STRATEGIC GAME THEORY

www.agsm.edu.au/bobm/teaching/SGTM.html

Outline of the course:

Lecture	*Topic*
	I *Foundations*
1	Introduction and General Principles
2, 3	Simultaneous-Move Games I
4	Games with Sequential Moves
5	Simultaneous-Move Games II
6	Combining Sequential and Simultaneous

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	II *Decision Analysis*
7–10	Decision Analysis: Games Against Nature

	III *Broad classes of games and strategies*
11	Mixed Strategies and Unpredictability
12, 13	Uncertainty and Information
	In-class mid-term exam (Oct. 31)
14	Strategic Moves, Credibility, and Commitment
15, 16	The Prisoner's Dilemma and Repetition

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18	Bidding and Auction Design
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	V
22, 23	Student presentations

Books:

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

On-Line References

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And the Game Theory Society at

www.gametheorysociety.org

HOW I TEACH

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- Topic introductions through lectures
  - Talk
  - Use of PDF slides/OHP slides
  - Use of whyteboard
  - Newspaper clippings.

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- Not by the case-study method.

HOW YOU LEARN

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- Read materials in course pack
- Complete assessments
- Write an imaginative Term Project.

- See a list of examples of excellent past projects at the back of the Course Outline. Email me for soft copies.

Question: Low Price or High Price?

You can choose Low or High Price:

Profits:

	Low Price	High Price
You	$40 m	$80 m

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You can choose Low or High Price:

Profits:

	Low Price	High Price
You	$40 m	$80 m
Rival	$20 m	$160 m

(Write down your answer.)

Further ...

Further ...

What if "Harm"?:

	Low Price	High Price
You	\$40 m	\$80 m
Rival	−\$100 m	\$40 m

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.

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⇨ Co-opetition

(See Lectures 20 & 21 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*.

	N.Y. Post	*N.Y. News*
January 1994	40¢	40¢

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	N.Y. Post	*N.Y. News*
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March 1994	25¢ (in Staten Island)	40¢

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

	N.Y. Post	*N.Y. News*
January 1994	40¢	40¢
February 1994	50¢	40¢
March 1994	25¢ (in Staten Island)	40¢
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).

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

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

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Ways to raise yours, or lower theirs.

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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.

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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 20 & 21 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 ...

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Which tyre?

Write down.

2. A Gentle Introduction

Piemax Inc. bakes and sells dessert pies.

Its decision:

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

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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,

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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 $\rightarrow$ 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.**

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A single Nash equilibrium is not necessarily the *outcome* of the game (see the Chicken! Game, with two N.E. below).

Repeated interactions.

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

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e.g. low price today may:

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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 in cutting its price!

Its rivals may be influenced by Piemax's price today

→ a low Piemax price may trigger

→ *a price war.*

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Such dynamic games can be analysed 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*, by their actions etc.

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  And vice versa.

3. Strategic Interaction

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  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).

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Look forward and reason backwards!

And the applications ...

— a *procurement manager* trying to induce a subcontractor to search for cost-reducing innovations

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- designing *a managerial incentive system*
- *how low to bid* for a government procurement contract

— ***how high to bid*** **in an auction**

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- 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 (Lectures 6–10)

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, 5)
- Total Conflict or Some Commonality?
- Once-Off or Repeated? (L 15, 16)
- Full or Asymmetric Information? (L 12, 13)
- Rules Fixed or Changeable? (L 20, 21)
- 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