the assumptions that the participants of the game have possibility to send and to receive (or to guess) some information about the chosen strategies of other participants and about their behavior. In this article we analyse static informational extended games, i.e. games in which the players choose their actions simultaneously, with assumption that they have some information about the future strategies which will be chosen by other players.

All informational extended games of this type will assume that players payoff functions are common knowledge. Under these assumptions we define the informational extended games and the main problem is to define the conditions of Nash equilibrium existence for this type of informational extended games. In this informational extended game we consider that each player is informed about the strategies of other players which will be chosen. In this case the sets of strategies for each player will be a set of functions defined on the product of the strategy sets of the rest players from the game (without some information). The essential result of this article is a theorem of Nash equilibrium existence in informational extended games with n players. The proof of this theorem is based on Kakutani fixed point theorem for point-to-set mappings and on other important theorems from the functional analysis and topology. We define the point-to-set mapping through the best response sets for each player for the chosen strategies of all players. Thus if the amount of the information increases for all participants, then the Nash equilibria sets are larger. This treatment confirms the importance of the information possession in all circumstances in the case of the make-decision problems and assure the best result.

**keywords:** noncooperative games, informational extended game, Nash equilibrium, payoff function, set of strategies, best response mapping, point-to-set mapping, fixed point.

### The evolution of preferences, punishment and collective action

**Calabuig, Vicente**, Univ. of Valencia, Vicente.Calabuig@uv.es  
**Olcina, Gonzalo***, Univ. of Valencia, Gonzalo.Olcina@uv.es

**Abstract.** In a social dilemma known as the trust game, one player (the investor) has the option of investing or not investing in a project, which is administered by the other player (the allocator). To invest results in a higher joint surplus, but the allocator controls the proceeds of investment. The trust game is a metaphor for many social bilateral relationships. A prominent example appears in the labour market. Many labour contracts assign significant authority to the employer (hierarchical governance). The threat of hold up of the employee by the employer, caused by this asymmetric distribution of decision rights, can be mitigated by a preference for reciprocity on the part of the employer or by a balance of power, arising from the credible threat by the employee to retaliate if he is exploited. In a previous work we showed that reciprocity is not enough to achieve efficiency, it is also needed a significant allocation of power to the player without authority (the worker) in order to make the threat of punishment a powerful tool to enhance efficiency and cooperation. But while in this previous work the workers power, that is, the maximal amount of money burning is given exogenously, in this current paper workers power is endogenous, depending on the number of workers adhering to this activity. In particular, they have to coordinate in choosing the level of individual costly punishment, in a situation where there is a temptation of freeriding. Therefore, workers power (their collective capacity to punish) depends on their coordination in the punishment phase. We study the interaction and evolution of preferences in the population of workers and their ability to coordinate in the punishment phase (collective action). This interaction
Abstract. In this work we introduce a new class of cooperative games over a specific kind of sub-digraphs, cycles. We present a mathematical model for this situation and an axiomatic characterization of a solution for this new class of games. This game theory application is introduced as a method to measure the importance of the nodes in a digraph when the allocation amount is a real number given before the game. We show axiomatic solutions for general classes of games as well as more specific results concerning well known allocation rules.

Keywords: games and economics, cultural dynamics, collective action, punishment, social preferences.

Values for games on the cycles of a digraph

Olvera, William*, Centro de Investigación en Matemáticas A.C., william@cimat.mx
Sánchez-Sánchez, Francisco, Centro de Investigación en Matemáticas A.C., sanfco@cimat.mx

Abstract. In this study we model an electricity market game in which producer acts as profit taker and consumer is a follower bounded to a cost function related to comfort of load shifting from day time to night time. The TOU tariff is modeled as a tariff scheme where night and day pricing differ. One retailer case is analyzed and extended to two retailer case which constitutes a game situation. It is shown that transition from one retailer monopoly to two retailer competition case may be unfavorable for all the stake holders besides the retailers themselves.

Keywords: differential games
Dynamic competition with consumer inertia

Pot, Erik, Maastricht Univ, e.pot@maastrichtuniversity.nl
Flesch, Janos, Maastricht Univ, j.flesch@maastrichtuniversity.nl
Peeters, Ronald*, Maastricht Univ, r.peeters@maastrichtuniversity.nl
Vermeulen, Dries, Maastricht Univ, d.vermeulen@maastrichtuniversity.nl

Abstract. We study a framework where two duopolists compete repeatedly in prices and where chosen prices potentially affect future market shares, but certainly do not affect current sales. This assumption of consumer inertia causes (noncooperative) coordination on high prices only to be possible as an equilibrium for low values of the discount factor. In particular, high discount factors increase opportunism and aggressiveness of competition to such an extent that high prices are no longer sustainable as an equilibrium outcome (not even in trigger strategies). In addition, we find that both monopolization and enduring market share and price fluctuations (price wars) can be equilibrium path phenomena without requiring exogenous shocks in market or firm characteristics.

keywords: oligopoly games, repeated games.

An extension of Owen allocations in linear production games

Fernández, Francisco R., Univ. of Seville
Perea, Federico*, Univ. of Saragossa
Puerto, Justo, Univ. of Seville

Abstract. Linear production processes are situations in which there is a finite set of resources and from those resources a set of consumption goods can be produced. Linear production games arise when a bunch of players with conflicting objectives control the resources of a linear production process. It is easy to check that, although players can try to produce individually, it is always more profitable to join their resources as the benefit they obtain this way is at least as high as the sum of the individual profits separately. Now a natural question arises: how to divide the profit made by the grand coalition among the players. One way of doing so are the well-known Owen allocations, which are included in the core of the game, that is, Owen allocations are stable in the sense that no group of players can obtain a better payoff by acting separately. Although Owen allocations are stable, they should not be taken as ideal allocations. Are they always “fair” allocations? It can be proven that sometimes Owen allocations give null payoff to players that are absolutely necessary to obtain the maximum benefit (or any benefit at all). This comes from the Complementary Slackness problem, since Owen allocations are built from optimal dual variables, which are zero if there is any slack in the corresponding constraint of the primal problem. Our presentation introduces a new solution concept on LP games that avoids the drawbacks mentioned before, based on the idea that players owning resources that produce surplus in the optimal production plan can get rid of them. This way, players owning surpluses do not need to have an allocation equal to zero (which is the situation with Owen allocations). One of the problems arising is who gets rid of the surpluses. We have proven that our solution concept extends Owen allocations, it is well defined, and we have given an axiomatic characterization of this concept when the underlying linear process has one optimal plan only. The case of multiple optimal production plans is still under study.

keywords: Linear Production Games; Cooperation; Fair allocations.

