Economics 409: Game Theory
Fall 2018 Syllabus

David A. Miller

This version: September 7, 2018

This is the syllabus for Prof. Miller's part of the course. (See Instructor's note, below.)

Course description

Game theory is the study of strategic interactions, where economic agents ("players" in a "game") affect each other through their actions, and make their decisions in light of what others are likely to choose. One fundamental puzzle in game theory is how players can cooperate when each of them faces an incentive to cheat the others. Why would a producer exert effort to produce a quality product if the consumer cannot verify the quality until after purchase? Why would people contribute time and effort to community projects when they could relax and let others do the work? More questions arises from games of conflict, where one player wins only if others lose. How can we predict who will win? Yet more questions arise from games of coordination, where the players agree on which outcomes are good but don't necessarily know how to obtain them. When should we expect players to coordinate successfully? Game theory provides a unified framework for addressing these questions. By formalizing the situations that players face, we can trace the logical implications of our assumptions on players' preferences, beliefs, and methods of reasoning. Game theory is a core tool of modern economics, and also yields useful insights into business strategy, political science, computer science, sociology, biology, and other fields. In this advanced course, students should be comfortable with rigorous definitions, logical reasoning, probabilities, and optimization using calculus.

Instructor's note

The regular instructor for this course is Prof. Anne-Katrin Roesler. Due to an injury she sustained in an accident shortly before the start of the term, Prof. David A. Miller will teach the first part of the course as a substitute. Prof. Roesler's return date has not yet been determined. The course will use two separate syllabi, one for each instructor. Letter grades for the full course will be assigned according to a weighted combination of scores for the two separate parts of the course, where the weights will be determined upon Prof. Roesler's return.

Logistics

- **Lectures:** Mondays and Wednesdays, 2:30–4:00PM (Michigan time) in East Hall B844
- **Course web site:** Canvas, at umich.instructure.com.

  Students are responsible for reading course announcements, lecture notes, and other materials posted on the course website. No handouts will be distributed in class; please download them yourself.
- **Textbook:** *Strategy: An Introduction to Game Theory*, 3rd. Edition, Joel Watson, New York: W. W. Norton, 2013.
- **Discussion sections:**

  Attendance in discussions is not required and will not be graded. However, if you attend discussion section you must attend the one for which you registered. While ungraded, discussion sections can be highly productive, though, and contribute to your success in the class. In discussion section, your GSI will cover additional examples that illustrate the concepts taught in lecture, and also discuss the answers to completed quizzes and exams.

Instructors & Office hours

Permanent office hours will be determined by a class survey.

- **Professor: David A. Miller**, econdm@umich.edu

  Office hours: Tuesdays 3:00–4:00 PM and Fridays 1:00–2:00 PM, in Lorch 339
- **GSI: Russell Morton**, rorodrig@umich.edu

  Office hours: TBA

Prerequisites

- **Enforced prerequisite:** Econ 401, Intermediate Microeconomics.
- **Alternative prerequisites:**
  - In lieu of Econ 401, I will also accept BE 300 as an alternative prerequisite for Ross BBA students, as it covers much of the same relevant material as Econ 401. This enables Ross BBA students to take Econ 409 without taking repetitive preparatory coursework.
  - In lieu of Econ 401, I will also accept Math 217, EECS 302, or a comparable proof-based math class, as an alternative prerequisite for students who are neither majoring nor minoring in economics. Since game theory is also studied in engineering, math, philosophy, and other disciplines, this provides a path into the class that does not involve taking multiple preparatory courses in economics.
  - To enroll in Econ 409 using an alternative prerequisite, please contact me by email for an override. Prior to the start of the semester, I will provide these overrides as long as the wait list does not exceed 10% of the class capacity (at the time of the override request). After the start of the semester, I will provide these overrides as long as there are open seats in the class.
- **Advisory prerequisite: Mathematics 215, Calculus III**

  If you are taking Math 215 (i.e., multivariable calculus) or equivalent simultaneously with Econ 409, you should be fine. However, students who have not taken any math beyond Math 115 (or equivalent, such as typical high school calculus in the U.S.) have managed a median grade of B-minus, significantly below the class median of B-plus. Consider waiting until you can take Math 215 simultaneously with Econ 409.

