

# Game Theory Principles | Spring 2024

Taylor J. Weidman

4702 Posvar | taylorjweidman@pitt.edu

## Course Description

Many important phenomena involve strategic interaction among small numbers of agents, like competition between firms, nuclear strategy, bargaining over the price of a car, and forming voting coalitions in a legislature. The word ‘game’ in Game Theory is a bit of a misnomer. Games are not trivial and can be life or death. Game theory emerged in the mid 1900s as a flexible set of tools to model an incredibly broad set of phenomena.

This course will provide an introduction to the fundamental concepts of modern game theory and applications to the social sciences. Topics include formats for describing games, solution concepts including Nash equilibria, repeated games, and evolutionary game theory.

Economics relies heavily on mathematics as a cognitive stepstool, and proficiency in algebra is helpful for this class. But no matter who you are or where you’re coming from, if you’re willing to work hard, you are more than capable of excelling in the class. Welcome!

## Course Format and Expectations

This class is composed somewhat differently than most economics classes. A considerable amount of time will be devoted to playing games in class. Since this class is highly participatory, student’s are expected to be present in every class period. Class time will also include lectures, group work, and exams. Obligations outside of class include reading the textbook, and somewhat frequent homework (*see calendar*).

## Course Resources

There are many resources available to help you master the material. Some of your time should be spent on reading, some doing practice work, and some in discussion with me and your colleagues in class. Economics is best learned through practice, so put in the time to master it. Class resources include:

- Textbook: We will roughly follow Dixit’s Games of Strategy (4th edition or later) ISBN: 9780393919684. It is one of the best textbooks I’ve ever read and is an excellent source of knowledge, especially if you are struggling.
- Canvas: The course’s main materials will be available on the course Canvas page.
- Gradescope: You will turn in homework directly to Gradescope for evaluation. Grades will be available on Gradescope.
- Moblab: Larger participatory games will require use of Moblab. You can access Moblab on the same device you use for class, or a separate device (including a smartphone or tablet).

If you have difficulty meeting the technology requirements for this course please contact me immediately. If you have issues during a particular class, email me regarding an excused absence for the day.

## Grading Policy

No matter your grade in the class, you belong in my classroom. All assessments are designed to push you to do excellent work and convince both you and me of your critical thinking skills with as little unpleasantness as possible. I've deliberately designed the class with no busywork, trick questions, or high-stakes exams. In return I expect you to work hard.

- **Moblab** (*150 Points*): In-class games will be played through Moblab. These games count toward your grade primarily through participation but also through effort. A low score cannot hurt your grade, but a high score can help.
- **Homework** (*100 Points*): There will be 10 Homework assignments, roughly every week on Wednesdays PRIOR TO class. Late Homework will be accepted on Saturday with a 10% haircut. Your Homework score will be automatically dropped. Homework will be a good guide to the material for the exams.
- **MiniExams** (*150 Points or 100 Points*): There will be five MiniExams. Your lowest MiniExam score will be automatically dropped. Your highest two MiniExam scores will be worth 150 points. The remaining two MiniExam scores will be worth 100 points. This has the effect of lowering the pressure on any one MiniExam and means your final grade will be no worse than simply adding up your scores. MiniExams will not be cumulative and will cover the material since the previous MiniExam.
- **Final Exam** (*300 Points*): The Final Exam will be cumulative and will take place during finals week.

No make-up assignments will be given. If you need to miss for illness or other reasons, contact me ahead of time.

## Topic List

### I: Welcome (Dixit Chapter 1 and 2)

### II: Normal Form Games (Chapter 4)

- Terminology
- Depicting a game in normal form
- Nash Equilibrium
- Other solution concepts: Dominant strategies, Minimax, etc.
- More choices, more players
- Pareto Optimality
- Zero Sum
- Specific important games

### III: Extensive Form Games (Chapter 3 and 6)

- Depicting a game in extensive form
- Strategies vs. decisions vs. paths vs. outcomes
- Path to any specific decision point or outcome
- Information sets
- Converting from Normal to Extensive
- Converting from Extensive to Normal
- Subgame Perfect Nash Equilibrium (SPNE)
- Finding every possible (pure) Nash Equilibrium

### IV: Mixed Strategies (Dixit Chapter 7)

- Expected Value and Expected Utility
- Expected payoffs
- How to calculate mixed strategies for a 2x2 game
- Best response graphs for a 2x2 game
- Mixed strategies and ties in an extensive form game (SPNE) (advanced)

