# Microeconomics III

## Introduction
## (Mar 4, 2012)

**School of Economics**
**The Interdisciplinary Center (IDC), Herzliya**

## Prologue

- Game theory is about what happens when decision makers (spouses, workers, managers, presidents) interact.

- In the past fifty years, game theory has gradually became a standard language in economics.

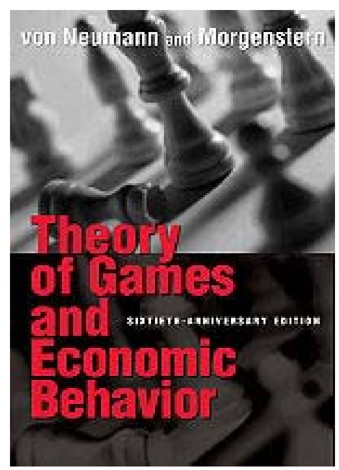
- The power of game theory is its generality and (mathematical) precision.

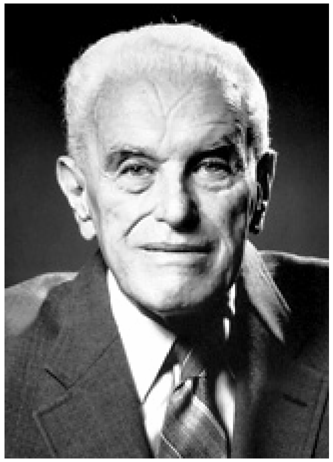
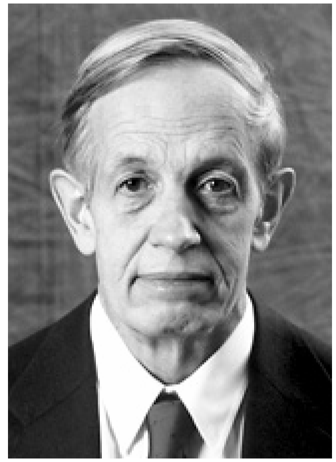
- Because game theory is <u>rich</u> and <u>crisp</u>, it could unify many parts of social science.

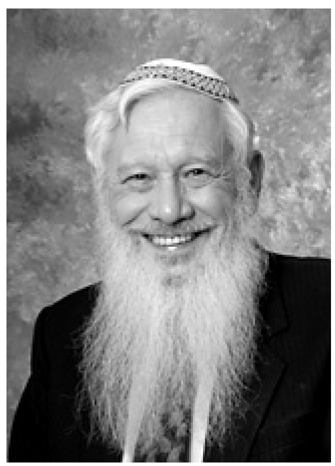
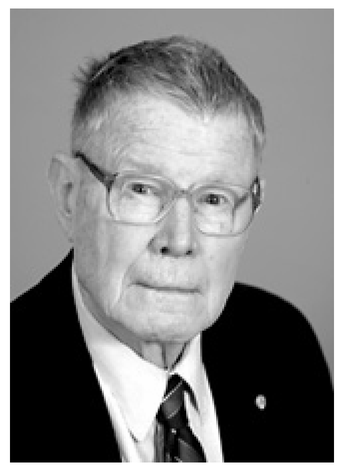
- The spread of game theory outside of economics has suffered because of the misconception that it requires a lot of fancy math.

- Game theory is also a natural tool for understanding complex social and economic phenomena in the real world.

## The paternity of game theory



## What is game theory good for?

$Q$ Is game theory meant to predict what decision makers do, to give them advice, or what?

$A$ The tools of analytical game theory are used to predict, postdict (explain), and prescribe.

Remember: even if game theory is not always accurate, descriptive failure is prescriptive opportunity!

Aumann (1987):

> "*Game theory is a sort of umbrella or 'unified field' theory for the rational side of social science, where 'social' is interpreted broadly, to include human as well as non-human players (computers, animals, plants).*"

## Three examples

### Example I: Hotelling's electoral competition game

- There are two candidates and a continuum of voters, each with a favorite position on the interval $[0, 1]$.
- Each voter's distaste for any position is given by the distance between the position and her favorite position.
- A candidate attracts the votes off all citizens whose favorite positions are closer to her position.

**Example II: Keynes's beauty contest game**

- Simultaneously, everyone choose a number (integer) in the interval $[0, 100]$.

- The person whose number is closest to $2/3$ of the average number wins a fixed prize.