Non-cooperative approaches to claims or bankruptcy problems

Atlamaz, Murat, Bates White LLC, murat.atlamaz@bateswhite.com
Berden, Caroline, SEO Economic Research, c berden@seo.nl
Palvölgyi, Denes, Maastricht Univ, d.palvolgyi@maastrichtuniversity.nl
Peters, Hans*, Maastricht Univ, h.peters@maastrichtuniversity.nl
Vermeulen, Dries, Maastricht Univ, d.vermeulen@maastrichtuniversity.nl

Abstract. In a claims or bankruptcy problem an estate has to be divided among several claimants whose total claim exceeds the size of the estate. This paper extends the noncooperative approach to this problem, as initiated by O’Neill (1982), who also initiated the cooperative, axiomatic approach. In the non-cooperative approach, players put claims on parts of the estate, and these parts are then distributed proportionally with respect to the number of claims. In the model where players have homogenous preferences on the estate, we extend the approach of O’Neill by allowing players to put multiple claims on the same part of the estate, and by considering the case where individual claims may exceed the estate. A full characterization of the set of Nash equilibria is obtained both for restricted claims problems, where individual claims do not exceed the estate, and for the general case. Variations on the claim game are considered, which result in proportional division in equilibrium. This part of the presentation is based on Atlamaz, Berden, Peters, and Vermeulen (revised version, January 2010). In a second part of the presentation the assumption of homogeneity of the preferences is dropped and, instead, we consider much more general preferences. This situation is more difficult to handle and the focus will be on existence of Nash equilibrium. This part of the presentation will be based on forthcoming work of Palvölgyi, Peters, and Vermeulen.


keywords: bankruptcy problems, claims problems, non-cooperative games.
Young’s axiomatization of the Shapley value - a new proof

Pintér, Miklós*, Univ. of Budapest, miklos.pinter@uni-corvinus.hu

Abstract. Young’s characterization of the Shapley value is considered. A new proof of this axiomatization is presented, moreover, as applications of the new proof, it is demonstrated that the axioms under consideration characterize the Shapley value on various well-known subclasses of TU games. The paper is available on http://arxiv.org/pdf/0805.2797v2

keywords: cooperative games

The co-evolution of entrepreneurship and the public sector efficiency

Escriche, Luisa, Univ. of Valencia, luisa.escriche@uv.es
Pons, Empar*, Univ. of Valencia, amparo.pons@uv.es

Abstract. It is often argued that social norms, attitudes or culture of a particular region have played a critical role determining its development. Several institutional, political or economic outcomes are difficult to explain just in terms of economic incentives. We observe large differences among countries in the efficiency of the bureaucracy, welfare policies and entrepreneurship. For instance, if we compare Mediterranean countries with Nordic countries, it is well known that not only bureaucracy are less efficient in the former countries but also the productive structure is less dynamic (lower level of entrepreneurship). We think that to explain these differences, we have to go beyond pure economic incentives and think about some social norms motivating individual behavior. Particularly relevant seems a social norm in favour of high effort (to induce cooperation, respect for the law, low level of corruption...) within public sector employees. This paper formalizes the two-way causality between the decision to become an entrepreneur and the efficiency of the public sector. A social norm in favour of hard effort against low effort in public bureaucracy acts the expected profits (or probability of success) of any new project and, consequently, the decision to become an entrepreneur or work as a civil servant. If the individual decides to become an entrepreneur and start a risky project, the results will depend crucially on the level of eort of the civil servants. If they work hard, that is, there exists work ethic, the profits for the entrepreneur are the highest. Conversely, if they make low effort, the project may fail and the entrepreneur falls into unemployment. In this case, he will obtain the unemployment insurance. The level of unemployment benefits, civil servant wages and taxes are designed to satisfy a balanced public budget. This is a political decision which is determined by an electoral process. We study the interaction between entrepreneurship and the public sector efficiency. This interaction takes place in an overlapping generations model with heterogeneous preferences and incomplete information, where there is intentional cultural transmission of preferences. We characterize the long run behavior of this society, that is, the stable steady states of the cultural dynamics. Our analysis can contribute to account for the differences observed among countries (Mediterranean vs. Nordic) or within countries (north vs. south of Italy or Spain) concerning the dynamics of the productive structure and public sector efficiency.

keywords: games and economics, social norms, intergenerational transmission of preferences, public sector efficiency, entrepreneurship

Bargaining one-dimensional policies and the efficiency of super majority rules

Cardona, Daniel, Univ. de les Illes Balears, d.cardona@uib.cat
Ponsati, Clara*, Institut d’Anàlisi Econòmica (CSIC), Barcelona, clara.ponsati@iae.csic.es

Abstract. We consider negotiations selecting one-dimensional policies. Individuals have single-peaked preferences, and they are impatient. Decisions arise from a bargaining game with random proposers and (super) majority approval, ranging from the simple majority up to unanimity. The existence and uniqueness of stationary sub-game perfect equilibrium is established, and its explicit characterization provided. We supply an explicit formula to determine the unique alternative that prevails, as impatience vanishes, for each majority. As an application, we examine the efficiency of majority rules. For symmetric distributions of peaks unanimity is the unanimously preferred majority rule. For asymmetric populations rules maximizing social surplus are characterized.

keywords: bargaining

Indirect control of corporations. Some applications

Prati, Nando*, Univ. of Udine, nando.prati@uniud.it

Abstract. Power indices, and in particular the Banzhaf Colemann power index, can be calculated in the indirect control of corporations too. Several proposals appeared in the literature: in compound games ([Owen1995], that should be also compared with games with a priori unions: e.g. [Owen 1977]), in indirect control of corporations ([Gambarelli Owen 1994]), and in games with alternatives, absence, abstentions ([Prati 2002], and [Denti Prati 2004]). After a presentation and a theoretical comparison of the several approaches, we show the applications of the Banzhaf Colemann power index in some real applications, showing the differences of the several approaches.

Abstract. In the paper, we generalize a model of influence in a social network with a single step of mutual influence to a framework with the iteration of influence. Each player is to make an acceptance-rejection decision and has an inclination either to say YES or NO. We also consider the case where each player has at disposal a continuum of actions. Due to influence by others, a final decision of a player may be different from his original inclination. Such a transformation from the players’ inclinations to their decisions is represented by an influence function. In the decision process, the mutual influence does not stop necessarily after one step but may iterate. We study the behavior of the series of the influence functions and determine convergence conditions for a sequence of influence functions. Moreover, the behavior of the sequence of specific influence functions are examined. We also investigate several unanimous influence functions for the continuum case, like the majority function, the guru function, the identity function, and the mass psychology function, and we study their properties. Under such influence functions, unanimously inclined players always decide according to their common inclination. Furthermore, we focus on linear influence functions, i.e., functions that can be written as a matrix. We also look at the set of fixed points under a given influence function, i.e., the set of the inclination vectors that coincide with the decision vectors resulted from these inclinations. In the paper, several examples illustrating the concepts in question are presented.

