

Grinnell College  
Economics 338  
Spring 2020

Bill Ferguson  
HSSC S 3364  
Ext. 3132  
Ferguso1@grinnell.edu

*Office Hours:* Tues & Thurs 2-5, and by appointment

### **Syllabus: Applied Game Theory**

Game theory offers a set of analytical tools that allow us to formally conceptualize and model strategic interactions among interdependent agents (individuals or organizations) who share awareness of their interdependence. As such, game theory offers foundations for modeling a broad range of relationships investigated by disciplines ranging from biology to economics, sociology, and political science. For example, game theory has significantly expanded the domain of theoretical modeling in economics by allowing precise specification along two related dimensions: (i) traditional economic tradeoffs faced by individuals (e.g., the tradeoff between allocating one's time between labor and leisure), and (ii) strategic responses to anticipated actions of others who share similar anticipation (e.g., Boeing's decision concerning possible research and development for a new airplane depends, in part, on their anticipation of similar decisions made by Airbus, realizing that Airbus makes similar strategic calculations). On a larger scale, simultaneous consideration of tradeoffs and strategic interdependence facilitates a deeper understanding of how social and political dynamics underlie, frame, or otherwise affect economic decisions and processes. Likewise, strategic analysis helps us understand how economic outcomes influence relevant social and political dynamics. This course will develop fundamentals of game-theoretic modeling using visual representation (diagrams, graphs, and game matrices) along with equations, with an emphasis on intuitive technique and direct application to examples from economics, politics, political economy, social encounters, biology, sports, and even everyday life.

### **COURSE POLICIES**

#### **Class Meetings and Etiquette**

Class meets Monday, Wednesday, Friday, 11:00 to 11:50. We start at 11:00 sharp! I expect students to attend class and arrive on time. Please plan to stay in the room for the entire class period (only 50 minutes), unless you are uncomfortable. Please TURN OFF your cell phones. I do not want you to even know that you received a text message! Please do not use laptops without my permission. Laptops are distracting and studies show that handwritten notes improve memory.

#### **Inclusivity and Accommodation for Disabilities**

At Grinnell, we strive to create fully inclusive classrooms. The college offers reasonable accommodations for students who observe religious holy days. Please contact me in advance to discuss specific instances that apply to you. I welcome individual students to approach me about distinctive learning needs. Grinnell College makes reasonable accommodations for students with documented disabilities. I encourage students with documented disabilities, including invisible or non-apparent disabilities such as chronic illness, learning disabilities, and psychiatric disabilities, to discuss reasonable accommodations with me. You will also need to have a conversation about and provide documentation of your disability to the Coordinator for Student Disability Resources, John Hirschman, located on the 3rd floor of Goodnow Hall (x3089).

## Assignments and Grading

There will be two in-class exams, one six-page paper, and a final exam. The mid-terms are each worth about 13% of the grade; the paper is worth about 17% and the final is worth about 26. All of these jointly will constitute about 70% of the grade. In addition, students will give a few oral presentations, including group presentations on four final chapters of the main text. Oral presentations, class participation, including attendance, and about 10 problem sets will jointly count for about 25% of the grade. For the paper and presentations, I encourage students to use the [Writing Lab](#) (HSSC N3129). In one-on-one sessions, students can get feedback as they brainstorm ideas, strengthen arguments, choose and analyze evidence, focus paragraphs, craft introductions and conclusions, rewrite sentences, organize and revise whole drafts, plan presentations, and more.

**Late work:** The paper must be turned in on time. Problem sets turned in late receives a grade deduction.

**Absence:** Attendance is *required* for all classes. For sports absence, give me advanced notice. For all absences, excused or unexcused (hopefully none of those), students should email me written answers to the discussion questions for the day(s) missed (before the next class is OK). These answers can raise a day's participation score above zero (the score for not doing so), but they are not equivalent to attending class. It is YOUR responsibility remember to email me your answers to discussion questions.

