Economics 618 is a graduate course in game theory. The primary objective of this class is to provide Ph.D. students with some of the fundamental ideas and tools in game theory, upon which a student may build original research. An explicit goal of this course is to prepare students for applications of game theory in different fields of economics. The list of topics and the problem sets have been prepared primarily with this in mind. For those of you who plan to do research in game theory itself, this course should be regarded as the first and a foundational one in a sequence of multiple courses on game theory.

Pre-requisites:
Students are expected to possess a good understanding of graduate core microeconomic theory, as covered in Econ 601 and Econ 603. Mathematical skill set at the level of Econ 600 is also assumed.

Econ 603 introduces game theory to graduate students and familiarizes you with the definitions of Nash equilibrium, sub-game perfect equilibrium, and perhaps Bayesian and perfect Bayesian equilibrium. The course will start with a review of this material but perhaps in greater detail — the goal being that at the end of this exercise you can use these frameworks for original research. We shall then discuss some of the latest tools available in a game theorist’s arsenal. A tentative list of topics is provided at the end of this document.

Required text:
You may choose to use either one of the following required textbooks. Both are equally comprehensive in their treatment of the required topics, so far as this course is concerned. I shall try to make copies available on reserve at the Parks Library. Homework problem sets and the Final Exam will be based on required readings.

1. Osborne and Rubinstein (henceforth O-R), The MIT Press, *A Course in Game Theory*.
2. Fudenberg and Tirole (henceforth F-T), The MIT Press, *Game Theory*

If you are planning for a career in research in any field of economics and want to buy a book on game theory, O-R is an inexpensive and concise option. F-T is more comprehensive with more illustrative examples.

Supplemental texts
You may choose to use any or all of the following books to supplement your study.

2. Osborne, Oxford University Press, *An introduction to Game Theory*
3. Aliprantis and Chakrabarti, Oxford University Press, *Games and Decision Making*
5. Weibull, The MIT Press, *Evolutionary game theory*


**Course Organization**

The course grade will be determined by your performance on the following items:

1. Homework problem sets (long): around 6 or 7 will contribute about 60% of the grade
2. A Final exam (as per University schedule) will contribute about 30% of the grade
3. Class presentation of a journal article on a research topic of your choice, will contribute about 10% of the grade (presentations will be scheduled over the last two weeks of the class)

**Homework and final exam**

You are encouraged to work on the problem sets in groups. All submissions must however be individual. Hard copies must be submitted by the due date. The Final exam will test basic skills in solving standard problems in game theory.

**Class presentation**

Choose a topic of current interest to researchers either in game theory or in an area to which game theory has been applied. You are encouraged to choose a topic from your intended area of specialization (for example, environmental economics or macroeconomics) as game theory is applied in virtually all areas of economics. Choose a paper that is considered a classic on the topic. Classic papers are usually published in top tier journals (general or field journals) and are widely cited. Present the research problem, the model and the results to the class.

You may choose to present a paper from the reading list below. But do not choose anything marked “required”. Whenever possible, I have suggested areas related to items on our list, to look around for interesting papers and further study. General interest journals such as *American Economic Review, Journal of Political Economy, Quarterly Journal of Economics* and to some extent *Review of Economic Studies* often publish papers which use very simple techniques to present great ideas and powerful new results. I recommend that you search these journals extensively for papers on an issue of interest.

The time limit for each presentation is 30 min with 10 min allotted for discussion. You must email me your presentation a week in advance. I shall post them on the class website so that everybody has a chance to look at the original paper and ask questions. Asking good questions on other papers will enhance your grade on the Class Presentation component of the course.

**Course outline with reading list**

The course is divided into several units. All problem sets and the Final exam will be based on the reading material marked “required”. You are however strongly encouraged to read and assimilate as many of the other papers as possible, as most of these are considered classics in the field.

1. Strategic form games with complete and incomplete information and their commonly used solution concepts
   a. (Pure strategy) Nash equilibrium (PSNE)
   b. Zero sum (strictly competitive) games
   c. Bayesian Nash equilibrium
d. Mixed strategy Nash Equilibrium, Harsanyi Purification Theorem, Behavioral and Distributional Strategies in Bayesian Games

e. Correlated equilibrium

f. Evolutionary equilibrium

g. Iterated dominance solvability

h. Rationalizability

The required reading for this unit is O-R, chapters 2 – 4 or related chapters from F-T. The following is a list of journal articles on these and related topics. Some papers are considered “classic” and are strongly recommended for supplemental reading with the required.