Keywords: voting and power indices, cooperative games.

Cooperation in multisuppliers distribution chains with stochastic and bounded demand

Meca, Ana, Miguel Hernández Univ. of Elche, ana.meca@umh.es
Puerto, Justo*, Univ. de Sevilla, puerto@us.es
Guardiola, Luis, Miguel Hernández Univ. of Elche, luis.guardiola@alu.umh.es

Abstract. In this paper we study single period models of distribution chains involving a single product. In these chains, several suppliers replenishes their goods to several retailers via a warehouse and demands are stochastic. We analyze two models of cooperation, namely among retailers and among a group of retailers and a group of suppliers. We prove that both types of cooperation are profitable. Moreover, the corresponding cooperative games built on the underlying situations, are balanced and in some interesting cases new core allocations are provided.

Keywords: cooperative games, distribution games, stochastic demand.

Innovation and bargaining

Ramsza, Michal*, Warsaw School of Economics, michal.ramsza@gmail.com

Abstract. Various experiments concerning human subjects playing the ultimatum game suggest that the rational game theory is completely wrong at predicting the outcome of the game. There are two main ways of explaining this phenomenon. One is rooted in the learning theory while the other postulates that people are inequity averse. A learning model from the class of pairwise comparison dynamics is proposed that can capture two selecting procedures: imitation and simple search. It is argued that even if subjects’ choices are consistent with inequity aversion it is not enough to guarantee the existence of the social norm and that the key component is innovation on behalf of players.

Keywords: evolutionary games, experiments, learning.

Stability in networks of relational capacities

Ruys, Pieter H.M.*, Tilburg Univ, ruys@uvt.nl

Abstract. Individualistic values and the commodity concept are the building blocks of standard neoclassical economic theory. This paradigm is under scrutiny. I propose to replace it by a relational approach in which the commodity concept as source of value is replaced by the concept of a relational capacity, such as a service. A relational capacity generates value through interaction with another relational capacity if their characteristics are complementary and if these capacities are carried by cognizable (institutional) frames. One such frame consists of agents incorporating the relational capacity. Another frame consists of teams playing the rules of an institutional matching mechanism that specifies conditions for matching. Both a team and an agent may be an individual or a group. We next consider a network economy in which economic agents are connected within a relational structure. Agents are endowed with three types of relational capacities: reflexive, binary, and group oriented. They are assumed to be able to participate in three types of teams: autarkic matching; binary matching; and multi-person cooperative matching. We introduce two concepts of stability and characterize stable interaction structures.
both in the absence of externalities from cooperation as well as in the presence of size-based externalities. We show that institutional elements such as the emergence of socio-economic roles and organizations based on hierarchical team structures are necessary for universal stability and as such support and promote stable economic development.

**Keywords:** games and economics, mechanism design, modes of governance, network games, stability, social networks.

**On the existence of Markov equilibria in perfect information games**

Salonen, Hannu*, Univ. of Turku, hansal@utu.fi
Vartiainen, Hannu, Univ. of Turku, Hannu.Vartiainen@tse.fi

**Abstract.** We study the existence of pure strategy Markov perfect equilibria in two-person perfect information games. There is a state space and each period players possible actions are a subset of this space. The set of feasible actions depends on the current state, which is determined by the choice of the other player in the previous period. We assume that the state space is compact Hausdorff and that action correspondence has an acyclic and asymmetric graph. For some states there may be no feasible actions and then the game ends. Payoffs are either discounted sums of utilities of the states visited, or the utility of the state where the game ends. We give sufficient conditions for the existence of equilibrium when either feasible action sets are finite or when players payoffs are continuously dependent on each other. The latter class of games includes zero-sum games and pure coordination games. Given an initial state, one of the players starts the game by choosing some action from the set of feasible actions. After that his opponent chooses an action from the set that is now feasible. Hence given an initial state and a first mover, we have a perfect information extensive form game. A Markov strategy for a player selects one feasible action to each state (whenever there are feasible actions). Hence in a Markov perfect equilibrium, such a strategy specifies to each state an action that a player uses whenever this state is reached and it is his turn to make a move. The utilities over states and action correspondence are kept unchanged. It turns out that when action sets may be infinite, best replies need not exist even when the state space is unit interval, the action correspondence is continuous and convex valued, utilities over states are continuous and concave and the game lasts at most three periods. Nonexistence of best replies in this example leads also to the nonexistence of equilibrium. This is in contrast to the classical existence results of Harris (1985a,b), Hellwig and Leininger (1987), Hellwig et al (1990) (see also Borgers (1989) and Carmona (2005)). The reason is that the set of feasible actions may be empty at some states unlike in the papers quoted above. Our main assumption (Assumption 1) is that to each uncountable subset of states, there exists a state in this subset such that the next state cannot be in this subset anymore. We show that if the set of feasible actions is finite, and the closure of the action correspondence satisfies Assumption 1, then there exists a Markov perfect equilibrium. Utility functions over states can be arbitrary. When the feasible action sets may be infinite, we assume that the action correspondence and utilities over states are continuous. If players payoffs depend continuously on each other and Assumption 1 holds, then there exists a Markov perfect equilibrium, given that a relatively weak technical assumption is satisfied. Players payoffs are continuously dependent for example in zero-sum games and in pure coordination games. But these cases are not the only ones since the state space need not be convex. The crux of the proofs of our results is that Assumption 1 guarantees that all histories are finite when action correspondence is closed. This result itself is nontrivial, and it implies that we may apply backwards induction. Finite histories alone will not suffice to guarantee the existence of equilibria however, as we show by an example. We assume throughout the paper that the graph of the action correspondence is an asymmetric and acyclic relation. This means that a given state will be visited at most once within any finite horizon. Fudenberg and Yamamoto (2009) and Hörner et al (2009) analyze irreducible stochastic games: a given state can be reached from any initial state with positive probability in finite time. They prove a Folk theorem for such games (strategies are of course not Markov), with finite state space and finite nonempty action sets. The dynamics studied in our paper is almost the polar opposite of irreducibility.

**Keywords:** multi stage and repeated games.

**Linear production games with a common-pool resource**

Llorca, Natividad, CIO, Miguel Hernández Univ., nllorca@umh.es
Mosquera, Manuel Alfredo, Vigo Univ., mamrguez@uvigo.es
Sánchez-Soriano, Joaquin*, CIO, Miguel Hernández Univ., joaquin@umh.es

**Abstract.** In this paper we deal with Linear Production situations in which there is a limited common-pool resource. In this case, if we are interested in approaching these problems from a cooperative point of view, then, in order to determine the worth of a coalition we would need to take into account not only what the members of the coalition can do but also what the outsiders could do. In this sense, the use of the characteristic function in partition function form seems more suitable than the coalitional function form. At this point, we approach the definition of these functions from a non cooperative perspective and propose three different models. Finally, we analyze the core-related concepts for these three models.

