

## DEFAP Ph.D. in ECONOMICS

# GAME THEORY (2018)

Prof. Mario Gilli

### **PURPOSE:**

This course is an introduction to topics in game theory. Its objective is to equip the students with tools, which are essential to study economics of information and of strategic behaviour and for setting up and solving a wide range of economic problems.

### **COURSE DESCRIPTION:**

The course consists of eight lectures of one hour and half

We begin reviewing decision theory. Then we start with game representations. First, a game tree is defined, as well as information sets and pure, mixed and behavioral strategies, perfect recall and Kuhn's theorem. Then we consider Strategic form games and the relation among different ways of modelling strategic Interaction. Thus existence and properties of solutions and of Nash equilibria are discussed.

Next Nash equilibria in extensive form games are analysed and refinements proposed. Finally we turn to the analysis of dynamic games with incomplete information.

### **STRUCTURE:**

The lectures will illustrate the main concepts through formal definitions and examples, with a particular attention to the calculus of solutions, some theorems and proof will be discussed in the lectures. There will be problem sets as homework. You are encouraged to form small group to solve problem sets. The problems will be quite difficult: you are not expected to be able to answer all the questions correctly. Your course grade will be based on the homework, on a class report and on the final exam. Good class participation can improve your evaluation. I expect you to come to class prepared to respond intelligently to questions about the readings and assignments.

### **Textbooks:**

1. Jurgen Eichberger, *Game Theory for Economists*, Academic Press, 1993 = E.
2. Martin Osborne and Ariel Rubinstein, *A Course in Game Theory*, MIT Press, 1994 = OR.
3. Klaus Ritzberger, *Foundations of Non-Cooperative Game Theory*, Oxford University Press, 2002 = R.
4. Lecture notes.

For each topic, I also listed some papers that will help to follow the lectures.

### **Few comments on the books:**

1. E is a basic, simple and clear book. Personally, I like it very much, unfortunately it is very expensive (more than 100€ on amazon.it), however there are four copies in the Bicocca library
2. OR is a complete, nice and clear book and it freely downloadable from Rubinstein homepage <http://arielrubinstein.tau.ac.il/>, unfortunately the notation used for extensive form games is very effective but not standard
3. R is an interesting book, with a formal approach we used mainly for chapters 3 and 4, again it is available in Bicocca library

### **OFFICE HOURS:**

Mario Gilli: **Wednesday 7.30-8.30** or contact Gilli by email [mario.gilli@unimib.it](mailto:mario.gilli@unimib.it)

Elena Manzoni: by appointment [elena.manzoni@unimib.it](mailto:elena.manzoni@unimib.it)

### **WEB SITE OF THE COURSE**

Slides, information and all you need to know can be found at the web site of course: <http://elearning.unimib.it/course/view.php?id=17704>

### **LECTURE ROOM**

The lectures will be at Bicocca University, DEMS seminar Room, building U7 Room 3 room 2104, second floor, Piazza Ateneo Nuovo 1, map:

<https://www.google.it/maps/place/Edificio+U6,+Piazza+dell'Ateneo+Nuovo,+1,+20126+Milano/@45.5183834,9.2112634,17z/data=!3m1!4b1!4m5!3m4!1s0x4786c745fa87c3c9:0xdbc962bf4a46ab6!8m2!3d45.5183834!4d9.2134521>

### **EXAMINATION:**

The examination consists of two parts: four problem sets and a written individual examination.

- **HOMEWORK:** the problem sets will consist in difficult questions that you have to solve working in a group. The marks are relative and they count for 40% of the final mark in Game Theory.
- **FINAL EXAM:** the final exam will consist in one question in one hour and it will count for 60% of the final mark in Game Theory.

## DETAILED TIMETABLE OF THE LECTURES

	<b>Topic of the lecture</b>	<b>Day</b>	<b>Chapters</b>
L1	<u>Decision Theory</u> - Decision Theory under certainty, risk and uncertainty - information and Bayes Theorem	07/02/2018 09.15 - 11.45 a.m. Seminar Room Bicocca U7/2104	OR chapter 1 R chapter 2
L2	<u>Models of Games</u> - Extensive Form Games - Perfect recall and Kuhn Theorem - Strategic Form Games - Thompson Axioms and equivalence of Extensive Forms Games	08/02/2018 10.00 - 12.30 a.m. Seminar Room Bicocca U7/2104	E chapter 1 R chapter 3
<b>HW1</b>	<a href="#"><u>HOMEWORK 1 on games models and information</u></a>	08/02/2018	
L3	<u>Dominance and Rationalizability</u> - Strict and weak dominance, simple and iterated - Bayesian rationality and rationalizability - Incomplete Information	13/02/2018 08.45 - 11.00 a.m.  Seminar Room Bicocca U7/2104	E chapter 3 OR chapter 4 R sections 5.1, 5.2
<b>E1</b>	<a href="#"><u>CORRECTION OF HW1</u></a>	14/02/2018 9.30 - 11.30 a.m. Seminar Room Bicocca U7/2104	
L4	<u>Nash and Bayes-Nash Equilibria</u> - Nash Theorem - Properties in strategic and in extensive form games	21/02/2018 10.00 - 11.30 a.m. Seminar Room Bicocca U7/2104	E chapters 4 and 5 OR chapter 2 R section 5.3
<b>HW2</b>	<a href="#"><u>HOMEWORK 2 on rationalizability and equilibria</u></a>	21/02/2018	

