POLI 215-01:
Introduction to Game Theory

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Office Hours: TBA
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Class Hours: Monday, 1:30-4:15
Classroom: SSM 150

Course Description

This course is designed to develop a consumer-level knowledge of game theory as a tool of theory development and its applications in political science. The bases of this knowledge will be an understanding of the role of theory in social scientific inquiry; the relationship between assumptions, logic, and predictions; and the implications of strategic behavior for political outcomes. We will focus primarily on noncooperative game theory, including the concepts of Nash equilibrium, subgame perfection and other equilibrium refinements, repeated and infinite-horizon games, and games of incomplete and imperfect information. Sessions will involve first presenting game theoretic techniques and then applying them to specific political questions. Readings will consist of chapters in the assigned text as well as scholarly articles.

There are no formal prerequisites for this course beyond graduate standing. Advanced undergraduates may take this course only with the expressed permission of the instructor. In order to succeed in the course, students should have familiarity with scientific research design and algebra.

Learner-Centered Outcomes

Political Science Learning Objectives (PLOs)

Through the courses and programs of the political science program, students should acquire:

1. An understanding of the processes, theories, and empirical regularities of political institutions and political behavior in the student's chosen emphasis area: American politics, comparative politics, or international relations.

2. An ability to employ critical thinking and demonstrate social scientific literacy, including basic quantitative literacy.

3. A capacity to utilize contemporary social science research methods to conduct rigorous research on political phenomena.

4. Effective written communication skills, especially the ability to convey complex concepts and information in a clear and concise manner.

5. An ability to apply abstract theory and research methods to understand contemporary political events and public policies.

Course Learning Objectives (CLOs)

By the end of this course, students should be able to:

1. describe and understand the role of the tenets of theory-building (PLO 2, 4)
2. identify pure and mixed strategy equilibrium behavior in complete information normal form and extensive form games (PLO 2, 3)
3. identify equilibrium behavior in incomplete information games (PLO 2, 3)
4. use comparative statics analysis to draw implications from a theoretical model (PLO 2, 3, 5)
5. explain how basic permutations in game structure are likely to affect equilibrium behavior and the implications drawn from them (PLO 5)
6. specify a basic game theoretic model derived from established first principles to answer a research question of interest (PLO 3, 4, 5)
7. identify, interpret, and critique the assumptions, logical reasoning, empirical implications, and conclusions of political science research that uses game theoretic models (PLO 1, 2)

Assessment

Grades will be distributed in the following manner:

Problem Sets	40%
Midterm Exam	15%
Final Exam	15%
Paper Proposal	30%

General Expectations *Attendance is required.* Students must participate in class discussions to succeed in this course. If you must miss more than one class meeting, I highly recommend that you speak to me about your prospects for the course. I expect students to have read the Osbourne chapters closely and even have worked through many of the examples before coming to each respective class. I expect students to be prepared to explain the assumptions and logic of all theories and methods in the required substantive readings and critically engage the relative merits and flaws of each piece. Read each item on the required list closely each week, and come to class prepared to pick the readings apart in excruciating detail. I want you to do most of the talking, not me. I understand that much of the assigned readings will be difficult at first reading. It is not sufficient to skip this material, but it is okay if some of it is foreign or difficult. Bring questions to class, and we will wrestle with these concepts together. This course relies heavily on learning by doing, which involves occasional work on the board in front of your colleagues. No one is exempt, and I will do my best to ensure that opportunities to work problems in front of the class are frequent and as equally distributed as possible. Refusal to participate in this fashion will hurt your grade, as well as your ability to perform well on the exams, so the best way to handle this is to simply be prepared.

Problem Sets Each week (except the first), students will be assigned a set of problems to practice applying the technical concepts covered in class each week. The problem sets are absolutely crucial to developing a facility with game theory; it is a set of skills that must be learned, cultivated, and maintained by doing.

Due to the large amount of material, I encourage you to work together on the problem sets, as such joint effort will help you learn from each other in the process of taking the course. However, this does *not* mean that you should divide up the problems. You should attempt all problem sets on your own before coming together to hash out the solutions. If you work together, you should each contribute to the solving of each assigned problem, and each student should write up the solutions themselves. If you do not spend time at least struggling with the exercise, you will not know the material well enough by the end of the class. Also, do not use Mathematica, Maple, or similar software for your assignments. Doing the algebra isn't just about math skills; it's about developing the intuition for what's really going on in the theory (model), and there's no substitute for intuition when it comes to game theory.

