

## **Game Theory and Applications**

ECO 4400 Section: 0150

**Class Periods:** Tuesday/Thursday, Periods 7-8, 1:55-3:50pm

**Location:** Online, Synchronous

**Academic Term:** Spring 2021

### ***Instructor:***

Professor Daniel Wagner

[wagnerdnlj@ufl.edu](mailto:wagnerdnlj@ufl.edu)

352.294.0989

Office Hours: T R 12:40-1:40pm or by appointment

### ***Course Description***

Introduces modern game theory, including the formal theory of Nash equilibrium and solutions techniques.

Applications include strategic barriers of entry; cooperative behavior in oligopoly, auctions and bidding strategies; and durable goods sales.

4 credits

### ***Course Pre-Requisites***

Intermediate Microeconomics(ECO 3101) and Calculus I(MAC 2311) or equivalents. Game Theory is an advanced interdisciplinary topic that is as much mathematics as it is Game Theory. This course builds heavily on the calculus and firm optimization explored in ECO 3101 and equivalents and it is important to not just have taken these courses but be comfortable with the material and algebra skills in general. Most students do well in this course but those who do not usually struggle with the calculus, probability, and manipulating firm profit functions in particular.

### ***Course Objectives***

Analyze and model strategic decision making by rational actors under perfect and imperfect information, study industrial organization and pricing decisions in a more mathematically rigorous context and conclude with longer games and decisions under uncertainty.

### ***Required Textbook***

- Games, Strategies, and Decision Making
- Joseph E. Harrington Jr.
- 2015, 2009, 2nd Edition
- ISBN number: 978-1-4292-3996-7

### ***Recommended Materials***

- Partial Derivatives- Khan Academy Review  
<https://www.khanacademy.org/math/multivariable-calculus/multivariable-derivatives/partial-derivatives/v/partial-derivatives-introduction>
- Dixit, Skeath, and McAdams- textbook used in other Game Theory section

### Module 1: Introduction to Game Theory

This module provides an introduction to Game Theory and develops concepts that will be used through the rest of the course. We study how equilibrium is achieved in simultaneous and sequential move games with 2 players, allowing modeling of topics such as firm duopolies and the Cold War, and setting the stage for more complex games.

Week 1: Simultaneous Move Games and Strict Dominance *January 11 – January 15*

- Read: Harrington Chapter 1 and 2 for Tuesday, 3 for Thursday
  - Optional reading- Dixit, Skeath, McAdams: Chapter 1 and 2
- Syllabus Quiz Thursday, Math assessment quiz asynchronously

Week 2: Nash Equilibrium and Best Responses *January 18 – January 22*

- Read: Harrington Chapter 4, up to part 4.5 for Tuesday, remainder for Thursday
  - Dixit Chapter 4
- Problem Set 1 given Thursday, due next Thursday
- Quiz 1 Thursday

Week 3: Sequential Move Games and Subgame Perfection *January 25 – January 29*

- Read: Harrington Chapter 8 to 8.4 Tuesday, remainder Thursday
  - Dixit Chapter 3
- Problem Set 1 due Thursday

Week 4: Relationship between Normal Form and Extensive Form *February 1 – February 5*

- Read: Review Harrington Chapter 8 and 2
  - Dixit Chapter 6
- Quiz 2 Thursday
- Problem Set 2 Given Thursday, Due next Thursday

Week 5: Alternate Strategies and Wrap up *February 8 – February 13*

- Alternate Strategies and module 1 topics wrap up
- Problem Set 2 due Thursday

Week 6: Exam 1 *February 15 - February 20*

- Pre-exam Review Session Tuesday
  - Exam 1 Thursday
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Module 2: Mixed Strategies, Continuous Strategies, and Repeated Games

This module integrates more complex math concepts and introduces mixed and continuous strategies before moving on to repeated games, building on the framework from the previous module with a wider range of moves, including randomizing moves, infinite strategy choices, and negotiating agreements available to players modeled with calculus and probabilities.