John Maynard Keynes (1936):

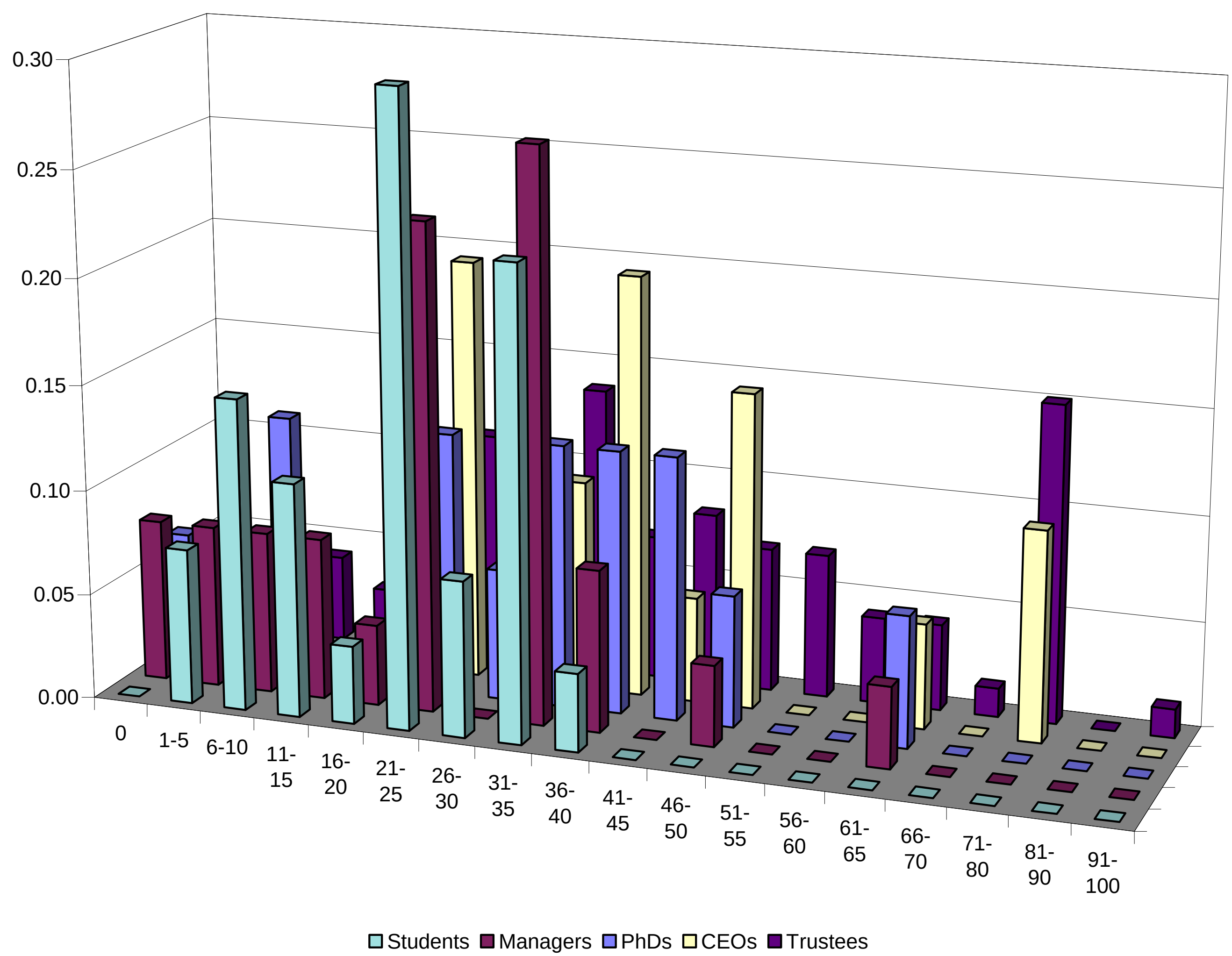
> "*It is not a case of choosing those [faces] that, to the best of one's judgment, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees.*"

$\Longrightarrow$ self-fulfilling price bubbles!