L5	<u>Refinements in extensive form games -1</u> - Sequential rationality - Backward Induction - Subgame Perfection Weak Perfect Bayesian Equilibria - Sequential equilibria	22/02/2018 10.00 - 12.30 a.m.  Seminar Room Bicocca U7/2104	E chapter 6 OR chapters 6 and 12 R section 6.1
<b>HW3</b>	<b><u>HOMEWORK 3 extensive form refinements</u></b>	22/02/2018	
<b>E2</b>	<b><u>CORRECTION OF HW2</u></b>	26/02/2018 9.30 - 11.30 a.m. Seminar Room Bicocca U7/2104	
L6	<u>Refinements in extensive form games - 2</u> - Structural consistency - Forward Induction - Signalling games	28/02/2018 12.00 - 14.30 a.m. Room A Via Lanzone 29	E section 7.1
<b>HW4</b>	<b><u>HOMEWORK 4 on refinements and signaling</u></b>	28/02/2018	
<b>E3</b>	<b><u>CORRECTION OF HW3</u></b>	02/03/2018 9.30 - 11.30 a.m. Seminar Room Bicocca U7/2104	
<b>E4</b>	<b><u>CORRECTION OF HW4</u></b>	06/03/2018 9.30 - 11.30 a.m. Seminar Room Bicocca U7/2104	
<b><u>Exam</u></b>		<b>???</b>	

## Topics and Papers

### 1. **Decision Theory:**

- Simone Cerreia-Vioglio, Fabio Maccheroni, Massimo Marinacci, and Luigi Montrucchio, "Classical Subjective Expected Utility", Proceedings of the National Academy of Sciences of the United States of America
- Konrad Grabiszewski, "On the Rejectability of the Subjective Expected Utility Theory", BE J. Theor. Econ. 2016; 16(2): 437–454
- Massimo Marinacci, "Model Uncertainty," Journal of the European Economic Association, 13, 998-1076, 2015.

### 2. **Models of Strategic Interaction:**

- D. R. Kreps and R. Wilson, "Sequential equilibria", *ECONOMETRICA*, 50(4):863–894, 1982.
- Mailath, G. J., Samuelson, L., Swinkels, J. M. (1993). "Extensive Form Reasoning in Normal Form Games," *Econometrica* 61, 273-302.
- B. von Stengel. Efficient computation of behavior strategies. *GAME ECON BEHAV*, 14 (2):220–246, 1996.

### 3. **Dominance and Rationalizability**

- Bernheim, B. D. (1984). "Rationalizable Strategic Behavior," *Econometrica* 52, 1007-1028.
- Borgers, T., Samuelson, L. (1992). "Cautious Utility Maximization and Iterated Weak Dominance," *Int. J. Game Theory* 21, 13-25.
- Marx, L. M., Swinkels, J. M. (1997). "Order Independence for Iterated Weak Dominance," *Games Econ. Behavior* 18, 219-245.

### 4. **Nash and Bayes Nash Equilibria**

- Roger B. Myerson, "John Nash's Contribution to Economics", *GAMES AND ECONOMIC BEHAVIOR* 14, 287–295 (1996)
- E. van Damme. Chapter 41 strategic equilibrium. volume 3 of *Handbook of Game Theory with Economic Applications*, pages 1521–1596. Elsevier, 2002.

### 5. **Refinements in Extensive Form Games**

- DREW FUDENBERG AND JEAN TIROLE, "Perfect Bayesian Equilibrium and Sequential Equilibrium", *JOURNAL OF ECONOMIC THEORY* 53, 236-260 (1991)
- David M. Kreps and Garey Ramey, "Structural Consistency, Consistency, and Sequential Rationality", *Econometrica*, Vol. 55, No. 6 (Nov., 1987), pp. 1331-1348
- D. R. Kreps and R. Wilson, "Sequential equilibria", *ECONOMETRICA*, 50(4):863–894, 1982.
- McLennan, A. 1985. Justifiable Beliefs in Sequential Equilibrium. *Econometrica*, Vol. 53, No. 4, 889-904

### 6. **Signaling Games**

- Banks J.S., and Sobel J. 1987. Equilibrium Selection in Signaling Games, *Econometrica*, Vol. 55, No. 3, pp. 647-661.
- Cho I., and Kreps D. M. 1987. Signaling Games and Stable Equilibria. *The Quarterly Journal of Economics*, Vol. 102, No. 2, pp. 179-222.
- GROSSMAN, S., AND M. PERRY (1986a): "Perfect Sequential Equilibrium," *Journal of Economic Theory*, 39, 97-119.