Syllabus for Introduction to Game Theory

Semester: Spring 2020	Craig School of Business, Department of Economics, Fresno State
Course: ECON 189T Introduction to Game Theory, Section 01	*Instructor:* Kevin W. Capehart, Ph.D.
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Website: https://classroom.google.com	*Office hours:* Tues. & Thur. 10:50am to 12:20pm

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Course description

Welcome to this course on game theory! **Game theory** is the multidisciplinary study of situations that are *strategic* in the following sense. A strategic situation is any situation with two or more players in which a player's payoff depends on not only their own strategy but also on the strategies of other players and, as such, a player's strategy should depend on other players' strategies or expectations thereof. We need to learn some game theory before we can fully appreciate that definition, but intuitively speaking, you and I are in a strategic situation if my payoff depends on not only *what I do* but also on *what you do* and, as such, *what I should do* depends on *what you do* or *what I think you'll do*.

Most of the models you learned in principles of microeconomics—except game-theoretic ones like models of oligopoly—try to assume away any strategic interaction. For example, you'll recall that a perfectly competitive firm takes market prices as given and chooses its optimal level of production under the assumption that it could produce as much or as little as it wants without affecting market prices. Finding the firm's optimal production level can be a bit involved, as you'll know if you remember some of the graphs from principles of micro or if you've taken intermediate micro, but that optimization problem doesn't involve any consideration of how households or other firms might act or react. To the extent there's any strategic interaction in perfectly competitive markets, it's always mediated through market prices.

Non-strategic microeconomic models are simple, but as generations of students have recognized until their instructors have persuaded them to suspend their disbelief, those models are unrealistic partly because they've abstracted away from strategic interactions. In contrast, the models of oligopolistic firms from your principles of micro course explicitly model interaction between firms. An oligopolistic firm sets the price of its good or the quantity of its production, but the firm's profit also depends on what other firms do, so the firm's decision about its pricing and production depends on other firms' decisions. An oligopolistic market is only one example of a strategic situation, of course. Strategic situations abound.

Due to the abundance of situations that can be seen as strategic, game theory is a multidisciplinary subject. Disciplines that study game theory include economics, other social sciences like political science, and physical sciences like biology. Depending on the discipline, the "players" and other elements of a game may be given very different interpretations. In biological applications of game theory, for example, a "player" could be a single gene, a single-cell organism, more complex life forms, or even an entire species.

In economic applications of game theory, players are traditionally assumed to be "rational" actors like the profit-maximizing firms and utility-maximizing households you met in principles of micro. Studying how fully, perfectly, unboundedly "rational" players should behave in strategic situations is one of the major branches of game theory we'll focus on. We'll call that branch "**traditional game theory**." That branch often involves mathematical formulations of games, and it's almost always preoccupied with studying the existence of any equilibriums in a game.

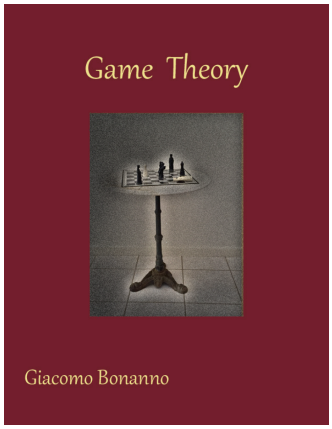
In addition to studying traditional game theory, we'll go beyond it. In particular, we'll explore "**behavioral game theory**," which is a largely experimental branch of game theory that studies how ordinary human beings—who may not behave in the same way as "rational" actors—behave in strategic situations. You are an ordinary enough human being, as far as I'm aware, so choices you make in strategic settings will help us explore behavioral game theory.

We'll also study "**evolutionary game theory**." For that branch of game theory, we don't necessarily assume that players select strategies by thinking and making decisions; instead, we assume that players pursuing successful strategies will tend to be selected for and players pursuing unsuccessful strategies will tend to be selected against as part of an evolutionary process. Biological applications of game theory are often evolutionary, but many economic situations can be seen as evolutionary if we dispense with the assumption of full, perfect, unbounded rationality. Evolutionary games lend themselves well to computer simulation, so we'll see computational versions of some of those games.

By studying game theory—in its traditional, behavioral, and evolutionary forms—you'll obtain new perspectives on the behavior of *Homo Economicus* and ordinary humans in strategic situations.

Required textbook

The required textbook for this course is *Game Theory* by University of California-Davis Economics Professor Giacomo Bonanno. That textbook is an open-access educational resource, so an electronic copy is freely available online as a PDF via the following link: <http://faculty.econ.ucdavis.edu/faculty/bonanno/GT_Book.html>. A hard copy of our book is also available in two volumes via that same link. I neither require nor recommend that you purchase a hard copy, but you can do so if you'd prefer it. All other course materials will be provided to you. Everyone in our class will also share one copy of the PDF of our textbook using the free Perusall collaborative reading platform, which you should immediately register for by following the instructions provided on our Google Classroom. I'll use that shared copy to emphasize and de-emphasize some parts of the textbook.



