ECO316: Applied Game Theory
Fall 2017

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Game theory is a set of tools for studying situations in which decision-makers (like consumers, firms, politicians, and governments) interact. This course provides an introduction to game theory, with a strong emphasis on applications in economics. The objective of the course is to give students an understanding of the core concepts of game theory and how to use them to understand economic, social, and political phenomena.

Game theory is an analytical subject, and an ability to follow logical arguments—including some that are complex—is required to follow the material. The only way to absorb analytical material is to work through problems. I will assign weekly problem sets; to keep up with the course it is essential that you complete them.

I will cover the following topics.

Strategic games; Nash equilibrium.
Cournot's and Bertrand's models of duopoly
Hotelling's model of electoral competition; the citizen-candidate model
Mixed strategy Nash equilibrium, with applications
Dominated strategies; iterated elimination of dominated strategies and common knowledge of rationality
Voting, the swing voter's curse, and juries
Strategic games with imperfect information; auctions
Extensive games; subgame perfect equilibrium
Ultimatum game, holdup game
Repeated games; collusion in repeated duopoly
The core, matching, and the deferred acceptance algorithm

Books

I know of no book that fits the course perfectly. I will refer you a lot to my book

An introduction to game theory (Oxford University Press, New York, 2003)

although the level of some parts of that book is a bit higher than the level of the course. Another book that covers some, but not all of the topics in the course, at approximately the same level, is

R. Gibbons, *Game theory for applied economists* (Princeton University Press, 1992).

Prerequisites

This course has prerequisites; for details, see its Arts and Science calendar entry. Please note the strict departmental policy on prerequisites.

Course components

The course has three main components.

Lectures

I will use fairly detailed slides, which I will post before each class. See the SCHEDULE page for details.

Use of electronic devices in class: I encourage you to use take notes on an electronic device. However, to do so you must sit in the first five rows of the classroom. *The use of an electronic device for any purpose unconnected with the class is prohibited during class time*, and **beyond the first five rows of the classroom the use of any electronic device for any purpose is prohibited.**

Tutorials

The tutorials are an essential part of the class. In them, the TA will guide you in solving problems related to the material in the previous class. The TA will not give you a solution, but will rather induce you to create a solution. The problems for each Tutorial will be posted on the SCHEDULE page shortly after the class on the previous day. You do not need to look at them before the Tutorial, but you should be prepared to participate actively in the Tutorial. I will post full solutions to the problems shortly after the tutorial.

Problem Sets

The Problem Sets are another essential part of the class. As for any analytical subject, the only way to learn the material in the course is to solve a lot of problems. I will assign a Problem Set each week. (I will post it on the SCHEDULE page shortly after each class.) Your answers to these problems will not contribute directly to your grade (they will not be marked), but they will definitely contribute indirectly: you will not be able to do well in the course unless you do the problems.

ECO316 and ECO326

ECO326 (Advanced Microeconomic Theory) also covers game theory. It is pitched at a somewhat higher level than this course; its approach is more rigorous. It emphasizes formal concepts, using applications as illustrations, whereas this course presents formal models mainly as a means to study applications. As a consequence, ECO326 is the preparation I recommend if you plan to pursue a theoretically-oriented Masters degree, and particularly if you want ultimately to pursue research in economics. However, a very strong performance in this course will also serve well for admission to most Masters programs.

Whether you take this course or ECO326, you should bear in mind that you can take only **one** of these courses, **NOT** both.

1. ECO316H and ECO326H are exclusions for each other, which means you **cannot** take both courses towards your degree.
2. ECO316H cannot be counted towards any program that requires ECO326H. In other words, if you need to take ECO326H for your program, you cannot take ECO316H.
3. The Department of Economics does not remove students from courses that are exclusions. However, when the time comes to graduate and courses are counted, the rules are strictly enforced, and exclusions do **not** count toward a degree or program. You are expected to comply with the rules of the calendar when you choose your courses.

Class schedule

Section L0101: Class R10-12 in MS 2172 (Martin J. Osborne). Tutorial F1-3 in ES 1050.

Section L0201: Class R2-4 in MS 2172 (Martin J. Osborne). Tutorial F1-3 in ES 1050.

In the following schedule, IGT refers to my book *An introduction to game theory*.

I will post slides for each class by the morning of the day of the class. The *compact* versions are best for printing, the *complete* ones best for viewing on a screen.

Week 1 (September 7)
: Strategic games and Nash equilibrium (IGT Chapter 1 and 2.1–2.7).

Week 2 (September 14)
: Examples of Nash equilibrium in games with many players. Competition between firms: the models of Bertrand and Cournot (IGT 3.2 and 3.1). Using best response functions to find Nash equilibria in general games (IGT 2.8)

Week 3 (September 21)
: Electoral competition (IGT 3.3).

Week 4 (September 28)
: Mixed strategy Nash equilibrium (IGT 4.1–4.3 and 4.5).

Week 5 (October 5)
: Applications of mixed strategy Nash equilibrium: expert diagnosis and the volunteer's dilemma (IGT 4.6 and 4.8).

