UKIERI
UK-India Education
and Research Initiative

International Conference on Game Theory and Networks

6 - 7 September, 2019

Dibrugarh, India

Program Booklet

Dibrugarh University, Dibrugarh, India

Queen's Unversity, Belfast, UK

International Conference on Game Theory and Networks

Game theory is an interdisciplinary branch bringing together researchers from Mathematics, Economics, Management, Political Science, Networks and Computer Science, Engineering, Quantum Physics, Biological Sciences, Ecology and Environmental Sciences. The aim of this workshop is to provide a common platform to the researchers working in diverse disciplines to share their recent researches.

The workshop is supported by UKIERI thematic partnership project 2016 - 2017 [184-15/2017(IC)] awarded to Prof. Surajit Borkotokey, Department of Mathematics, Dibrugarh University, India and Dr. Rajnish Kumar, Queen's Management School, Queen's University, Belfast, UK. The workshop is jointly organized by Dibrugarh University and Queen's University and is hosted by Dibrugarh University in Dibrugarh during 6 - 7 September, 2019.

About UKIERI

UK India Education Research Initiative (UKIERI) started in April 2006 with the aim of enhancing educational links between India and the UK.

UKIERI projects are funded from the UK by the Department for Business, Energy and Industrial Strategy, Foreign and Commonwealth Office, British Council, Scottish Government, Welsh Government and Department for Economy; and from India by the Ministry of Human Resource Development, Department for Science and Technology, Ministry of Skill Development and Entrepreneurship, University Grants Commission and All India Council for Technical Education.

About Dibrugarh University

Dibrugarh University, the easternmost University in India, was established in 1965 consequent upon the provisions of the Dibrugarh University Act, 1965, enacted by the Assam Legislative Assembly. It is a leading research and innovation driven University that acts as a spatial slot to configure the socio-cultural dynamics of North East India. In 2017, Dibrugarh University is granted 'A' grade by the National Assessment and Accreditation Council (NAAC).

It is situated at Rajabheta, five kilometres to the South of the Dibrugarh town and well connected by road, rails, air and waterways. The University has a vast sprawling campus (550 acres) set in bucolic and idyllic surroundings. Dibrugarh, which is one of the commercial and industrial hubs of North East India, also occupies a unique place in the field of art, literature and culture. It is internationally known as a rich tea producing district, and is also on the global map for its rich reserve of minerals like coal, oil and natural gas. Its diverse flora and fauna make it an exciting region from the environmental and ecological point of view.

UKIERI activities during the last three years

Event 1: A workshop on Game Theory and Networks was held at the Department of Mathematics during the visit of the UK team comprising Dr. Rajnish Kumar, Dr. Chirantan Ganguly and Dr. Saurav Bhattacharya on 22/12/2017. The day long workshop featured presentations by all the three visitors and the host researcher Prof. Surajit Borkotokey on topics related to the main theme of the UKIERI project.

Event 2: An International Workshop on Game Theory and Networks was held during 13-15 September 2018 as part of the project programme. The objective of the workshop was three folded namely, to provide the beginners a suitable learning experience of the basics of Cooperative games, Networks and Mechanism Design; to provide some insights to the research scholars who have the basic knowledge of the topics, by

means of some expository talks and finally to provide a platform to the research scholars for showcasing their current works in the form of poster presentations. Three mini courses were offered by respectively Prof. Manipushpak Mitra from the Indian Statistical Institute, Kolkata; Prof. Sudipta Sarangi from Virginia Tech, USA and Prof. Arunava Sen from the Indian Statistical Institute, Delhi for the beginners in the field of Game Theory and Networks. Prof. Indrajit Ray, Cardiff University, Birmingham, UK; Dr. Rajnish Kumar, Queen's University, Belfast, UK; Dr. Souvik Roy, ISI-Kolkata; Dr. Mallikarjun Rao, IIT Bombay; Dr. Diganta Mukherjee, ISI-Kolkata; Dr. Nagarajan Krisnamurty, IIM-Indore; Dr. Anirban Ghatak, IIM-Vishakhapatnam; Dr. Amarjyoti Mahanta, IIT Guwahati; Dr. Mriduprabal Goswami, ISI-NE, Tezpur were among others who presented some expository talks for the research scholars who have already engaged themselves into the research in these areas.

Event 3: A seven day training programme was organized under the Marketing and Dissemination head of the UKIERI project during 24-30 March 2019. Dr. Mridu Prabal Goswami, ISI-NE, Dr. Soumendu Sarkar, TERI University and Dr. Souvik Roy, ISI-Kolkata delivered lectures on Game Theory and Mechanism Design. 20 research scholars from Mathematics, Economics and Computer Science attended the training programme.

Event 4: Prof. Surajit Borkotokey delivered an invited talk on "Group Interactions in TU games: The k-lateral value" at the Joint Mathematical Meet of the American Mathematical Society held in Baltimore, USA during 16-19 January 2019 in a special session hosted by Prof. Ram Mohapatra, University of Central Florida, USA under the programme head of Marketing and Dissemination.

