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Economics 414: Game Theory

Spring 09, UNH 1858, MWF 12:00-1:00pm

SYLLABUS

This class offers an introduction to the basic concepts and applications of game theory. Game theory characterizes and analyzes optimal behavior in a strategic context. An individual acts strategically if it takes into account other individuals' options and decisions.

As Osborne/Rubinstein (1994) put it, "*[g]ame theory is a bag of analytical tools designed to help us understand the phenomena that we observe when decision-makers interact. The [...] assumptions that underlie the theory are that decision makers ... are rational ... and reason strategically. The models of game theory are highly abstract representations of classes or real-life situations*" (p1).

The models are analyzed with mathematical tools. Almost all the mathematical tools used in this class are tools you are already familiar with. We will be taking derivatives on a fairly regular basis, solve equations for unknowns, and also use probabilities. The challenge in this class will (hopefully) not be the mathematics, but rather the abstract way of thinking - even in very simple models. Most of the applications we will consider in class are either simple games you are familiar with or very simplified real-life situations.

Economics 310 is a prerequisite for this class or permission granted by me. Although I will start from scratch, I will assume that you have some idea of what normal form games are and what a Nash equilibrium is. If you feel you are lacking some basics, be it in math or any other aspect of the class – make sure you come to talk to me right away.

The class will offer an opportunity for you to explore how far you do and do want to think strategically and how rational your behavior is (according to a well-defined concept of rationality). Game theory will also give you the means to analyze real-life strategic situations (most business decisions have to be taken in such context) and to learn the basic tools that are used in almost all fields of economics and beyond.

The main topics covered in this class are

- rational choice and utility theory
- non-cooperative game theory
 - normal form games
 - extensive form games
 - imperfect information
 - repeated games
 - bargaining
 - incomplete information

The class will be lecture-based, but we will also do in-class exercises, consider applications, and play several games. You will be able to make some money in those games (I will keep track throughout the semester and pay you at the end of the semester for all games). This class heavily depends on your active participation – volunteer answers (even if you are not sure), ask questions, participate in discussion, make suggestions, etc ...

Game Theory is even more cumulative than most of economics. It is therefore paramount to your success in this class that you do not fall behind. If you miss something, you will have to catch up; you cannot skip parts of the class and then do well on later topics. To learn the tools, there will be almost weekly homework assignments in this class to make sure you are familiar with the material we cover.

There is no mandatory textbook for this class – you can survive w/o a book if you take good notes and keep all handouts. However, I strongly recommend one of the two following books (Osborne is the more thorough and theoretical book, Harrington is more applied and does things in a quite different order):

Osborne, M., *An Introduction to Game Theory*, 2004, Oxford University Press.
Harrington, J.E., *Games, Strategies, and Decision Making*, 2009, Worth Publishers.

More specifically, we will be covering the following topics (in brackets are the relevant book sections/chapters):

- Strategic Behavior, Rationality, Knowledge (O1, H1)
- Normal Form Games, Dominant Strategies (O2.1-2.5, O2.9, H2.5, H3)
- Rationalizable Strategies (O12, H3.5)
- Nash Equilibria, Reaction Functions (O2.6-2.8, O 2.10, H4, H5)
- Cournot and Bertrand Duopoly (O3.1, O 3.2, H6)
- Dynamic Interpretation of Nash Equilibrium
- Voting Models (O3.3)
- Probability Theory, Expected Utility Theory (O4.12, H7.2)
- Mixed Strategies (O4.1-4.5, H7.3)
- Minimax, Maximin, Security Strategies (O11, H7.6)
- Equilibrium Selection, Risk Dominance, Quantal Response Equilibrium
- Existence and Uniqueness of Nash Equilibria (O4.10)
- Extensive Form Games, Perfect and Imperfect Information (O5.1-5.3, O7.1, O10.1, H2)
- Backward Induction, Subgame Perfect Equilibrium (O5.4, H8, H9)
- Ultimatum and other Related Games (O6.1)
- Stackelberg Duopoly (O6.2)
- Subgame Perfect Equilibrium vs. Nash Equilibrium (O5.5)
- Finitely and Infinitely Repeated Games (O14, H13, H14)
- Bargaining (O16)
- Incomplete Information, Bayesian Nash Equilibrium (O9.1-9.5, H10)
- Bayesian Subgame Perfect Equilibrium (O10.1-10.4, H11)
- Signaling Games (O10.5-10.7, H11, H12)

Minor changes in the sequence of topics and in the applications chosen may occur as the class proceeds. Such changes will be announced on time.

