Game Theory Syllabus

John W. Patty

ICPSR Summer Session II, 2020

This course introduces students to noncooperative game theory and its application in the social sciences. Topics include dominance, Nash equilibrium, subgame perfect Nash equilibrium, perfect Bayesian equilibrium, coordination games, bargaining games, signaling games, and mechanism design. The course is assessed on the basis of homework assignments and two exams, and includes guidance about both how to develop one's own models and how to write research articles utilizing a formal model.

Course Text. The course text is *Game Theory: An Introduction*, by Steven Tadelis. It should be available online. I also recommend William Spaniel’s *Game Theory 101* and *Bargaining 101*, both of which are also available online.

Course TA. The course TAs are Ahmed Raed (fz2094@wayne.edu) and Giulia Venturini (gventurini@fsu.edu).

Contact Information. My email is jwpatty@gmail.com.

Course Website. There is a canvas site for the course.

Course Meetings. The course will be taught using a hybrid structure. Each weekday from July 21st through August 13th (there is no class on July 20th or August 14th) will involve the following.

- 1 hour of synchronous lecture,
- 1 hour per day of asynchronous content, and
- 1 hour of (optional) "drop-in" synchronous contact time with Professor Patty.

Synchronous Sessions. The first class will be held 10am-Noon (EDT) on July 21st. On every other day, the synchronous session will begin at 11am. The idea is that you will review the asynchronous content prior to the synchronous session. That session will be a lecture, but I want you to ask questions!

Asynchronous Content. The principal sources of asynchronous material are William Spaniel’s “Game Theory 101” and “Bargaining 101” videos.\(^1\)

- The Game Theory 101 videos can be accessed here.

\(^1\)As said above, I also recommend his books. And, I apologize for the YouTube ads, but that’s the price of free asynchronous material.
• The Bargaining 101 videos can be accessed here.

I realize that the asynchronous material is not distributed uniformly through the session. I apologize for this, but the reality is that the material later in the course is more specialized and there is less content available (to my knowledge) on these topics. I will try to add more to this as I find (or create) more sources. This material is for your studying/learning—the definitive “source” for the course (in the sense of the assignments and exams) is the textbook and my lectures. Please feel encouraged to ask about inconsistencies, uncertainties, etc. throughout the session.

Drop-in Sessions. These are scheduled at various times in the afternoon and evening to aid students in different time zones. (And apologies for no early morning sessions—I’m not a morning person!)

Office Hours. In addition to the daily drop-in session, I am available by appointment and the TAs will have office hours as well. The schedule for their office hours, as well as links to schedule appointments with each of us, will be on the canvas site.

Course Grading.

| To receive an official grade for the course, notify me prior to the Midterm Exam. |
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- We will grade all students’ homework and exams to provide feedback. However, we will prioritize feedback for those who choose to take the course for a grade. For those who wish to be assigned a grade, the course grade will be based on the following criteria:

  1. **Two Problem Sets.** Combined, these are worth 40% of the final course grade. Each assignment is due at the beginning of the class for which it is listed below. The assignments should be turned in electronically using the canvas site by the beginning of class on the date listed below in the course schedule (the first and third Fridays of the session). Late assignments will be penalized by 25 points (out of 100) for each day late.

  2. **Midterm Exam.** The midterm exam is worth 20% of the final course grade.

  3. **Final Exam.** The final exam is comprehensive. It is worth 40% of the final course grade and due at 10am on the last day of class.

The course is graded on the following scale:

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I do not round grades so, for example, a final grade of 93.9 is an “A-.”

Teaching Philosophy. I hope you will meet with me during the session, especially if you have questions about the course material. I welcome questions during class: if you have a question or comment, please interrupt me!

Various Policies.

- You may work together on the problem sets, but you should each prepare your answers separately.
• The homework assignments and the take-home exam should be typed (preferably prepared in \LaTeX{}) and submitted electronically as a pdf (there’s a link on the course website). We will not grade handwritten assignments. If you need/want to draw a figure, I recommend Inkscape, a free vector graphics program.