**Keywords:** linear production, common-pool resource, partition function form, Nash equilibrium, core.

**A solution concept in two-sided market models**

Llorca, Natividad, CIO, Miguel Hernández Univ., nllorca@umh.es
Sánchez-Soriano, Joaquin*, CIO, Miguel Hernández Univ., joaquin@umh.es

**Abstract.** Transportation and assignment problems can be interpreted as two-sided market situations. Since Shapley and Shubik (1972), where assignment games associated with assignment problems were introduced, different generalizations related to two-sided
Abstract. This paper characterizes the perfect Bayesian equilibrium in an ascending price package auction. Bidders play history-dependent strategies in an ascending auction, and we show that it leads to serious underbidding. We suppose that there are 2 objects and 3 bidders: 2 local and 1 global bidders. The local bidders want only one unit of the objects, while the global bidder wants both. The local bidders want only one unit of the objects, while the global bidder wants both. We show that either of the 2 local bidders stops bidding at the beginning. Although local bidders generally face the threshold problem and have incentives to underbid, once a bidder becomes a unique remaining local bidder, he/she bids truthfully after that subgame. This implies that stopping early by a local bidder makes the remaining bidder behave aggressively and truthfully. Hence, each local bidder wants to stop bidding earlier than the other and a race for a “freeriding seat” arises. The equilibrium outcome is unique under some conditions. The equivalence between sealed-bid and ascending auctions does not hold, and a sealed-bid package auction performs better on an average.

keywords: auctions, package auction, threshold problem, perfect Bayesian equilibrium, market design, combinatorial auction.

Anti-evasion auditing policy in the presence of common income shocks

Villalba-Sanchez, Miguel*, Univ. of Alicante, masanchez@merlin.fae.ua.es

Abstract. When fairly homogeneous taxpayers are affected by common income shocks, a tax agency’s optimal auditing strategy consists of auditing a low-income declarer with a probability that (weakly) increases with the other taxpayers’ declarations. Such policy generates a coordination game among taxpayers, who then face both strategic uncertainty - about the equilibrium that will be selected - and fundamental uncertainty - about the type of agency they face. Thus the situation can be realistically modelled as a global game that yields a unique and usually interior equilibrium which is consistent with empirical evidence. Results are also applicable to other areas like regulation or welfare benefit allocation.

keywords: tax evasion, coordination/global games, expectations, asymmetric information.

Tax evasion as a global game (TEGG) in the laboratory

Villalba-Sanchez, Miguel*, Univ. of Alicante, masanchez@merlin.fae.ua.es

Abstract. Sanchez Villalba (2009) claims tax evasion can be modelled as a global game when income shocks are common and prescribes that the tax agency should audit each individual taxpayer with a probability that is a non-decreasing function of every other taxpayer’s declarations (“contingent policy rule”). This paper uses experimental data to test the predictions of the model and finds supporting evidence for the hypothesis that the contingent policy rule is superior to the alternative “cut-off” one. It also finds that data fits the qualitative predictions of the global game model, regarding both participants’ decisions and the experiment’s comparative statics.

keywords: experimental economics, tax evasion, global games, rationality, information, beliefs.

Competing for free-riding: strategic non-bidding in an ascending package auction

Sano, Ryui*, Univ. of Tokyo, ryujisano@gmail.com

Abstract. This paper characterizes the perfect Bayesian equilibrium in an ascending price package auction. Bidders play history-dependent strategies in an ascending auction, and we show that it leads to serious underbidding. We suppose that there are 2 objects and 3 bidders: 2 local and 1 global bidders. The local bidders want only one unit of the objects, while the global bidder wants both. We show that either of the 2 local bidders stops bidding at the beginning. Although local bidders generally face the threshold problem and have incentives to underbid, once a bidder becomes a unique remaining local bidder, he/she bids truthfully after that subgame. This implies that stopping early by a local bidder makes the remaining bidder behave aggressively and truthfully. Hence, each local bidder wants to stop bidding earlier than the other and a race for a “freeriding seat” arises. The equilibrium outcome is unique under some conditions. The equivalence between sealed-bid and ascending auctions does not hold, and a sealed-bid package auction performs better on an average.

keywords: auctions, package auction, threshold problem, perfect Bayesian equilibrium, market design, combinatorial auction.

Bankruptcy in a fuzzy framework and new solution concepts

Mallozzi, Lina, Univ. of Naples “Federico II”, mallozzi@unina.it
Scalzo, Vincenzo*, Univ. of Naples “Federico II”, scalzo@unina.it
Tijs, Stef, Univ. of Tilburg, S.H.Tijs@uvt.nl

Abstract. Inspired by a generalization of the bankruptcy problem, where creditors claim by means of lower and upper bounds for what they are willing to accept and choosing amounts according to an increasing utility functions, we propose a new core-like concept for cooperative games with fuzzy-interval characteristic functions (shortly: fuzzy-interval games). Our core extends to fuzzy interval games the interval core introduced by Alparslan, Branzei and Tijs in 2008. We provide a balanced-like condition in the spirit of Bondareva-Shapley and prove that this condition is necessary but not sufficient for the existence of fuzzy core elements (in our sense).

keywords: fuzzy intervals, cooperative games, core.
A Game Theoretic Approach to Resources Management in Home Automation Systems

Conte, Giuseppe, Univ. Politecnica delle Marche, gconte@univpm.it
Perdon, Anna Maria, Univ. Politecnica delle Marche, perdon@univpm.it
Scaradozzi, David*, Univ. Politecnica delle Marche, d.scaradozzi@univpm.it
Rosettani, Matteo, Univ. Politecnica delle Marche, m.rosettani@diega.univpm.it