The Osborne book contains most of the basic material covered in this class. However, it is advisable to refer to other textbooks in particular when you encounter difficulties with specific chapters and sections in Osborne (please let me know about such difficulties) and/or if we go beyond the coverage in the Osborne book in class. The books in the list are on reserve in the library (please be considerate of your classmates and return the books on time).

Axelrod, R. (1984), *Evolution of Cooperation*, Basic Books.

Axelrod, R. (1997), *Complexity of Cooperation*, Princeton (NJ): Princeton University Press.

Binmore, K. (1992), *Fun and Games*, Lexington (MA): Heath.

Camerer, C. (2003), *Behavioral Game Theory: Experiments in Strategic Interaction*, Princeton (NJ): Princeton University Press.

Dixit, A., Nalebuff, B. (1991), *Thinking Strategically*, New York (NY): Norton.

Dutta, P. (1999), *Strategies and Games*, Cambridge (MA): MIT Press.

Gibbons, R. (1992), *Game Theory for Applied Economists*, Princeton (NJ): Princeton University Press.

Gardner, R. (1995), *Games for Business and Economics*, New York (NY): Wiley.

Osborne, M., Rubinstein, A. (1994), *A Course in Game Theory*, Cambridge (MA): MIT Press.

Schelling, T. (1960), *Strategy of Conflict*, Cambridge (MA): Harvard University Press.

Watson, J. (2002), *Strategy: An Introduction to Game Theory*, New York (NY): Norton.

I will be using **Blackboard** extensively. You will be able to retrieve this syllabus, handouts, in-class exercises, experiments instructions, problem sets, exam answer keys, etc. from there. You will need Acrobat Reader¹ for everything I put on Blackboard. Moreover, I will be using Blackboard's **email** function to communicate with you.

¹ Available at <http://www.adobe.com>.

This means, that all my emails will be sent to your LMU account. It is your responsibility to make sure that you receive those emails:² do not go over quota on your account (otherwise my messages get bounced) and check it regularly.

On occasion I will send you an email asking you to consider some simple game(s) and to send me a short reply indicating what you would do (and possibly why).

You will not do well in this class if you do not regularly attend class. **Class attendance is mandatory.** Attendance and participation are part of your grade. I will take attendance at the beginning of every class.

Make sure you let me know at the beginning of the semester if you are going to miss classes because of required athletic activities by providing a written detailed schedule. I also expect you to remind me every time you have to miss a class the class before and to discuss with me how to best study the material on your own.

There is a **problem set** almost *every week*. Game theory requires practice which you get by doing problems – the problem sets are integral part of this class. Problem sets are due Wednesday at the beginning of class, unless indicated otherwise. Late problem sets are not accepted. Problem sets are posted on Blackboard under Assignments before the weekend before the due date. You may work in groups of 2 (or 3 with my permission, no larger groups) on the problem sets. Each group has to turn in one set of answers. Please let me know by the end of the first week of term who you are working with.

I encourage you to talk with each other about problems, but each problem set group has to write its own set of answers. All members of a problem set group have to work on *all* questions of a problem set. Any indication of copying or free-riding is treated as plagiarism and will guarantee you an F.

I will drop the two weakest problem set grades at the end of the semester (whether you actually attempted to do them or not) to determine the problem set grade component. I strongly suggest that you do *all* problem sets in order to learn the material. You probably will need my help on problem sets. I have ample office hours (on Wednesday afternoon for that purpose – see footer) – please do come by and make use of my office hours.

I am always happy to help – be it that you have a question about class material, do not understand a homework question, or you want to discuss something beyond what we did in class. I enjoy meeting you and I enjoy helping you learn and understand. If you cannot make it during my office hours, send me an email with your questions or contact me to set up an appointment at a different time – I will tell you what times are available and meet with you at a mutually agreeable time if you send me a confirmation email on time.

Do not expect me to answer homework questions for you, but I will happily make sure that you understand the question and know how to approach it. I do not re-lecture in my office if you miss a class, it is your responsibility to figure out what we covered by consulting the available online material and by talking to your peers.

Please get in touch with me if you have any concerns about your performance or any other aspect of the class. Do not delay talking to me – I can help with a problem only if I know about it.

