Game Theory (QTM315/POLS385)

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Description

Game Theory studies how individuals pursue their goals in situations in which the best course of action depends on the behavior of others. Candidates competing for votes, arms races, public good provision, auctions, and bargaining are some of the applications that we will study. The tools that we will learn in this course, however, can be more broadly applied to many more political and economic phenomena.

Prerequisites

This course assumes prior mathematical knowledge at the level of high school algebra. This means you should have a good working knowledge of sets, functions, fractions, inequalities, and one-variable equations. We will be applying rigorous reasoning and the more comfortable you feel with logical and mathematical analysis, the easier it will be to understand the class material.

Course structure

This is an online course and we will have Zoom synchronous sessions twice per week (see meeting ID and hours above). The lecture slides for each of our sessions will be uploaded to Canvas prior to each session. You are encouraged to use the discussion board on Canvas to post questions or comments regarding the slides.

Goals

The general goal of this course is for you to familiarize and learn to apply the main concepts of noncooperative game theory. Doing so has the potential to improve how you make your own choices in strategic settings. It can also help you build educated guesses on how others will react in a given strategic interaction. At the end of this course you should be able to:

- Identify the players, payoffs, and actions in a game, as well as to describe the information available to each player.

- Be able to describe a strategy for each player of a game and recognize whether it is dominant, dominated, or neither.

- Be able to correctly specify a pure or a mixed strategy.

- Apply iterative elimination of dominated strategies and backward induction.

- Find equilibria in a game using the concepts of Nash equilibrium, subgame perfection, Bayesian Nash equilibrium, and weakly sequential equilibrium.

Grading

- Homework assignments (25%): there will be (approximately) eight problem sets. Every two problem sets, I will randomly select one of them to be graded (the other will not be graded). At the end of the semester, you may drop the lowest of the four graded assignments to calculate your final grade.

- Midterms (40%): there will be two midterms (20% each). The first one on Wednesday, September 23, and the second on Wednesday, October 21.

- Final (20%): there will be a non-cumulative final on Monday, November 23.

- Group modelling project (15%): The goal of this exercise is for you and a partner to apply game theoretic tools to a strategic situation of your interest. This situation could be a real life social interaction, come from something you read in the news or a movie, or more generally, any situation in which the benefits or costs of a choice by one agent depend on others' actions. Be creative! This is an opportunity to apply what you learned during the semester to something you care about. You and your partner will first find the strategic situation you think can be modeled with one of the games covered in class and at the end of the semester, you will write a short report (3 pages maximum) that will include the following:

  - Motivation: description in words of the strategic situation you analyse and the reasons for your choice (general importance for society, potential to solve a practical problem).
  - Game description: list of players, actions, description of the timing of events, information structure, and payoffs of your game.
  - Equilibrium analysis: you will find equilibria of your game and state whether there are any dominated or weakly dominated strategies.
  - Conclusion: you will summarize the conclusion or predictions derived from your model in words and discuss whether those predictions might or might not be observed in reality. You should also discuss what relevant factors your game might be missing.

  The report is due Friday, December 11.

All problem sets, exams, and final project report will be given a score from 1 to 100 and a letter grade. The final course grade as well as those of other assignments will be given according to the following scale:

Grade	Score
A	$(95, 100]$
A-	$(90, 95]$
B+	$(85, 90]$
B	$(80, 85]$
B-	$(75, 80]$
C+	$(70, 75]$
C	$(67, 70]$
C-	$(65, 67]$
D+	$(63, 65]$
D	$(60, 63]$
D-	$(55, 60]$
E	$(0, 55]$

Additional policies

- For our Zoom sessions, I will ask you to please turn your camera on if possible. Seeing your facial expressions helps me assess whether the material is being understood.

- You are encouraged to discuss problem sets with other classmates. However, each student must turn in their own work. Open book and open notes are also allowed when you are working on problem sets.

- When answering the midterms or the final, you are not allowed to discuss their content with any other person and you should not consult books, notes, or any other material. I am required to report any violation of this policy to the Honor Council.

- Exams will take place during synchronous sessions. You should prepare your webcam in advance for those days and make sure that it will work properly. Please also have at least one backup alternative (another laptop with full battery and camera if possible, or a mobile phone). You should also plan to be in a place where the internet connection will not fail. Throughout the exam you will be recorded and you are expected to remain in the frame. At the end of the exam, you will take a clear picture of your answers as well as your scrap paper and upload them via Canvas.

- It is important for you to make an effort to take good quality pictures of your answers once you finish an exam or problem set as well as to write clearly. Please download a document scanning app to your phone. I have used Adobe Scan and Scanbot before with good results, but you are free to choose any other scanning app you want. There will be a penalty of 5 points if it is difficult for me (or the grader) to read your handwriting.

