AKSOE 7: Economic Models and Evolutionary Game Theory I

Time: Tuesday 10:15–12:45 Location: H8

AKSOE 7.1 Tue 10:15 H8

Combinatorial auctions as frustrated lattice gases — •Tobias Galla[1,2], Michele Leone[3], Matteo Marsili[1], Mauro Sellitto[1], Martin Weigt[3], and Riccardo Zecchina[1] — [1]International Centre for Theoretical Physics, Strada Costiera 11, I-34014 Trieste, Italy — [2]SISSA-CNR-INFM, Via Beirut 2-4, I-34014 Trieste, Italy — [3]ISI Foundation, Viale S. Severo 65, I-10133 Torino, Italy

Combinatorial auctions are auctions in which bidders bid on combinations of items, as opposed to single items in conventional formats. The winner-determination problem of such multi-item auctions turns out to be non-trivial and computationally complex due to overlapping bids and overall frustration. In particular, the highest bid is not guaranteed to win.

We show how combinatorial auctions can be formulated as frustrated lattice gases on sparse random graphs, allowing the determination of the optimal revenue by methods of statistical physics. Transitions between computationally easy and hard regimes are found and interpreted in terms of the geometric structure of the space of solutions. We introduce an iterative algorithm to solve intermediate and large instances, and discuss competing states of optimal revenue and maximal number of satisfied bidders. The algorithm can be generalized to the hard phase and to more sophisticated auction protocols.

AKSOE 7.2 Tue 10:45 H8

Game dynamics in finite populations — •Arne Traulsen — Program for Evolutionary Dynamics, Harvard University, USA

For the study of evolutionary game dynamics in finite populations, the Fermi function from statistical physics is chosen to govern strategy changes. The inverse temperature controls the intensity of selection, leading from random drift to imitation dynamics. This framework results in a closed analytical expression for the probability that a certain type will take over the population [1]. In this process, one can also relax the usual assumption that two individuals of the same type have the same fitness. Instead, each individual has a randomly distributed number of interactions with other individuals. This increases the temperature of selection [2]. Finally, the process can be utilized to describe limiting cases of games on dynamical networks. We assume that individuals differ in the rate at which they seek interactions. Links are formed and broken off accoring to their productivity. If this active linking process is fast compared to strategy changes, it introduces a simple transformation of the payoff matrix [3]. For slow active linking, the system is equivalent to strategy dynamics on a static network. For intermediate ranges, a numerical investigation of the detailed interplay determined by these two time-scales shows that the analytical results extends to a much wider ratio of time scales than expected [4].

[1] Traulsen, Nowak, and Pacheco, Phys.Rev.E 74, 11909 (2006).
[2] Traulsen, Nowak, and Pacheco, J.Theor.Biol., 244, 349 (2007).
[3] Pacheco, Traulsen, and Nowak, J.Theor.Biol. 243, 437 (2006).
[4] Pacheco, Traulsen, and Nowak, Phys.Rev.Lett., in press.

AKSOE 7.3 Tue 11:15 H8

Noether Theorem of Monetary Systems — •Dieter Braun — Angewandte Physik, Amalienstr. 54, 80799 München

Contrary to common belief, monetary systems can be implemented by bookkeeping in various ways. I classify the implementations by the symmetry properties of their transactions. Each symmetry relates to a conservation law in close analog to the Noether theorem:

- Symmetry of time asks for constant quantity of money
- Symmetry between transaction partners asks for zero profit
- Inclusion of the money issuer asks for internal exchange rates

Above relations can be directly visualized with a Feynman-Graph mapping of bookkeeping to mechanics. I give real world examples on how above symmetries are not implemented by modern monetary systems. Obeying the symmetries would implement monetary systems more stably with less inertial feedback loops.

References:

Physica A 290:491-500 (2001)
Physica A 321:605-618 (2003)
Physica A 324:266-271 (2003)
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AKSOE 7.4 Tue 11:45 H8

Agents under pressure: Altrusim before the transition to extinction — •Konstantin Klemm — Bioinformatics, Leipzig University, H"artelstr. 16-18, D-04107 Leipzig

We study the evolution of altruism in spatially extended populations at the survival-extinction transition. At contrast with earlier spatial models, e.g. [Nowak and May, Nature (1992)], we consider variations in the population density by allowing lattice sites to be empty. As the selective pressure p, defined as the death rate of agents in the absence of cooperating neighbors, approaches the critical value p_c from below, the dominance of defectors becomes unstable at a value $p_u < p_c$. Cooperators can invade and become dominant. This effect — cooperation before extinction — is observed whenever the total benefit is larger than the cost incurred by the altruistic act. For a sufficiently large benefit-cost ratio, the increase in the number of cooperators is larger than the decrease in the number of defectors as p rises from p_u to p_c. Thus the overall population density increases as a function of the pressure. These properties of the phase diagram are derived analytically using pair approximation.

AKSOE 7.5 Tue 12:15 H8

Impacts of Information Use and Stochastic Effects on the Dynamics of an Evolutionary Game — juergen jost[1] and •wei li[2] — [1]MPI for Math. in the Sci, Leipzig, Germany — [2]MPI for Phy. Compl. Sys., Dresden, Germany

We once introduced an evolutionary complementarity game where in each round a member of population 1 plays with a member of population 2. In this work, systematic analysis through simulations and partly mathematics are given on what kind of roles information use and stochastic effects may play in the dynamics of our game.

Generally we find that players who use the information more efficiently can gain advantages over those who do less or not. There are several ways to use the information more efficiently. For example, players can have shorter generation times which enable them to update more frequently and thus have many more chances to access the information. Players may also determine their present-round offers on the basis of average of offers of all their previous encounters, no matter by direct copying or evolving the look-up table.

Stochastic effects have very complicated impacts on the dynamics of the game, based on the levels of evolution. Individually it is better for each player to have less randomness. Collectively, this is also better for the population as a whole when all its members are uniform. However, it is better for the population to have some members with higher randomness because they seem to confuse the opponent.