• The problem sets and problem sets are “open book and open notes.” Otherwise, you are to consult only with Professor Patty and the TAs regarding the midterm and final exams.

Class Schedule. The class schedule is as follows (the details of synchronous versus asynchronous materials will be updated as available—I will be available during the course times each day, and we’ll figure out how best to use that time (e.g. lecture or question-answer, etc.)):

1. (July 20) Non Class on Morning of 1st Day.

2. (July 21) Introduction, Notation, and Choice Theory
   • Asynchronous Material (for after class):
     - Game Theory 101 (#42): Expected Utility Theory
     - Game Theory 101 (#43): Completeness
     - Game Theory 101 (#44): Transitivity
     - Game Theory 101 (#45): Rationality
   • Reading: Tadelis, Chapters 1 & 19.

3. (July 22) Expected Utility & Normal Form Games
   • Asynchronous Material (ideally before class):
     - Game Theory 101 (#47): Lotteries
     - Game Theory 101 (#48): Independence over Lotteries
     - Game Theory 101 (#50): Continuity
     - Game Theory 101 (#51): Expected Utility Transformations
     - Game Theory 101 (#53): Risk Averse, Risk Neutral, and Risk Acceptant Preferences
     - Game Theory 101 (#55): Discount Factors
     - (Optional) Game Theory 101 (#49): The Allais Paradox
   • Reading: Tadelis, Chapters 2 & 3.

4. (July 23) Dominance & Nash Equilibrium
   • Asynchronous Material:
     - Game Theory 101 (#2): The Prisoner’s Dilemma and Strict Dominance
     - Game Theory 101 (#3): Iterated Elimination of Strictly Dominated Strategies
     - Game Theory 101 (#5): What Is a Nash Equilibrium?
     - Game Theory 101 (#6): Best Responses
   • Reading: Tadelis, Chapters 4 & 5.

5. (July 24) Mixed Strategies
   • Asynchronous Material:
- Game Theory 101 (#8): The Mixed Strategy Algorithm
- Game Theory 101 (#9): How NOT to Write a Mixed Strategy Nash Equilibrium
- Game Theory 101 (#10): Battle of the Sexes
- Game Theory 101 (#11): Calculating Payoffs
- Game Theory 101 (#12): Strict Dominance in Mixed Strategies
- Game Theory 101 (#13): Weak Dominance
- Game Theory 101 (#14): Infinitely Many Equilibria
- Game Theory 101 (#15): The Odd Rule

- **Reading**: Tadelis, Chapter 6.

**Homework 1 Due.**

6. (July 27) Extensive Form Games

- Asynchronous Material:
  - William Spaniel’s Video on “Matrices versus Game Trees.”
- **Reading**: Tadelis, Chapter 7.

7. (July 28) Sequential Rationality

- Asynchronous Material:
  - Game Theory 101 (#16): Subgame Perfect Equilibrium
  - Game Theory 101 (#17): Backward Induction
  - Game Theory 101 (#18): How NOT to Write a Subgame Perfect Equilibrium
  - Game Theory 101 (#19): Multiple Subgame Perfect Equilibria
- **Reading**: Tadelis, Chapter 8.

8. (July 29) Multistage Games

- Asynchronous Material:
  - Game Theory 101 (#20): Games with Stages
  - Game Theory 101 (#21): Punishment Strategies
  - Game Theory 101 (#22): Tying Hands (Burning Bridges)
  - Game Theory 101 (#23): Commitment Problems
  - Game Theory 101 (#24): The Centipede Game
  - Game Theory 101 (#25): Problems with Backward Induction
  - Game Theory 101 (#26): Forward Induction
- **Reading**: Tadelis, Chapter 9.