Event 5: Prof. Surajit Borkotokey presented talks at the Department of Mathematics, University of Central Florida on Game Theory and Networks on 13/01/2019. A talk on TU games and networks was delivered at the Department of Economics, Virgina Tech, USA and also at the LeMoyne College, Syracuse.

Network Activities

On 5th evening, there is a network activity followed by gala dinner. Venue: Guest house On 6th evening, Piano concert by Michel Grabisch and cultural performances by the students of the deparment of Matheamtics. Venue: Indira Miri Conference Hall, Dibrugarh University.

Participants

1. A. Chandrashekaran, Central University of Tamilnadu, India
2. Abhinash Borah, Ashoka Unviersity
3. Adonies Y Ngullie, NIT Nagaland
4. Agneiszka Rusinowska, CNRS, Paris School of Economics, Paris.
5. Amarjyoti Mahanta, IIT Guwahati, India
6. Anindya S Chakrabarti, IIM Ahmedabad, India.
7. Arunava Sen, ISI Delhi, India
8. Chipem Zimik, NIT Nagaland, India
9. Diganta Mukherjee, ISI Kolkata, India
10. Dhrubajit Choudhury, Dibrugarh University, India
11. Doudou Gong, Northwestern Polytechnical University, PR China
12. Genjiu Xu, Northwestern Polytechnical University, PR China
13. Jun Su, Xi'an University of Science and Technology, China
14. Indrajit Ray, Cardiff University, UK
15. K.S. Mallikarjun Rao, IIT Bombay, India
16. Loyimee Gogoi, Tezpur University, India
17. Madhuparna Karmokar, Indian Statistical Institute, Kolkata
18. Manish Sarkhel, Woxsen School of Business, Hyderabad, India
19. Michel Grabisch, Université Paris I Panthéon-Sorbonne, Paris School of Economics, Paris.
20. Pankaj Hazarika, Dibrugarh University, India
21. Papori Neog Bora, Dibrugarh University, India
22. Parishmita Boruah, Dibrugarh University, India
23. Pramod Mane, IIM Indore, India
24. Pranjal Bora, Dibrugarh University, India
25. Prem Prakash Mishra, NIT Nagaland, India
26. Pritha Dev, IIM Ahmedabad, India
27. Rajnish Kumar, Queen's University, Belfast, UK
28. Ritu Dutta, Dibrugarh University, India
29. Sanjeev Goyal, University of Cambridge, London, UK
30. Santanu Acharjee, DR College Golaghat
31. Sinan Ertemel, Istanbul Technical University, Istanbul, Turkey
32. Soumendu Sarkar, TERI School of Advanced Studies, New Delhi
33. Soumyarup Sadhukhan, ISI Kolkata, India
34. Sourav Bhattacharya, Royal Holloway University of London, UK
35. Souvik Roy, ISI Kolkata, India
36. Sujata Gowala, Dibrugarh University, India
37. Surajit Borkotokey, Dibrugarh University, India
38. Tiken Singh Moirangthem, Dibrugarh University, India
39. Tsuknungchila Jamir, National Institute of Technology Nagaland, India
40. Ujjwal Kumar, ISI Kolkata, India
41. Utpala Borgohain, Dibrugarh University, India
42. Vishwa Jyoti Baruah, Dibrugarh University, India.
43. Vitsono Lungalang, NIT Nagaland
44. Wenzhong Li, Northwestern Polytechnical University, PR China

Program Schedule

All the sessions take place in the Indira Miri Conference Hall, Dibrugarh University.

Day 1		6th September
Registration		9:00 - 9:30
Session Topic		**Speaker**
Game Theory	9:30 - 10:00	Indrajit Ray: Equilibria in Market Games
	10:00 - 10:30	Amarjyoti Mahanta: Learning Through Imitation with Strategy Specific Barriers
	10:30 - 11:00	A Chandrashekaran: Z-trasformations and generalized bi-matrix games
Tea Break		
Collective Behavior	11:30 - 12:00	Michel Grabisch: Anti-conformism in the threshold model of collective behavior
	12:00 - 12:30	Prita Dev: Social norms and punishment for hard-to-prove crimes
	12:30 - 13.00	Abhinash Borah: Choice via Social Influence
Lunch Break		
Cooperative Behavior I	14:30 - 15:00	Sourav Bhattacharya: Group formation and diversity
	15:00 - 15:30	Sinan Ertemel: Parametric rules for state contingent claims
	15:30 - 16:00	Rajnish Kumar: Group Contributions in TU-games : A class of k-lateral Shapley values
Poster Session & Tea		16:00 - 17:00
Day 2		**7th September**
Networks	9:30 - 10:00	Sanjeev Goyal: Targeting Interventions in Networks
	10:00 - 10:30	Agnieszka Rusinowska: The Degree Ratio Ranking Method for Directed Networks
	10:30 - 11:00	Anindya S Chakrabarthi: Ripples on financial networks
Tea Break		
Mechanism Design	11:30 - 12:00	Arunava Sen: Local Global Equivalence in Voting Models: A Characterization and Applications
	12:00 - 12:30	Souvik Roy: Bayesian incentive compatibility with correlated beliefs
	12:30 - 13:00	Soumendu Sarkar: Coalitional bargaining in assembly problem
Lunch Break		
Cooperative Behavior II	14:30 - 15:00	Prem Prakash Mishra: Reduction of Total Cost of EOQ Through Nash Security Point in the Degrees of Horizontal and Vertical Cooperation
	15:00 - 15:30	Pankaj Hazarika: Cooperative Games with Multiple attributes
Poster Session & Tea		16:00 - 17:00

