

ECON 673 - Information, Game Theory and Market Design

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University of Maryland - College Park
Master of Science in Applied Economics Program
Washington, DC location: 1400 16th Street, NW, suite 140
TA: TBD

Class Time: Tuesday, 6:45-9:30PM
Office Hours: Tuesday, 5:50-6:40 PM and by appt.
E-mail: jgrana@umd.edu
Mandatory Makeup Class Sunday, 4/28

Course Description

Game theory is a standard analytical tool for modeling and understanding interacting decision makers in strategic scenarios. Such scenarios are ubiquitous across the social sciences, especially in economics. Examples include deterrence strategy, auctions, emissions abatement, organizational design, price competition and real options. This course serves as an introduction to game theory that covers both static and dynamic games of perfect and imperfect information and will draw on examples in economics, engineering and security, among others. The course will then cover recent advances in behavioral game theory and illustrate how game theory takes into account imperfect human reasoning.

Learning Objectives

The program has 7 general learning outcomes for students:

1. Ability to understand, evaluate and analyze economic data
2. Ability to understand and interpret statistical evidence from economic data
3. Ability to apply empirical evidence to assessing economic arguments
4. Ability to apply macroeconomic theories to policy discussions
5. **Ability to apply microeconomic theories to policy discussions**
6. **Ability to communicate economic ideas to a broader audience**
7. **Ability to evaluate the effectiveness of policy programs using sound economic techniques**

The learning outcomes that pertain to this course are 5-7.

After completing the class, you should

1. understand how multi-agent decision scenarios are fundamentally different from single agent decision problems.
2. understand, and critically evaluate the assumptions of “full rationality.”
3. be able to solve static and dynamic games of complete and imperfect information
4. be able to analyze a policy issue by understanding the key decision makers, their possible actions, their tradeoffs and the available information.
5. be aware of the experimental evidence that contradicts the predictions of standard game theory and the behavioral models such experiments have inspired.

Optional Course Materials

Tadelis, Steven. Game theory: an introduction. Princeton University Press, 2013.

Much of the material will come from lectures so attending class is paramount.

Prerequisites and a note about “Math”

Prerequisites: ECON 641 and ECON 644 (can be taken concurrently with ECON 644)

The level of mathematics in the class will be fairly rudimentary. The most sophisticated piece of mathematical knowledge required in this class is an understanding of Bayes rule (which we will review) and solving optimization problems similar to ECON 641. However the class is highly *analytical* and may feel “math-y” at times. In this class, we will use math to express ideas. The mathematical work in this class is akin to “word problems” from elementary school. That is, once you figure out what the question is asking, the math is easy. Figuring out how to set up the problem is the challenge.

Assignments and Exams

Homework

There will be 2 homework assignments due on the week before the exams. The assignments will be graded based on conscientious completion. That is, as long as you conscientiously attempted every question, you will receive full credit. Students are responsible for uploading their assignments to the ELMS/Canvas Course website. The homework assignments — while difficult — will mirror the in-class exams. Thus, *a thorough understanding of the homework assignment problems are a key indicator of success on the exams*. You are allowed to work together on the homework but every student must turn in their own assignment. I will provide an answer key after the homework is submitted and we will review the homework in detail in class.

I will make the homework assignments available on the first day of class and the class after the midterm. It is highly encouraged that students work on the homework continuously and not wait until the week they are due.

Exams

There will be two open-book in-class exams. The exams will mirror the homework assignments. The final exam will be cumulative.

Short Paper and Presentation

The short paper offers the opportunity to apply game theory to a current economic or policy issue. Specifically, the student will select a current economic or policy topic and discuss the players, strategies, information structures, payoff structure and plausible equilibria. The paper is *not* a research paper and does not require an extensive literature review. Instead, it is an exercise in thinking about others that are thinking strategically. The paper should be between 3 and 5 pages single spaced (likely closer to 3).

Students will work in pairs.

Paper presentations will be held synchronously over Zoom during the makeup class tentatively scheduled for Sunday, April 28th. Presentations should be approximately 20 minutes with 5 minutes of student and instructor questioning for a total of 25 minutes.

Weekly Discussion Boards

There will be weekly discussion questions posted on ELMS. Each student is required to either respond to the main question or respond to another student each week.

Grading Policy

- Two homework assignments graded for completion — **5% Each**
- One short paper — **20%**
- Paper Presentation — **15%**
- Two in-class exams — **25% Midterm, 25% Final**
- Weekly online discussions **5% Total**

At the end of the term, every student will have a numerical course grade between 0 and 100. I will decide upon the numerical cutoffs between various letter grades based on my professional judgment. I will consider students' performance relative to the class. I will also consider absolute standards of professional competence. Highly competent students will get A's. Barely competent students will get B's. Incompetent students will get B-'s or worse. The cutoffs that I use will respect the ordinal ranking of numerical course grades. No student with a given numerical course grade will receive a lower letter grade than someone else with a lower numerical course grade. The cutoffs that I use will never be higher than indicated below.

