

STRATEGIC GAME THEORY

Outline of the course:

| <i>Lecture</i> | <i>Topic</i> |
|----------------|--|
| 1 | Introduction and General Principles |
| 2 | Simultaneous-Move Games I |
| 3 | Games with Sequential Moves |
| 4 | Simultaneous-Move Games II |
| 5 | Combining Sequential and Simultaneous |
| 6, 7 | Decision Analysis: Games Against Nature |
| 8 | Mixed Strategies and Unpredictability |
| 9, 10 | Uncertainty and Information |

| | |
|---------------|--|
| 11 | Strategic Moves, Credibility, and Commitment |
| 12, 13 | The Prisoner's Dilemma and Repetition |
| 14 | Bargaining |
| 15 | Bidding and Auction Design |
| 16 | Contracting – Employing, Financing, Franchising |
| 17, 18 | Choosing the Right Game: Co-opetition |
| 19 | Student presentations |

Books:

Dixit A., & Skeath S., *Games of Strategy*, New York: Norton: 2nd edition, 2004.

Dixit A., & Nalebuff B., *Thinking Strategically: the Competitive Edge in Business, Politics, and Everyday Life*, New York: Norton, 1991.

McMillan J., *Games, Strategies, and Managers*, Oxford: OUP, 1992.

Bierman H.S. & Fernandez L., *Game Theory with Economic Applications*, Addison-Wesley, 2nd ed., 1998.

On-Line References

For topical readings from the media (ideas for term projects, for instance), on-line games, and other goodies, see:

www.gametheory.net

For a history of game theory (by Paul Walker) since Old Testament times, point your browser at the following URL:

*[www.econ.canterbury.ac.nz/
personal_pages/paul_walker/gt/hist.htm](http://www.econ.canterbury.ac.nz/personal_pages/paul_walker/gt/hist.htm)*

For further surfing on the 'Net about game theory, start at the following URL:

kuznets.fas.harvard.edu/~aroth/alroth.html

And the Game Theory Society at

www.gametheorysociety.org

HOW I TEACH

- **Topic introductions through lectures**
 - **Talk**
 - **Use of PDF slides/OHP slides**
 - **Use of whiteboard**
 - **Newspaper clippings.**
- **Interaction and discussion in class.**
- **Not by the case-study method.**

HOW YOU LEARN

- **Attend lectures and participate**
- **Read textbook**
- **Read materials in course pack**
- **Complete assessments**
- **Write an imaginative Term Project.**

Question: Left or Right?

You can choose Left or Right:

Profits:

| | Left | Right |
|--------------|---------------|----------------|
| You | \$40 m | \$80 m |
| Rival | \$20 m | \$160 m |

(Write down your answer.)

The Moral?

Quotable Quotes – Game Theory:

“When government auctioneers need worldly advice, where can they turn? To mathematical economists, of course ... As for the firms that want to get their hands on a sliver of the airwaves, their best bet is to go out first and hire themselves a good game theorist.”

***The Economist*, July 23, 1994, p.70.**

the “most dramatic example of game theory’s new power ... It was a triumph, not only for the FCC and the taxpayers, but also for game theory (and game theorists).”

***Fortune*, February 6, 1995, p.36.**

“Game theory, long an intellectual pastime, came into its own as a business tool.”

***Forbes*, July 3, 1995, p.62.**

Game Theory

“Conventional economics takes the structure of markets as fixed. People are thought of as simple stimulus-response machines. Sellers and buyers assume that products and prices are fixed, and they optimize production and consumption accordingly. Conventional economics has its place in describing the operation of established, mature markets, but it doesn’t capture people’s creativity in finding new ways of interacting with one another.

But ...

“Game theory is a different way of looking at the world. In game theory, nothing is fixed. The economy is dynamic and evolving. The players create new markets and take on multiple roles. They innovate. No one takes products or prices as given. If this sounds like the free-form and rapidly transforming marketplace, that’s why game theory may be the kernel of a new economics for the new economy.”

**— Brandenburger & Nalebuff
Foreword to *Co-opetition***

Strategic Decision Making

Business is war and peace.

- **Cooperation in creating value.**
- **Competition in dividing it up.**
- **No cycles of War, Peace, War,
but simultaneously war and peace.**

“You have to compete and cooperate at the same time.”