Abstracts of Invited Talks

Group formation and diversity

Sourav Bhattacharya and Ming Li
Royal Holloway University of London

We consider formation of groups within a population with heterogeneous preferences. A group commits to a common action. Larger groups have the advantage of scale or resources and can therefore perform the chosen action more efficiently, but the common action will be far from the preferred action of a large number of group members. This tradeoff between efficiency and control over the action choice drives group membership. We show that in equilibrium, the groups will be formed in such a way that maximizes the minimum payoff in the society. We use both non-cooperative (SPNE of a natural extensive form) and co-operative solution concepts as our prediction standard. We illustrate our results with applications in various contexts: information-sharing groups, cost-sharing groups, informal monitoring communities etc.

Choice via Social Influence

Abhinash Borah
Ashoka Unviersity, Sonepat, Haryana

We introduce a theory of socially influenced individual choices. The source of social influence on an individual is his reference groups in society, formed of societal members he psychologically or contextually relates to. Choices made within an individual's reference group have an influence on the choices he makes. Specifically, we propose a choice procedure under which, in any choice problem, he considers only those alternatives that he can identify with his reference group. From this "consideration set," he chooses the best alternative according to his preferences. The procedure is an interactive one and captures the steady state of a process of mutual social influence. We behaviorally characterize this choice procedure. We also highlight the empirical content of the procedure by relating it to both experimental evidence and real world applications.

Ripples on financial networks

Sudarshan Kumar, Avijit Bansal and **Anindya S Chakrabarti**
Indian Institute of Technology Ahmedabad

In the financial markets, asset returns exhibit collective dynamics masking individual impacts on the rest of the market. Hence, it is still an open problem to identify how shocks originating from one particular asset would create spillover effects across other assets. The problem is more acute when there is a large number of simultaneously traded assets, making the identification of which asset affects which other assets even more difficult. In this paper, we construct a network of the conditional volatility series estimated from asset returns and propose a many-dimensional VAR model with unique identification criteria based on the network topology. Because of the interlinkages across stocks, volatility shock to a particular asset propagates through the network creating a ripple effect. Our method allows us to find the exact path the ripple effect follows on the whole network of assets.

Z-trasformations and generalized bimatrix games

A Chandrashekaran and Gokulraj S

Department of Mathematics, Central University of Tamil Nadu, Thiruvarur, Tamil Nadu, India 610 005

Bimatrix game is the game played by the two players(player I and II) whose payoff matrices are $A_{m\times n}$ and $B_{m\times n}$ respectively. In detail, If player I(row player) choose to play by i^{th} row and player II(column player) by j^{th} column, their expected payoff is a_{ij} and b_{ij} respectively. In case players play with probability distributions x^* on the rows and y^* on the columns, then player I and II's expected payoff is $\langle x^*, Ay^*\rangle$ and $\langle x^*, By^*\rangle$ respectively. If the following inequalities are true for all probability vectors $x \in \mathbb{R}^m, y \in \mathbb{R}^n$,

$$v_1 := \langle x^*, Ay^*\rangle \geq \langle x, Ay^*\rangle,$$

$$v_2 := \langle x^*, By^*\rangle \geq \langle x^*, By\rangle.$$

we say (x^*, y^*) forms a equilibrium pair. Payoff v_1 and v_2 at the equilibrium pair is called the value of the players I and II respectively.

Let V be a finite dimensional real inner product space and K be a proper cone in V. In this talk we present the generalized bimatrix game $\Gamma(L,T)$ defined for a Z-transformation L of the type $L = sI - T$ where $T(K) \subseteq K$. We consider two games, namely, the generalized bimatrix game $\Gamma(L,T)$ and the zero sum game $\Gamma(L)$. We study the relationship between the optimal strategies (values) of these two games.