Week 1: Mixed Strategies *February 22 – February 27*

- Read: Harrington Chapter 7, Through 7.3 for Tuesday, Remainder for next Tuesday
  - Dixit Chapter 7
- Recharge day Thursday

Week 2: Mixed Strategies Finish/ Continuous Strategies 1 *March 1 – March 5*

- Read: Harrington Chapter 6, part 6.1 and 6.2 for Thursday, and 6.3 for next Tuesday
  - Review Derivatives and Partial Derivatives on Khan Academy
  - Dixit Chapter 5
- Problem Set 3 given Tuesday
- Quiz 3 Tuesday

Week 3: Continuous Strategies 2 *March 8 – March 12*

- Read: Harrington Chapter 6
  - Dixit Chapter 5
- Problem Set 3 due Tuesday

Week 4: Continuous Wrap up, Repeated Games and Tacit Collusion *March 15 – March 19*

- Read: Harrington Chapter 13 for Tuesday and 14 for Thursday
- Quiz 4 Tuesday
- Problem Set 4 given Tuesday, due next Tuesday

Week 5: Exam 2 *March 22 – March 26*

- Problem Set 3 due Tuesday
- Review Session Wednesday (Optional, Recorded)
- Exam 2 Thursday

Module 3: Incomplete Information and Applications

This module introduces games with incomplete information, and applications of Game Theory to more complex real world examples and other disciplines. We study Bayesian and Perfect Bayesian Nash Equilibrium concerning players who are unsure who their rival(s) are. Continuing more complex real world games we will study N-Player Games- games with many or infinite players and more complex strategic scenarios such as purchase of durable goods. These topics further integrate probability for actions under uncertainty and combine calculus with discount rates to model Tacit Collusion, or implicit restrictions of supply used to form cartels without direct communication.

Week 1: Bayesian Games and Tacit Collusion Wrap up *March 29 – April 2*

- Read: Harrington Chapter 9, up to 9.4 for Thursday, Remainder for next Tuesday
  - Dixit Chapter 8 and 9

Week 2: Bayesian Games/Signaling *April 5 – April 9*

- Read: Harrington Chapter 10, up to 10.4 for Thursday, Remainder for next Tuesday
- Quiz 5 Tuesday
- Problem Set 5 given Tuesday, due next Tuesday

Week 3: Signaling/N Player Games *April 12 – April 16*

- Read: Harrington Chapter 5 for Thursday
- Problem Set 6 given Tuesday, due next Tuesday
- Quiz 6 Tuesday due to break

Week 4: Finish N Player Games, Durable Goods *April 19-April 21*

- Read: Harrington Chapter 5
- Problem Set 6 Due Tuesday
- Final Review Session(Optional) Wednesday

Final Exam: TBD, during assigned UF final exam slot

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***Attendance Policy, Class Expectations, and Make-Up Policy***

While not graded, attendance is required. You are responsible for the material covered in lecture. A pattern I have noticed over 4 years as a TA and then a teacher is that students who attend class regularly and complete all problem sets and quizzes comfortably get an A or a B, while failure to complete material is correlated with poor exam performance. Classes will be recorded and said recordings will be posted for a week, but class is most effective when attended in person, and quizzes must be completed in class.

For record keeping purposes office hours will also be recorded, but not posted.

Late work will be accepted at a letter grade penalty per day. Work without a name will receive a one letter grade penalty, but this should not be an issue with all assignments submitted via Canvas.

- The problem sets, readings, and quizzes are intended to prepare you for the exams. Similarly to Intermediate Microeconomics this course involves intuition that can be difficult to grasp; practice is key. The course is designed with the assumption that you are practicing examples of the material, if you do not complete the quizzes and problem sets yourself you will not be prepared for the exams.
- Problem sets are due at the beginning of class on Canvas and students will be selected at random without replacement to present solutions. I will assist you if you are unsure of the answer but presenting answers is not optional.
- Quizzes are on alternate weeks to the problem sets, first individually and then a second time with groups. This is intended to encourage study groups but both quizzes will count as the final grade is an average of the two takes; you are responsible for the materials in the lectures and readings. Your lowest quiz grade will be dropped. Skipping the first take of a quiz and completing it only with your group is an automatic 0.
- While collaboration on problem sets and group quizzes is allowed this is again intended as a study tool; your classmates are a valuable resource but if you do not work through the problems yourself it is easy to falsely think you understand the material.
- Exams will be taken using Honorlock, they are not open book but a non-graphing calculator is allowed.