Your **grade** in this class will be based on

- games and class participation 15%
- problem sets 25%
- two midterms (20 % each) 40 %
- final exam 25%

Your class participation takes into account your class contributions (mainly quality, less quantity), your attendance (perfect attendance alone guarantees you only a C), and your classroom etiquette (see below).

The total adds up to 105%. I will be reducing the weight of your weakest exam by 5% at the end of the class.

I offer you two extra credit assignments as follows (no other extra credit assignments – do not bother to raise the question); each extra credit assignment is worth 2.5% - they are due May 1st in class at the latest:

Take a recent news story and analyze it from a game theoretic point of view. Provide the source of your news story and consult relevant game theoretic literature (list your references and quote properly). Write a 3-5 page essay in

² If you do not use your LMU account, then make sure that you have enabled forwarding to another email account you regularly use – see <http://www.lmu.edu/blackboard/forwardinglion.pdf> for instructions.

which you construct and analyze/solve a game that models the main aspects of the news story you consider. Justify the assumptions you make and explain how you could/should relax these assumptions to make the game more realistic and what kind of results you expect to obtain. – It is a good idea to consult with me about your choice of news story and analysis; feel free to do this at an earlier point during the semester.

I will assign numerical grades (0-100%) to everything. At the end of the term, I will convert numerical averages into letter grades with appropriate +/- according to the standard scale;³ A: 90-100%, B: 80-89%, C: 70-79%, D: 60-69%, F: <60. On rare occasions, I may minimally adjust this scale for all students uniformly to their advantage.

The midterm exams are on **Feb 11** and **Mar 25** during regular class hours. The final exam is on Wednesday, **May 6 at 11:00am**.

You have to notify me of any accommodations for disabilities you get at the beginning of the semester by providing me with the written documentation released by the Learning Resources Center (the LRC does *not* notify me). You also have to discuss the particular arrangements for *each* exam at the latest *one week before* an exam – it is your responsibility to approach me with that. If you fail to do so, then you will take the exam with everybody else at the same conditions as everybody else.

If you have to miss a midterm exam for a scheduled university-sponsored and required activity, you will have to provide written proof and contact me *at least 2 weeks before the exam* to set up an *earlier* exam time. Such an earlier exam may ask different questions and emphasize other aspects of the relevant material than the regular exam. In *documented* cases of a serious family emergency or grave medical illness (I need a doctor's certificate for the day of the exam – it is your responsibility to secure that), I will not offer a make-up midterm exam, but shift 2/3 of that exam's weight to the final, and 1/3 to the other midterm exam. If you do not follow these rules, you will get an F for a missed exam.

Bring your own calculator, ruler, pen and pencil, and eraser to each exam. I will provide the paper. If the use of any other material is admissible (highly unlikely), I will specify that clearly before and during the exam. You are *not* allowed to use or have within reach any other non-authorized material, nor are you allowed to use your own paper. Any attempt of using any unauthorized material – including consulting another classmate's work – will be considered cheating, guarantee you an F on the exam and a report to the Dean (see Bulletin for the University's Honor Code and Process). If you have any doubts or questions, about what material may be used during an exam – ask before you start working on an exam!

Doing your homework and class attendance are the best preparation for the exams. Working through additional problems in the textbook are also a good preparation for the exam – I am happy to check your answers. All exams are cumulative, but there will always be a strong emphasis on material that was covered since the last exam.

Although, these rules hopefully represent common sense to all of you, let me state what I consider necessary **classroom etiquette**:

- do not disturb the class by arriving late, departing early, or leaving the classroom during class unless for a medical necessity/emergency (if you have an important reason, let me know beforehand; do not make it a regular occurrence);
- do not distract others with personal conversations, eating, using electronic or other gadgets, etc;
- contribute to class in a constructive manner by asking questions, volunteering answers, participating in discussions and activities, and by collaborating with others when requested;
- switch off the volume on all electronic devices and do not dare to use them in class (let alone during an exam) unless you have to do so for a disability (talk to me at the beginning of the semester about that);
- behave in a respectful and civil manner towards everybody else.

Work hard, keep up, participate, and enjoy!

³ Do not forget what grades stand for: A, Superior; A-, Outstanding; B+, Very Good; B, Good; B-, Better than Average; C+, Above Average; C, Average; C-, Below Average; D, Poor; F, Failure. Any grade above a C is therefore better than the average university performance, where university standards are substantially higher than high school standards.