– Ray Noorda of Novell.

⇨ Co-opetition

(See Lectures 17 & 18 later and Brandenburger & Nalebuff in the Package.)

Manual for “Co-opetition”

How to:

- **cooperate without being a saint**
- **compete without killing the opposition.**

⇒ **Game Theory**

A Case: The New York Post v. the New York News

- **Rupert Murdoch's *New York Post* takes on the *New York Daily News*.**

| | <i>N. Y. Post</i> | <i>N. Y. News</i> |
|----------------------|---------------------------|--------------------------|
| January 1994 | 40¢ | 40¢ |
| February 1994 | 50¢ | 40¢ |
| March 1994 | 25¢ | 40¢ |
| | (in Staten Island) | |
| July 1994 | 50¢ | 50¢ |

What happened?

Until Feb 1994 both papers were sold at 40¢. Then the *Post* raised its price to 50¢ but the *News* held to 40¢ (since it was used to being the first mover).

So in March the *Post* dropped its Staten Island price to 25¢ but kept its price elsewhere at 50¢, until *News* raised its price to 50¢ in July, having lost market share in Staten Island to the *Post* and having accepted that the *Post* would henceforth be the leader in any price hike.

So both were now priced at 50¢ everywhere in NYC.

I. Business is a Game, of Sorts

Business is a game, but different from structured board games or arcade games or computer games:

- **it is not win-lose (not zero-sum): possible for all players to win**
- **apart from the law, there is no rule book**
- **others will change the game to their advantage**
- **the game is made up of five PARTS (see below)**
- **success comes from *playing the right game***

So game theory provides a framework for an ever-rapidly changing world.

The PARTS of the Business Game

***Players:* customers, suppliers, rivals, allies;
Change any, including yourself.**

***Added Values:* what each player adds to the game
(taking the player out would subtract their added value).**

Ways to raise yours, or lower theirs.

***Rules:* give structure to the game; in business – no
universal set of rules
from law, custom, practicality, or contracts
Can revise exiting rules, or devise new ones.**

More PARTS ...

Tactics: moves to shape the way:

- players perceive the game, and hence
- how they play

Tactics to reduce misperception, or to create or maintain misperception.

Scope: the bounds of the game: expand or shrink.

PARTS does more than give a framework, it also provides a complete set of levers.

PARTS provides a method to promote non-routine thinking.

Wider issues.

**In Lectures 17 & 18 we go beyond the more micro issues
→ wider issues:**

Which game should your firm/organisation be in?

**It's no good sticking to
your knitting if there's
no demand for jumpers.**

**There we elaborate on the five PARTS, and introduce
the Value Net.**

The flat tyre and myopia ...

Two college students, very confident about their mid-term exam performance in a subject, decided to attend a party the weekend before the final exam. The party was so good that they overslept the whole Sunday.

Instead of taking the exam unprepared on Monday, they pleaded to the professor to give them a make-up exam. Their excuse was a flat tyre without a spare and any help. The professor agreed.

On Tuesday morning, the professor placed them in separate rooms and handed them the test. The test had just one question:

Which tyre?

2. A Gentle Introduction

Piemax Inc. bakes and sells dessert pies.

Its decision:

- price *high* or *low* for today's pies?

Things to be considered:

- prices of rivals' pies?
- prices of non-pie substitutes?

A naïve option:

simply optimise its pricing policy given its beliefs about rivals' prices, or . . .

Think strategically...

Alternative:

**try to predict those prices,
using Piemax' knowledge of the industry,
in particular: its knowledge that its rivals will
choose their prices based on their own
predictions of the market environment, including
Piemax' own prices.**

Game Theory →

- **Piemax should build a *model* of the behaviour of each individual competitor,**
- **Which behaviour would be most reasonable to expect?**

Issues for Later

Later: what is an equilibrium?

**Later: ought Piemax to believe that the market outcome
→ equilibrium?**

Now: what kind of model?

The simplest kind of model.

- All bakers operate *for one day only* (a so-called one-shot model)**
- All bakers know the production technologies and objectives of the others**
- Study with the tools of:**
 - *payoff matrix* games and**
 - *Nash equilibrium***

John Forbes Nash's Equilibrium.