A	93
A-	90
B+	80
B	70
B-	60
C+	50
C	40
C-	30
D	10
F	<10

Course Policies

Attendance Policy

There is no strict attendance policy but the majority of the course material will be covered in class so attendance is critical to success. In the event of a missed class, it is imperative to obtain notes from at least one other student. If that is not possible, please see me immediately.

Schedule

Meeting 01, 02/27

- Introduction and Course Review
- Underlying Assumptions, Normal Form Games and Nash Equilibrium *Tadelis Ch. 1, 3*
- Best Responses *Tadelis Ch. 3,4*

Meeting 02, 03/05

- Dominant and Dominated Strategies Strategies
- Games with continuous actions
- Mixed Strategy Equilibria *Tadelis Ch 6*

Meeting 03, 03/12

- Dynamic Games of Perfect Information *Tadelis Ch 7, 8*
- Infinitely Repeated Games and Cooperation *Tadelis Ch 9,10*

03/19 Spring Break, No Class

Meeting 04, 03/26

- Exam Review
- Bayes Rule
- **Homework 1 Due by Start of Class**

Meeting 05, 04/02

- **In-Class Open-Book Exam (90 minutes)**
- Static Games of Incomplete Information *Tadelis Ch 12*

Meeting 06, 04/09

- Static Games of Incomplete Information (cont)
- Dynamic Games of Incomplete Information *Tadelis Ch 15*
- **Post Paper Topics as Weekly Discussion**

Meeting 07, 04/16

- Dynamic Games of Incomplete Information *Tadelis Ch 15*

Meeting 08, 04/23

- Behavioral Game Theory
- The Level-K model

Meeting 09, Virtual, Sunday 4/28

- **Paper Presentations via Zoom**

Meeting 10, 04/30

- Auctions, revelation principle, Mechanism Design *Tadelis Ch 13*
- Advanced Topics: Mechanism Design, Artificial Intelligence, Networks, Platforms, Rational Inattention, Social Choice, Bargaining, Deterrence, Computation

Meeting 11, 05/07

- Advanced Topics (cont.)
- Exam Review
- **Paper Due**

Meeting 12, 05/14

- **In-Class Open-Book Comprehensive Final Exam**

Other References

There are numerous resources available for students looking for more information:

Online References

- Khan Academy Tutorials:

<https://www.khanacademy.org/economics-finance-domain/microeconomics/nash-equilibrium-tutorial>

- (My) Santa Fe Institute Game Theory Tutorial on Static Games

<https://www.complexityexplorer.org/courses/69-game-theory-i-static-games>

- (My) Santa Fe Institute Game Theory Tutorial on Dynamic Games

<https://www.complexityexplorer.org/courses/78-game-theory-ii-dynamic-games>

Economics Textbooks Since game theory is so fundamental to modern microeconomics, many economics textbooks give detailed treatments of game theory. In approximate increasing order of difficulty:

- Pindyck, R., Rubinfeld, D., Farnham, P. G., Miles, D., Scott, A., and Breedon, F. (2009). Microeconomics, 8th Edition. Pearson Education, Inc Chapter 13
- Nicholson, W. and Snyder, C. (2005). Microeconomic theory. South Western/Thomson Chapter 8
- Varian, H. R. (2014). Intermediate Microeconomics: A Modern Approach, 9th edition. WW Norton Company Chapter 29 and 30
- Mas-Cole, A., Whinston, W., and Green, J. (1995). Microeconomic theory. Oxford university press Chapters 7-9
- Jehle, G. A. (2001). Advanced microeconomic theory. Pearson Education India Chapter 7

Game Theory Textbooks There are a litany of game theory books where the technical requirements vary not just between books but also within books. However, here are some of the classics that you can expect to encounter in any game theory course:

- Fudenberg, D. and Tirole, J. (1991). Game theory. MIT press Cambridge, MA
- Osborne, M. J. and Rubinstein, A. (1994). A course in game theory. MIT press

UMD Grad School and Program-level policies

Policies related to all graduate courses at the University of Maryland are posted on this page of the Graduate School's website:

<https://gradschool.umd.edu/faculty-and-staff/course-related-policies>

Please familiarize yourself with these policies related to academic integrity, non-discrimination policy, accessibility, absences and accommodations, grading, academic standing, grievance procedures, and other important policies.

Email: The University has adopted email as the primary means of communication outside of the classroom, and the instructor will use it to inform students of important announcements. The University creates an "@umd.edu" email address for every graduate student. All official UMD communications will be sent to students at their "@umd.edu" email address. Students are responsible for reading their @umd.edu email, including ELMS/Canvas Announcements that are sent to the class. Students should make sure that ELMS/Canvas Announcements and messages are forwarded to an email address that they check regularly. Failure to check email, errors in forwarding email, and returned email due to "mailbox full" or "user unknown" will not excuse a student from missing announcements or deadlines. The instructor will do their best to respond to email within 36 hours.