9. (July 30) Repeated Games

- Asynchronous Material:
  - Game Theory 101 (#52): Pareto Efficiency
  - Game Theory 101 (#54): Repeated Prisoner’s Dilemma (Finite)
  - Game Theory 101 (#56): Geometric Series and Infinite Payoffs
  - Game Theory 101 (#57): The One-Shot Deviation Principle
  - Game Theory 101 (#58): Grim Trigger in the Repeated Prisoner’s Dilemma
  - Game Theory 101 (#59): Tit-for-Tat in the Repeated Prisoner’s Dilemma
  - Game Theory 101 (#60): Tit-for-Tat Isn’t Subgame Perfect
– Game Theory 101 (#61): The Folk Theorem
– Game Theory 101 (#62): Repeated Games and the Prediction Problem
  • Reading: Tadelis, Chapter 10.

10. (July 31) **Midterm Exam** (We’re halfway there!)

11. (Aug 3) Bargaining Games

  • Asynchronous Material:
    – Bargaining 101 (#4): Ultimatum Game Assumptions
    – Bargaining 101 (#5): The Ultimatum Game (Discrete)
    – Bargaining 101 (#6): Other Solutions to the Ultimatum Game
    – Bargaining 101 (#7): Continuous Ultimatum Game
    – Bargaining 101 (#8): Ultimatum Game Uniqueness Proof
    – Bargaining 101 (#9): The Power of Counteroffers
    – Bargaining 101 (#10): The "Power" of Rejection
    – Bargaining 101 (#11): Alternating Offers
    – Bargaining 101 (#12): Rubinstein Bargaining
    – Bargaining 101 (#13): First Offer Advantage
  • Reading: Tadelis, Chapter 11.

12. (Aug 4) Static Bayesian Games

  • Asynchronous Material:
    – Game Theory 101 (#63): Incomplete Information
    – Game Theory 101 (#64): Bayesian Nash Equilibrium
    – Game Theory 101 (#65): Solving for Bayesian Nash Equilibrium
    – Game Theory 101 (#66): Ex Ante and Interim Dominance
    – Game Theory 101 (#67): Why Are There Antes in Poker?
    – Game Theory 101 (#69): Cutpoint Strategies, Continuous Type Spaces, and Bayesian Nash Equilibrium
    – Game Theory 101 (#70): The Purification Theorem
    – Game Theory 101 (#71): Bayes’ Rule
    – Game Theory 101 (#72): The Winner’s Curse, Part 1
    – Game Theory 101 (#73): The Winner’s Curse, Part 2
  • Reading: Tadelis, Chapter 12.

13. (Aug 5) Auctions

  • Asynchronous Material:
    – Game Theory 101 (#41): Second Price Auctions
  • Reading: Tadelis, Chapter 13.

14. (Aug 6) Mechanism Design

  • Asynchronous Material:
    – Adam G.’s Mechanism Design Video
Eric Maskin Talk

- Reading: Tadelis, Chapter 14.

15. (Aug 7) Perfect Bayesian & Sequential Equilibrium

- Asynchronous Material:
  - Game Theory 101 (#74): Perfect Bayesian Equilibrium
- Reading: Tadelis, Chapter 15.
- **Homework 2 Due.**

16. (Aug 10) Signaling Games

- Asynchronous Material:
  - Game Theory 101 (#75): Screening Games
  - Game Theory 101 (#76): Adverse Selection
  - Game Theory 101 (#77): Signaling Games
  - Game Theory 101 (#78): Separating Equilibrium
  - Game Theory 101 (#79): Pooling Equilibrium
  - Game Theory 101 (#80): Off-the-Path Beliefs
- Reading: Tadelis, Chapter 16.

17. (Aug 11) Reputation

- Asynchronous Material:
  - Game Theory 101 (#81): The Beer-Quiche Game
  - Game Theory 101 (#82): Semi-Separating Equilibrium/Partially-Pooling Equilibrium
- Reading: Tadelis, Chapter 17.

18. (Aug 12) Cheap Talk Signaling

- Reading: Tadelis, Chapter 18.

19. (Aug 13) Review/Catch-up

20. (Aug 14) **No Class.**

- Take-Home Exam Due at 10am.