

**Syllabus: ECON 212 – Introduction to Game Theory  
Winter 2020**

**Class meeting times:**

Monday & Wednesday 10:00-11:20 in PHY145

**Instructor:**

Prof. Joel Blit

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Office Hours: Monday 11:30-1:00 (or by appointment)

**Teaching Assistant:**

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**Objectives:**

Game Theory is the study of strategic interactions between agents where the outcome for an agent depends not only on her choice of action but also on the actions of other players. This course is an introduction to Game Theory. We will develop game theoretic tools that can be used to analyze all sorts of situations including a game of poker, negotiations, auctions, military strategy, or the inability of the world community to curb carbon emissions. We will develop methods for determining best strategies for the different players and for determining the equilibrium outcomes of games.

The course will also have a hands-on component. You will put the theory into action by playing games against fellow students. These will teach you to think strategically. But beware, theory and practice don't always line up!

**Required Readings:**

- Martin J. Osborne. *An introduction to Game Theory*, Oxford University Press, 2004.
  - Partial solutions to the exercises are available at:  
<http://www.economics.utoronto.ca/osborne/igt/index.html>

**Prerequisites:**

You will be expected to know algebra well enough to solve systems of equations. Some calculus is strongly recommended but not absolutely necessary.

**My Expectations:**

- You will come to class and you will participate
- You will stay on top of the material
- You will participate fully in the out of class exercises and submit them on time

- You will complete the assigned problems from the book

**Method of Evaluation:**

Games (8):	20% of final grade (3%, 1%, 4%, 2%: 1%, 2%, 4%, 3%)
Midterm Examination:	Monday March 4 <sup>th</sup> (in TBD) - 30% of final grade
Final Examination:	Date TBD - 50% of final grade
Participation:	Exceptional participation may earn a bonus of 1%-2%

NOTE: Students who write the midterm exam but do better on the final exam will have half of the weight of the midterm shifted to the final. Thus, your final mark would be 20% Games, 15% midterm, and 65% final.

Note: While the games are nominally worth 20% of the final mark, it is possible to score above 100% or below 0% in a given game. Thus, they could in principle contribute more than 20% to your final mark.

**Late Submission of Strategies for Games:**

Because of the nature of the games (each student submission plays against all others), late submissions will not be accepted and will earn a grade of 0. Failure to submit will also earn a grade of 0 for that game.

**Absence from Exams:**

Failure to write an exam results in a grade of zero. Exceptions will only be made under the most extreme circumstances, with a written note, and according to the policies of the department of economics and faculty of Arts.

If you miss the midterm due to illness or other excused absence the 30% weight will be shifted to the final examination.

If you miss the final exam it is your responsibility to petition the department of economics as per the regulations for the opportunity to write a make-up exam.

## Course Outline:

Some of the major topics covered include: strictly and weakly dominated strategies; static games of complete information (Nash equilibrium and mixed strategy equilibrium); dynamic games of complete information (subgame perfect equilibrium); and repeated games with complete information. Depending on time we may cover additional topics.

The following is a tentative course schedule/outline and could be updated as we proceed through the course.

**Note:** Problems marked with an asterisk do not have publicly available solutions.

### Week 1: Introduction, Strategic Games

Chapter 1 and Sections 2.1-2.5

Problems:

- 16.1 Working on a joint project
- 17.1 Games equivalent to the Prisoner's Dilemma
- 20.1 Games without conflict

Game 1: Choose 2/3 of the Average is due

Game 2: Take II: Choose 2/3 of the Average is due

### Week 2: Nash Equilibrium, Best Response Functions, Dominated Actions

Sections 2.6-2.9

Problems:

- 27.2\* Selfish and altruistic social behaviour
- 33.1\* Contributing to a public good
- 34.2\* Voter participation
- 37.1 Finding NE using best response functions
- 38.1 Constructing best response functions
- 38.2 Dividing money
- 42.1\* Finding NE using best response functions
- 42.2\* A joint project
- 47.1 Strict equilibria and dominated actions
- 47.2 NE and weakly dominated actions
- 48.1\* Voting

### Week 3: Cournot, Bertrand, Electoral Competition

Sections 3.1-3.3

Problems:

- 52.2 Equilibrium for pairwise interactions in a single population
- 58.1 Cournot game with linear inverse demand and different unit costs
- 60.2 NE of Cournot game and collusive outcomes
- 61.1\* Cournot game with many firms

- 63.1 Interaction among resource users
- 67.1 Bertrand game with constant unit cost
- 68.1 Bertrand oligopoly game
- 68.2 Bertrand duopoly game with different unit costs
- 73.1 Electoral competition with asymmetric voters' preferences
- 74.1\* Electoral competition with three candidates
- 76.1 Competition in product characteristics