Contact Hours: Three credit master's-level courses at the University of Maryland require a minimum amount of contact between instructors and students. Our courses' 12 weekly meetings only satisfy 80% of the university's contact requirement. The other 20% is satisfied by weekly mandatory and graded online contact. In principle, the contact hours requirement could be satisfied by scheduling 3 additional 150-minute meetings per term, or 6 additional 75-minute meetings, or 10 additional 45-minute meetings. But in practice the contact hours requirement is satisfied by the weekly online discussion boards. The weekly online discussions are a more flexible way to ensure that our program's courses in DC provide the same level of student-instructor contact as the traditional 15-week face-to-face version of the same course when it is taught on campus in College Park.

Workload: Mastering the material covered in this course requires a significant amount of work outside of class. Students should expect to spend more time outside of class than in class – typically at least twice as much time.

In a regular 15-week semester (as in the College Park version of our program): Taking 3 master's-level courses is supposed to approach the time commitment of a full-time job (~36-39 hours per week, so 12-13 hours per week per course). Taking 3 master's-level courses while simultaneously working at a demanding full-time job during the day is not advisable. Students with questions about the workload in this program should speak with one of the program directors.

The courses in our DC program are 12-week courses that cover all the same material as a traditional semester-long 3-credit course (15 weeks). The compressed schedule makes it possible to complete our degree in just 15 months if you take 2 courses each term. But the compressed schedule also implies an accelerated pace with an average of 25% more work per week in a given course ($15/12 = 1.25$). The weekly workload when taking 2 of our DC courses per term is equivalent to the weekly load from 2.5 "normal" 15-week courses - so $2.5/3.0=83\%$ of a full-time load. Students who take 2 courses per quarter in our DC program complete 8 courses per year. So over the course of a year, taking 2 courses per

quarter in our DC program is equivalent to 133% of a full-time load ($8/6 = 1.33$).

Academic Progress: The graduate school requires that students maintain a GPA of at least 3.0. Students whose cumulative GPA falls below 3.0 will be placed on academic probation by the graduate school. Students on academic probation must ask the program's director to petition the graduate school if they want to remain in the program. The petition must include a plan for getting the student's GPA up to at least 3.0. Students who do not live up to their plan can be forced to leave the program without having earned the degree. Note: a grade of "B" corresponds to a GPA of 3.0. A grade of "B-" corresponds to a GPA of 2.7.

Excused Absences: If you miss any class meetings for any reason, you are still responsible for all material covered during the meeting you missed. It is your responsibility to work with study partners, the teaching assistant, and the instructor to make sure you catch up on the missed material. Instructors routinely facilitate things by posting lecture notes, etc.

If you need to miss an exam or other graded course requirement because of illness, injury, or some other emergency: Follow doctor's orders and get documentation. Get in touch with the instructor as soon as you're able – preferably prior to missing the exam or deadline. Communicate with the instructor to make up the course requirement as soon as possible. You are entitled to recover before you make up the course requirement, but you are not entitled to extra days to study beyond the time the doctor's note says you've been incapacitated. If you are incapacitated for more than a week or so beyond the end of the term, your grade in the course will be an "Incomplete." In such cases you must negotiate a plan with your instructor for completing the course requirements. Once you make up the course requirement the instructor will change your "I" to the appropriate letter grade.

School Closings and Delays: Information regarding official University closing and delays can be found on the campus website and the snow phone line: (301) 405-SNOW (405-7669) The program director will also announce cancellation information to the program as an announcement on the program's ELMS/Canvas site. This will generally be done by 1:00 p.m. on days when weather or other factors are an issue. When classes need to be canceled during the semester, we make every effort to schedule makeup classes.

UMD Counseling Center: Sometimes students experience academic, personal and/or emotional distress. The UMD Counseling Center in Shoemaker Hall provides comprehensive and confidential support services that promote personal, social, and academic success. The cost of these services is covered by the fees you already paid when you registered for classes, and there is no additional charge if you use the services. Proactively explore the range of services available at

<http://www.counseling.umd.edu/>

UMD Accessibility & Disability Service: The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the

services, programs, or activities of the University, or be subjected to discrimination. The Accessibility & Disability Service (ADS) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact ADS as soon as possible so that they have sufficient time to make arrangements. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu. Information about sharing your accommodation letter, discussing accommodation logistics and getting assistance from ADS staff and more can be found on the ADS website.

Graduate Academic Counselor: The UMD Graduate School also has an academic counselor available to support students who are having difficulty navigating mental health resources on campus, are considering a leave of absence and/or need assistance finding mental health care off campus. The Graduate Academic Counselor also facilitates bi-weekly Graduate Student Circle Sessions which provide an opportunity to learn about resources and connect with other graduate students. Students can learn more about the Graduate Academic Counselor by going to: <https://gradschool.umd.edu/gradcounselor>

Course Evaluations: Near the end of the term, you will receive an email inviting you to submit a voluntary and anonymous course evaluation. Your feedback on courses will be very helpful in improving the quality of instruction in our program. **Building Access:** There is a smartphone app that can be used to enter our building after normal business hours. The program coordinator will provide information about this. We will also provide information about the code for entering the front door of our suite. Please make sure you are receiving the ELMS-Announcements that we send out to the program about these and other important matters.