# STRATEGIC GAME THEORY FOR MANAGERS

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Books

Recommended (but not required) text:


As well, the following books will be found useful:


Package

Assessment
Quotable Quotes

Game theory:

“the greatest auction in history”

“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.”

“Game theory is hot.”

... but not new!

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

For more game theory on the Web, see
   www.economics.harvard.edu/~aroth/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 A Decision

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
Think strategically.

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?
The simplest 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 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.
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

→ 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 there are dangers.

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 game trees

→ solution concept of subgame perfection

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

— later ...
Uncertainty and information.

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.

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 payoffs
   - by redistributing the joint outcome, or
   - by making monetary side payments

Coalitional Form:
   - binding agreements possible
   - payoffs can be transferred among players (how?)

(See Co-opetition later.)