Laptops are not recommended for note taking as course notes will heavily rely on diagrams that are easier to draw by hand. Quizzes on Canvas can be taken on laptops or smartphones with a web browser or the Canvas application.

Excused absences must be consistent with university policies in the Undergraduate Catalog and require appropriate documentation. Please notify me in advance if you will be absent during a quiz or exam or when a problem set is due if at all possible. Additional information can be found here:  
<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

***Evaluation of Grades***

<b>Assignment</b>	<b>Percentage of Final Grade</b>
Problem Sets	15%
Quizzes	10%
Midterm Exam 1	25%
Midterm Exam 2	25%
Final Exam	25%
	100%

***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90.0 - 100.0	A	4.00
87.0 - 89.99	B+	3.33
80.0 - 86.99	B	3.00
77.0 - 79.99	C+	2.33
70.0 - 76.99	C	2.00
67.0 - 69.99	D+	1.33
60.0 - 66.99	D	1.00
0 - 59.9	E	0.00

Grades will not be rounded, an 89.99 is a B+. A curve will be implemented on exams only if the class average is below 70, which has not yet been necessary in a year of teaching this course. Quizzes will also be curved if the average is below 70%. The homework and quizzes are intended as a buffer in addition to preparing you for the exams.

If you feel there is an error in an assigned grade, you may submit a written request with the specific error(s) outlined and the entire assignment will be regraded.

Substitute work will not be offered. If an assignment without a name can be identified, it will be accepted at a letter grade penalty. If ownership is disputed and cannot be identified it will not be accepted. Makeup exams must be prearranged and only for UF approved conflicts.

More information on UF grading policy may be found at:  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

In the interests of fairness I will not deviate from the syllabus.

I will not deviate from the grading scheme outlined no matter the consequence of a particular letter grade for you; I don't like giving low grades but deviating from the syllabus is not fair to other students. This message is not necessary for most students but has been added to this syllabus out of hard experience- it is on you to

attend class, complete the problem sets and quizzes, study, and make a rational assessment of your chances before the withdrawal period closes.

If you are struggling with the material or think you don't understand, seek help from me or your study group- don't wait for the exam or ask me for extra credit after the fact.

### **Email**

Most of our one-on-one communication will occur via email. There are two important course policies regarding email:

- 1) I expect that you are reading your email at least once per day, and
- 2) All emails that you send must follow basic rules for professional correspondence. If you are unsure of what constitutes professionalism, feel free to ask or simply err on the side of caution.

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

**Present your accommodation letter to me as early in the semester as possible to allow time for accommodations to be arranged.**

### ***Course Evaluation***

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

## ***Campus Resources:***

### ***Health and Wellness***

#### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### ***Academic Resources***

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.

Honorlock will proctor your exams this semester. Honorlock is an online proctoring service that allows you to take your exam from the comfort of your home. You DO NOT need to create an account, download software or schedule an appointment in advance. Honorlock is available 24/7 and all that is needed is a computer, a working webcam, and a stable Internet connection.

To get started, you will need Google Chrome and to download the Honorlock Chrome Extension. You can download the extension at [www.honorlock.com/extension/install](http://www.honorlock.com/extension/install)

When you are ready to test, log into Canvas, go to your course, and click on your exam. Clicking "Launch Proctoring" will begin the Honorlock authentication process, where you will take a picture of yourself, show your ID, and complete a scan of your room. Honorlock will be recording your exam session by webcam as well as recording your screen. Honorlock also has an integrity algorithm that can detect search-engine use, so please do not attempt to search for answers, even if it's on a secondary device.

Good luck! Honorlock support is available 24/7/365. If you encounter any issues, you may contact them by live chat, phone (855-828-4004), and/or email ([support@honorlock.com](mailto:support@honorlock.com)).