Social norms and punishment for hard-to-prove crimes

Pritha Dev and Jeevant Rampal

Indian Institute of Management Ahemedabad

We study the equilibrium effects of social norms and punishments regarding crimes that occur in conjunction with mutually beneficial economic activity, but are hard-to-prove. For instance, sexual harassment at the workplace. The model contains two groups of agents: the weak and the powerful. Members of the two groups are endowed with a type which can capture criminal tendencies. Each member first chooses whether to participate. Next, as the economic activity occurs, the powerful member chooses whether to commit the crime. This is followed by the weak member choosing to report the crime or not. We allow the weak members to have types that file false complaints. Each complaint results in two kinds of punishments for the accused powerful agent: punishment by the justice system and punishment by social norms which can also impose punishments on the weak. We find that the crime rate is decreasing in the punishment for the powerful up to a threshold, but any level of punishment above this threshold leads to a high crime rate in the meetings. We also find that while high punishments can reduce crime, they increase the proportion of complaints that are false.

Parametric rules for state contingent claims

Siddharth Chatterjee, **Sinan Ertemel** and Rajnish Kumar
Istanbul Technical University, Istanbul, Turkey

We study bankruptcy rules in a setting where individuals have state contingent claims. A rule must distribute shares before uncertainty resolves. Within a wide class of parametric rules, we first characterize rules of ex–ante form in terms of the way that the rule processes inherent uncertainty in the individual claims. The key property is: No Penalty for Risk. It says that the rule does not penalize an individual in a situation that differs from another only in terms of the this individual's claim in that the former situation has a risky version of the riskless claim in the latter situation. Whereas for the ex–post characterization, our key property is: Indifference to Independent Combinations. It says that if an individual is risk neutral with expected utility preferences then any rule that makes her indifferent between any bankruptcy problem and a corresponding independent combination of gamble between a degenerate gamble and a zero game (any bankruptcy game with zero endowment) forces the rule to be in the ex–post form. Finally, a partial comparative static result is established which establishes that ex–ante rules may be normatively more appealing for individuals when the level of the resource is low enough.

Targeting Interventions in Networks

Andrea Galeotti, Benjamin Golub, and **Sanjeev Goyal**
Faculty of Economics and Christ's College, University of Cambridge

We study the design of optimal interventions in network games, where individuals' incentives to act are affected by their network neighbors' actions. A planner shapes individuals' incentives, seeking to maximize the group's welfare. We characterize how the planner's intervention depends on the network structure. A key tool is the decomposition of any possible intervention into principal components, which are determined by diagonalizing the adjacency matrix of interactions. There is a close connection between the strategic structure of the game and the emphasis of the optimal intervention on various principal components: In games of strategic complements (substitutes), interventions place more weight on the top (bottom) principal components. For large budgets, optimal interventions are simple - targeting a single principal component.

Anti-conformism in the threshold model of collective behavior

Michel Grabisch and F. Li
Université Paris I Panthéon-Sorbonne Paris School of Economics, Paris, France

We provide a detailed study of the threshold model, where both conformist and anti-conformist agents coexist. Our study bears essentially on the convergence of the opinion dynamics in the society of agents, i.e., finding absorbing classes, cycles, etc. Also, we are interested in the existence of cascade effects, as this may constitute an undesirable phenomenon in collective behavior. We divide our study into two parts. In the first one, we basically study the threshold model supposing a fixed complete network, where every one is connected to every one, like in the seminal work of Granovetter. We study the case of a uniform distribution of the threshold, of a Gaussian distribution, and finally give a result for arbitrary distributions, supposing there is one type of anti-conformist. In a second part, the graph is no more complete and we suppose that the neighborhood of an agent is random, drawn at each time step from a distribution. We distinguish the case where the degree (number of links) of an agent is fixed, and where there is an arbitrary degree distribution. We show the existence of cascades and that for most societies, the opinion converges to a chaotic situation.

Cooperative Games with Multiple attributes

Surajit Borkotokey and **Pankaj Hazarika**
Department of Mathematics, Dibrugarh University, Dibrugarh

In this paper we introduce the notion of cooperative game with multiple attributes where players can provide partial participations in multiple attributes and form coalitions. The power of influence of players is determined based on their memberships in the coalitions. For this class of games we propose the Shapley function as rational and fair solution concept. We obtain the cooperative games with multiple attributes from their crisp counterparts and subsequently determine their Shapley function.

Group Contributions in TU-games : A class of k-lateral Shapley values

Surajit Borkotokey, Dhrubajit Choudhury, Loyimee Gogoi and **Rajnish Kumar**
Queen's University, Belfast, UK

In this paper we introduce the notion of group contributions in TU-games and propose a new class of values which we call the class of k-lateral Shapley values. Most of the values for TU-games implicitly assume that players are independent in deciding to leave or join a coalition. However, in many real life situations players are bound by the decisions taken by their peers. This leads to the idea of group contributions where we consider the marginality of groups upto a certain size. We show that group contributions can play an important role in determining players' shares in the total resource they generate. The proposed value has the flavor of egalitarianism within group contributions. We provide two characterizations of our value.