***Nash Equilibrium:* no player has any incentive to change his or her action, assuming that the other player(s) have chosen their best actions for themselves.**

Nash equilibria are *self-reinforcing*.

In two-player games, a Nash equilibrium prescribes strategies that are mutually best response (not universally best responses, as with dominant strategies).

Repeated interactions.

If *more than one day* (a repeated game or interaction):

– then Piemax's objectives?

(more than maximising today's profits)

e.g. low price today may:

→ customers switch from a rival brand

→ increase Piemax' market share in the future

e.g. baking a large batch of pies may

→ allow learning by doing by the staff

& lower production costs in the future.

But there are dangers!

Its rivals may be influenced by Piemax's price today

- **a low Piemax price may trigger**
- ***a price war.***

Such dynamic games can be dealt with using:

- **extensive-form game trees and**
- **the solution concept of *subgame perfection***

Later: *Subgame Perfect Equilibrium:*

a Nash equilibrium that does not rely on non-credible threats (that satisfies backwards induction).

How about information?

- **What if Piemax is *uncertain* of the cost functions or the long-term objectives of its rivals?**
 - **Has Cupcake Pty Ltd just made a breakthrough in large-batch production?**
 - **Does Sweetstuff plc care more about market share than about current profits?**
 - **And how much do these rivals know about Piemax?**

Incomplete information games.

Acting in a fog: perceptions rule!

And learning?

- **If the industry continues for several periods, then Piemax ought to *learn* about Cupcake's and Sweetstuff's private information *from their current pricing behaviour* and use this information to improve its future strategy.**
- **In anticipation, Cupcake and Sweetstuff may be loath to let their prices reveal information that enhances Piemax's competitive position:**
- **They may attempt to *manipulate Piemax's information*.**

In a nutshell ...

Game theory is the study of rational behaviour in situations involving interdependence:

- **May involve common interests: *coordination***
- **May involve competing interests: *rivalry***
- ***Rational behaviour*: players do the best they can, in their eyes;**
- **Because of the players' interdependence, a rational decision in a game must be based on a prediction of others' responses.**

Put yourself in the other's shoes and predicting what action the other person will choose, you can decide your own best action.

And vice versa.

3. Strategic Interaction

- **Game theory** → a game plan, a specification of actions covering all possible eventualities in strategic interactions.
- ***Strategic situations:***
involving two or more participants, each trying to influence, to outguess, or to adapt to the decisions or lines of behaviour that others have just adopted or are expected to adopt (Tom Schelling).

Look forward and reason backwards!

And the applications ...

- a *procurement manager* trying to induce a subcontractor to search for cost-reducing innovations
- an *entrepreneur* negotiating a royalty arrangement with a manufacturing firm to license the use of a new technology
- a *sales manager* devising a commission–payments scheme to motivate salespeople
- a *production manager* deciding between piece-rate and wage payments to workers
- designing a *managerial incentive system*
- *how low to bid* for a government procurement contract

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- ***how high to bid*** in an auction
 - ***a takeover raider's decision on what price to offer for a firm***
 - ***a negotiation between a multinational and a foreign government over the setting up of a manufacturing plant***
 - ***the haggling between a buyer and seller of a used car***
 - ***collective bargaining between a trade union/employees and an employer***

Games v. Decisions

Decisions:

no strategic elements, just uncertainty (Lect 6, 7)

Games:

**mutual awareness of the interactive effects;
head-to-head interactions of 2 or a few players
or**

**mutual commitment and private information;
from competitive market to bilateral relationship**

e.g. credit and insurance markets

Classifying Games

- **Sequential or Simultaneous? (L 2, 3, 4)**
- **Total Conflict or Some Commonality?**
- **Once-Off or Repeated? (L 12, 13)**
- **Full or Asymmetric Information? (L 9, 10)**
- **Rules Fixed or Changeable? (L 17, 18)**
- **Agreements to Cooperate Enforceable?**

Terminology and Assumptions

- **Strategies, actions**
- **Payoffs, not just \$**
- **Rationality (not selfishness), know one's self**
- **Common Knowledge, I know that you know that I know that ...**
- **Equilibrium, no regrets**
- **Dynamics and Evolutionary Games, repetition**
- **Observation and Experiment, experiments**