Abstract. The aim of this paper is to propose an application of game theoretic methods to the management of resources in Home Automation Systems. A home automation system consists of a set of appliances and devices for home management which can be viewed as individual agents that act in a common environment and share common resources, like electricity, gas and water. Since resource availability is either limited in absolute terms or in relation to cost, concurrent use may cause conflicts that degrade the performances of individual appliances with respect to the user expectations and increase costs or time for accomplishing individual tasks. The optimal allocation of limited resources with respect to given objectives is therefore the main problem that a centralized or distributed controller has to solve in governing the system. In both cases, the general strategy to solve this problem consists in assigning an order of priority to each agent with respect to the others in accessing a given resource, when the available amount cannot satisfy the global actual demand. A collateral effect of this solution is a loss of efficiency in terms of delays in executing the assigned task, occurring when an agent must yield and wait until the resource is free. The resulting situation is handled by considering also time as a systems resource that, although not limited in principle, has to be saved. We employ a multi agent system point of view to describe and model the home automation system, in such a way to define formally a set of performances indices. Then, considering the case of electricity, we apply to the power allocation problem a game theoretic approach derived from the Cournot oligopoly, trying to maximize the resource availability for each agent, taking into account the global demand and the delay in assigning the resource with respect to the time of the request. The theoretic solution is not directly applicable, since power must be either completely denied (in that case the agent goes to a standby status) or granted in such a way to match the agents demand. In addition, the theoretic solution in general does not saturate the resource availability. This second aspect is dealt with by scaling in a suitable way the solution, while the first is dealt with by choosing, among all possible coalitions of agents, the one which is closer, in a suitable metric, to the scaled solution. Optimality of the chosen coalition is checked at fixed intervals and, possibly, a new, better solution is found and implemented, depending on the evolution of the demand and on the delay that, in the mean time, builds up for agents in standby status. Viability of the strategy described above has been tested by simulating several scenarios which represent standard home installations and typical usage. This has been possible thanks to the use of a proprietary simulator, specifically developed for modelling and studying home automation systems. Application of the strategy gives rise, for each scenario, to a particular behaviour of the system and performances, in terms of user expectations, can be evaluated offline. Performance evaluation keeps into account the global delay in executing tasks and the costs associated to the use of the resource. In general, the strategy shows to be able to solve conflicts in a satisfactory way, achieving good performances. It is worthwhile to note that the strategy described above can be implemented, in practice, by a centralized controller endowed with basic computational capacity, with the ability to measure time and the instantaneous load of each appliance and with the authority to exert an on-off control on each plug. Appliances need only to be able to go to a standby status when power is denied and to resume from it when power is granted again. At the present state of technology, all these features can easily be integrated, at low costs, in a suitable device to be used as centralized controller and in modern appliances.

keywords: coalition formation, games and decisions, home automation.

Equilibrium solution in a game between a cooperative and its members

Gambarelli, Gianfranco, Univ. of Bergamo, gianfranco.gambarelli@unibg.it
Bertini, Cesario, Univ. of Bergamo, cesario@unibg.it
Scarelli, Antonino*, Univ. of Tuscia, scarelli@unitus.it
Varga, Zoltán, Szent István Univ., Varga.Zoltan@gek.szie.hu

Abstract. An agricultural cooperative in a given region may perform several activities, ranging from product processing to complex marketing. Producers of a given product often form a marketing cooperative, only for the commercialization of their product. A typical situation is when a marketing cooperative negotiates a contracted price with large buyers, sharing risk among members of the cooperative. However, by the time of the actual commercialization of the product, the direct market price may be higher then that the cooperative can guarantee for members, negotiated on beforehand. Some unfaithful members may be interested in selling at least a part of their product outside, the cooperative, however, can punish them for it. This conflict situation is described in terms of a game-theoretical model. In the present paper we consider an agricultural cooperative where producers, as part of their strategy in dealing with the cooperative, at the beginning of the yearly production cycle declare a projected quantity to be sold to the cooperative at a contracted price. At the time of the harvest, as a second strategy choice, each producer decides how much of his production he would actually sell to the cooperative. If a producer does not deliver the contracted amount, he will be punished by the cooperative, proportionally to the undelivered amount and to the extra profit gained from selling on the direct market. It is up to the cooperative to set the penalty rates. If by the time of the harvest, the direct market price turns out to be lower than the contracted price guaranteed by the cooperative, the latter would not buy more than the contracted amount. We will find a Nash equilibrium solution for this conflict situation, supposing that the higher direct market price will occur with a given probability. The obtained theorems are illustrated with a marketing cooperative for the commercialization of apples.

keywords: non-cooperative games, Nash equilibrium, behaviour in cooperative.
Minimum cut tree games - solution concepts for special cases

Schwahn, Anne M.*, Univ. of Kaiserslautern, schwahn@mathematik.uni-kl.de

Abstract. We investigate minimum cut trees as introduced by Gomory & Hu (1961) from a game-theoretic point of view. Minimum cut trees of a given graph can be computed in polynomial time and have different applications: They compactly represent minimum cuts and maximum flows between every vertex pair in a graph, and they solve the maximum reliable tree problem, the minimum cut basis problem, and the optimal requirement tree problem. In an earlier paper, the author of this abstract introduced a cooperative game based on minimum cut trees in which every vertex of a graph (except the root vertex) is owned by a player. Given an established but outdated network with capacities which is induced by vertices of a coalition, we looked for a structure providing the same capacity for non-simultaneous multi-terminal flows. The number of edges and the total capacity of the network were to be minimized in order to have lowest possible construction costs. Minimum cut trees comply with these requirements. These minimum cut tree games were shown to be totally balanced and are thus transformable to maximum flow games. Methods were proposed to obtain solutions in their core in polynomial time. Two classes of graphs implying convex games were identified, namely, cactus graphs and graphs having a special weight structure, a heavy root. The latter is fulfilled if the weight of an edge connecting two non-root vertices does not exceed the weights of the edges connecting these vertices to the root. For both special cases explicit formulas for the Shapley value were given. In the current paper, further solution concepts are investigated and the core is characterized for the before mentioned special cases. In graphs having a heavy root and in tree graphs, the nucleolus coincides with the Shapley value and the core can be described completely. For tree graphs, elements of the aggregate-monotonic core can be calculated efficiently. If the root is not a leaf vertex, the aggregate-monotonic core coincides with the core and their dimension is given. It is shown that one of the methods to compute a core allocation can be used to obtain population monotonic allocation schemes in cactus graphs. Even though minimum cut tree games are a proper subset of maximum flow games and core allocations in the latter can be computed with a better running time, a transformation of cut tree games into ow games is shown to be inefficient.

keywords: cooperative games, cost sharing, network games, OR games, minimum cut tree, core, nucleolus, population-monotonic allocation scheme, aggregate-monotonic core.

Local conventions and social planners

Shi, Fei*, Univ. of Konstanz, fei.shi@unikonstanz.de

Abstract. This paper extends Ely (2002) and Anwar (2002)'s location models by endogenizing capacity and mobility constraints as decisions of rational social planners. If the planners are only concerned with efficiency, neither Ely (2002)'s prediction on global efficient coordination nor Anwar (2002)'s results on the co-existence of conventions in a symmetric setting hold. If the planners care both about efficiency and scale, they will completely restrict the mobility of individuals in each location, leading to global coordination in inefficient equilibria.

keywords: stochastic learning, social planner, local convention

An existence theorem for Cournot-Walras equilibria in a monopolistically competitive economy

Shirai, Koji*, Waseda Univ., shiraeconomics@suou.waseda.jp

Abstract. We establish an existence theorem for the Cournot-Walras equilibria in the model which consists of a representative consumer and n-monopolistically competitive firms. Instead of the traditional approach which depends on Kakutani's fixed point theorem, we employ the theory of the relationship between games with monotone best responses and potential games. We show that, under some conditions on a utility function and production technologies, the profit maximization game is the (pseudo) best reply potential game and hence, the existence of the equilibria is proved independently of the well known convexvalued assumption on best responses. The key property is the separability of the utility function. We exclude neither cost-diminishing technologies nor the existence of fixed costs. In addition, in our framework, the rationality of each monopolistically competitive firm can be alleviated in the sense that it can figure out the inverse demand curve from less information than is required in existing studies.