## **V: Continuous Strategies (Dixit Chapter 5)**

- Best Response Functions
- Cournot model (quantity competition) with identical firms
- More than 2 identical firms in Cournot
- Cournot model with non-identical firms
- Bertrand (price competition) with any number of firms but homogeneous goods
- Bertrand with different demand functions / imperfect substitutes
- Keynesian Beauty Contest / other related continuous strategy games
- Rationalizability and the Nash Equilibrium

## **VI: Repeated Games (Chapter 10)**

- Future Value and Present Value
- Finitely repeated games: Sum up the payoffs
- Equilibrium in the one-shot game vs. equilibrium in the repeated game
- Infinitely repeated games – new equilibrium concepts
- Grim Trigger
- Tit-for-tat

## **VII: Evolutionary Games (Chapter 12)**

- Symmetric 2x2 evolutionary games
- One generation at a time: changes to the population mix
- Evolutionary graph for symmetric games
- Evolutionarily stable strategies

## **VII: Voting (Chapter 15)**

- Arrow's axioms of an ideal voting system
- Outcomes for various methods
- Strategic voting
- Median voter theorem

## **IX: Asymmetric Information and special topics (*time permitting*)**

- Bullwhip Effect
- Adverse selection
- Moral hazard
- Principal/agent
- Pooling and separating
- Cheap Talk
- Strategic Changes

## **Disability Services**

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS), 140 William Pitt Union, (412) 648-7890, [drsrecep@pitt.edu](mailto:drsrecep@pitt.edu), (412) 228-5347 for P3 ASL users, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

## **Academic Integrity**

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University

Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. The expected sanction for violating the academic dishonesty policy during an exam is a failing grade for the course.

Students ARE PERMITTED and are even encouraged to work together to complete the homework assignments; however, each student may be required to turn in their own work separately. The expected sanction for violating the academic dishonesty policy for a homework or in class problem set is a full letter grade reduction for the course.

## **Statement on Classroom Recording**

To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.

## **Diversity and Inclusion**

The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, see: [: https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/policies-procedures-and-practices](https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/policies-procedures-and-practices)

I ask that everyone in the class strive to help ensure that other members of this class can learn in a supportive and respectful environment. If there are instances of the aforementioned issues, please contact the Title IX Coordinator, by calling 412-648-7860, or e-mailing [titleixcoordinator@pitt.edu](mailto:titleixcoordinator@pitt.edu). Reports can also be filed online: <https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/make-report/report-form>

You may also choose to report this to a faculty/staff member; they are required to communicate this to the University's Office of Diversity and Inclusion. If you wish to maintain complete confidentiality, you may also contact the University Counseling Center (412-648-7930).

## **Course Calendar**

The course calendar below is tentative and is subject to change. Any changes will be announced in class and on Canvas. Some important dates to remember:

- January 15th: Dr. Martin Luther King's Birthday Observance (no classes)
- January 19th: Spring term add/drop ends
- January 26th: Spring term extended drop ends
- March 8th: Monitored withdrawal and the final exam conflict form submission deadline
- March 11th – 15th: Spring break (no classes)

Class	Date	Day	Homework	Exams
1	8-Jan	Monday		
2	10-Jan	Wednesday		
3	15-Jan	Monday		MLK Day
4	18-Jan	Wednesday	HW 1 Due	
5	22-Jan	Monday		
6	24-Jan	Wednesday	HW 2 Due	
7	29-Jan	Monday		Mini-Exam 1
8	31-Jan	Wednesday	HW 3 Due	
9	5-Feb	Monday		
10	7-Feb	Wednesday	HW 4 Due	
11	12-Feb	Monday		Mini-Exam 2
12	14-Feb	Wednesday	HW 5 Due	
13	19-Feb	Monday		
14	21-Feb	Wednesday	HW 6 Due	
15	26-Feb	Monday		Mini-Exam 3
16	28-Feb	Wednesday		
17	4-Mar	Monday		
18	6-Mar	Wednesday	HW 7 Due	
19	11-Mar	Monday		Spring Break
20	13-Mar	Wednesday		Spring Break
21	18-Mar	Monday		
22	20-Mar	Wednesday	HW 8 Due	
23	25-Mar	Monday		Mini-Exam 4
24	27-Mar	Wednesday	HW 9 Due	
25	1-Apr	Monday		
26	3-Apr	Wednesday	HW 10 Due	
27	8-Apr	Monday		Mini-Exam 5
28	10-Apr	Wednesday		
29	15-Apr	Monday		
30	17-Apr	Wednesday		