  That said, the math techniques we use in Econ 409 are elementary compared to Math 215. I advise Math 215 because students who take it typically have found a level of comfort with mathematical reasoning that is helpful in game theory. If you feel comfortable with mathematical reasoning but neither have taken nor are taking Math 215 or equivalent, do not be deterred by the advisory prerequisite. If you are unsure, please visit me in office hours so we can discuss your specific situation.
- **Wait list advice:**

General advice: In my experience, most students on the wait list have eventually been able to enroll in the class. If you are on the wait list, I recommend that you continue participating in the class while waiting for the wait list to clear.

Assignments

- **Weekly quizzes or problem sets:** There will be approximately fourteen weekly assignments, which may include online quizzes, written problem sets, and short writing assignments.
  - For online quizzes, you will have a window of several days in which to take each quiz, but once you start a quiz there will be a shorter, but generous time limit. Each quiz can be worth up to 30 points, with an average of about 15 points. No collaboration is allowed. Quizzes are administered through Canvas.
  - Procedures for any written problem sets or short writing assignments will be described in class and in a revised syllabus to be issued later.
- **Two midterm exams:**
  - First Midterm (200 points): Monday, October 8, 2017
  - Second Midterm: TBA
- **Final exam:** Wednesday, December 19th, 10:30am to 12:30pm, Location TBA
- **Grading:** A skewed normal distribution is fitted to the empirical point total distribution among UM undergraduate students.[1] The curve reflects the advanced, elective nature of the class and accounts for the fact that a disproportionate number of excellent students take the class. Grades are assigned to quantiles of the fitted distribution according to the following approximate cutoffs:[2]

A+ 96%	A 79%	A− 60%	B+ 42.5%	B 28%	B− 18%
C+ 11.5%	C 7.5%	C− 5%	D+ 3.5%	D 3%	D− 2.5%

[1] Students who dropped or withdrew from the class are counted at 25% weight toward the curve if they completed one midterm exam, and 50% if they completed two midterm exams.

[2] The exact cutoffs are determined from the least-squares best fit of the function $w(1+e^{-x+yt})^{-1}+z$ applied to the listed cutoffs at A+ ($t=1$), A− ($t=3$), B− ($t=6$), C− ($t=9$), and D− ($t=12$).

That is, in expectation about 40% of the class will get some sort of A grade, 42% will get some sort of B grade, 13% will get some sort of C grade, etc. (not including bonus points). Note that these cutoffs are somewhat more generous than the cutoffs used in 2016 and earlier. Actual outcomes may differ from expectations.

The key implication of this complicated system is that your letter grade will not depend on whether another person's score ranks just above or just below yours. Instead the letter grade cutoffs are determined from the entire distribution of scores. So you are essentially never in competition with any particular other student in the class.

- **Bonus points:** During the course, bonus points are assigned for various optional activities, some in class and some on the course website. Bonus points are counted only after the letter grade cutoffs have been assigned from the curve. Thus your letter grade will not be hurt by the curve if you earn fewer bonus points than your classmates.

Class rules

- **Collaboration:** No collaboration is allowed on quizzes and exams.
- **Electronic devices:** Cell phones, computers, music players, and other such devices must be silent during class. No electronic devices may be used for personal entertainment during class.
- **Academic honesty:** This course follows the Economics Department Policy on Academic Integrity in Undergraduate Courses in full. In particular, documented academic misconduct will be punished with automatic failure for the entire course.

  Students are also reminded of LSA's Community Standards of Academic Integrity, quoted below. (Source: www.lsa.umich.edu/academicintegrity.)