- The penalty for unexcused late homework is 20 points per day.

- No incomplete grades will be given unless there is an agreement between the instructor and the student prior to the end of the course.

- You are expected to attend all sessions. I understand this semester is unlike any other and I plan to be flexible to account for unforseen circumstances. If you have to miss a class, please

notify me and send me proper written justification (medical or otherwise) within a week after your missed class.

Readings

There is one required textbook:

- Osborne, Martin J. *An Introduction to Game Theory*. Oxford University Press.

There are other good optional textbooks that you may use to see additional examples:

- Gibbons, Robert. *Game Theory for Applied Economists*. Princeton University Press.

- Dutta, Prajit K. *Strategies and Games: Theory and Practice*. MIT Press.

- Tadelis, Steven. *Game Theory. An Introduction*. Princeton University Press

The Osborne book is available for purchase at the University bookstore. Gibbons and Dutta are available online via the library website and Tadelis will be placed on reserves at the library. At the end of every session, I will let you know what the relevant readings for the next session are. As with any other class where mathematical material is discussed, it is much easier to follow the lectures if you have carefully done the readings in advance.

Instructor responsibilities

Your success in this class is important to me. These are some of the actions I will take to help you master the material of this course:

- I will carefully prepare each of the lectures, exams, and assignments, in a way that enhances your understanding of the core concepts of game theory. This involves the selection of applications from fields compatible with your majors, a clear correspondence between what is covered in class and what is included in exams and assignments, and lectures that follow closely the material included in the assigned textbook.

- I will be available during office hours in person and online to attend any question (see personal meeting ID above). If my office hours are not compatible with your schedule, I will do my best to accommodate particular circumstances. Part of my job is to answer and clarify any question regarding the material that you might have. Interruptions and questions during synchronous sessions are more than welcome (just raise your hand or send me a message on the chat).

- If you need to communicate with me outside regular class hours, please send me an email (see my email address above). I respond to emails in less than 48 hours (most likely within a day).

- I am committed to give you information about your performance in the course in a timely manner. I usually take one week after you have turned in an exam or problem set to grade it. If I am taking longer, please remind me about this commitment.

- I will provide you with answer keys for each problem set and exam regardless of whether they are graded. This will help you identify past mistakes and gaps in your understanding. If you have questions about the answer keys, do not hesitate to ask me.

Outline

The schedule described here might change slightly as the semester unfolds.

- Topic 1. Rational choice (first day of classes 08/19-08/24)

  - Mathematical models of social, economic, and political phenomena
  - Actions, outcomes, and preferences
  - Rationality
  - Single agent decisions under uncertainty

- Topic 2. Strategic Form Games (8/26-9/21)

  - Dominated actions
  - Nash equilibrium
  - Mixed strategies

  Midterm 1 (09/23)

- Topic 3. Extensive Form Games (09/28-10/19)

  - Strategies
  - Subgame perfect Nash equilibrium
  - Backward induction

- Topic 4. Games of Imperfect Information (09/27-10/12)

  - Information sets
  - Equivalence between extensive and strategic forms

  Midterm 2 (10/021)

- Topic 5. Games of Incomplete Information I (10/26-11/10)

  - Bayesian games
  - Weakly sequential equilibrium
  - Signaling games

- Topic 6. Repeated Games (11/16-11/18)

  Final (last day of classes 11/23)

Others

- It is one of my goals to provide an inclusive learning environment. The Department of Accessibility Services (DAS) works with students who have disabilities to provide reasonable accommodations. It is your responsibility to request accommodations registering with the DAS (http://accessibility.emory.edu/students/). Accommodations cannot be retroactively applied so you need to contact DAS as early as possible and contact me as early as possible in the semester to discuss the plan for implementation of your accommodations. For additional information about accessibility and accommodations, please contact the Department of Accessibility Services at (404) 727-9877 or accessibility@emory.edu..

- The honor code is in effect throughout the semester. Familiarize with the honor code http://catalog.college.emory.edu/academic/policies-regulations/honor-code.html, and please do not put me in a situation where I am forced to report you to the council.

- Our class sessions on Zoom will all be audio visually recorded for students in the class to refer back to the information, and for enrolled students who are unable to attend live. The recordings and other materials posted on Canvas are for the sole purpose of educating the students enrolled in the course. The release of such information (including but not limited to directly sharing, screen capturing, or recording content) is prohibited. Doing so without my permission will be considered an Honor Code violation and may also be a Copyright violation. Students who participate with their camera and mic engaged or utilize a profile image are agreeing to have their video, image, and voices recorded. If you are unwilling to consent to have your profile image, video, or audio recorded and posted on canvas, be sure to keep your camera off, do not use a profile image, and use the "chat" feature to communicate during class.