

Grinnell College
Economics 291
Spring 2006

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Office Hours: Mon., Thurs. 2:00 - 4:00, and by appointment

Syllabus: Applied Game Theory

Game theory offers a set of tools used to formally conceptualize and model strategic interactions among interdependent agents who share awareness of their interdependence. As such it offers analytical foundations for a broad range of relationships investigated by disciplines ranging from biology to economics 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 how Airbus is making similar decisions, understanding that Airbus makes similar strategic calculations). On a more general scale, simultaneous consideration of individual tradeoffs and strategic interdependence facilitates a deeper understanding of social and political dynamics which underlie certain kinds of economic decisions as well as the impact of economic tradeoffs and constraints on relevant social and political dynamics. This course will develop fundamentals of game theoretic modeling using visual representation (diagrams, graphs and game matrices) along with solving equations, with an emphasis on intuitive technique and direct application to examples primarily from economics, politics, and political economy.

Readings

Avinash Dixit and Susan Skeath, *Games of Strategy*, Second Edition, New York and London: W.W. Norton, 2004.

Avinash Dixit and Barry Nalebuff, *Thinking Strategically: The Competitive Edge in Business, Politics, and Everyday Life*, New York and London: W.W. Norton, 1991.

Robert Gibbons, *Game Theory for Applied Economists*, Princeton, N.J.: Princeton University Press, 1992.

Dixit and Skeath (hereafter D&S) is the key text for this course. Dixit and Nalebuff (hereafter D&N) offers an informal discussion of many game theoretic principles, stressing stories and applications. Gibbons offers a more formal treatment focused on economics. All three are required. Purchasing Gibbons is optional; essential sections will be posted on e-reserve.

Evaluation:

There will be two mid-term exams and one final exam. The mid-terms will count as $\frac{1}{2}$ of the final. There will be a student project (written paper) which will count as one mid-term. All of these jointly will constitute about 75% of the grade. In addition, students will give periodic oral presentations, including a formal presentation of their final project. Oral presentations, class participation, *including attendance*, and about 10 problem sets will jointly count for approximately 25% of the grade.

Course Outline -- Preliminary Schedule

I. CONCEPTUALIZING STRATEGIC INTERDEPENDENT BEHAVIOR – Jan. 23 and 25

Illustrations of games, types of games, elements of games:

D&S Chapters 1 & 2; D&N Chapter 1

II. FOUNDATIONS OF GAME THEORY

A. Basic Concepts: Jan. 27 and week 2

Sequential games with complete information:

D&S Chapter 3; D&N Chapter 2; Gibbons, 2.1A

Simultaneous games with discrete pure strategies:

D&S Chapter 4; D&N, Chapter 3; Gibbons, through 1.1

B. Elaborations and Complications of Basic Games: weeks 3 - 5

Continuous strategies:

D&S Chapter 5; Gibbons, 1.2A, 1.2B, 2.1B

Combining sequential and simultaneous games:

D&S chapter 6; Gibbons, 2.4

Mixed strategies:

D&S chapters 7 and 8; D&N chapter 7; Gibbons, 1.3A

First Hour Exam: Monday, Feb. 27

III. IMPORTANT CATEGORIES OF GAMES

Dimensions of uncertainty, strategy, coordination and evolutionary dynamics:

A. Strategizing in the Face of 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. – Douglas North (awarded Nobel Prize in economics in 1993 for his work on economic history; underline is mine).

Asymmetric information theory underlies much contemporary development in economic theory and political economy, including contracting theory, incentive compatibility, enforcement, and – as the above quote indicates – institutional preconditions for economic growth and development. In the past 10 years, three Nobel prizes in economics have cited developments in the economics of uncertainty as reasons for the award. 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 screen for reliable information?

D&S chapter 9; Gibbons selections from chapters 3 and 4

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 [Cortes] gave orders that led to all but one of his ships being burnt or disabled. – Dixit and Nalebuff

When possible outcomes of a game are relatively predictable and less than ideal, players can sometimes create a pre-game to alter outcomes to their advantage. To do so, they may engage in commitments, threats or promises, but to be effective, such moves need to be credible.

D&S chapter 10; D&N, chapters 5 and 6; Gibbons, 2.4

C. The Prisoner's Dilemma 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

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 economics, 2005)

The Prisoners' dilemma game illustrates, at a simple level, the potential divergence between individual self-interest and group well being. We will consider various possible solutions, via an expectation of repeated contact, possible rewards or punishments, leadership and other mechanisms. Collective-action problems reflect similar divergence between individual and group interest on a larger scale.

D&S chapters 11 and 12; D&N, chapter 9; Gibbons, 1.2D and 2.3

D. Evolutionary Games: 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 (discussing the emergence of conventions)

Darwinian competition and cooperation offer a foundation for game theoretic analysis which does not require the conceptual abilities which underlie rational calculation, yet it generates, and sometimes strengthens, refines, and extends key game theoretic results from rational calculation. Evolutionary game theory may be applied not only to biology, but also to many social, political, and economic interactions where strategies are transmitted among players through various cultural mechanisms, such as education. Successful strategies are more likely to reproduce themselves than unsuccessful strategies, leading to a process of social, political or economic evolution.

D&S, chapter 13

Second Hour Exam

IV. CASES AND APPLICATIONS: Remaining Weeks

Brinkmanship: *D&S, chapter 14*

Voting Strategy: *D&S, chapter 15*

Auctions and Bidding: *D&S, chapter 16*

Bargaining: *D&S, chapter 17*

Markets and Competition: *D&S, chapter 18*

Students will develop projects based on the application of concepts in at least one of these chapters to real-world situations.

FINAL EXAM: Wednesday, May 17, 9:00 a.m. Plan accordingly!