Week 6 (October 12)
: Implications of rationality and beliefs about others' rationality. Strict domination (IGT 2.9.1). Never-best responses. Iterated elimination of strictly dominated actions. Weak domination. (IGT 2.9; see also 12.2 and 12.3, although the treatment there is more advanced than the one in class.)

Week 7 (October 19)
: Collective choice: voting (IGT 2.9.3); committee decision-making (IGT 2.9.4); voting with imperfect information and the "swing voter's curse"; juries (IGT 9.7).

  Friday October 20, 1:10pm - 3pm: Midterm exam in room EX 100.

Week 8 (October 26)
: Auctions: private value sealed-bid auctions under first- and second-price rules; common value auctions (IGT 9.6).

Week 9 (November 2)
: Extensive games: subgame perfect equilibrium (IGT 5.1-5.5).

Week 10 (November 16)
: Extensive games: Stackelberg duopoly; ultimatum and holdup games (IGT 6.1, 6.2).

Week 11 (November 23)
: Repeated games and collusion (IGT 14.1-14.12).

Week 12 (November 30)
: The core, matching, and the deferred acceptance algorithm (IGT 8.1, 8.2, and 8.7)

Evaluation

Your grade in the course will be based on your marks in a midterm test and a final exam.

Midterm exam

The midterm test will be held on **Friday October 20, 1:10pm–3:00pm** in room **EX 100**. (This time slot is a regularly scheduled meeting time for the course, so I do not offer an alternative time in case of a conflict with another course. If you have such a conflict, you need to get the instructor of the other course to resolve it for you.)

The room assignment will be announced on the SCHEDULE page when it is available.

The midterm exam will receive a weight of 40% in the final grade.

Midterm exam, Fall 2016 • Midterm exam with solutions, Fall 2016
Midterm exam, Fall 2015 • Midterm exam with solutions, Fall 2015
Midterm exam, Fall 2013 • Midterm exam with solutions, Fall 2013
Midterm exam, Winter 2013 • Midterm exam with solutions, Winter 2013
Note that the material covered by these exams may be slightly different from the material covered by the exam in the current class.

Final exam

The final exam will receive a weight of 60% in the final grade. It will cover the entire term's work. Much of the material in the second half of the course builds on the material in the first half, so it is difficult to say exactly how much of the exam relates to each part of the course. However, probably between a quarter and a third of the points on the final exam will be for problems that could be answered on the basis of the material in the first half of the course alone.

Final exam, Fall 2017 • Final exam with solutions, Fall 2017
Final exam, Fall 2015 • Final exam with solutions, Fall 2015
Final exam, Fall 2013 • Final exam with solutions, Fall 2013
Final exam, Winter 2013 • Final exam with solutions, Winter 2013
Note that the material covered by these exams may be slightly different from the material covered by the exam in the current class.

Redemption

A low but passing mark in the midterm test will be redeemable by a high mark on the final exam, and a mark between 40% and 50% on the midterm test will be *partly* redeemable. Specifically, if your mark on the midterm test is at least 50% and is lower than your mark on the final exam, the 40% weight for the test will be transferred to the final exam. If your mark on the midterm test is between 40% and 50% and is lower than your mark on the final exam, the midterm test mark, say x, will receive a weight of $4(50 - x)\%$ and the weight $40 - 4(50 - x)\%$ will be transferred to the final exam. (For example, if you score 45% on the midterm test, then that test will receive a weight of 20% and the remaining 20% of the weight for the test will be transferred to the final exam.) *If you receive a mark of 40% or less on the midterm, no weight for the test will be transferred to the final exam.* For example, if your mark on the midterm is 60 and your mark on the final exam is 80, your mark for the course will be 80, but if your mark on the midterm is 40 and your mark on the final exam is 80, your mark for the course will be 64 (0.4 times 40 plus 0.6 times 80).

No calculators or any other aids will be permitted in the midterm exam or in the final exam.

If you miss the midterm exam because of a serious illness, you need to obtain a fully completed University of Toronto "Verification of Student Illness or Injury" Certificate, available at http://www.illnessverification.utoronto.ca/. **I will not accept any other form.** Here are the rules.

1. You need to see the doctor **before** the exam. I will not accept certificates that relate to visits after the exam.
2. The illness must be serious enough that you are **unable** to write the exam. It is not enough that, given the illness, you would not do as well as you otherwise might. I will not accept certificates concerning minor ailments.
3. The certificate must be completed by a qualified medical doctor (not, for example, a chiropractor, acupuncturist, or other medical professional).
4. The certificate **must** include the doctor's OHIP registration number.
5. The certificate must be completed in full and must be completely legible. In particular, I will not accept a certificate unless the doctor's name, licensing body, and registration number are legible.
6. You **must** email me the day of the exam, explaining the circumstances.
7. You **must** bring me the **original** certificate (not a scan or copy) in person as soon as you are better. I will not accept emailed certificates.
8. You must write the makeup exam, which will be held on **Friday October 27, 10:10am–12:00pm**. If you do not write the makeup exam, you will receive 0 for the midterm. (There will be no makeup for the makeup.)