For analytical questions, you should include your intermediate steps, as well as comments on those steps when appropriate. You can demonstrate the intuition of your choices by describing how to interpret each step. Your completed problem sets must be extremely legible, and I recommend typing them in a program like LaTeXor Scientific Word, but this is not required. If, however, I cannot read your explanations or your math, you will not receive credit for the problem, and I will start requiring that submissions be typed. I reserve the right to give quizzes if I feel they are necessary, and any quizzes will be incorporated into the homework grade. I will not accept late problem sets (at all) unless you are physically unable to complete the assignment (and that's a big hurdle to clear) or have an emergency that you can verify. If you know that you will be out of town, it is your responsibility to make arrangements to turn the problem set in to me by the specified due date. If a problem set is not accepted, you receive no credit for it.

Two Examinations The exams will include both problems of the sort that are assigned in the weekly problem sets and general questions concerning the applied readings. The exams will be time-limited and closed book.

Paper Proposal Students will submit a short game-theoretic paper. These papers should be no more than 10 double-spaced pages in the main body (i.e., not including title, abstract, or references) with 12-point font and 1-inch margins. It must have a title and an abstract of no more than 150 words. Students are free to choose any topic they want, as long as they have a clear research question that they solve with a formal model. Projects co-authored with another student are generally encouraged.

Students need to meet the following milestones for their project:

1. January & early February: Identify a theoretical or empirical puzzle of interest that includes a strategic tension. Start from whatever political science questions move you. Feel free to email or meet with me to discuss ideas and hone in on that strategic tension.
2. February 16: Submit a proposal for your paper that includes
   (a) the puzzle: a research question, what do people think is the answer, what observation or logic suggests that answer doesn't jibe, what do we need to do to get at that inconsistency.

   (b) the strategic tension: an actor wants something—what prevents them from getting what they want? Why is this a situation that cries out for game theory?
   (c) bullet points of the basic tenets of a model to answer the question
3. April 2: Submit a draft to the professor and all members of the class in which you do the following:
   (a) identify a theoretical or empirical puzzle of interest that identifies a strategic tension
   (b) use a (brief!) motivation section to establish and justify (a) the puzzle or lacuna to be addressed with this paper and (b) the assumptions that will constitute the first principles of your theory
   (c) fully specify a game theoretic model drawn from these first principles that answers the research question
   (d) identify what you think the implications of the model will be if fully solved and justify your expectations
   (e) explain how the theory will contribute to existing relevant scholarship
4. April 4 or so: Paper workshop.
5. May 10: Submit substantially revised and improved final draft of paper. You may, if you like, discuss the solution of the model and/or how you might test the model's implications empirically, paying special attention to the challenges of testing formal theories, but these things are not required. You may put any elements of literature discussion, model proof, etc. that will not fit in the 10-page limit in appendices.

Course Policies

CatCourses Site: I maintain a CatCourses website for this course. Use this site liberally and often. I will post announcements and changes to the home page of the site—keep an eye out. *If a change to the syllabus or requirements is posted in the announcements on this site, you are responsible for those changes.* I will not post any grades on the CatCourses site.

Cell Phones, Laptops, Tablets, Etc.: Cell phones and other distracting devices should be turned off during class and put away. Answering a cell phone or text-messaging during class will result in scowling gaze from me. I strongly recommend taking all class notes by hand, for purposes of practice and internalization. However, you may bring your laptop or tablet to class if you wish. If it turns out that you cannot contribute to discussion with your screen in front of you, I will ask you to turn it off.

Academic Honor Code: Students are assumed to have read and agreed with the University of California, Merced Academic Honesty policy, found at URL: http://studentlife.campuscms.ucmerced.edu/_les/page/documents/academichonestypolicy.pdf. The following is taken verbatim from that document: "Academic misconduct includes, but is not limited to cheating, fabrication, plagiarism, altering graded examinations for additional credit, having another person take an examination for you, or facilitating academic dishonesty or as further specified in this policy or other campus regulations." These and other forms of cheating are all potentially grounds for penalties including failure of the assignment or the course, as well as program- or university-level disciplinary action.