Learning Through Imitation with Strategy Specific Barriers

Amarjyoti Mahanta
Indian Institute of Technology Guwahati

In this paper we introduce strategy specific barriers to imitation in a learning model. By strategy specific barriers to imitation, we imply that only a fraction of all the agents imitating a particular strategy will be able to successfully imitate that strategy. It is similar to what was done in the Sethi(1998). We introduce two modifications in Sethi(1998) model. First, we take these strategy specific barriers as an increasing function of the pay-off of that strategy, in other words if the pay-off of a strategy is high a lesser fraction of agents can imitate that strategy as its difficulty level is high. Secondly, we take it to be a decreasing function of the fraction of the agents playing that strategy, that is, if the fraction of the population playing a strategy increases, it is easier to imitate that strategy such that a higher fraction imitate that strategy. We show that for a class of game (potential games), the trajectories converge at the maximum expected value which is a Nash equilibrium. Later, we introduce strategy specific barriers in imitation driven by dissatisfaction. We show that additional conditions are required for the non-degenerate mixed strategy to be the fixed point of the dynamic system. It is possible that the dynamics driven by dissatisfaction have an interior fixed point which is not a mixed strategy Nash equilibrium. For the potential games, trajectories converge at the interior mixed strategy Nash equilibrium under certain conditions.

Reduction of Total Cost of EOQ Through Nash Security Point in the Degrees of Horizontal and Vertical Cooperation

Prem Prakash Mishra
Department of Science and Humanities National Institute of Technology Nagaland

There is a competition between two cooperative team of players to reduce the total cost of inventory at the source. The players are enhancing the degrees of horizontal and vertical cooperation with the investment of linking cost in the random network of supply chain. We establish line of regression between the degrees of horizontal and vertical cooperation. The objective is to obtain Nash security point of this competitive game and to determine the economic order quantity (EOQ) when horizontal links reduce the carrying cost and vertical links reduce the ordering cost.

Equilibria in Market Games

Indrajit Ray, Manipushpak Mitra and Souvik Roy
Cardiff University, UK

We provide a full characterisation of the set of trading equilibria in a Shapley-Shubik strategic market game, for both “buy and sell” and “buy or sell” models and interpret the crucial equilibrium condition.

Bayesian incentive compatibility with correlated beliefs

Souvik Roy
Indian Statistical Institute Kolkata

We consider social choice problems where agents have correlated (positively or negatively) beliefs about the preferences of others. The belief of an agent is positively (negatively) correlated if he/she thinks that others are more (less) likely to have preferences similar to his/her own one. A social choice function is ordinally Bayesian incentive compatible (OBIC) if no agent can improve his/her expected utility according to his/her belief by misrepresenting his/her sincere preference. In this framework, we explore the structure of OBIC social choice functions. We show that (i) sequential ordinal non-dominance is a necessary condition on a social choice function for OBIC, and (ii) strong ordinal non-dominance is a sufficient condition on a soicial choice function for OBIC. Finally, we present a general notion of correlation with respect to arbitrary binary relations and extend all these results for that framework.

The Degree Ratio Ranking Method for Directed Networks

René van den Brink and **Agnieszka Rusinowska**
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One of the most famous ranking methods for digraphs is the ranking by Copeland score. The Copeland score of a node in a digraph is the difference between its outdegree (i.e. its number of outgoing arcs) and its indegree (i.e. its number of ingoing arcs). In the ranking by Copeland score, a node is ranked higher, the higher is its Copeland score. In this paper, we deal with an alternative to rank nodes according to their out- and indegree, namely ranking the nodes according to their degree ratio, i.e. the outdegree divided by the indegree. To avoid dividing by a zero indegree, we implicitly take the out- and indegree of the reflexive digraph. We provide an axiomatization of the ranking by degree ratio using a sibling neutrality axiom, which says that the entrance of a sibling (i.e. a node that is in some sense similar to the original node) does not change the ranking among the original nodes. We also provide a new axiomatization of the ranking by Copeland score using the same axioms except that this method satisfies a different sibling neutrality. Finally, we modify the ranking by degree ratio by not considering the reflexive digraph, but by definition assume nodes with indegree zero to be ranked higher than nodes with a positive indegree. We provide an axiomatization of this ranking by modified degree ratio using yet another sibling neutrality and a maximal property. In this way, we can compare the three ranking methods by their respective sibling neutrality.

Coalitional bargaining in assembly problem

Soumendu Sarkar
TERI School of Advanced Studies, New Delhi

A buyer wants to purchase a fixed number of items from sellers holding a unit each. The complementarity of these items is modelled with the help of a graph in which nodes represent items and an edge between a pair of nodes indicate that they are complementary inputs in the production process. The buyer wants to purchase items that constitute a path of desired length in this graph. A seller holding an item that lies in the intersection of all feasible paths is called critical. We consider the use of an extended version of the bargaining protocol by Rubinstein (1982): in each period, either the buyer or all active sellers make offers of shares of the aggregate surplus. Accepting sellers are paid in cash and leave the market immediately while rejecting party or parties makes offers in the next period. Bargaining takes place until the desired number of complementary items have been traded. We characterize a non-cooperative equilibrium that sustains the grand coalition in the absence of critical sellers. In this equilibrium, the buyer gets the same equilibrium surplus share as she would have obtained if there were only one feasible path on the graph; the sellers obtain equal shares of the remainder surplus as expected payoffs. However, if critical sellers exist in the graph, at least one of them walks out of the grand coalition with higher equilibrium payoffs. This set of results complements our earlier results on non-coalitional bargaining in assembly problems.