keywords: oligopoly games, potential games, general equilibrium with imperfect competition, aggregative game, separable utility.
Coalition structures induced by the strength of a graph

Grabisch, Michel, Univ. de Paris, michel.grabisch@univ-paris1.fr
Skoda, Alexandre*, Univ. de Paris I, alexandre.skoda@univ-paris1.fr

Abstract. We study cooperative games associated with a communication structure which takes into account a level of communication between players. Let us consider an undirected communication graph: each node represents a player and there is an edge between two nodes if the corresponding players can communicate directly. Moreover we suppose that a weight is associated with each edge. We compute the so called strength of the graph and use the corresponding partition to determine a particular coalition structure. The strength of the graph is a measure introduced in graph theory to evaluate the resistance of networks under attacks. It corresponds to the minimum on all subsets of edges of the ratio between the sum of the weights of the edges and the number of connected components created when the set of edges is suppressed from the graph. The set of edges corresponding to the minimum ratio induces a partition of the graph. We can iterate the calculation of the strength on the subgraphs of the partition to obtain refined partitions which we use to define a hierarchy of coalition structures. For a given game on the graph, we build new games induced by these coalition structures and study convexity properties, the core and the Shapley value associated with them.

keywords: communication networks, coalition structure

Information aggregation and communication in group decision making

Sopher, Barry*, Rutgers Univ, sopher@econ.rutgers.edu
Lau, Richard, Rutgers Univ, nicklau@rci.rutgers.edu
Birchby, Jeffrey, Rutgers Univ, birchby@econ.rutgers.edu
Andersen, David, Rutgers Univ, davandra@rci.rutgers.edu

Abstract. We study small group decision making in an environment where decision makers receive independent and private signals about the probability of payoff-relevant states of the world. Two policies, one risky and one safe, are available for adoption. We use laboratory experimental methods. Subjects are assigned randomly to groups of five decision makers in each of 12 rounds of play. In later rounds subjects are given individual payoff biases favoring or disfavoring one of the policies. Subjects communicate over given network architectures and then vote to determine which policy to adopt. We study connected and unconnected networks. Communication is free-form, via computer chat boxes. Subjects know the payoff biases of other subjects to whom they are connected. We find that connected networks are best at promoting full information aggregation, and also lead more often to the socially best policy being adopted. In rounds without payoff biases communication is generally truthful (in reporting own signals), while in rounds with payoff biases the truthfulness of communication is about 80% overall. Interestingly, subjects effectively discount communication from biased sources, and groups manage to adopt

the socially efficient outcome remarkably often, in spite of substantial individual biases that frequently provide a majority of the subjects in a group the incentive to deviate from the socially efficient policy and adopt the individually optimal policy. Misrepresentation of signal information occurs mainly in cases where a subject has an incentive to do so, i.e., where a subject would gain from the policy being adopted, even if adoption of the policy would not be socially efficient. We also report on a second experiment that studies the introduction of fixed “party” affiliations, with associated biases, in essentially the same decision making environment. We find that such party affiliations (or their associated real payoff biases) lead to noticeable polarization in voting behavior, often outweighing individual payoff biases.

keywords: experiments, communication networks, information aggregation

Stable group purchasing organizations

Nagarajan, Mahesh, Sauder School of Business, mahesh.nagarajan@sauder.ubc.ca
Sosić, Greys*, Marshall School of Business, sosic@marshall.usc.edu
Zhang, Hao, Marshall School of Business, zhanghao@marshall.usc.edu

Abstract. We study the stability of Group Purchasing Organizations (GPOs). GPOs exist in several sectors and benefit its members through quantity discounts and negotiation power when dealing with suppliers. However, despite several obvious benefits, GPOs suffer from member dissatisfaction due to unfair allocations of the accrued savings among its members. We first explore the benefits of allocation rules that are commonly reported as being used in practice. We characterize stable coalitional outcomes when these rules are used and provide conditions under which the grand coalition emerges as a tenable outcome. These conditions are somewhat restrictive. We then propose an allocation mechanism based on the marginal value of a member’s contribution and find that this leads to stable GPOs in many scenarios of interest. In this analysis, we look at discount schedules that encompass a large class of practical schedules and analyze cases when purchasing requirements of the members are both exogenous as well as endogenous. We use a concept of stability that allows for players to be farsighted, i.e., players will consider the possibility that once they act (say by causing a defection), another coalition may react, and a third coalition might in turn react, and so on, nullifying their original advantage in making the initial move.

keywords: coalition formation, cooperative games, cost sharing.
An approach to values based on sub-coalition

Bertini, Cesareno, Univ. of Bergamo, cesareno.bertini@unibg.it
Gambarelli, Gianfranco, Univ. of Bergamo, gianfranco.gambarelli@unibg.it
Stach, Izabella, AGH Univ. of Science and Technology, istach@eazar.agh.edu.pl

Abstract. We propose some values based on sub-coalition. The bargaining model of the Shapley value assumes that the construction of the whole coalition is realized through successive addition of the players, one by one, in a randomly chosen order to the coalition being formed. Each player gets his marginal contribution which he contributes to the coalition in formation opportunely weighted. In this work we suggest an approach to values based on sub-coalition, where these contributions are considered as given by sets of players. The approach is also extended to sub-coalitional structure. Some properties and recent developments of these values are shown.

keywords: coalition formation, cooperative games, values.

Measuring power and satisfaction in societies with opinion leaders: an axiomatization

van den Brink, Rene, Free Univ. of Amsterdam, jbrink@feweb.vu.nl
Rusinowska, Agnieszka, CNRS Univ of Lyon, rusinowska@gate.cnrs.fr
Steffen, Frank, Univ. of Liverpool Management School, steffen2@liverpool.ac.uk

Abstract. A well-known and established model in communication policy in sociology and marketing is that of opinion leadership. Opinion leaders are actors in a society who are able to affect the behavior of other members of the society called followers. Hence, opinion leaders might have a considerable impact on the behavior of markets and other social agglomerations being made up of individual actors choosing among a number of alternatives. For marketing or policy purposes it appears to be interesting to investigate the effect of different opinion leader-follower structures in markets or any other collective decision-making situations in a society. We study a two-action model in which the members of a society are to choose one action, for instance, to buy or not to buy a certain joint product, or to vote yes or no on a specific proposal. Each of the actors has an inclination to choose one of the actions. By definition opinion leaders have some power over their followers, and they exercise this power by influencing the behavior of their followers, i.e. their choice of action. After all actors have chosen their actions, a decision-making mechanism determines the collective choice resulting out of the individual choices. Making use of bipartite digraphs we axiomatize satisfaction and power scores which allow us to analyze the actors’ satisfaction and power with respect to the collective choice for societies with different opinion leader-follower structures.

keywords: voting and power indices, bipartite digraph, inclination, collective choice, opinion leader, follower, satisfaction axiomatization.