Our textbook

Prerequisites

The prerequisites for this course are ECON 40 "Principles of Microeconomics" and ECON 50 "Principles of Macroeconomics." In addition to those formal prerequisites, you should also have: an interest in studying game theory; a willingness to dedicate time and energy to your studies; and a desire to be an active participant in the learning community we'll create over the semester. If you have any concerns about your level of preparation for this course, then you should consult with me as soon as possible.

Course goals

By the end of this course, you should understand the following essential concepts. You should understand:

● Essential elements of any game—players, strategies, and payoffs
● Classic games—Battle of the Sexes, Chicken, Stag Hunt, Prisoners' Dilemma, and more
● Equilibriums—pure- and mixed-strategy Nash and subgame-perfect and more, oh my!
● Evolution of cooperation—why can't we all just get along?
● Game theory in the real world—what actually happens in the real world?

Student learning objectives

By the end of this course, you should be able to demonstrate the following essential competencies. You should be able to:

● Take real-world situations and describe them as simple games
● Use traditional game theory to analyze classic games and extensions to them
● Describe insights offered by behavioral and evolutionary game theory
● Critically evaluate the relevance of simple games to real-world situations

University policies

University policies apply to all courses, including this one. For university policies on adding and dropping classes, cheating and plagiarism, computers, copyright, disruptive classroom behavior, the honor code, students with disabilities, and Title IX, see the following link: <http://www.fresnostate.edu/academics/curriculum/instruction/policies.html>. It is your responsibility to know those university-wide policies as well as the course-specific policies detailed below.

Course policies

The other policies that apply to this specific course are as follows.

Grading

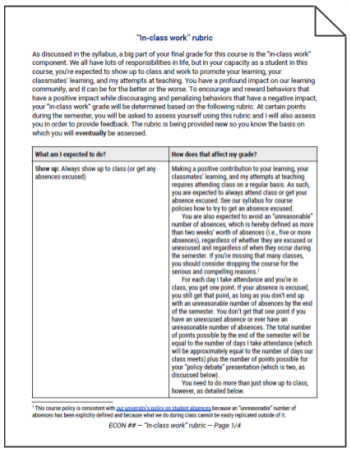
Your final grade for this course will be based on the following five components.

1. Homework
2. In-class work
3. First midterm exam on **Thur., Feb. 20th** during our normal class period
4. Second midterm exam on ~~Tues., March 24th during our normal class period~~ ***EDIT: April 2nd***
5. Final exam on **Tues., May 12th** at its scheduled time ***EDIT: And also a wider window around our scheduled day and time. See "Alternative Instruction Plan"***

Each component will be equally weighted (i.e., count towards 20% of your final grade).

The **homework** component of your final grade will be determined based on the large number of homework assignments we'll do over the semester. All homeworks will be assigned and submitted through our Google Classroom. Each assignment will be relatively short, due at least 15 minutes before our next class after it's assigned, and count equally towards your homework grade. The homeworks will help you stay engaged with our class and prepare for exams.

The **in-class work** component of your final grade will be determined based on the rubric that can be found via the following link: <http://bit.ly/2R170gB>. That component of your grade is meant to encourage and reward behaviors that have a positive impact on your learning, your classmates' learning, and my attempts at teaching while discouraging and penalizing behaviors that have a negative impact on your learning, your classmates' learning, and/or my attempts at teaching. See the rubric linked to above for exactly how your in-class work grade will be determined, but showing up to class, participating in in-class activities, and other behaviors are what you'll need to do in order to do well in that component of your final grade and in this course overall.



"In-class work" rubric

As discussed in the syllabus, a big part of your final grade for this course is the "in-class work" component. We all have lots of responsibilities in life, but in your capacity as a student in this course, you're expected to show up to class and work to promote your learning, your classmates' learning, and my attempts at teaching. You have a profound impact on our learning community, and it can be for the better or the worse. To encourage and reward behaviors that have a positive impact while discouraging and penalizing behaviors that have a negative impact, your "in-class work" grade will be determined based on the following rubric. At certain points during the semester, you will be asked to assess yourself using this rubric and I will also assess you in order to provide feedback. The rubric is being provided now so you know the basis on which you will **eventually** be assessed.