Local Global Equivalence in Voting Models: A Characterization and Applications

Ujjwal Kumar, Souvik Roy, **Arunava Sen**, Sonal Yadav and Huaxia Zeng
Indian Statistical Institute New Delhi, India

The paper considers a voting model where each voter's type is her preference ordering. The type graph for a voter is a graph whose nodes are the possible types of the voter. A social choice function is locally strategy-proof if no type of a voter can gain by misrepresentation to a type that is connected to her true type by an edge in the type graph. A social choice function is strategy-proof if no type of a voter can gain by misrepresentation to an arbitrary type. Local-Global equivalence (LGE) is satisfied if local strategy-proofness implies strategy-proofness. The paper identifies a condition on the graph that characterizes LGE. Our notion of "localness" is perfectly general - we use this feature of our model to identify notions of localness according to which various models of multi-dimensional voting and models with weak preferences, satisfy LGE. Finally, we show that LGE for deterministic social choice functions does not imply LGE for random social choice functions.

Generalizations of Sobolev's Consistency and Values for TU-Games

Jun Su, Theo S.H. Driessen and Genjiu Xu
School of Science, Xi'an University of Science and Technology, Xi'an, Shaanxi 710054, China

In the framework of cooperative game theory, Sobolev (1973) axiomatized the well-known Shapley value by means of a so-called consistency property with reference to a specifically chosen reduced game. The goal of this paper is to generalize Sobolev's consistency approach to the class of efficient, symmetric and linear values.

Self-associated Consistency for the Shapley value

Genjiu Xu and Wenzhong Li
Department of Applied Mathematics, Northwestern Polytechnical University, PR China

A so-called self-associated game is introduced for a solution of TU games. Every coalition can be viewed as a unified player and the allocation to the unified player in a solution of the coalition-contracted game would be thought of as a revaluation by the coalition. It generates the characteristic function of the self-associated game. A solution is self-associated consistent when it allocates to every player invariably in a game and its self-associated game. We show that the Shapley value is self-associated consistent and characterize the Shapley value as the unique solution for TU games satisfying the inessential game property, continuity and self-associated consistency. The characterization is obtained by applying the matrix approach as the pivotal technique for characterizing linear transformations on game space.

Abstracts of Poster Presentations

Comprehensive Network analysis of High throughput expression data to elucidate potential targets for bio-therapeutics

Vishwa Jyoti Baruah and Bhaswati Sarmah
Centre for Biotechnology and Bioinformatics, Dibrugarh University, Dibrugarh

Cancer, being one of the most dreaded diseases, is a collection of disorders that leads to anomalous growth of the cell followed by migration to other non-native part of the body. A subset of cancer that is lethal and has very high frequency of occurrence, Leukaemia, is a collection of cancers in the blood cells that leads to abnormally high count of malformed blood cells. Both Acute myeloid leukemia (AML) and chronic myeloid leukemia (CML) are cancers that make protective white blood cells work against the organism. Herein, AML and CML were comprehended using phenotypic attributes and associated it with underlying factors. High throughput data were retrieved for the two phenotypes, processed followed by filtering and analysis to obtain the primary factors. Network study of the ontology was employed and compared for elucidating the possible changes in the underlying biological processes. Network studies were also utilized for identifying best process as targets for bio-therapeutics.

Analysis of Amino Acids Network based on Degeneracy

Pranjal Kumar Bora and Sanjay Sharma
Centre for Computer Science and Applications Dibrugarh University, Dibrugarh

In the genetic code, Codon degeneracy refers to a single amino acid being encoded by more than one codon. Degeneracy of genetic codes helps an organism to prosper on earth. Each amino acid is a sequence of triplet code of four possible (Adenine (A), Cytosine (C), Guanine (G), or Thymine (T/U)) bases. The genetic code degenerate mainly occour on third position e.g. the amino acids Glycine is coded by four codons GGU,GGC,GGA,GGG differ only in third base. Since there are 20 amino acids and 64 possible tri-nucleotide sequences, more than one among these 64 triplets can code for a single amino acid which incorporates the problem of degeneracy. Here in this paper we have constructed an amino acids graph network based on predefined mathematical parameter called impression and from the degeneracy of codon table. Secondly, we examine the relative importance of the different amino acids with respect to the network we have discussed mainly four commonly used centrality measures. Further we have investigated the correlation coefficients between this four centrality measures.

