

Knowledge, belief and rationality

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NES summer school 2013

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Course description

The epistemic program seeks to derive positive theories of behavior directly from different assumptions on the rationality and the beliefs of the agents involved. The objective of this course is to introduce the students to the basic concepts in epistemic game theory and to motivate further interest by discussing some general results and economic applications. The course is divided into three parts. The first part presents different ways to model knowledge and belief, as well as the idea of *common knowledge*. The second part studies the notion of *rationalizability*, which results from assuming that agents are rational and that this fact is common knowledge. The last part discusses the epistemic assumptions that are required to justify different notions of equilibrium, and discusses their plausibility in different settings.

Prerequisites

The course expects that students have had a minimal exposure to the basic elements of Game Theory and Probability Theory, as well as Logic, Set Theory and Linear Algebra. The students should be familiar with the notions of: expected utility, strategic-form and extensive-form games, Nash equilibrium, probability, conditional probability, Bayes rule, independence, expectation, sets, relations, union, intersection, partitions, and linear spaces.

Readings

Lecture slides and notes will be posted on the course website tiny.cc/KNOW. For most of the materials covered in class I will follow Osborne and Rubinstein (1994), hereon OR, which is available for free on the authors' website. I also recommend that you read the papers indicated in the lesson plan. Other good books in epistemic game theory (not required for the class) are Gintis (2009) and Perea (2012). The lecture notes also contain several references for further reading.

Lesson plan

1. Knowledge and agreement [lectures 1–3]

1.a. Models of knowledge and belief

- Epistemic modality · Aumann's model · Equivalence
- OR §5.1 · plato.stanford.edu (entries on epistemic logic and common knowledge)

1.b. Common knowledge

- Common knowledge · Self-evident events · Equivalence · Other axiomatizations · Email game
- OR §5.2 · Rubinstein (1989)

1.c. Agreeing to disagree

- Harsanyi's doctrine · Aumann's theorem · We can't disagree forever · No-trade theorems
- OR §5.3 · Aumann (1976)

2. Rationalizability [lectures 4–6]

2.a. Rationality and dominance

- Never-best-responses · Strict dominance · Separating hyperplane theorem

2.b. Rationalizability

- Hierarchies of beliefs · Self-rationalizable sets · Common knowledge of rationality (CKR)
- OR §4.1

2.c. Iterated dominance

- Iterated dominance · Equivalence · Order independence · Duopoly · Location games
- OR §4.2

3. Knowledge and equilibrium [lectures 7–8]

3.a. Correlated equilibrium

- Mediators · Characterization · Common prior + CKR
- Aumann (1987)

3.b. Nash equilibrium

- R + MK of choices (pure) · MK of rationality and conjectures (2 players) · MK of rationality + CK of conjectures
- OR §5.4 · Brandenburger (1992)

3.c. Justifications and limitations

- On the common prior assumption · Focal points · Communication · Precedence

Grading

The course will be graded with a take-home exam that will be handed out on the first day, and is due back on the last day of class. You are encouraged to discuss ideas, but the reports must be written and submitted individually. Also there will be short practical quizzes. The final grade will be determined as follows: 90% from the exam and 10% from the quizzes.

Communication

The best way to contact me is via e-mail messages sent to bruno@psu.edu. The subject line should begin with “NES”. Also, I spend most of the day (approx. 8am–5pm) in my office located at 407 Kern. You are welcome to knock on the door if you wish to speak with me. Please feel free to communicate any concerns or comments about the course.

References

Aumann, R. J. (1976). Agreeing to disagree. *The Annals of Statistics*, 4(6):1236–1239.

Aumann, R. J. (1987). Correlated equilibrium as an expression of Bayesian rationality. *Econometrica*, 55(12):1–18.

Brandenburger, A. (1992). Knowledge and equilibrium in games. *The Journal of Economic Perspectives*, 6(4):83–101.

Gintis, H. (2009). *The bounds of reason: game theory and the unification of the behavioral sciences*. Princeton University Press.

Osborne, M. J. and Rubinstein, A. (1994). *A course in game theory*. MIT Press.

Perea, A. (2012). *Epistemic game theory: reasoning and choice*. Cambridge University Press.

Rubinstein, A. (1989). The electronic mail game: strategic behavior under “almost common knowledge”. *The American Economic Review*, pages 385–391.