What am I expected to do?	How does that affect my grade?
Show up: Always show up to class (or get any absences excused)	Making a positive contribution to your learning, your classmates' learning, and my attempts at teaching requires attending class on a regular basis. As such, you are expected to always attend class or get your absence excused. See our syllabus for course policies how to try to get an absence excused. You are also expected to avoid an "unreasonable" number of absences, which is hereby defined as more than two weeks' worth of absences (i.e., five or more absences), regardless of whether they are excused or unexcused and regardless of when they occur during the semester. If you're missing that many classes, you should consider dropping the course for the serious and compelling reasons.[1] For each day I take attendance and you're in class, you get one point. If your absence is excused, you still get that point, as long as you don't end up with an unreasonable number of absences by the end of the semester. You don't get that one point if you have an unexcused absence or ever have an unreasonable number of absences. The total number of points possible by the end of the semester will be equal to the number of days I take attendance (which will be approximately equal to the number of days our class meets) plus the number of points possible for your "policy debate" presentation (which is two, as discussed below). You need to do more than just show up to class, however, as detailed below.

[1] This course policy is consistent with our university's policy on student absences because an "unreasonable" number of absences has been explicitly defined and because what we do during class cannot be easily replicated outside of it.

ECON ### — "In-class work" rubric — Page 1/4

In-class work rubric

The **three exams** will be given on the dates and times listed above. The exams will all be multiple choice with questions similar to the ones you'll answer for your homework assignments and in-class activities. Each exam will be comprehensive but focus on more recent material.

At the end of the semester, you will have earned some percentage of the total points possible. Final letter grades will be assigned as follows based on that percentage.

A: 90 to 100 percent of the total points possible
B: 80 to 89 percent
C: 70 to 79 percent
D: 60 to 69 percent
F: 59 percent or less

Attendance

Attendance at all classes is required, but absences can be excused, and excused absences will not hurt your grade, unless you miss an unreasonable number of classes over the semester (as detailed in the "in-class work" rubric linked to above). Unexcused absences hurt your grade, as detailed in that same rubric.

To try to get an absence excused, you must submit an "Absence Notification Form" via our Google Classroom site or the following link: <http://bit.ly/2Fkzvlp> (Fresno State login required). You must do that *as soon as possible before an expected absence* and *as soon as possible after an unexpected absence*. If you do that, then I will generally excuse your absence without question, but I reserve the right to request you provide documentation justifying both your absence and any delay in informing me of it. Failure to promptly provide requested documentation will result in an unexcused absence. I will automatically request documentation if you're missing classes at the beginning of the semester, if you demonstrate a record of poor attendance as the semester progresses, or if you miss exams or student presentations.

Late homework assignments

An excused absence is *not* an extension for any homework assignments, so any homeworks that are due must always be submitted by the deadline to do so, unless I explicitly grant you an extension. The penalty for late assignments goes up as the semester goes by; late assignments receive partial credit equal to the percentage of weeks remaining in our 17-week semester with zero credit for assignments submitted during the week of final exams or thereafter. If you believe you should not be penalized for turning in an assignment late because of unexpected circumstances, then you must provide documentation to me justifying the delay in turning in the assignment.

Missed in-class activities

Over the semester, we will do "in-class activities," which are activities we do in class. You need to be in class to do them, they cannot be done outside of class, and they cannot be made up. Some will be pre-announced; others will not. Those activities affect your "attendance, participation, and professionalism" grade, as detailed in the rubric linked to above.

Make-up exams

If you miss an exam, you will receive zero points for the exam if your absence is unexcused. If your absence is excused, we will try to arrange a make-up exam as quickly as possible.[1]

Plagiarism detection consent

Our university subscribes to the Turnitin and SafeAssign plagiarism detection services. By enrolling in this course, you agree to allow me to submit your work to those services for plagiarism detection purposes. The reports generated by the services will not be made available for your viewing, unless an issue arises.

Lecture capture consent

I hereby grant students enrolled in this course the right to record the audio of my lectures for—and only for—their own personal use in their study and preparation related to the class. By enrolling in this course, you acknowledge that audio of you speaking could incidentally be recorded during class if your classmates are recording the audio of my lecture, and you grant your classmates permission to record that incidental audio for—and only for—their own personal use in their study and preparation related to the class. By enrolling in this course, you also grant me the right to record the audio of my lecture, as well as any incidental audio from you during class, and to share that recording for educational purposes.

Support services

Our campus has developed SupportNet (<http://fresnostate.edu/studentaffairs/lrc/supportnet/students.html>) to connect students with campus resources promoting academic success. I have agreed to participate in that program and will refer you to it if I believe you would benefit from its services.