Special Needs: Reasonable accommodation for persons with known disabilities will be made in accordance with section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990. No person with a known disability will be intentionally excluded from

participation in, be denied the benefit of, or otherwise be subject to discrimination under any University policy, program, service, or in relation to employment because of a disability. University programs and facilities are intended to be accessible to persons with disabilities. *Any student who feels he or she may need an accommodation based on the impact of a disability should contact me privately to discuss his or her specific needs.* If you have a disability, but have not contacted the Office of Disability Services, please call (209) 228-7884 as soon as possible to become registered and thereby ensure that such accommodations are implemented in a timely fashion. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students with disabilities must be registered with the Office of Disability Services before receiving academic adjustments. Student responsibilities are listed on the ODS website: http://disability.ucmerced.edu/

If You Need Help: There are many things that you might be dealing with that can hinder your ability to succeed in this course, your college career, and your life. You might be struggling with illness, socioeconomic issues, or personal issues that make it hard to concentrate, to work, or to attend class. If any of these or other things begin to hinder your ability to do your best, you can reach out to the office of the Dean of Students for programs, training, accommodations, and assistance (more information is available here: http://studentaffairs.campuscms.ucmerced.edu/). *If you specifically need help or accommodation in this course due to your difficulties, please come meet with me so we can find a solution that allows you to succeed while being fair to others.*

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate contacts for resources and confidence here: http://prevent-violence.ucmerced.edu/contact

Statement on Diversity: Diversity is defined as that incredible and beautiful variety of personal identities, experiences, values and world views that result from differences of origin, culture and circumstance. We define and appreciate diversity in all of its forms including age, ability or disability, ethnicity, national origin, race, religion, sex, gender, sexual orientation, and family and marital status. In this class, we will actively foster an environment of awareness, appreciation, and intentional inclusivity.

Gender-Inclusive Language and Preferred Names/Pronouns: Language is gender-inclusive and non-sexist when we use words that affirm and respect how people describe, express, and experience their gender. Just as sexist language excludes womens experiences, non-gender-inclusive language excludes the experiences of individuals whose identities may not fit the gender binary, and/or who may not identify with the sex they were assigned at birth. Identities including trans, intersex, and genderqueer reflect personal descriptions, expressions, and experiences. Gender-inclusive/non-sexist language acknowledges people of any gender (for example, first year student versus freshman, chair versus chairman, humankind versus mankind, etc.). It also affirms non-binary gender identifications, and recognizes the difference between biological sex and gender expression. Teachers and students should use gender-inclusive words and language whenever possible in the classroom and in writing. *Students, faculty, and staff may share their preferred pronouns and names, either to the class or privately to the professor, and these gender identities and gender expressions should be honored.*

Syllabus as Contract: This syllabus is a contract to which the student agrees in taking this course. As the instructor, I reserve the right to alter this syllabus according to my discretion, though I

will make every attempt to alert students of any changes made. For my part, I will strive to be fair and transparent in all matters regarding this course.

Office Hours and Email Concerns: Students are encouraged to meet with me during office hours to discuss any questions or concerns they may have, including readings, paper topics, etc. If you cannot meet with me during office hours, please email me to set up an appointment that will work. I will also respond to email concerns, but be reasonable in your expectations of response time—I only check email during business hours on weekdays.

Grading Standards

The following standards will be applied to the evaluation of assignments and course performance for graduate-level credit:

A *Exceptional Performance*

Consistently outstanding work on all course-related tasks at a level that distinguishes the student from other members of the class. A comprehensive and incisive command of the issues, literature, and substantive information relevant to the course. A frequently demonstrated exceptional capacity for original, creative, critical and logical thinking. The ability to master and integrate large amounts of factual material and abstract theories. An outstanding ability to discuss effectively course subject matter using both written and oral communication skills.

A- *Very Good Performance*

Consistently above average work on all course-related tasks. A very good grasp of the issues, literature, and substantive information relevant to the course. A generally demonstrated capacity for original, creative, critical, and logical thinking. A very good command of factual and theoretical material, and some capacity to integrate the two. A solid ability to discuss effectively course subject matter using both written and oral communication skills.

B+ *Good Performance*

Good and generally consistent work on all course-related tasks. A general understanding of the issues, literature, and substantive information relevant to the course. Modest evidence of the capacity for original, creative, critical and logical thinking. A good understanding of factual and theoretical material, but limited evidence of the capacity to integrate the two. A basic ability to discuss effectively course subject matter using both written and oral communication skills.

B *Satisfactory Performance*

Satisfactory work on course-related tasks. A reasonable understanding of the issues, literature, and substantive information relevant to the course. An infrequently demonstrated capacity for original, creative, critical and logical thinking. Understands at a basic level the facts and theories related to the course, but demonstrates weak integration skills. A limited or inconsistent ability to discuss effectively course subject matter using both written and oral communication skills.

