

Siqi Liu ([sliu2@brandeis.edu](mailto:sliu2@brandeis.edu))  
Class Time: M T W TH 6:30-8:30 PM EST  
Office Hours: M T W TH 5:00-6:20 PM EST  
Department of Economics, Brandeis University  
Summer 2021  
Syllabus

## **Econ 181: Game Theory and Its Applications**

**Overview:** Wouldn't life be simple if, in making decisions, we could ignore the interests and actions of others? Simple yes—but boring too. The fact remains that most real-world decisions are not made in isolation, but involve interaction with others. This course studies the competitive and cooperative behavior that results when several parties with conflicting interests must work together. We will learn how to use game theory to formally study situations of potential conflict: situations where the eventual outcome depends not just on your decision and chance, but the actions of others as well. Typically there will be no clear cut “answers” to these problems (unlike most single-person decisions). Our analysis can only suggest what issues are important and provide guidelines for appropriate behavior in certain situations. The course is intended for upper-level undergraduates.

**Learning Goals:** Students will be able to take any strategic situation and analyze it using the concepts of game theory, to make recommendations as to how the players should act, and make predictions of likely outcomes. Students should also be able to comment on the caveats that should be applied in using the theory in any given situation, based both on the formal limitations of the theory and the experimental and empirical evidence regarding its validity.

**Prerequisites and mathematical preparation:** Students should have completed Econ 80a (microeconomic theory) and Econ 83a (statistics) or their equivalents. Students will need to be able to apply mathematical reasoning and methods, including:

- Solving  $n$  linear equations with  $n$  unknowns;
- Solving simple maximization problems, by taking the derivative of simple algebraic functions, setting the derivative to zero and solving the resulting equation for the decision variable;
- Calculating the expected value of a set of outcomes with corresponding probabilities;
- Using graphical representations of equilibria as the intersection of two curves, and analyzing how the equilibrium changes when the curves shift.

**Course requirements:** Success in this four- credit course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class (readings, papers, discussion sections, preparation for exams, etc.).

1. Problem sets (20%)

The problem sets are designed to test your understanding of the theory *after* we have covered it in class. You are encouraged to work in groups on the problem sets, but to get grade credit you must turn in your own individual answer sheets. There will be 3 problem sets.

2. Attendance/Participation (10%)

I expect active participation from students. Students are welcome to stop me for clarifying issues whenever possible. Students are allowed 1 free absence. Each additional absence will result in a grade decrease of 1%, up to 5% of the grade.

3. Mid-term exam (20%)

Midterm will be in class.

4. Registrar-scheduled 3-hour final exam (30%)

To be scheduled

5. 2 page Headline Analysis Paper (20%)

You must identify an issue or topic that is currently in the news and use the techniques of game theory to analyze that situation. I am available to talk to anyone about their ideas.

**Textbooks:**

Osborne, Martin, An Introduction to Game Theory ("IGT")

Dixit, Avinash and Barry Nalebuff, The Art of Strategy ("AOS")

IGT is a traditional textbook; most of the problem-set problems will be from it. AOS is more verbal, but is very good.

**Special Accommodations:** If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately.

**Academic Honesty:** You are expected to be familiar with and to follow the University's policies on academic integrity (<http://www.brandeis.edu/studentlife/sdc/ai/>). Instances of alleged dishonesty will be forwarded to the Office of Campus Life for possible referral to the Student Judiciary System. Sanctions may include failure in the course and suspension from Brandeis. If you have any questions about expectations, please ask.

**Policy on Homework Sets Reading Questions and Exams:**

1. Homework sets are designed to help you learn how to apply the material presented in lectures. You are encouraged to discuss course material, including homework, with other students in the class. However, you are expected to turn in your own individual solutions for each homework set. Discussion with others is intended to clarify ideas, concepts, and technical questions, not to derive group homework set solutions. Identical homework set answers (especially when the steps used to derive answers are not shown or when questions of interpretation are involved) violate this policy and may receive no credit or occasion disciplinary action. In order to help with grading, please list on your problem set the members of a group (if any) with whom you have worked.
2. Handwritten solutions are fine, so long as they are legible and neat. Please remember: if we can't read it, we can't grade it.
3. In fairness to students who complete assignments on time, late homework sets will not be accepted. You must turn in assignments during the lecture on the day they are due or earlier in the day.
4. During exams, you may consult the proctor administering the exam if you need clarification of exam questions. No discussion or other form of communication with anyone else will be permitted after the exams have been handed out, until all students have turned in their exam books. Students found to have cheated or engaged in any other unethical behavior will be given a grade of F on the examination involved, and will be turned over to the appropriate disciplinary committees within Brandeis University for further action.

## COURSE SCHEDULE

### I. Introduction to modeling of strategic situations

#### *Week 1*

7/7: Introduction and Modern Day Game Theory

Read: IGT pages 1-8

7/8: Strategic form games and Nash Equilibrium

Read: IGT pages 11-24

7/12: Strategic form games 2

Read: IGT 11-24

7/13: Strict dominance and weak dominance and iterated deletion

Read: IGT 21-28

#### *Week 2*

7/14: Best-Response Functions in discrete games

Read: IGT 33-51

-----PS 1 DUE IN CLASS 7/15-----

7/15: Best-Response Functions and continuous games I

Read: IGT 33-51

7/19: Best-Response Functions and continuous games 2

Read: IGT 33-51

7/20: Mixed Strategies I

Read: IGT 55-70

-----PS 2 DUE IN CLASS 7/21-----

## *Week 3*

7/21 Mixed Strategies 2

Class Slides

7/22: Oligopoly Models 1

IGT 53-67

7/26 Oligopoly Models 2

IGT 53-67

7/27 Product Differentiation/ Hotelling Model

Read: Product Differentiations slides

MIDTERM (Materials up to 7/22) (7/28)

## **II. Playing over time: sequential games**

### *Week 4*

7/29 Anti-Trust Economics

Read: Anti-Trust Slides

## **III. Private information and signaling**

8/2 Games of incomplete information; Bayes-Nash equilibrium

Read: IGT 273-285, 313-323

### *Week 5*

-----**PS 3 In Class 8/3**-----

8/3 Dynamic Bayesian Games II; Beer Quiche Example and Signaling

8/4 Moral Hazard and Adverse Selection

**HEADLINE ANALYSIS PAPER DUE BY 11:55 pm on 8/4**

**FINAL EXAM: TBD**