Game Theory
Overview & Applications

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Today's Plan

◆ What: What is it: 'a game of
  strategy'?
◆ Why: Why to study this subject?
◆ How: How to approach games?
◆ Classification of Games
◆ Concepts and Techniques
◆ Examples of Games

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What, Why …

- ◆ What: What is it: 'a game of strategy'?
- ◆ Why: Why to study this subject?
- ◆ What … A game of strategy is a formal mathematical presentation of the game
- ◆ Why … Because we play games every day, almost all the time.
- ◆ Why … When we communicate with each other we ALWAYS play: whether we want it or not.

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… & How

- ◆ How: How to approach games?
- ◆ How … Formal axiomatic analytical approach to games
- ◆ How … Our strategy for studying games: outline the formal approach and show how it works (on examples)

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Subject & Structure

- ◆ Classification of Games:
  - – One time (non-repeated) & repeated,
    - » Finitely repeated and infinitely repeated
  - – Simultaneous move & sequential move
- ◆ Terminology, Concepts and Techniques
  - – Definition of the Game
  - – Solution Concept: **Nash** Equilibrium
- ◆ Examples of Games
  - – Divide a Dollar Game
  - – Prisoners Dilemma

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Classification of the Games

– constant-sum games ≈ zero-sum games
– bargaining games & brinkmanship
– sequential moves games
– simultaneous moves games
– cooperative games **(we will not address)**
  [i.e. games with a possibility of
  enforceable joint-action agreements]

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Classification of the Games (cont.)

– **non-cooperative games**
– non-repeated games (one-shot games)
– repeated games
  » Finitely repeated
  » Infinitely repeated (super games)
– repeated but with different opponents
– dynamic games (evolutionary games)
  [or, are the rules fixed or permit
  manipulation?]

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Terminology

◆ Definitions
– Player
– action
– strategy
– outcome
– equilibrium
– payoff
– expectations

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A Game: the Major Definition

- ◆ Our definition of the rules of the game
  - – list of players
  - – strategies available to each of them
  - – payoffs of each player for all possible combinations of all player strategies
  - – each player is a rational maximizer

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More Definitions

- ◆ **Strategy** is a set of the choices (actions) available for the players
- ◆ **Payoff** is a number associated with each possible outcome of the game (and the notion of Expected payoff)
- ◆ **Nash Equilibrium –** each player strategy is a best response to the strategies of others

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Example: Divide a Dollar Game

- ◆ Divide a Dollar Game (see a handout)
  - » `normal' version &
  - » dictator version
- ◆ Nash Equilibrium (via a backward induction) ("rollback methodology")
- ◆ What is a fair split?
- ◆ How to explain the results of strategy experiments?
  - – The notion of Social (cultural) norm

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When Social Norms are important

- information is incomplete [why clothing is more important for teenagers than for their parents?]
- information acquisition is costly
- if you want to signal information
- Who has social norm in possession?
- Leaders and followers
  - who? & why? & when?

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When Do you Gain from Using Social Norm

- your information is
  - incomplete
  - inferior [or both]
- information acquisition is
  - costly or
  - time consuming [or both]
- you want to signal information
  - how about just signal, without social norm?

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What is in the game?

- Chance
- Skill
- Strategy
- But the proportions differ in different games

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What matters to win?

- Skill
- Strategy
- Luck
- Information
  - examples:
    - About your opponent
    - About the weather

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Summary of Today

- Game Theory: Subject & Approach
- Why to study games &
- Who plays them?
- Further Reading: A Good Textbook:
  Games of Strategy by
  Dixit, Avinash & Skeath, Susan, 1999,
  W.W. Norton & Company: New York.

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1994:
Nobel Prize to Game Theorists

- 1994 Nobel Price in economics was awarded to
  John C. Harsanyi, **John F. Nash** and Reinhard
  Selten
  "for their pioneering analysis of equilibria
  in the theory of non-cooperative games."
  http://www.nobel.se/economics/laureates/1994/press.html

- John Nash
  web page: http://www.math.princeton.edu/~jfnj/

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John Nash: A Beautiful Mind

- **A Beautiful Mind:** *A Biography of John Forbes Nash, Jr.,*
Winner of the Nobel Prize in Economics, 1994, by Sylvia Nasar; (1998 - 1999).
- *First chapter   on the web:*
   http://www.nytimes.com/books/first/n/nasar-mind.html
- "A beautiful mind" at amazon.com:
http://www.amazon.com/exec/obidos/tg/stores/detail/-
   /books/0684853701/excerpt/ref=pm_dp_ln_b_3
   /002-3531560-5797602

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John Nash: A Beautiful Mind

- Professor Ariel Rubinstein: Review of Sylvia Nasar's book "Beautiful Mind" (on John Nash)
http://www.princeton.edu/~ariel/articles/nasarreview.html
      or
http://www.princeton.edu/~ariel/articles/nasarE.pdf
- The reaction to the announcement of Nobel Prize award to John Nash was jubilation.
   "The main message to the world is that the academy says mental illness is just like cancer, nothing special," said Ariel Rubinstein, "It's great."

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