[1] If we cannot arrange a make-up exam in a timely manner, then here's the "fine print" on what we'll do. If the missed exam was a midterm, your exams will be reweighted so the final counts for the missing exam(s). If the missed exam was the final, you'll receive an incomplete grade for the course if you've earned at least two-thirds of the points possible for all other components of the course. You'll receive zero points for the final if you fail to meet that criterion because, per university policies, such students cannot receive incomplete grades. Like all course policies, I've designed this policy so I can apply it fairly without arbitrariness or capriciousness.

Course schedule

A schedule for our course that includes topics to be discussed, related readings from our textbook, and major grading events is given below. The topics to be discussed on any given day may change, but you will be fully aware of any changes to the topics discussed if you attend class and/or consult our Google Classroom.

Week	*Tuesday*	*Thursday*
1	**Jan 21:** Intro to game theory [ch. 1] / Essential elements of a game—players, strategies, & playoffs [sec. 2.1] / Simultaneous-move games & payoff matrices	**Jan 23:** "Dominant-strategy" equilibriums—does each player have a dominant strategy? [sec. 2.2] / "Iterated-dominance" equilibriums—I don't have a dominant strategy, but do you? [sec. 2.5]
2	**Jan 28:** "Pure-strategy Nash" equilibriums—do any players have any incentive to unilaterally switch their strategy? [sec. 2.6]	**Jan 30:** Some classic simultaneous-move games—Battle of the Sexes, Chicken, Stag Hunt, & Prisoners' Dilemma [sec. 2.2, p. 499]
3	**Feb 4:** More on the Prisoners' Dilemma—what's good for me and good for you is bad for us! [sec. 2.2]	**Feb 6:** Sequential-move games, game trees, backward induction, & "subgame perfect Nash" equilibriums [ch. 3]
4	**Feb 11:** More on sequential-move games, including Entry Deterrence games [sec 3.4], Ultimatum, Dictator, & Centipede	**Feb 13:** Cournot, Bertrand, & Stackelberg duopoly models as game theory [sec. 2.7]
5	**Feb 18:** Game performances / Review for first midterm exam	**Feb 20:** **FIRST MIDTERM EXAM**, which'll focus on pure-strategy equilibriums in one-shot, simultaneous- and sequential-move games between rational players
6	**Feb 25:** Probability, expected value, & "mixed" strategies [sec. 6.2] / "Mixed-strategy" Nash equilibriums—what do you have to do to make me indifferent between my pure strategies? [sec. 6.3]	**Feb 27:** "Mixed-strategy" Nash equilibriums, cont'd
7	**Mar 3:** "Mixed-strategy" Nash equilibriums, cont'd / Repeated games	**Mar 5:** Playing again and again—finitely, infinitely, & indefinitely repeated games
8	**Mar 10:** Simulation-based approaches to cooperation & conflict in repeated version of the Prisoners' Dilemma	**Mar 12:** Simulation-based & analytical approaches to evolutionary game theory
9	~~**Mar 17:** Evolutionary game theory, cont'd~~ ***EDIT: Instructional pause***	~~**Mar 19:** Review for second exam~~ ***EDIT: Instructional pause***

10	**~~Mar 24:~~** ~~**SECOND MIDTERM EXAM,** which'll focus on mixed-strategy equilibriums in one-shot games between rational players, repeated games with rational-and-non-rational players, and evolutionary game theory~~ ***EDIT: See "Alternative Instruction Plan" for a calendar that supersedes this one.***	**~~Mar 26:~~** ~~Guest lecture~~
11	~~*Mar 31: No classes (Cesar Chavez day)*~~	**~~April 2:~~** ~~Online activity in lieu of physically meeting during normal class time~~
	~~*April 7: No classes (Spring break)*~~	~~*April 9: No classes (Spring break)*~~
12	**~~April 14:~~** ~~More simulations of strategic situations—Hotelling's law, Schelling's segregation model, & the Peter principle~~	**~~April 16:~~** ~~Incomplete information games & "Bayesian Nash" equilibriums [chs. 14, 15, 16]~~
13	**~~April 21:~~** ~~Incomplete information, cont'd~~	**~~April 23:~~** ~~Bargaining / More fun & games~~
14	**~~April 28:~~** ~~Game performances~~	**~~April 30:~~** ~~More fun & games, cont'd / Start to review for final exam~~
15	**~~May 5:~~** ~~Last day of scheduled instruction / More review for final exam~~	~~*May 7: No classes (Reading day)*~~
16	**May 12:** **FINAL EXAM**, which will be held at its scheduled day and time ***EDIT: And also a wider window around that time. See "Alternative Instruction Plan"***	

Note we'll do an **online activity on April 2nd in lieu of physical meeting during our normal class time.**

Subject to change statement

Our university recommends that the following statement appear on all syllabi: "This syllabus is subject to change in the event of extenuating circumstances."