  > **Academic Misconduct:** The LSA undergraduate academic community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. The College holds all members of its community to high standards of scholarship and integrity. To accomplish its mission of providing an optimal educational environment and developing leaders of society, the College promotes the assumption of personal responsibility and integrity and

prohibits all forms of academic dishonesty and misconduct. Academic dishonesty may be understood as any action or attempted action that may result in creating an unfair academic advantage for oneself or an unfair academic advantage or disadvantage for any other member or members of the academic community. Conduct, without regard to motive, that violates the academic integrity and ethical standards of the College community cannot be tolerated. The College seeks vigorously to achieve compliance with its community standards of academic integrity. Violations of the standards will not be tolerated and will result in serious consequences and disciplinary action.

- **Medical excuse from exams:** Accommodations will be made for any student who must miss an exam due to a medical emergency. Medical emergencies should be verified using the Economics Department's Medical Emergency Form. (In particular, University Health Service's "Visit Verification" Form does NOT constitute verifiable documentation of a medical excuse.)

- **Disability accommodations:** If you think you may need an accommodation for a disability, please let me know at the beginning of the term. Next, you should contact the Services for Students with Disabilities (SSD) office. Once your eligibility for an accommodation has been determined, you will be issued a Verified Individual Services Accommodation (VISA) form and we can arrange for your accommodation. Any information you provide is private and confidential and will be treated as such.

  If you already have a VISA form from SSD, please present this form to me at the beginning of the term, but no later than at least two weeks prior to the need for the accommodation so that there is enough time for the appropriate arrangements to be made.

Suggestions on how to study

- Game theory has just a few main concepts; the difficulty is to be able to apply them to complex problems. Therefore the best tools for studying are practice problems. There are some practice problems in the textbook for which answers are given in Appendix E. However, the best practice problems for this course are in the back catalog of my old exams, available on the course website. Since there are many old exams, I suggest the following:

  1. First, work through the practice problems in the book that are answered in Appendix E.

2. Next, work through one exam with the answer key in front of you.
3. Then, work through another exam without the answer key, but without a time limit. Check your answers against the key afterward.
4. When you're ready, work through a third exam with a time limit. Check your answers against the key afterward.
5. Repeat Step 4 until you feel you're ready for the real exam.

Keep in mind that the practice exam you are working on may have some questions on topics that haven't been introduced yet.

Also, you will notice that many of the *final* exams have a "particularly difficult" question at the end. Don't worry if you are unable to answer these questions; they are tough enough to be difficult for Ph.D. students, and typically only A-plus undergraduate students are able to make much progress on them. Even if you ignore these particularly difficult questions, simply by doing well on the the other questions you should be able to earn an A grade.

Lecture outline

Lecture material is organized by unit numbers, on the left. Units do not precisely correspond to class meetings. In some class meetings we will cover parts of two or even three units, and some units will be spread over two or even three class meetings. We will cover all of Parts I–IV, and as much of Part V as we can.

The two midterm exams are scheduled for approximately the ends of Part II and Part III, but we might go faster or slower through those parts depending on how the class progresses. Regardless of the progress we make, the midterm exams will be held as scheduled.

Textbook readings for each unit are shown in parentheses.

Part I: Representing Games

1. Extensive form (chs. 1–2)
2. Normal form (ch. 3)
3. Tools (ch. 4, "the concept of efficiency" from ch. 6)

Part II: Static Settings

4. Dominance ("rationality" from ch. 5, "dominance" from ch. 6)

5. Rationalizability ("common knowledge" from ch. 5, chs. 7–8)
6. Nash equilibrium (chs. 9–10)[3]
7. Mixed strategy Nash equilibrium (ch. 11)

Part III: Dynamic Settings

8. Subgame perfection (chs. 14–15, review ch. 2)
9. Applications of subgame perfection (chs. 16–17)
10. Bargaining (chs. 18–19)
11. Negotiation equilibrium (chs. 20–21)
12. Repeated games (chs. 22–23)

Parts IV–V: Omitted

[3] You should skip "congruous sets" in ch. 9.