(9) Ben-Habib, J. and Farmer, R. (1994): “Indeterminacy and Increasing returns”, \textit{Journal of Economic Theory, June issue. The June 1994 issue was also a symposium on “Sunspots” and very useful to look at for other papers.}

(10) Prescott, E and Shell, K. (2002): “Introduction to Sunspots and Lotteries”, \textit{Journal of Economic Theory, Nov issue. The Nov 2002 is yet another symposium on “sunspot equilibrium” and “lottery equilibrium” (a closely related concept) which is useful to look at.}

A paper by Gu, Chao in \textit{Macroeconomics Dynamics, June 2011} is titled “Noisy sunspots and bank runs” and may be interesting if you are looking for applications of correlated equilibrium in macro.


Correlated equilibrium has caught the attention of Experimental economists. Look in \textit{Economic Theory} and \textit{Games and Economic Behavior} over the last few years for interesting papers.


If you are interested in Correlated equilibrium per se or in this concept in the context of Implementation and Mechanism design, look in \textit{Games and Economic Behavior} over the last three or four years. There are quite a few papers.

The literature on Evolutionary Game theory is too huge to list even some of the classic papers here. If you are interested in interdisciplinary research or research that will interest a really wide audience, you should definitely look into this literature. Paper (14) could be a starting point. The interest in social norms/conventions and their role, is very strong amongst economists and Evolutionary Game Theory is a good starting point to try and understand these issues.

2. Some special classes of games and their applications

   a. Games of strategic complements and their applications – existence of PSNE
   b. Games of strategic substitutes and their applications – non-existence of PSNE, existence of symmetric PSNE in a Cournot oligopoly
   c. Global games and existence of PSNE, global games with strategic complementarities and their applications – currency attacks

Readings:

(1). Topkis, D. (1998): *Supermodularity and Complementarity*, Princeton University Press, is not exactly a required reading. However lattice theory is the tool of choice of many applied economists these days, especially in Industrial Organization. This is a most user friendly book on these tools, I have come across.


(3). (required) Milgrom P. R. and J. Roberts (1990): “Rationalizability, Learning and Equilibrium in Games with Strategic Complementarities”, *Econometrica*


Here is a list of additional papers on this unit that you may choose for further study or class presentation.


(4). Bulow J. I., J. D. Geanakoplos and P. D. Klemperer (1985): “Multimarket Oligopoly: Strategic Substitutes and Complements”, *Journal of Political Economy*, is a very influential paper which is credited with the first coining of the terms “games of strategic complements” and “games of strategic substitutes”.


3. Elements of Cooperative Game Theory (time permitting)
   a. The Core
   b. The Bondareva-Shapley Theorem
   c. Core and the Exchange Economy
   d. Stable Sets
   e. Bargaining Set, Kernel, Nucleolus (time permitting)
   f. Shapley Value (time permitting)

The required reading for this unit is O-R, chapters 13 and 14. I shall shortly post a set of journal articles for supplementary reading.

4. Extensive form games with complete and incomplete information and their commonly used solution concepts (time permitting)
   a. Subgame perfect equilibrium
   b. Perfect Bayesian equilibrium
   c. Sequential equilibrium
   d. Trembling Hand Perfect equilibrium

Readings:

1. (required) O-R, chapters 6, 11-12 or related chapters from F-T

We shall not have time to discuss “Repeated Games, the Folk Theorems and their applications”. However if you have spent some time in Econ 603 on these, feel free to read and present a paper in this area, towards the requirement for this course. Some classic papers in this area are:

Readings:

3. Fudenberg D. and E. Maskin (1986): “The Folk Theorem in Repeated Games with Discounting or with Incomplete Information”, *Econometrica*
In a Ph.D. level course it is always important to at least know some of the most important areas that have NOT been addressed in a semester long course such as this. In this course we have not addressed the following important areas (which therefore you must learn from other courses) – learning models, the theory of knowledge, experimental and behavioral game theory. The course also focuses on Non-Cooperative rather than Cooperative game theory. Finally, of course time constraints do not allow us to do a comprehensive treatment of all the important issues even in each of the chosen areas.