Coalitional Game Theory based Distributed Cooperative Spectrum Sensing for Throughput Maximization in CRNs

Utpala Borgohain and Surajit Borkotokey
Centre for Computer Science and Applications Dibrugarh University, Dibrugarh

Cooperative Spectrum Sensing (CSS) among Secondary Users(SU)s has emerged as a com- petent technique in Cognitive Radio Network (CRN) overcoming the issues of individual spec- trum sensing. There exists a trade off between maximising the gain in terms of probability of detection of Primary Users(PU)s and minimising the costs in terms of probability of miss detection of PU by maintaining a reasonable false alarm probability within the coalition. The impact of this trade off has been used in this work for devising the utility function of the coalition and there by improving the average throughput of the coalition. A distributed coop- erative spectrum sensing algorithm using simple merge and split rule has been proposed for coalition formation by SUs which contributes to improve the detection performance as well as throughput. For selection of coalitional head for collaborative decisions ,a novel algorithm is also proposed. The proposed coalition formation game has Non transferable utility. Performance of this distributed cooperative game model is evaluated through a simulation based study.

Social interdependence: A new value for TU-cooperative games

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This paper studies cooperative games with restricted cooperation among the players. We analyze situations, where different groups of people, that are involved in different activities and each group's profit is affected by the actions of other groups. Based on players interdependence, we define a new value for TU-cooperative games which reflects players marginal contributions, their status and the height of cooperation with other players in different groups. Further, we characterize our value axiomatically using four new axioms, namely; G-Symmetry, G-Efficiency, G-Linearity and G-Null Player Property.

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

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

Cooperative solutions based on voting rules

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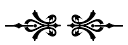
We consider a situation where individuals are agree to work together in a joint project. Assuming that they only knew their own type i.e., individual worth and approximate value (range) of the grand coalitional worth i.e., $v(N)$. And not aware any of the sub coalitional worth. Because of incomplete information, the problem can't be solve by using classical cooperative solution concepts like the core, the Shapley value etc.

In this work, we try to analyze this kind of problem using voting rules. Applying different voting rules we try to divide the grand coalitional worth among the players of the game. And analyze the problem from various possible angles.



Multi-bankruptcy problems with intercorporate debts

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We explore an extended class of bankruptcy problems, called multi-bankruptcy problems with intercorporate debts. Both intercorporate debts among companies and agents' claims are considered in these problems inspired by the spread of financial risk. In view of a natural assumption that intercorporate debts are cleared preferentially, we transform the original problems into two-stage bankruptcy problems. At the first stage, we propose a new bankruptcy rule, the amendatory run-to-the-bank rule, by integrating the idea of optimization and recursive arrival. Interestingly, the solution of the amendatory run-to-the-bank rule turns out to be the Shapley value of the corresponding bankruptcy game. Subsequently, the proportion rule is considered at the second stage. Finally, the two-stage amendatory run-to-the-bank proportion rule is characterized by the axiomatic perspective.

Optimization of Quality of Life Index with α-level of Significance of Linear Constraints

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A statistical quantification approach has been presented to optimize the Quality of Life Index (QOLI) in a specific region subject to linear constraints. The QOLI is based on certain parameters of vital life which measures Physical, Psychological, Economical, Social and Environmental conditions in terms of ranking. Principle Component Analysis (PCA) contributes to the formation of the QOLI and plane of regression provides information about the linear constraints with an α-level of significance. An exhaustive case study of QOLI for Nagaland, India has been done in support of this mathematical model.

Strategy-proof Rules on Multi-dimensional Lexicographic Domains

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We consider a social choice environment where the alternatives have multiple dimensions and agents have lexicographic preferences over those. It follows from Le Breton and Sen (1999) that if such a domain satisfies some 'richness' property, then every strategy-proof and unanimous social choice function (SCF) on it is decomposable. However, to the best of our knowledge, there is no necessary and sufficient condition in the literature for the said decomposability. In view of this, we provide a necessary and sufficient condition on a multi-dimensional lexicographic domain so that every strategy-proof and unanimous SCF is decomposable. Moreover, we provide the structure of non-decomposable unanimous and strategy-proof SCFs on arbitrary lexicographic domains.

Local vs Global incentive compatibility on ordinal type spaces

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A fundamental principle in mechanism design is that an agent should have no incentive to report any type in the type space other than his true type. However, in many settings, verifying all possible incentive constraints of a mechanism may be too demanding. Further, a reasonable behavioral assumption is that an agent of a particular type only misreports types in a neighborhood of his true type which is strictly smaller than the entire type space. So it is quite reasonable to weaken incentive compatibility to local incentive compatibility in mechanism design problems with deterministic allocation rules and transfers with quasilinear utility. We consider locally incentive compatible mechanisms with deterministic allocation rules and transfers with quasilinear utility. We identify a large class of strict ordinal domains such as single-peaked, single-dipped, single-crossing, etc and obtain that locally IC and IC are equivalent on the cardinal versions of these domains. We also identify a rich class of type spaces, which includes a large class of single peaked type space, where local incentive compatibility does not imply incentive compatibility. We show that, on such type spaces, any locally incentive compatible mechanism is almost incentive compatible, meaning incentive compatibility can be violated only on types that lie on the boundary.