Game 3: Bidding for a dollar is due

#### **Week 4: Auctions**

Section 3.5

Problems:

- 84.1\* Nash equilibrium of 2<sup>nd</sup> price sealed bid auction
- 85.1 Second price sealed bid auction with two bidders
- 86.1\* Auctioning the right to choose
- 86.2 Nash equilibrium of 1<sup>st</sup> price sealed bid auction
- 87.1 First price sealed bid auction
- 88.1\* Third price auction

Game 4: All-pay auction is due

Game 5: Bidding for a jar of pennies is due

#### **Week 5: Mixed Strategy Equilibrium**

Sections 4.1-4.5

Read Section 4.10

Problems:

- 106.2 Extensions of BoS with vNM preferences
- 110.1 Expected payoffs
- 111.1 Best responses
- 114.2\* Games with mixed strategy equilibria
- 114.3\* A coordination game
- 117.2 Choosing numbers
- 118.2\* Voter participation
- 120.2 Strictly dominating mixed strategies
- 120.3 Strict domination for mixed strategies
- 121.2\* Eliminating dominated actions when finding equilibria

#### **Week 6: Illustrations of Mixed Strategy Equilibrium**

Sections 4.6, 4.8

Problems

- 127.2\* Incompetent experts
- 128.1\* Choosing a seller
- 132.2 Reporting a crime when the witnesses are heterogeneous
- 132.3\* Contributing to a public good

**Week 7: Buffer week (the previous sections all take a little more than one week)**

**Week 8: Midterm Thursday October 31<sup>st</sup> (in TBA)**

**Week 9: Extensive Games with Perfect Information**

Sections 5.1-5.4

Read Section 5.5

Problems

- 156.2\* Examples of extensive games with perfect information
- 161.1\* Strategies in extensive games
- 163.1 Nash equilibria of extensive games
- 163.2\* Voting by alternating veto
- 164.2 Subgames
- 168.1 Checking for subgame perfect equilibria
- 173.2\* Finding subgame perfect equilibria
- 173.3\* Voting by alternating veto
- 177.1\* Firm-union bargaining
- 177.3 Comparing simultaneous and sequential games

Game 6: “Tyler vs. Kroetsch” is due

**Week 10: Illustrations of Extensive Games with Perfect Information**

Sections 6.1-6.2

Problems

- 183.1 Nash equilibria of the ultimatum game
- 183.2 Subgame perfect equilibria of the ultimatum game with indivisible units
- 183.3\* Dictator game and impunity game
- 186.1 Holdup game
- 189.1 Stackelberg’s duopoly game with quadratic costs
- 192.1\* Sequential variant of Bertrand duopoly game

Game 7: “Eating Cookies” is due

**Week 11: Bargaining**

Section 16.1, 16.3

Problems:

- 468.1 Two-period bargaining with constant cost of delay
- 468.2 Three-period bargaining with constant cost of delay
- 473.1\* One-sided offers
- 473.2\* Alternating offer bargaining with constant cost of delay

**Week 12: Repeated Prisoner’s Dilemma**

Sections 14.1 – 14.8

Problems:

- 429.1\* Grim trigger strategies in a general Prisoner's Dilemma
- 430.1\* Limited punishment strategies in an infinitely repeated Prisoner's Dilemma
- 431.1\* Tit-for-tat in an infinitely repeated Prisoner's Dilemma
- 431.2\* Nash equilibria of an infinitely repeated Prisoner's Dilemma

Game 8: "Repeated Prisoner's Dilemma" is due

## **Economics Department Deferred Final Exam Policy**

Deferred Final Exam Policy found at <https://uwaterloo.ca/economics/undergraduate/resources-and-policies/deferred-final-exam-policy>

### **Cross-listed course**

Please note that a cross-listed course will count in all respective averages no matter under which rubric it has been taken. For example, a PHIL/PSCI cross-list will count in a Philosophy major average, even if the course was taken under the Political Science rubric.

### **Academic Integrity**

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo are expected to promote honesty, trust, fairness, respect and responsibility. See the [UWaterloo Academic Integrity](#) webpage and the [Arts Academic Integrity](#) webpage for more information.

**Discipline:** A student is expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to [Policy 71 - Student Discipline](#). For typical penalties check [Guidelines for the Assessment of Penalties](#).

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. [Read Policy 70 - Student Petitions and Grievances](#), Section 4. When in doubt, please be certain to contact the department’s administrative assistant who will provide further assistance.

**Appeals:** A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to [Policy 72 - Student Appeals](#).

### **Accommodation for Students with Disabilities**

**Note for students with disabilities:** [The AccessAbility Services office](#), located on the first floor of the Needles Hall extension (1401), collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AS office at the beginning of each academic term.