## Readings

Required (at book store; available on Amazon; get these by the first day!):

- Avinash Dixit, Susan Skeath, and David Reiley, Jr., *Games of Strategy*, **Fourth** Edition, New: W.W. Norton, **2015**. (Hereafter DSR)
- Avinash Dixit and Barry Nalebuff, *The Art of Strategy: A Game Theorists' Guide to Success in Business and Life*, New York: W.W. Norton, **2008**. (Hereafter D&N)

Optional, at book store (chapters also on e-reserve):

- Robert Gibbons, *Game Theory for Applied Economists*, Princeton, N.J.: Princeton University Press, 1992, chapter 1 (also on e-reserve) and selections from chapter 2.

On e-reserve:

- Samuel Bowles, *Microeconomics: Behavior, Institutions and Evolution*, Princeton, N.J. Princeton University Press, 2004, selected pages.
- Selections from Dixit and Skeath *Games of Strategy*, Second Edition (2004).
- Selections from Ferguson, *Collective Action and Exchange: A Game-Theoretic Approach to Contemporary Political Economy*, Stanford, CA: Stanford University Press, 2013
- Selections from Milgrom and Roberts *Economics, Organization and Management*, Englewood Cliffs, NJ: Prentice Hall, 1992

Dixit, Skeath, and Reiley (hereafter DSR) is the key text for this course. Dixit and Nalebuff (hereafter D&N) offers an intuitive discussion of many game theoretic principles, stressing stories and applications. Gibbons offers a more formal treatment focused on economics.

## Course Outline

### I. CONCEPTUALIZING STRATEGIC INTERDEPENDENT BEHAVIOR

Game Theory is central to understanding the dynamics of life forms in general, and humans in particular. Living creatures not only play games but also dynamically transform the games they play and have thereby evolved their unique identities. –Herbert Gintis (2009)

1. Illustrations of games, types of games, elements of games:  
*DSR Chapters 1 & 2; D&N Chapter 1*

### II. FOUNDATIONS OF CLASSICAL GAME THEORY

#### A. Basic Concepts

1. Sequential games with complete information:
  - *DSR Chapter 3; D&N Chapters 2; Gibbons, 2.1A*
2. Simultaneous games with discrete pure strategies:
  - *DSR Chapter 4; D&N, Chapters 3-4; Gibbons, through 1.1*

#### B. Elaborations and Complications of Basic Games

1. Continuous strategies:
  - *DSR Chapter 5; Gibbons, 1.2A, 1.2B, 2.1B*
2. Combining sequential and simultaneous games:
  - *DSR chapter 6; Gibbons, 2.4*
3. Mixed strategies:
  - *DSR chapter 7; D&N chapter 5; Gibbons, 1.3A*

### First Hour Exam: Monday, Feb. 24

### III. IMPORTANT CATEGORIES OF GAMES

#### A. Games with Imperfect and Asymmetric Information: week 6

*But without institutional constraints, self-interested behavior will foreclose complex exchange, because of the uncertainty that the other party will find it in his or her interest to live up to the agreement. The transaction cost will reflect the uncertainty by including a risk premium, the magnitude of which will turn on the likelihood of defection by the other party and the consequent cost to the first party. Throughout history the size of this premium has largely foreclosed complex exchange and therefore limited the possibilities of economic growth. – Douglass North, 1990 (awarded Nobel Prize in economics in 1993 for his work on economic history; italics are mine).*

*Competition among agents. . . has merit solely as a device to extract information optimally. Competition per se is worthless. – Bengt Holmstrom, 1982 (an economist)*

Asymmetric information theory underlies many contemporary developments in economic theory and political economy related to contracting, incentives, enforcement, and—as the

first quotation above indicates—institutional preconditions for economic growth and development. In the past 15 years, several Nobel prizes in economics have recognized key developments in the economics of incomplete information. This section of the course addresses questions such as: how much private information will strategic players reveal? When will they choose deception? How can players interpret signals from others and how might they screen for reliable information?

