STRATEGIC GAME THEORY FOR MANAGERS

Outline of subject:

Lecture	*Topic*
1.	**1. Strategic Decision Making**
2.	Firms Behaving Badly.
3.	Further Equilibria.
4.	More Examples.
5.	**2. Decision Analysis: Games Against Nature**
6.	Evaluation.
7.	Gaining Insight.
8.	Utility.
9.	**6. Unpredictability**

10. **7. Bargaining**
11. **8. Using Information Strategically**
12. Screening, Signalling.
13. **9. Bidding and Auction Design**
14. Concluded.
15. **10. Contracting, or the Rules of the Game**
16. Employing, Financing, Franchising.
17. **13. Choosing the Right Game: Coopetition**
18. Concluded.
19. **Student presentations**
20. Concluded.

Books

Recommended (but not required) text:

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

Dixit A., and Skeath S., *Games of Strategy*, New York: Norton, 1999.

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

As well, the following books will be found useful:

Dutta P.K., *Strategies and Games: Theory and Practice*, Camb.: MIT Press, 1999.

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.

On-line Refeences

. . . but game theory is 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

For a glossary of terms you should be familiar with after Chongwoo's SET introduction, see
www.agsm.edu.au/~bobm/teaching/SGTM/glossary.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 From SET: 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.

1.2 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

— *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

1.3 Some Interactions

1.3.1 Auctioning a Five-Dollar Note

Rules:
- ➢ First bid: 20¢
- ➢ Lowest step in bidding: 20¢
  (or multiples of 20¢)
- ➢ Auction lasts until the clock starts ringing.
- ➢ Highest bidder pays bid and gets $5 in return.
- ➢ Second-highest bidder also pays, but gets nothing.

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Write down the situation as seen by

1. the high bidder, and
2. the second highest bidder.

What happened?

Escalation and entrapment

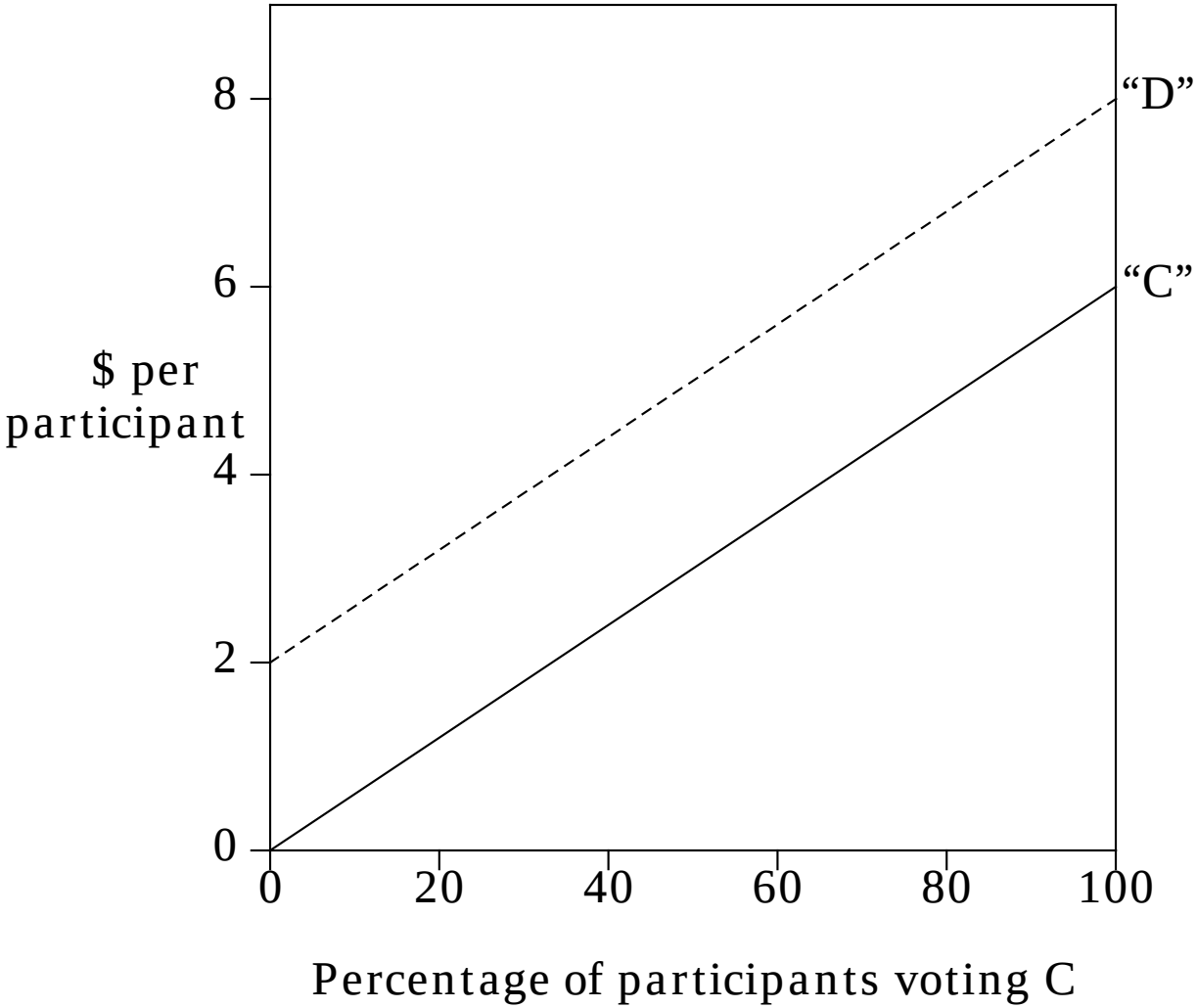
Examples? (See O'Neal's paper in the package.)