The allocation of marginal surplus in cooperative situations

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Marginal contributions and marginal surplus are two significant indexes to measure one player's influence. According to marginal contributions, the Shapley value and the Solidarity value are introduced as two classical distribution schemes in cooperative situations, which assign the expectation of marginal contributions and average marginal contributions to every player, respectively. In this paper, a new allocation named the average-surplus value is proposed from the perspective of marginal surplus. Firstly, we give out the procedural definition of the value. According to the allocation scheme, every player obtains the sum of his individual worth and the expectation of average marginal surplus. Then, we characterize the average-surplus value by three classical methods of cooperative game theory, which are axiomatization, potential function and mechanism design. Especially, the average-surplus value is characterized by two sets of different axioms.

Formation of Stable and Efficient Social Cloud

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We study the formation of endogenous social storage cloud in a dynamic setting, where rational agents build their data backup connections strategically. We propose a degree-distance based utility model, which is a combination of benefit and cost functions. The benefit function of an agent captures the expected benefit that the agent obtains by placing its data on others' storage devices, given the prevailing data loss rate in the network. The cost function of an agent captures the cost that the agent incurs to maintain links in the network. With this utility function, we analyse what network is likely to evolve when agents themselves decide with whom they want to form links and with whom they do not. Further, we analyse which networks are pairwise stable and efficient.

We show that for the proposed utility function, there always exists a pairwise stable network, which is also efficient. We show that all pairwise stable networks are efficient, and hence, the price of anarchy is the best that is possible. We also study the effect of link addition and deletion between a pair of agents on closeness and resource availability.

When does upper contour strategy-proofness imply strategy-proofness?

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We consider a weaker notion of strategy-proofness called upper contour strategy-proofness and explore its connection with strategy-proofness. The notion of strategy-proofness involves too many constraints making it hard to check if some rule is strategy-proof or not. It has received a lot of attention in recent time whether some significantly smaller set of constraints can ensure strategy-proofness. Local strategy-proofness turns out to be such a weakening for many domains. Local strategy-proofness, informally speaking, says that an agent cannot manipulate via a "small deviation".

In this paper, we consider another type of weakening of strategy-proofness that ensures that an agent cannot manipulate by maintaining his/her upper contour sets. It is worth noting that upper contour strategy-proofness requires significantly smaller number of constraints compared to strategy-proofness. We consider random rules in this paper and show that upper contour strategy-proofness implies strategy-proofness on a large class of domains on one dimensions, such as the unrestricted, single-peaked, single-dipped, single-crossing, etc., and some multi-dimensional domains such as domain for committee formation, etc.

Adoption of Ride-Sharing Platforms in Developing Economies: A Game-theoretic Perspective

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Design of appropriate incentive structures for cab drivers is an important problem for ride-sharing platforms. High incentives for cab drivers translate into higher tariffs for customers which in turn decreases demand. Alternatively, low incentives for the cab drivers render the ride-sharing platforms unattractive for them. In this paper, we come up with different incentive structures which have the potential for appropriately compensating the cab drivers when they are part of the ride-sharing platforms while ensuring the profitability of the platforms themselves. We model the scenario as a two-stage non-cooperative game. In the first stage, the ride-sharing company acts as the leader and sets the compensation for the cab driver. In the second stage, the cab driver sets the service levels it wants to offer to the customers. Better services improve demand while higher prices decrease demand. We compare the profits obtained with the benchmark case when the cab driver is not a part of the ride-sharing platform and sets its own price and service levels. We obtain an appropriate revenue-sharing fraction between the cab driver and the platform above which the cab driver is always incentivized to join the ride-sharing platform. We also compare various strategies which the ride-sharing platform can use to better incentivize the cab drivers such as sharing the cost of offering better service, offering a fixed base fare and variable component for each ride to the cab driver, etc.

Modified Distribution approach in formation of Horizontal Cooperation among Oligopolistic firms, allocation of profits and studies of synergies emanating from such cooperation

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National Institute of Technology, Nagaland

Logistics transportation cost constitutes a major fraction of operating cost in an oligopolistic market. Horizontal cooperation among oligopolistic firms plays a significant role to reduce the transportation cost /logistic running cost. In this paper, an algorithmic approach based on modified distribution method has been employed to get the perfect horizontal cooperation between, firms with available capacity space and firms with required capacity space in the oligopolistic marketing structure. The perfect horizontal cooperation results in reducing the linking cost, transportation/running logistic cost, number of vehicles used and enhance the efficiency of each participating firms. The profit of horizontal cooperation is fairly distributed among the firms by Shapley value. The existence of stable cooperation is expressed in terms of the core of a cooperative game.

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Speakers' Index