Game Theory

Lecturer: Ludovic Renou

Game Theory is a theory of rational behavior for interactive decision problems. In a game, several agents strive to maximize their (expected) utility index by choosing particular courses of action, and each agent's final utility payoffs depend on the profile of courses of action chosen by all agents. The interactive situation, specified by the set of participants, the possible courses of action of each agent, and the set of all possible utility payoffs, is called a *game*; the agents 'playing' a game are called the players.

Game theory provides general methods of dealing with interactive optimization problems; its methods and concepts, particularly the notion of strategy and strategic equilibrium find a vast number of applications throughout social sciences (including biology). Although the word 'game' suggests peaceful and 'kind' behavior, most relevant situations in politics, psychology, biology, and economics involve rather strong conflicts of interest, competition between the players of a game. However, it might also leave room for cooperation or mutually beneficially actions. Many real-world situations e.g. oligopolistic competition, negotiation, war, bargaining, etc, are naturally modelled as games.

The purpose of this course is to introduce students with key concepts of Game Theory. A temptative outline is as follows.

1. **WEEK 1.** A brief historical perspective on Game Theory. Definition of a game. Incomplete/complete information. Asymmetric/symmetric information. Perfect information. Cooperative/Non-cooperative Game Theory.

2. **WEEK 2 and 3.** Normal form games. (Mixed) Strategies. Dominated strategies. Iterative deletion of dominated strategies. Rationalizability. Nash equilibrium. Strong Nash equilibrium. Coalition-Proof Nash equilibrium.

3. **WEEK 4 and 5.** Extensive form games. Perfect recall. Mixed versus Behavioral strategies. Subgame perfect equilibrium. Trembling-hand perfect equilibrium. One-shot principle.

4. **WEEK 5 and 6.** Games of incomplete information. Type space (Harsanyi and universal). Bayesian equilibrium. Perfect Bayesian equilibrium. Sequential equilibrium.

5. If time, we will cover topics on signaling games, supermodular games, coalition formation games and cooperative game theory.

An essential reference for the course is Osborne and Rubinstein, "A course in Game Theory", MIT Press, 1994. Two other (optional) textbooks are Fudenberg and Tirole, Game Theory, MIT Press, 1991 and Myerson, "Game Theory: Analysis of Conflicts", Harvard University Press, 1997.

References

[1] R. Aumann, "Correlated Equilibrium as an Expression of Bayesian Rationality", *Econometrica*, 1987, 55, 1-18.

[2] D. Bernheim, "Rationalizable Strategic Behavior", *Econometrica*, 1984, 52, 1007-1028.

[3] D. Berheim, B. Peleg and A. Winston, "Coalition-Proof Nash Equilibria I: Concepts", *Journal of Economic Theory*, 1987, 42, 1-12.

[4] J. Harsanyi, "Games with Incomplete Information played by Bayesian Players, Part I, II and III", *Management Science*, 1968/69, 14, 159-182, 320-334 and 486-502.

[5] J.F. Nash, "Equilibrium Points in N-Person Games", *Proceeding of the National Academy of Sciences of the USA*, 1950, 36, 48-49.

[6] J.F. Nash, "Non-cooperative Games", *Annals of Mathematics*, 1951, 54, 286-296.

[7] D. Pearce, "Rationalizable Strategic Behavior and the Problem of Perfection", *Econometrica*, 1984, 52, 1029-1050.

[8] A. Rubinstein, "Commments on the Interpretation of Game Theory", *Econometrica*, 1991, 59, 909-924.

[9] R. Selten, "Reexamination of the Perfectness Concept for Equilibrium Points in Extensive Games", *International Journal of Game Theory*, 1975, 4, 25-55.

Grades will be based on a final closed-book exam.