- *DSR chapter 8; chapter 13, selections; D&N, chapter 8*

## B. Strategic Moves and Credibility: week 7

*When you surround an army, leave an outlet free.* – Sun Tzu

*Upon his arrival in Cempoalla, Mexico, he [Cortés] gave orders that led to all but one of his ships being burnt or disabled.* – Avinash Dixit and Barry Nalebuff, 1991

When, prior to entering a game, a player can predict game outcomes that would be disadvantageous, that player can sometimes (in what is called a pre-game) manipulate rules of that game to alter outcomes to the player's advantage. To do so, a player may engage in commitments, threats, or promises. Yet to be effective, such moves need to be credible—an often difficult requirement. By analyzing possibilities for strategic manipulation along with underlying issues of credibility and potential failure, we gain insight into exercises of power within the economic, political, and social spheres of human interaction.

- *DSR chapter 9; D&N, chapters 6 and 7; Gibbons, 2.4*

## C. Repeated Prisoner's Dilemma Games and Collective-Action Problems: weeks 8 - 9

*What is missing from the policy analyst's tool kit – and from the set of accepted, well-developed theories of human organization – is an adequately specified theory of collective action whereby a group of principals can organize themselves voluntarily to retain the residuals of their own effort.* – Elinor Ostrom (Awarded Nobel Prize in Economic Science, 2009)

*A good part of social organization—of what we call society—consists of institutional arrangements to overcome these divergences between perceived individual interest and some larger collective bargain.* – Thomas Schelling (Awarded Nobel Prize in Economic Science, 2005)

The Prisoners' dilemma game offers intuitive illustrations of various potential divergences between individual self-interest and group wellbeing, called collective-action problems. We will consider possible resolutions to such problems, via an expectation of repeated contact, possible rewards or punishments, leadership, and other mechanisms. Multi-player games—prisoners' dilemmas, chicken, or assurance—can illustrate large-scale collective-action problems.

- *DSR chapters 10 and 11; D&N, chapters 3, 9; Gibbons, 1.2D and 2.3; Bowles, pp. 27-31.*

## D. Evolutionary Game Theory: weeks 10 - 11

*Eventually one way of doing things drives out others, not because it is inherently better, but because historical circumstances gave it an early lead that allowed it to pull ahead of the rest. – Peyton Young*

*Both evolutionary game theory and models of cultural evolution describe the interactions of adaptive agents, eschewing both the zero intelligence agents of the standard biological models and the highly cognitive agents of classical game theory. Adaptive agents adopt behaviors in a manner similar to the way people come to have a particular accent. . . Thus individuals are the bearers of behavioral rules. Analytical attention is focused on the success or failure of these behavioral rules themselves as they either diffuse and become pervasive in a population or fail to do so and are confined to minor ecological niches or are eliminated. . . A key idea here is that the institutional and behavioral characteristics of individuals and societies that we commonly observe are those that have been copied and diffused – in short, replicated – while competing rules, beliefs, and preferences have suffered extinction (or have been replicated only in marginal niches). – Samuel Bowles, 2004*

Evolutionary game theory facilitates analyzing dynamic strategic adaptation in a manner that does not require that agents possess the conceptual abilities of standard rational calculation; yet evolutionary game theory can generate, and sometimes strengthen, refine, refute, or extend traditional game-theoretic findings. Evolutionary game theory applies not only to biology, but also to social, political, and economic interactions in which various cultural mechanisms—such as education and imitation—transmit (i.e., reproduce) strategies and behavioral patterns across individuals and groups. Strategies that appear to be successful transmit more readily than apparent failures. People like to imitate practices that generate good results. A form of evolutionary selection thus applies to many social, political, and economic processes.

- *DSR, chapter 12*

### **Second Hour Exam: Monday, April 20**

#### IV. CASES AND APPLICATIONS: Remaining Weeks

In this section of the course, student groups will present each of the following four chapters:

1. Brinkmanship: *DSR, chapter 14*
2. Voting Strategy: *DSR, chapter 15*
3. Auctions and Bidding: *DSR, chapter 16*
4. Bargaining: *DSR, chapter 17*

**Paper:** Students will write six-page papers that apply two separate game-theoretic models drawn from sections III and IV of the class to real-world situations. **Due Wed. May 6**

**FINAL EXAM: Friday, May 15, 2-5 p.m.** You know this now; plan your travels accordingly!