1.3.2 Schelling's Game

Rules:

- Single play, \$4 to play
- Vote "C" (Coöperate) or "D" (Defect).
- Sign your ballot. (and commit to pay the entry fee.)
- If x% vote "C" and (100 – x)% vote "D":
  - then "C"s' payoff = $\left(\frac{x}{100} \times \$6\right) - \$4$
  - then "D"s' payoff = "C" payoff + \$2
- Or: You needn't play at all.

Schelling's Game



Note: the game costs $4 to join.

Schelling's Game

WHAT HAPPENED?

- numbers & payoffs.
- previous years?

Dilemma: { coöperate for the common good *or* defect for oneself

Public/private information

Examples?

1.3.3 The Ice-Cream Sellers

(See Marks in the Folder)

L C R

- Demonstration
- Payoff matrix
- Incentives for movement?
- Examples?

Modelling the ice-cream sellers.

We can model this interaction with a simplification: each seller can either:

- ➢ move to the centre of the beach (M), or
- ➢ not move (stay put) (NM).

The share of ice-creams each sells (to the total population of 80 sunbathers) depends on its move and that of its rival.

Since each has two choices for its location, there are $2 \times 2 = 4$ possibilities.

We use *arrows* and a **payoff matrix**[1], which clearly outlines the possible actions of each and the resulting outcomes.

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1. See the on-line **Glossary** for new meanings.

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What are the sales if neither moves (or both NM)? Each sells to half the beach.

What are the sales if You move to the centre (M) and your rival stays put at the three-quarter point?

What if you both move?

Given the analysis, what *should* you do?

The Ice-Cream Sellers

		The other seller	
		M	NM
You	M	**40, 40**	50, 30
	NM	30, 50	40, 40

TABLE 1. The payoff matrix (You, Other)

A non-cooperative, zero-sum game,
with a **dominant strategy**,
or dominant move.

Ice-cream sellers: market examples?

Think of the beach as a product spectrum, each end representing a particular niche, and the centre representating the most popular product.

Demand is largest for the most popular product, but so is competition.

1.3.4 The Prisoner's Dilemma

(See Marks in the Folder)

The Payoff Matrix:

- The Cheater's Reward = 5
- The Sucker's Payoff = 0
- Mutual defection = 2
- Mutual coöperation = 4

These are chosen so that: $5 + 0 < 4 + 4$
so that C,C is **efficient** in a repeated game.

The Prisoner's Dilemma

A need for:

- communication
- coördination
- trust
- **or**?

Efficient Outcome: there is no other combination of actions or strategies that would make at least one player better off without making any other player worse off.

The Prisoner's Dilemma

		The other player	
		C	D
You	C	4, 4	0, 5
	D	5, 0	**2, 2**

TABLE 2. The payoff matrix (You, Other)

A non-cooperative, positive-sum game,
with a dominant strategy.

Efficient at _____

Nash Equilibrium at _____

1.3.5 The Capacity Game

Two firms each produce identical products and each must decide whether to Expand (E) its capacity in the next year or not (DNE).

A larger capacity will increase its share of the market, but at a lower price.

The simultaneous capacity game between Alpha and Beta can be written as a payoff matrix.

The Capacity Game

		Beta	
		DNE	Expand
Alpha	DNE	$18, $18	$15, $20
	Expand	$20, $15	**$16, $16**

TABLE 3. The payoff matrix (Alpha, Beta)

A non-cooperative, positive-sum game,
with a dominant strategy.

