

*Department of Business Economics & Public Policy  
The Wharton School - University of Pennsylvania*

**BEPP 284 - Managerial Economics and Game Theory**

Prof. Joseph Harrington <harrij@wharton.upenn.edu>

Class Location and Time: T, Th 12:00 - 1:20

Office: Steinberg Hall/Dietrich Hall 3408, Office Hours: M, W 3:00 - 4:00

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One of the reasons game theory has finally been discovered by managers is the rapidity with which companies can now respond to changes in product, technologies and prices. Game theory helps you pay attention to your interactions with competitors, customers and suppliers, and to focus on the end-game so that your near-term actions promote your long-term interest by influencing what these “players” do. - F. William Barnett, McKinsey & Company, (*Wall Street Journal*, 13 February 1995)

The objective of this course is to introduce you to game-theoretic reasoning and convey its usefulness in understanding economic and social phenomena and in developing business strategy. Game theory, which has been the focus of two rounds of Nobel Prizes in Economics, has proven to be a monumental step in the development of appropriate tools for solving the puzzles and tackling the challenges put forth by a collection of conscious, purposeful agents, whether they comprise a household, a team, a village, a company, a market, a government, or a society.

Game theory forces you to see a business situation over many periods from two perspectives: yours and your competitor's. - Judy Lewent, CFO, Merck (*Harvard Business Review*, Jan-Feb 1994)

A course on how game theory informs business strategy could be taught at many levels and, in principle, some insight could be conveyed without a student ever solving a game-theoretic model. However, if one is to really understand this insight and be able to produce new insight, you need to know how to model a strategic situation as a game and how to solve it. This course then has three objectives: 1) learn some game theory; 2) learn how game theory can be used to inform business strategy; and 3) have an intellectually stimulating and enjoyable time.

At Bell Atlantic, we've found that the lessons of game theory give us a wider view of our business situation and provide us a more nimble approach to corporate planning. - Raymond W. Smith, Chairman, Bell Atlantic (*Fortune*, Sept 1996)

## Books

Joseph Harrington, *Games, Strategies, and Decision Making*, Worth Publishers, 2009. [GSDM] - This is the primary text book and I will not be offended if you show up for class with a used copy.

Paul Papayioanou, *Game Theory for Business: A Primer in Strategic Gaming*, Probabilistic Publishing, 2010. - The author has a consulting firm which uses game theory to advise businesses. The book's value to this course is that it describes how, in practice, managers can use game theory for strategizing. Though the description is in fairly general terms (specifics are available from the author at the usual hourly consulting rate), many sensible and thoughtful remarks are provided to lead the reader from the pristine abstract domain of game theory to the messy practical realm of business. The book is most effectively read in one or two sittings so as to better appreciate the gestalt of the author's approach to constructing a business strategy. As the book also provides a simple introduction to game theory, you might want to read it early on and then again in the second half of the semester. As I have not previously assigned this book, I welcome your feedback on it at the end of the semester.

## Readings Packet

Brandenburger, Adam, "Bitter Competition: The Holland Sweetener Company versus NutraSweet (A)," Harvard Business Publishing Case 9-794-079, 13 November 2000.

Courtney, Hugh, John T. Horn, and Jayanti Kar, "Getting into Your Competitor's Head," *McKinsey Quarterly*, February 2009.

Coyne, Kevin P. and John Horn, "Predicting Your Competitor's Reaction," *Harvard Business Review*, April 2009.

Decarolis, Francesco and Michael Klein, "Auctions That Are Too Good To Be True," Boston University, working paper, November 2011.

Deighton, John and Leora Kornfeld, "Slanket: Responding to Snuggie's Market Entry," Harvard Business Publishing Case 9-510-034, 23 August 2010.

Eisenmann, Thomas, Geoffrey Parker, and Marshall W. Van Alstyne, "Strategies for Two-Sided Markets," *Harvard Business Review*, October 2006.

Ghemawat, Pankaj, "Preemptive Capacity Expansion in the Titanium Dioxide Industry," Chapter 3 in *Games Businesses Play: Cases and Models*, 1997.

Harrington, Joseph, "How Do Cartels Operate?," *Foundations and Trends in Microeconomics*, Volume 2, Issue 1, July 2006.

Lindstädt, Hagen and Jürgen Müller, "Making Game Theory Work for Managers," *McKinsey Quarterly*, January 2010.

*Official Journal of the European Communities*, L 152/24, 7.6.2001, Case COMP/36.545/F3 - Amino Acids, Decision of June 7, 2000.

Shapiro, Carl and Hal R. Varian, "Networks and Positive Feedback" Chapters 5, 6, 7 in *Information Rules: A Strategic Guide to the Network Economy*, 1999.

**Pre-requisites:** BEPP 250 Managerial Economics is recommended, but not required. While it's helpful to have some of the economic concepts from BEPP 250, game theory is a self-contained subject matter. As to mathematical pre-reqs, BEPP 284 is NOT a calculus-intensive course (in contrast to BEPP 250). While a few lectures will involve some calculus, calculus will not appear on problem sets and examinations. The beauty to game theory is that the concepts can be presented with minimal mathematics but, for some applications, a little dollop of calculus makes it easier to appreciate the main insight.

