STRATEGIC GAME THEORY FOR MANAGERS

Outline of subject:

Lecture   *Topic*

1.	**1. Strategic Decision Making**
2.	Strategic Interactions.
3.	More Strategic Interactions.
4.	Yet More Strategic Interactions.
5.	Game Trees. Oligopolies.
6.	**2. Decision Analysis:**
	Games Against Nature
7.	Sensitivity Analysis.
8.	Utility.
9.	**3. Strategic Moves**
10.	**4. Credible Commitments**
11.	**5. Repetition and Reputation**
12.	**6. Unpredictability**
13.	**7. Bargaining**
14.	**8. Using Information Strategically**
15.	Signalling.
16.	**9. Bidding in Competition**
17.	**10. Contracting,**
	or the Rules of the Game
18.	Employing, Financing, Franchising.
19.	**13. Choosing the Right Game**
20.	Student presentations

Books

Recommended (but not required) text:

Bierman H.S. & Fernandez L., *Game Theory with Economic Applications,* Reading: Addison-Wesley, 1993.

Dixit A., and 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.

As well, the following books will be found useful:

Baird D.G., Gertner R.H., and Picker R.C., *Game Theory and the Law,* Camb.: Harvard U.P., 1994.

Rasmusen E., *Games and Information: An Introduction to Game Theory,* Oxford: B. Blackwell, 2nd edition, 1994.

Gardner R., *Games for Business and Economics,* N.Y.: Wiley, 1995.

Ghemawat P., *Games Businesses Play: Cases and Models,* MIT Press, 1997.

Package

Assessment

Quotable Quotes

Game theory:

"the greatest auction in history"
   The New York Times, March 16, 1995, p.A17.

"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 is hot."
   The Wall Street Journal, February 13, 1995,
   p.A14.

 . . . but not new!

For a history of game theory, see
`http://www.econ.canterbury.ac.nz/hist.htm`

For more game theory on the Web, see
`http://www.pitt.edu/~alroth/alroth.html`

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.

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*

1. Strategic Decision Making

1.1 Introduction

Piemax Inc. bakes and sells sweet (dessert) pies.

Its decision:

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

Considerations?

— prices of rivals' pies?

— prices of non-pie substitutes?

One possibility:

simply optimise its pricing policy for some, given its beliefs about rivals' prices

Or:

try to predict those prices,

using Piemax' knowledge of the industry,

in particular: Piemax' knowledge that its rivals choose their prices on the basis of 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,

? look for behaviour → *an equilibrium* of the model?

Later: what is an equilibrium?

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

Now: what kind of model?

Simplest:

— all bakers operate *for one day only* (a so-called one-shot model)

— all firms know the production technology of the others

— study with the tools of:

• **payoff matrix** (or normal-form) games and

• **Nash 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*.

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

→ may 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 beware:

its rivals may be influenced by Piemax's price today

→ low Piemax price, which may

→ *a price war.*

dynamic games and extensive-form models

→ solution concept of *subgame perfection*

Subgame Perfect Equilibrium: a Nash equilibrium that does not rely on non-credible threats.

Uncertainty?

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.

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.*

Games:

> players' objectives complex:
> competing in terms of market shares
> a common interest (in high prices)

Noncooperative:

> players' choices based only on their perceived
> self-interest
> not based on sharing or fairness

Games?

- a newspaper's price fall (e.g.?)

- OPEC members choosing their output

- Qld coal miners selling coal to the Japanese utilities

- a board of directors setting up a stock-option plans for a CEO

- Qantas and Ansett pricing airfares

- Telstra and Optus pricing phone calls

- Pacific Power's investment in new generating capacity

- the Australian Graduate School of Management's hiring decisions

- India v. Pakistan

- a committee's voting on which one of several candidates to promote

Q: *Is there interaction between players?*

1.1.1 Issues addressed in game theory:

1. What does it mean to choose strategies "rationally" when outcomes depend on the strategies chosen by others and when information is incomplete?

2. In "games" that allow mutual gain (or mutual loss) is it "rational" to cooperate to realise the mutual gain (or to avoid the mutual loss) or is it "rational" to act aggressively in seeking individual gain regardless of mutual gain or loss?

3. If the answers to 2. are "sometimes," then in what circumstances is aggression rational and in what circumstances is cooperation rational?

4. In particular, do continuing relationships differ from one-off encounters (one-night stands?) in this issue?

5. Can moral rules of cooperation emerge spontaneously from the interactions of rational egoists?

6. How well does actual human behaviour correspond to "rational" behaviour in these cases?

7. If it differs, then how? Are people more cooperative than would be "rational?" More aggressive? Both?

1.1.2 Cooperative and Non-cooperative Games

Cooperative game theory: what kinds of *coalitions* a group of players will form:

— if different coalitions produce different outcomes?

— if these joint outcomes have to be shared among members?

Non-cooperative game theory: which *strategies* will players choose?

Cooperative Theory:

1. what different groups of players can achieve jointly — coalitions

2. to what extent the joint results can be shared among participating players

1. Problem:

- if there are gains from cooperation, but

- if the distribution of these gains doesn't provide sufficient incentives for the coalition of players to conform to the cooperative strategy combination,

- then there must be an outside institution to force cooperative agreement

- lest one or more cooperating agents renege

so: assume existence of a mechanism to guarantee cooperative agreements, e.g. *binding agreements*

2. Moreover:

- cannot distribute subjective probabilities, but

- can redistribute monetary payments or private goods.

Coalition can reach a set of payoff vectors:

- by redistributing the joint outcome, or

- by making monetary side payments

Coalitional Form:

- binding agreements possible

- payoffs can be transferred among players (how?)