B- *Minimal Passing Performance*

Adequate performance on course-related tasks. An understanding of the basic elements of the issues, literature, and substantive information relevant to the course. A rarely demonstrated capacity for original, creative, critical and logical thinking. An inability to go beyond a recitation of basic factual material related to the class. Demonstrated weaknesses in the ability to discuss effectively

course subject matter using both written and oral communication skills.

C *Poor Performance*

Barely acceptable work on course-related tasks. A generally superficial and often inconsistent familiarity with the issues, literature, and substantive information relevant to the course. A failure to demonstrate the capacity for original, creative, critical and logical thinking related to course content. An uneven understanding of basic factual material related to the course; no evidence of fact/theory integration. Demonstrates significant gaps in the ability to discuss effectively course subject matter using both written and oral communication skills.

F *Unacceptable Performance*

Fails to meet minimum course expectations. Unable to understand even the most basic elements of the issues, literature, and substantive information relevant to the course. Demonstrates an inability to engage in coherent written or oral discussion of course material. Does not satisfy specific course expectations with respect to attendance, deadlines, participation, etc.

Schedule

The following books are available for purchase at your preferred book vendor.

- Osborne, Martin J. 2004. *An Introduction to Game Theory.* New York: Oxford University Press.
- Moore, Will H. and David A. Siegel. 2013. *A Mathematics Course for Political & Social Research.* First edition. Princeton University Press: Princeton, NJ.

♢ Thomson, William. 2011. *A Guide for the Young Economist. 2nd Edition.* Cambridge: MIT Press. *Recommended.*

All readings marked with a dot (•) are available electronically on CatCourses or through the library's electronic journal holdings accessible through the Melvyn search; those marked with a star (⋆) are from the required texts; and those marked with a diamond (♢) are recommended.

I expect that you will have completed the readings before the sessions for which they are assigned. Falling behind in this course is never, ever easily overcome.

January 22: Introduction to Rational Choice and Game Theory

Overview of the course, define game theory and rational choice, debate the value of each for social science.

- Syllabus
- Aumann, Robert. 1985. "What Is Game Theory Trying to Accomplish?" Chapter 1 in Arrow, K. and Honkapohja, S. *Frontiers of Economics.* Oxford: Basil Blackwell. *Read pages 5-17. Will finish the chapter in week 3.*
- Wagner, R. Harrison. 2001. "Who's Afraid of Rational Choice Theory?" http://hw.webhost.utexas.edu/papers/rct.pdf
- Myerson, Roger B. 1992. "On the value of game theory in social science." *Rationality and Society,* 4: 62-73. *Read only to page 69.*

- Quackenbush, Stephen L. 2004. "The Rationality of Rational Choice Theory." *International Interactions* 30: 87-107.
- Servedio MR, et al. (2014) "Not just a theory: The utility of mathematical models in evolutionary biology." PLOS Biology 12(12): e1002017.

Students must read the following for use when writing their paper proposals, but we will not discuss these readings in class.

- Varian, Hal R. 1997. "How to build an economic model in your spare time." In Michael Szenberg, editor, *Passion and craft: Economists at work.* University of Michigan Press. http://people.ischool.berkeley.edu/~hal/Papers/how.pdf

January 29: No class meeting

Research presentation at the University of Wisconsin - Madison.

Read Chapters 1-4 of the Moore and Siegel math text, and complete homework 1 to refresh your math skills.

February 5: The Theory of Choice

Homework 1 due.
Rationality, preferences, utility functions, and expected utility. Define institutions and discuss how they influence decision-making. Decision-theoretic vs strategic games. A rundown of the major concepts of noncooperative game theory.

- ⋆ Osbourne, Chapter 1.
- Morrow, James. 1994. *Game Theory for Political Scientists.* Princeton: Princeton University Press. Chapter 2: Utility Theory, pp. 16-50.
- Tsebelis, George. 1989. "The Abuse of Probability in Political Analysis: The Robinson Crusoe Fallacy." *American Political Science Review* 83(1): 77-91.

Recommended:

- ♢ Rubinstein, Ariel. 1991. "Comments on the interpretation of game theory." *Econometrica,* 59: 909-924.

February 12: Nash Equilibrium I

Homework 2 due.
Introduction to strategic/normal form games, Nash equilibria, best response functions, multiple equilibria, dominance, symmetric equilibria. Explain the structure of simple cooperation games: Prisoner's Dilemma, Stag Hunt, Bach/Stravinsky.