## Course Requirements

Problem Sets: 10%

Mid-Term Examination: 25%

Final Examination (Comprehensive): 30%

Paper: 25%

Participation and Experiments: 5%

Virtual Corporate Reality: 5%

## Important Dates

Mid-Term Examination: March 6

Paper is to be turned in by April 22

Final Examination: May 12, 9:00 - 11:00

## VCR

January 23 at 5:00pm - Deadline for students to inform me that they wish to be on the same team

January 24 - Students are informed of the composition of teams

January 30 at 11:45pm - Deadline for first decisions

Decisions are due every Monday and Thursday by 11:45pm except for March 10 and 13 (spring break) when no decisions are due

April 21 at 11:45pm - Final decision is due

**Problem Sets:** Unless stated otherwise, a problem set is due one week after it is assigned. A problem set is considered “late” if it is not turned in at the start of class on the day it is due. A late problem set is penalized 50% while one that is turned in after answers have been distributed receives zero credit.

**Paper:** For the paper, game theory is to be used to model and make descriptive and/or predictive statements for a business situation. The situation can be generic or be a particular historical episode. While the situation can be related to one that we have gone over in class, it must have some novel touches. The paper is to be original work and will be graded on how: 1) relevant, inventive, and original is the business situation; 2) creative, sophisticated, and appropriate is the model; 3) compelling and correct is the analysis; and 4) insightful are the lessons learned. As a target length, the paper should be 10-20 double-spaced typed pages. It should have: 1) an introduction which describes and motivates the business situation and problem; 2) a description of the model; 3) an analysis of the model; and 4) a discussion of results including takeaways for business strategy. In writing your paper, please avoid the pitfalls that have befallen many a writer in the business genre:

In economic writing, the distinction of "unquestionably the worst" is a hard competition to win. But the elementary training in awfulness of business people who themselves write about their enterprise has given business prose the edge. Some years back, a leading business school asked me to participate in an effort to see if anything could be done. For a semester I joined some young colleagues in trying to find ways to encourage and guide improvement. The effort was a ghastly failure. The last papers still spoke of “charismatizing” the product; one budding executive, talking about worker participation, commented on the need for producing “an osmotic upward flow of intelligence.” There was more, some of it worse. It is my recollection that the whole attempt was later shelved. In any case, I keep encountering the same kind of meaninglessness on my occasional

excursions into business writing. [John Kenneth Galbraith, “Executive Suite,”  
The New York Times Book Review, Nov. 5, 1995]

**Participation and Experiments:** Over the course of the semester, students will participate in experiments involving strategic reasoning. These experiments are of intrinsic value (and really quite fun) and are tied to key concepts in the class. Students will be incentivized by earning points that will be applied to their course grade. Active participation in class discussion will also contribute to your grade.

**Virtual Corporate Reality:** VCR is an industry simulation package co-developed by Professor Chris Ruebeck at Lafayette College and me. Students will form teams and compete with other teams in a market setting. If some students would like to be on the same team, they should inform me by Jan 23 (5:00pm). Otherwise, students will be randomly assigned to teams (which is perfectly fine). You will be informed of the composition of teams by Jan 24 (5:00pm) and your first decisions are due by January 30 (11:45pm). Your grade will be based on the value of your company at the end of the semester. It is to be emphasized that your performance will NOT be compared to the performance of other teams in your market but rather to average performance based on this simulation from past semesters. Details are provided in a separate document.

**Attendance:** While attendance is not mandatory, 5% of your grade is tied to participation and in class experiments. If you miss an experiment without having received approval prior to class, you will receive zero points on that experiment.

**Electronics:** Checking your smartphone, tablet, laptop, smartwatch, or any other device that connects you to the world outside of this classroom is *verboten* during class unless an exception is announced.

**Ethics:** You are expected to review and abide by the University of Pennsylvania’s Code of Academic Integrity. Violations of the code carry serious sanctions. The faculty will turn all cases of code violations over to the Office of Student Conduct and reserve the right to impose additional sanctions, including a failing grade for the assignment or exam and for the course. In other words, it’s a nasty business that you want to avoid.

## Topics and Readings

- Introduction to game theory - GSDM (Chp 1)
  - Can game theory inform business strategy?
    - \* Kevin P. Coyne and John Horn, "Predicting Your Competitor's Reaction," *Harvard Business Review*, April 2009.
    - \* Hagen Lindstädt and Jürgen Müller, "Making Game Theory Work for Managers," *McKinsey Quarterly*, January 2010
- Modelling a strategic situation as a game - GSDM (Chp 2)
- Deriving optimal play by eliminating dominated strategies - GSDM (Chp 3; skip Appendix on Rationalizability)
  - Hugh Courtney, John T. Horn, and Jayanti Kar, "Getting into Your Competitor's Head," *McKinsey Quarterly*, February 2009.
  - Applications
    - \* Advertising in the market for cigarettes
    - \* Product innovation and the chewy cookie
    - \* Product introduction and generic cigarettes
- Strategic play when there are few actions - GSDM (Chps 4, 5)
  - Francesco Decarolis and Michael Klein, "Auctions That Are Too Good To Be True," Boston University, working paper, November 2011.
  - Applications
    - \* Strategic capacity withholding in the California wholesale market for electric power
    - \* Bidding to take advantage of a poorly designed auction: average bid procurement auctions in Italy
- Strategic play when there are many actions - GSDM (Chp 6)
  - Thomas Eisenmann, Geoffrey Parker, and Marshall W. Van Alstyne, "Strategies for Two-Sided Markets," *Harvard Business Review*, October 2006.
  - Carl Shapiro and Hal R. Varian, "Networks and Positive Feedback" Chapters 5-7 in *Information Rules: A Strategic Guide to the Network Economy*, 1999.

