Syllabus, AS.440.684 (Game theory)

Thursday 6pm-8:45pm, Washington DC Center, room 407

January 28-May 5 (no meeting March 17th)

Course description: Game theory is the foundation of modern microeconomics. The strategic interactions of game theory have been applied to address questions such as:

- How do markets more competitive than monopoly, but less competitive than perfect competition work?
- How will entrants to the labor force differentiate themselves when quality is hard for firms to observe?
- Why does Costco pay an average wage of $21/hour, when it is obvious that this is far more than is necessary to attract competent workers?
- What type of auction generates the most revenue for sellers?
- How can we explain the proliferation of McDonald's and similar restaurants when everyone knows there are better restaurants?
- Are affirmative action policies necessary if it is widely accepted that minority groups have ability equal to majority groups?
- Do soccer players correctly optimize when attempting penalty kicks?

The course will study Nash equilibrium and its refinements, applied to static, dynamic, and repeated games of both complete and incomplete information. As much as possible, we will focus on applications of game theory, such as oligopoly models, job market signalling, adverse selection, bargaining, auctions, efficiency wages, and moral hazard.

Contact info: My name is Jeremy Sandford, and I am an adjunct professor at JHU. I also work for the FTC. Please call me Jeremy. My email address is jsandfo3@jhu.edu. My office phone number is 202-326-2766. My website is jasandford.com. It has a detailed schedule, which I will update after each class, and information on assignments and exams.

Homework: In addition to reading the textbook and reviewing class notes, I expect you to work on solving problems. There will be about 5 collected homework assignments. The grade on these assignments will be based both on correctness of a subset of assigned problems as well as my assessment of the effort you put into the homework.

Some homework problems will be easy, some will be hard. When possible, I encourage you to work in study groups to compare answers and try to reach more correct answers together. Please email me questions you have as you work on the homework assignments.

Exams: There will be one midterm exam and one final exam. The midterm will be on Thursday, March 24, in class. The final exam is Thursday, May 5, in class.

Course materials: The required book is "Game theory for applied economists," by Robert Gibbons. This book is very commonly used for this level of course. If you find yourself struggling with this book, I recommend consulting a second book. "Games of strategy" by Dixit, Skeath, and Reily and "An introduction to game theory" by Osborne are two good undergraduate books that have thorough treatments of most topics we will cover and are each less advanced than the Gibbons book. "Game Theory: An Introduction" by Steven Tadelis is roughly at the same level as the Gibbons book. I find the treatment of game theory in Mas-Collel, Whinston, and Green to be particularly clear, though it is at a somewhat higher level than Gibbons. Any microeconomic theory textbook you own, whether graduate or undergraduate, will have one or more game theory chapters that may be helpful.

There will also be a small number of readings from economics journal articles. Three are listed on this syllabus, while more may be added later.

Grading: Course grades will be determined by a weighting of homework assignments (10%), a midterm exam (40%), and a final exam (50%). I will follow the following distribution: A (80-100%), B (60-80%), C (40-60%), D/F (0-40%), although I may lower cutoffs for certain grades as necessary. In general, the following reflects my beliefs about how performance in a graduate-level class should map to a letter grade:

- **A:** Work suggests a sound understanding of equilibrium concepts and their relevance to applied economics. An A student is well-versed in the applications studied in class, and can explain their relevance, assumptions, and results.
- **B:** Work suggests at least the beginnings of understanding of equilibrium concepts, and the student is at least broadly familiar with applications studied, even if more work is needed to become completely comfortable.
- **C:** Work suggests a fair amount of confusion regarding the models and applications studied in class. A C student has some ability to describe applications and solve for equilibria in simple games, but struggles with masters-level material.
- **D/F:** Work suggests the student does not have even a minimal mastery of concepts and applications studied in class.

Students with Disabilities: The Johns Hopkins University is committed to providing reasonable and appropriate accommodations to students with disabilities. Students in Advanced Academic Programs (AAP) who are in need of accommodations should visit http://advanced.jhu.edu/current-students/current-students-resources/disability-accommodations/ for the appropriate steps and documentation needed. Requesting accommodations before the semester is preferable, but not required. The student should submit the Request for Accommodation Form prior to the beginning of each semester he or she is registered to ensure that accommodations continue for that semester. Depending on the accommodation, there may be a time delay before accommodations can be implemented.

Academic dishonesty: I will pursue the maximum penalty for any cheating on exams.

Topics Covered

1. Nash equilibrium in normal form games (reading: Gibbons, chapter 1)
    - What constitutes a game?
    - Alternative solution concepts: iterated removal of dominated strategies and rationalizability.
    - Motivation for the Nash equilibrium concept.
    - Mixed strategies.
    - Finding Nash equilibria in 3x3 games.
    - Games with infinite strategy sets.
    - Applications: oligopoly models, public goods games, final offer arbitration, evolutionary interpretation of mixed strategy equilibrium.
2. Dynamic games and subgame perfection (reading: Gibbons, chapter 2.1, 2.2, 2.4)
    - Incorporating timing into games.
    - The role of information.
    - Subgame perfect Nash equilibrium.
    - Applications: Stackelberg oligopoly, tournaments, bargaining models with finite and infinite time horizons
3. Repeated games (reading: Gibbons, chapter 2.3)
    - Folk theorems for supportable equilibrium payoffs.
    - Minmax payoffs.
    - Applications: collusion in oligopoly models, efficiency wages
4. Bayesian games (reading: Gibbons, chapter 3)
    - The role of uncertainty.
    - Bayes' rule
    - Bayesian Nash equilibrium
    - Applications: auctions, oligopoly under uncertainty.
5. Dynamic games of incomplete information (reading: Gibbons, chapter 4)
    - Modeling uncertainty in a dynamic setting.
    - Principal of backward induction under uncertainty.
    - Perfect Bayesian equilibrium.
    - Signalling games.
    - The intuitive criterion.
    - Applications: job market signalling, cheap talk, reputation

6. Oligopoly models (reading: Gibbons sections 1.2.A, 1.2.B, 2.1.B, 2.3.C, 3.1.A, a micro theory book of your choice, and Porter, R. (1983), "A study of cartel stability: the Joint Executive Committee, 1880-1886," *Bell Journal of Economics*, 14(2), pp.301-314)
    - Comparing outcomes between perfect competition, monopoly, and oligopoly.
    - Comparing outcomes across oligopoly models.
    - The role of entry.
    - Application: merger analysis, price discrimination,
7. Affirmative action and labor market discrimination (reading: Coate, S. and G. Loury (1993), "Will affirmative-action policies eliminate negative stereotypes?" *American Economic Review*, 83, pp.1220-1240)
    - Statistical discrimination concept.
    - Separating equilibrium (equal workers experiencing unequal outcomes).
    - The role of affirmative action policies.
8. Adverse Selection and moral hazard (reading: Akerlof, G. 1970. "The market for 'lemons': quality uncertainty and the market mechanism," *Quarterly Journal of Economics*, 84(3), pp.488-500)

Each unit will take 1-3 classes. A brief description of each class will be posted to my website, along with any relevant readings or handouts.