- ⋆ Osbourne, Chapter 2.
- Aumann, Robert. 1985. "What Is Game Theory Trying to Accomplish?" Chapter 1 in Arrow, K. and Honkapohja, S. *Frontiers of Economics.* Oxford: Basil Blackwell. *Read pages 18-28.*
- Chapter 6, "Prisoner's Dilemma," in Poundstone, William. 1992. *Prisoner's Dilemma.* New York: Anchor Books.

- Chapter 1, "The Stag Hunt," in Skyrms, Brian. 2004. *The stag hunt and the evolution of social structure*. New York: Cambridge University Press.
- Hardin, Garrett. 1968. "The tragedy of the commons." *Science*, 162(3859): 1243-48.

Recommended:

◇ Myerson, Roger B. 1999. "Nash Equilibrium and the History of Economic Theory." *Journal of Economic Literature*, 37: 1067-1082.

February 19: No class meeting

Presidents' Day.

February 26: Nash Equilibrium II

Homework 3 due.
Email Dr. Ritter with description of the puzzle and the research question of your paper proposal by start of class.
Applications of Nash, Nash equilibria with continuous functions.

⋆ Osbourne, Chapter 3.

- Clinton, Robert Lowry. 1994. "Game Theory, Legal History, and the Origins of Judicial Review," *American Journal of Political Science* 38: 285-302.
- Snidal, Duncan. 1985. "Coordination versus Prisoner's Dilemma: Implications for International Cooperation and Regimes." *American Political Science Review* 79(4): 923-942.

March 5: Mixed Strategy Equilibrium

Randomization, von Neumann-Morgenstern utility functions, the formation of player's beliefs, continuous choice.

⋆ Osbourne, Chapter 4

- Myerson, Roger B. 1992. "On the value of game theory in social science." *Rationality and Society,* 4: 6273. *Read pages 69-73.*

March 12: Extensive Form Games I

Homework 4 due.
Backward induction, subgame perfect equilibrium.

⋆ Osbourne, Chapter 5, 6.1 & 6.3

March 19: Extensive Form Games II

Homework 5 due.
Simultaneous and chance moves.

⋆ Osbourne, Chapter 7

- Ritter, Emily Hencken. 2014. "Policy Disputes, Political Survival, and the Onset and Severity of State Repression." *Journal of Conflict Resolution* 58 (1): 143-168.

To Be Scheduled: **Midterm Exam**

March 26: **Spring Break**

No class.

April 2: Bayesian Games in Normal Form

***Complete draft of paper proposal due**: Circulate your draft by email to all students and Dr. Ritter.*
Incomplete information in a normal form game, Bayes's Rule.

- ⋆ Osbourne, Chapter 9

April 4: Paper draft workshop

We will decide in advance on a mutually acceptable time and meeting place to have a paper workshop. Your participation is highly recommended, but it is not required. All students should read one another's papers. Any participants in the workshop will not introduce their paper, but instead we will open the floor for comments as to (a) what the author does well in the draft, so they know what to keep, and (b) what the author could improve, from your perspective. Reading each other's papers and working to improve them as a group should make your paper much better. I will attend and participate in this workshop but will not lead it.

April 9: Extensive Form Games III

Homework 6 due.
Extensive games with incomplete information, signaling models.

- ⋆ Osbourne, Chapter 10
- Fearon, James D. 1997. "Signaling Foreign Policy Interests: Tying Hands versus Sinking Costs." *Journal of Conflict Resolution* 41(1): 63-90.

April 16: Repeated Games I

Homework 7 due.
Nash equilibrium in repeated games, finitely and infinitely repeated Prisoner's Dilemma

- ⋆ Osbourne, Chapter 14
- ⋆ Axelrod, Robert. 1980. "Effective Choice in the Prisoner's Dilemma." *The Journal of Conflict Resolution.* 24 (March): 3-25.

April 23: Repeated Games II

Homework 8 due.
More on repeated games, imperfect observability.

- ⋆ Osbourne, Chapter 15
- Milgrom, Paul, Douglass North, and Barry Weingast. 1990. "The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs," *Economics and Politics* Chapter 2.

April 30: Bargaining

Bargaining games: alternating offers, ultimatum games.

- ⋆ Osbourne, Chapter 16
- ⋆ Muthoo, Abhinay. 2000. A Non-Technical Introduction to Bargaining Theory. *World Economics* 1(2): 145-166.

RESCHEDULE: Implications of Formal Models

Homework 8 due.

RESCHEDULE: Computational Models

May 8, 11:59 pm Pacific Time

Final Draft of Paper Proposal due.

May 9-13: Final Exam Week