Linear bid in asymmetric first-price auctions

Tanno, Tadanobu*, Atomi Univ., tanno@atomi.ac.jp

Abstract. We propose a necessary and sufficient condition for the existence of the equilibrium linear bid in asymmetric first-price auctions with two bidders and uniform distributions. Introducing asymmetry in linear symmetric equilibrium increases expected revenue subject to constant expected sum of valuations. If auctions are asymmetric, the revenue in the linear equilibrium is larger than that in second-price auctions. If auctions in simple case are similar enough, the revenue in the first-price auction moves close to the optimal revenue as auctions are asymmetric. If auctions are similar enough, the linear equilibrium more efficiently allocates the item than the optimal mechanism.

keywords: auctions, first-price, asymmetry, linear bid, revenue, optimal auction, efficiency.

Multi-sided Böhm-Bawerk assignment games: point solutions

Tejada, Oriol*, Univ. de Barcelona, oriol.tejada@gmail.com

Abstract. We study the nucleolus, the tau-value, the core-center and the Shapley value for the class of multi-sided Böhm-Bawerk assignment games. To do so, we exploit the fact that the core and the extreme core allocations of a multi-sided Böhm-Bawerk assignment game are respectively the image through an injective linear function of the core and the extreme core allocations of an associated convex game (sectors game) defined on the set of sectors instead of the set of buyers and sellers (Tejada, 2010). We prove that the nucleolus and the core-center of a multi-sided Böhm-Bawerk assignment game, unlike the tau-value and the Shapley value, are also obtained respectively from the nucleolus and the core-center of the associated convex game through the same transformation. Moreover, the nucleolus of this latter game is only determined by coalitions of size 1 and size m − 1, where m is the number of players (sectors) of the game. Finally, we characterize four different point solutions for this class of games, namely the transformation of the nucleolus, the core-center, the tau-value and the Shapley value of the sectors game, which belong all to the core of a multi-sided Böhm-Bawerk assignment game. These solutions always coincide in the classical two-sided case.

keywords: cooperative games, assignment games, multi-sided markets, homogeneous goods, core, nucleolus, core-center, tau-value, Shapley-value.
Cooperation in tandem lines

Timmer, Judith*, Univ. of Twente, j.b.timmer@utwente.nl
Scheinhardt, Werner, Univ. of Twente, w.z.scheinhardt@utwente.nl

Abstract. We consider a number of servers in a tandem line. Each server is an M/M/1 queue with exponential service times and Poisson demand. The servers may improve the efficiency of the system by redistributing their service capacities. This improvement is due to the reduction in the steady-state mean total number of customers in the tandem line. We investigate how the cost of the system after redistribution should be divided among the servers. For this we use tools from cooperative game theory.

keywords: OR games, cooperative games.

A generalized MAC protocol for contention-based infrastructure networks

Tinnirello, Ilenia*, Univ. of Palermo, ilenia.tinnirello@tti.unipa.it
Giarré, Laura, Univ. of Palermo, giarre@unipa.it

Abstract. Wireless networks operation intrinsically assume different forms of cooperation among the network nodes, such as sharing a common wireless medium without interfering, relaying frames belonging to other nodes, controlling the transmission power for optimizing spectrum reuse, coding cooperatively multiple frames for improving information redundancy, and so on. For this reason, Game Theory has been extensively employed to model wireless networks. In particular, we propose a game-theoretic approach for defining a generalized medium access protocol for slotted contention-based channels. Contention-based channels are largely adopted in data networks, such as WiFi or WiMax, and even emerging cellular standards. We assume that each node of the network acts as a decision maker or player, and implements a best response strategy on the basis of simple estimators of the network status. When stations are interested in both uploading and downloading traffic, we show that efficient equilibrium conditions can be reached. More interesting, these equilibria are reached when all the stations play the same strategy, thus guaranteeing a fair resource sharing. For infrastructure networks, we also propose to exploit the role of the base station to incentive the nodes to operate on the Pareto optimal equilibrium and achieve global optimality and fair performance.

keywords: communication networks, game theory, mechanism design, WiFi, WiMax.

A class of solutions for river games with multiple springs and externalities

van den Brink, Rene, Free Univ. of Amsterdam, j.brink@feweb.vu.nl
van der Laan, Gerard*, Free Univ. of Amsterdam, g.laan@feweb.vu.nl
Moes, Nigel, Free Univ. of Amsterdam

Abstract. In this paper we consider the problem of sharing water from a river among a group of agents located along the river. The benefit of each agent depends on the amount of water consumed by the agent. An allocation of water among the agents is efficient when it maximizes the total benefits. A solution is an efficient distribution among the agents of the total benefits of an efficient allocation. The problem of finding a solution satisfying certain properties can be modelled by a cooperative game. For a river with one spring and increasing benefit functions, Ambec and Sprumont (JET, 2002) propose the downstream incremental solution as the unique solution satisfying core-stability and a fairness condition, saying that no agent gets a payoff above its aspiration level. In this paper we generalize the Ambec and Sprumont river game to river situations with multiple springs and with satiable agents, i.e., the benefit function is decreasing beyond some satiation point. Such a general situation can be modelled by a cooperative graph game in partition function form. For such games we propose a class of weighted hierarchical outcomes. When every agent has an increasing benefit function (no externalities) then every outcome is core-stable. In case of satiation points, it appears that every outcome in the class of weighted hierarchical outcomes is independent of the externalities.

keywords: water allocation, river game, externality, core, Shapley value, Myerson value, Average tree solution, weighted hierarchical outcome.

The determinants of collusion under exogenous demand fluctuations

Pot, Erik, Maastricht Univ, e.pot@maastrichtuniversity.nl
Peeters, Ronald, Maastricht Univ., r.peeters@maastrichtuniversity.nl
Peters, Hans, Maastricht Univ, h.peters@maastrichtuniversity.nl
Vermeulen, Dries*, Maastricht Univ, d.vermeulen@maastrichtuniversity.nl

Abstract. This paper is an attempt to reconcile the - at first sight different - views on the determinants of collusion and price wars expressed in Rotemberg and Saloner (1986), Green and Porter (1984), and Stigler (1964). We first argue that the logic of R&S presupposes two determinants for collusion, namely (1) market shares are publicly observable, and (2) volatility of market shares due to exogenous factors is limited. We make our arguments in a model in which firms repeatedly play a Bertrand type price competition game. Following R&S we show under the two conditions of public observability and limited volatility of market shares that within the model firms can collude using dynamic price adjustment strategies. We show that when the first condition (public observability) is violated, we revert
to the logic of Green and Porter. When the second condition (limited volatility of market shares) is violated, for example when consumer loyalty has decreased, we also observe that collusion can no longer be sustained, in line with the arguments in Stigler (1964).