- Applications
  - \* Competing in a contest
  - \* Price competition and price-matching guarantees: grocery retailers
  - \* Pricing in a two-sided market: online auctions and video games

Have you read *Game Theory for Business: A Primer in Strategic Gaming*?

- Strategic play in sequential-move environments with perfect information - GSDM (Chp 8)
  - Brandenburger, Adam, "Bitter Competition: The Holland Sweetener Company versus NutraSweet (A)," Harvard Business Publishing Case 9-794-079, 13 November 2000.
  - John Deighton and Leora Kornfeld, "Slanket: Responding to Snuggie's Market Entry," Harvard Business Publishing Case 9-510-034, 23 August 2010.
  - Applications
    - \* "Look forward, reason backward": Slanket and Softsoap
    - \* Sequential investment and the hold-up problem: Holland Sweetener
    - \* Most-favored-customer clauses
- Strategic play in sequential-move environments with imperfect information - GSDM (Chp 9)
  - Pankaj Ghemawat, "Preemptive Capacity Expansion in the Titanium Dioxide Industry," Chapter 3 in *Games Businesses Play: Cases and Models*, 1997.
  - Applications
    - \* Making managers aggressive
    - \* Softening competition through product location: computer printers
    - \* Capacity investment and entry deterrence: DuPont and titanium dioxide
- Strategic play when there is private information - GSDM (Chps 10, 11)
  - Applications
    - \* Signaling to deter entry and to promote exit

- \* Warranties and the market for lemons
- Strategic play when there is repeated interaction - GSDM (Chps 13, 14)
  - Joseph Harrington, "How Do Cartels Operate?," *Foundations and Trends in Microeconomics*, Volume 2, Issue 1, July 2006.
  - *Official Journal of the European Communities*, L 152/24, 7.6.2001, Case COMP/36.545/F3 - Amino Acids, Decision of June 7, 2000.
  - Applications
    - \* Collusion: global market for lysine
    - \* Semi-collusion: Norwegian market for cement
    - \* Developing a reputation for aggressiveness

### Further Reading

Some books recommended to read:

- *The Art of Strategy: A Game Theorist's Guide to Success in Business and Life* by Avinash Dixit and Barry Nalebuff, 2008. A well-written and clever introduction to game theory. While "business" is in the title, there is actually not much of a focus on business but that does not take away from the many entertaining and insightful examples. (They originally wrote *Thinking Strategically* which is in the same vein.)
- *Games Businesses Play: Cases and Models* by Pankaj Ghemawat, 1997. A collection of relatively detailed cases that exploit the insight that game theory can deliver.
- *Co-opetition* by Adam Brandenburger and Barry Nalebuff, 1996. This is what a book of business strategy should be. The content is original, clever, and practical. My only complaint is that they succumbed to the strategy book formula of having an iconic figure ("value net") and acronym which, in this case, is PARTS: **P**layers, **A**dded values, **R**ules, **T**actics, **S**cope. (While economists usually refer to it as "value added" rather than "added value," the authors needed a vowel in their acronym so they flipped it around.) With the exception of those snarky comments, I have nothing but praise for this book which stands out in the strategy genre.



- *Fart Proudly: Writings of Benjamin Franklin You Never Read in School*, Carl Japiske, ed., 1990. As Benjamin Franklin is "the dude" at Penn (like Thomas Jefferson is "the dude" at my alma mater the University of Virginia), your education would be incomplete without reading this trove of wise, poignant, and bawdy thoughts. (Feel free to borrow my copy.)
- *Games, Strategies and Managers* by John McMillan, 1992. A well-written introduction to the role of game theory in business strategy. The book is packed with relevant and insightful anecdotes.
- *The Strategy of Conflict* by Thomas Schelling, 1960. A classic in strategy. Few books have been more influential in subsequent research and thought in the areas of game theory and all realms of strategy - business, government, military, etc. For this and other contributions, Professor Schelling was awarded the Nobel Prize in 2005.
- *The Art of War* by Sun Tzu. This ancient Chinese military treatise has been influencing strategic thought for two millennia. Most recently, it has been adapted to business strategy in *Wake Up or Die* by Corrine Sandler (2013) (which I have not read but hyperbole is never a good sign).

Some books recommended NOT to read:

- *Game Theory in Management: Modelling Business Decisions and Their Consequences* by Michael Hatfield, 2012. - Some of the game theory is wrong and, when correct, the analysis tends to the pedestrian.