Efficient at _____

Nash Equilibrium at _____

Equilibrium.

At a **Nash equilibrium**, each player is doing the best it can, given the strategies of the other players.

We can use *arrows* in the payoff matrix to see what each player should do, given the other player's action.

The Nash equilibrium is a self-reinforcing focal point, and expectations of the other's behaviour are fulfilled.

The Nash equilibrium is not necessarily efficient.

The game above is an example of the Prisoner's Dilemma: in its one-shot version there is a conflict between collective interest and self-interest.

1.4 Modelling Players' Preferences

Without uncertainty or any dice-rolling,

we need only *rank* the four combinations:

best, good, bad, worst:

$\rightarrow$ payoffs of 4, 3, 2, and 1, respectively, in a 2×2 interaction.

1.5 More Interactions

1.5.1 The Ultimatum Game

- Your daughter, Maggie, asks for your sage advice.
- She has agreed to participate in a lab experiment.
- The experiment is two-player bargaining, with Maggie as Player 1.
- She is to be given $10, and will be asked to divide it between herself and Player 2, whose identity is unknown to her.
- Maggie must make Player 2 an offer,
- Then Player 2 can either:
  - accept the offer, in which case he will receive whatever Maggie offered him, or
  - he can reject, in which case neither player receives anything.
- How much should Maggie offer?

Maggie's choices.

- Distinguish:
  ① *the rationalist's answer* from
  ② *the likely agreement* in practice from
  ③ *the just agreement.*

The rationalist:

- Player 1 should offer Player 2 5¢ (the smallest coin).
- Player 2 will accept, since 5¢ is better than nothing.
- But offering only 5¢ seems risky, since, if Player 2 is insulted, it would cost him only 5¢ to reject it.
- Maybe Maggie should offer more. But how much more?

A market example:

- At a local motel in a small town, a few times a year (graduations, local festivals etc.) there is enormous demand for rooms.
- (On graduation weekends, for instance, some parents stay in hotels as much as 80 km away.)
- The usual price for a room in his motel is $95 a night. Normal practice in town is to retain the usual rates, but insist on a three-night minimum stay.
- The motel owner estimates he could easily fill the motel for graduation weekends at a rate of $280 a night, while retaining the three-night minimum stay.
- But there is a risk of being labelled a “gouger”, which could damage regular business.
- What should he do?

1.5.2 The Inheritance Game

The players:

- Elizabeth, an aged mother, wishes to give an heirloom to one of
- her several daughters.

The game:

- E. wants to benefit the daughter who values it most.
- But the daughters may be dishonest: each has an incentive to exaggerate its worth to her.

A second-price auction.

➢ so E. devises the following scheme:

— asks the daughters to tell her confidentially (i.e. a sealed bid) their values, and

— promises to give it to the one who reports the highest value

— the highest bidder gets the heirloom, but only pays the second-highest reported valuation.

Will Elizabeth's scheme (a Vickrey[2] auction, or *second-price* auction) make honesty the best policy?

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2. The late Bill Vickrey shared the Nobel prize in economics in 1996.

A second-price auction.

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  - promises to give it to the one who reports the highest value
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Will Elizabeth's scheme (a Vickrey auction, or *second-price* auction) make honesty the best policy?

Yes.

Why? Thinking through the options.

Consider your reasoning as one of the daughters:

- three options: *truthfulness, exaggeration, or understatement.*
- The amount you pay is independent of what you say it's worth,
- so the only effect of your report is to determine whether or not you win the heirloom, and hence what you must pay.

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- *Exaggeration*: the possibility that you make the highest report when you would not otherwise have, had you been honest.

  i.e., that the second-highest report, the one you now exceed, is higher than your true valuation.

  But → that what you must pay (the second-highest report) is more than what you think the heirloom is worth.

  Exaggeration not in your interest.

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  Exaggeration not in your interest.
- *Understating* changes the outcome only when you would have won with an honest report;

  but now you report a value lower than that of one of your sisters, so you do not win the heirloom.

  Not in your interest either.

It works.

So the mother's scheme works, and the truth is obtained—but at a price, to Elizabeth, the Mum.

E. receives a payment less than the successful daughter's valuation,

so this daughter earns a profit:

= her valuation – the 2nd-highest valuation.

= the premium the mother forgoes to induce honesty

Market Analogue ?

Think: how can the neighbours who propose building a park overcome each household's temptation to *free-ride* on the others' efforts by claiming not to care about the park, when contributions should reflect the household's valuation of the park?

How can the users of a satellite be induced to reveal their profits so that the operating cost of the satellite can be divided according to the profit each user earns?