**Keywords:** non-cooperative collusion, price wars, repeated games.

**Expectations of altruistic punishment in a public goods game experiment**

Vyrastekova, Jana*, Radboud Univ., J.Vyrastekova@fm.ru.nl
Funaki, Yukihiko, Waseda Univ., funaki@waseda.jp. Takeuki, Al, Waseda Univ.

**Abstract.** Altruistic punishment increases cooperation in public goods games, but the mechanisms by which it exerts its impact on behavior are yet to be studied in detail. We show experimentally that in the presence of sanctioning, subjects adjust their behavior so that to avoid the freerider's status. They do that in the STANDARD sanctions treatment, where they directly experience any sanctions assigned to them, but also in the SECRET sanctions treatment, where no information on sanctions received is available until the end of the experiment. We observe no such freeriding avoidance in the treatment without sanctioning. We conclude that the mere knowledge that sanctions might be assigned increases cooperation: subjects expect that altruistic sanctioning takes place against freeriders. Moreover, these expectations are correct as we observe similar pattern and extent of sanctioning in both treatments. Our findings support the hypothesis built into the recent evolutionary explanations of altruistic punishment, that beliefs in altruistic punishment have co-evolved with the individual traits for altruistic punishment. Altruistic punishment can be seen as a social norm. This approach to the role of sanctioning in sustaining cooperation in social dilemmas may also explain why some societies are more cooperative than others. In our population of western students, altruistically driven sanctioning is expected, and this expectation is justified by our observations that the actual probability and extent of sanctioning are similar in treatments with observable and unobservable sanctions, where the latter allows only for altruistic sanctioning and excludes any strategic motives of sanctioning.

**Keywords:** experiments, altruistic punishment, nonstrategic sanctions, strategic sanctions, public goods.

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**Belief distorted Nash equilibria - introduction of a new kind of equilibrium**

Wiszniewska-Matyszkiel, Agnieszka*, Warsaw Univ., agnese@hydra.mimuw.edu.pl

**Abstract.** In the paper we examine discrete time dynamic games in which the state variable changes in response to players’ decisions while the players form some expectations about its future values based on the history. A general model is built, encompassing both games with finitely many players as well as games with infinitely many players. Notions of belief-distorted Nash equilibrium (BDNE) and self-verification of beliefs are introduced. The relations between self-verifying BDNE and Nash or subjective Nash equilibria are examined as well as the existence and properties of BDNE. Examples are presented, including models of a common ecosystem, repeated Cournot oligopoly, a minority game or local public good with congestion effect and a repeated prisoner’s dilemma.

**Keywords:** games with continuum of players, n-player dynamic games, Nash equilibrium, belief-distorted Nash equilibrium, subjective equilibrium, self-verification of beliefs, common ecosystem, Cournot oligopoly, competitive equilibrium, minority game, prisoner’s dilemma.

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**The Dutta-Ray solution for games with restricted cooperation**

Yanovskaya, Elena*, Russian Academy of Sciences, eyanov@emi.nw.ru

**Abstract.** Cooperative TU games with restricted cooperation are considered. The restricted cooperation is defined by an arbitrary collection of feasible coalitions including the grand coalition. The Egalitarian Split-off Solution (ESOS) for games with restricted cooperation is defined by the same way as for arbitrary TU game (Branzei R. et al. 2006). If the ESOS consists of a unique payoff vector we call it the Dutta-Ray solution as for convex TU games, since in this case the ESOS solution coincides with the Dutta-Ray one. The first result shows that if an arbitrary vector from the ESOS of a game with restricted cooperation belongs to the restricted core (FLerena, 2007), then it is unique and Lorenz dominates other vectors from the core. The DR solution for a special class of the collection of feasible coalitions of the partition (CS) is studied. Such a collection consists of a partition of players and their unions, and also of all subcoalitions of every coalition of the partition. Every game with CS defines several TU games: an outer game of coalitions of the partition, and inner games being subgames of the initial game on every coalition of the partition. Given that all these games are convex, we may define two types of the Dutta-Ray solutions for them. The first solution is defined by the Dutta-Ray algorithm for finding the solution. The second one remined the “Shapley-Shapley” solution, where instead of the Shapley the Dutta-Ray solution is used. On the first step the DR solution for the outer game is defined. On the second step the DR solution of all inner games where the values of the grand coalitions are replaced by the corresponding components of the DR solution found on the first step are found. The collection of the DR values of all such inner games are found. It is shown that
Market games and the bargaining set

Ziros, Nicholas*, Univ. of Cyprus, ziros@ucy.ac.cy

Abstract. The idea that in a mass economy individuals act as price takers, found some formal proof in two theories of competition the “cooperative” and the “noncooperative” that emerged from the works of Edgeworth and Cournot respectively. The cooperative approach with the various equilibrium notions, i.e. the core and the bargaining set, as well as the noncooperative approach with the theory of strategic market games, has helped us to formalize terms and shape our understanding as to what it takes for a market to exhibit perfectly competitive characteristics. Despite the great differences of the two theories, one does not preclude the other. Moreover there is a substantial overlap between the set of conditions, which the two approaches identify as important for the prevalence of perfect competition. One could try to bring together the coalitional bargaining ideas with the norms of strategic market games. This idea was the starting point in Koutsougeras and Ziros (JET, 2008), where a synthesis of the two theories was presented by defining the core of an economy where trades are conducted via the Shapley-Shubik mechanism. However, a question was left unexplored in that paper; whether other cooperative equilibrium notions can be studied in the same framework. In this paper, we proceed in that direction by defining in the context of strategic market games the bargaining set, a notion that is complementary to the core. Briefly, we examine the possibility of individuals to form coalitions in order to object (or counter-object) proposed distributions of commodities as in the standard bargaining set theory, but we consider only allocations that are attainable through the norms of strategic market games. In this context we define a kind of constrained equilibrium notion, namely the Shapley-Shubik Bargaining Bet. In contrast to the traditional bargaining set, our approach provides an explicit description of the formation of market outcomes, i.e., how individual activities are aggregated to produce the price vectors that a coalition would prefer to trade at. In the main part of the paper we address the properties of the resulting allocations. It turns out that in an atomless economy the allocations resulting from this hybrid equilibrium notion are competitive. In other words, our results show that in large economies the allocations, which cannot be blocked when arbitrary redistribution of endowments is allowed, are identical to those that cannot be blocked via trades within the rules of a strategic market game.

keywords: games and economics, oligopoly games, bargaining set, competition.

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