## Beauty contest results

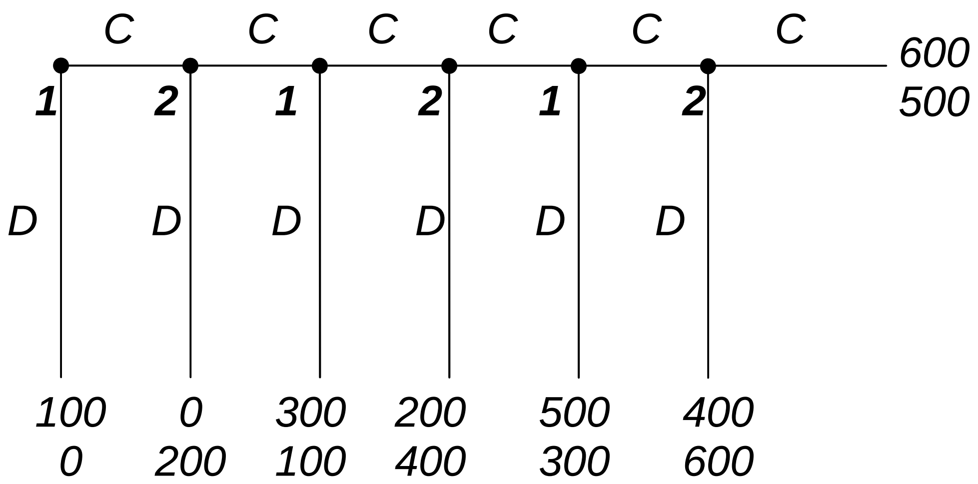
| | Portfolio Managers | Economics PhDs | CEOs | Caltech students | Caltech trustees |
|---|---|---|---|---|---|
| Mean | 24.3 | 27.4 | 37.8 | 21.9 | 42.6 |
| Median | 24.4 | 30.0 | 36.5 | 23.0 | 40.0 |
| Fraction choosing zero | 7.7% | 12.5% | 10.0% | 7.4% | 2.7% |

| | Germany | Singapore | UCLA | Wharton | High school (US) |
|---|---|---|---|---|---|
| Mean | 36.7 | 46.1 | 42.3 | 37.9 | 32.4 |
| Median | 33.0 | 50.0 | 40.5 | 35.0 | 28.0 |
| Fraction choosing zero | 3.0% | 2.0% | 0.0% | 0.0% | 3.8% |



0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
1-5
6-10
11-15
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
61-65
66-70
71-80
81-90
91-100
Students
Managers
PhDs
CEOs
Trustees

**Example III: the centipede game (graphically resembles a centipede insect)**



## Games

We study four groups of game theoretic models:

I strategic games

II extensive games (with and without perfect information)

III repeated games

IV coalitional games

## Strategic games

A strategic game consists of

- a set of players (decision makers)
- for each player, a set of possible actions
- for each player, preferences over the set of action profiles (outcomes).

In strategic games, players move simultaneously. A wide range of situations may be modeled as strategic games.

A two-player (finite) strategic game can be described conveniently in a so-called bi-matrix.

For example, a generic $2 \times 2$ (two players and two possible actions for each player) game

| | $L$ | $R$ |
|---|---|---|
| $T$ | $A_1, A_2$ | $B_1, B_2$ |
| $B$ | $C_1, C_2$ | $D_1, D_2$ |

where the two rows (resp. columns) correspond to the possible actions of player 1 (resp. 2).

For example, rock-paper-scissors (over a dollar):

| | $R$ | $P$ | $S$ |
|---|---|---|---|
| $R$ | $0, 0$ | $-1, 1$ | $1, -1$ |
| $P$ | $1, -1$ | $0, 0$ | $-1, 1$ |
| $S$ | $-1, 1$ | $1, -1$ | $0, 0$ |

Each player's set of actions is $\{Rock, Papar, Scissors\}$ and the set of action profiles is

$$\{RR, RP, RS, PR, PP, PS, SR.SP, SS\}.$$

## Classical $2 \times 2$ games

- The following simple $2 \times 2$ games represent a variety of strategic situations.

- Despite their simplicity, each game captures the essence of a type of strategic interaction that is present in more complex situations.

- These classical games "span" the set of almost *all* games (strategic equivalence).

**Game I: Prisoner's Dilemma**

| | $Work$ | $Goof$ |
|---|---|---|
| $Work$ | $3, 3$ | $0, 4$ |
| $Goof$ | $4, 0$ | $1, 1$ |

A situation where there are gains from cooperation but each player has an incentive to "free ride."

Examples: team work, duopoly, arm/advertisement/R&D race, public goods, and more.

**Game II: Battle of the Sexes (BoS)**

| | $Ball$ | $Show$ |
|---|---|---|
| $Ball$ | $2, 1$ | $0, 0$ |
| $Show$ | $0, 0$ | $1, 2$ |

Like the Prisoner's Dilemma, Battle of the Sexes models a wide variety of situations.

Examples: political stands, mergers, among others.

## Game III-V: Coordination, Hawk-Dove, and Matching Pennies

| | $Ball$ | $Show$ |
|---|---|---|
| $Ball$ | 2, 2 | 0, 0 |
| $Show$ | 0, 0 | 1, 1 |

| | $Dove$ | $Hawk$ |
|---|---|---|
| $Dove$ | 3, 3 | 1, 4 |
| $Hawk$ | 1, 4 | 0, 0 |

| | $Head$ | $Tail$ |
|---|---|---|
| $Head$ | $1, -1$ | $-1, 1$ |
| $Tail$ | $-1, 1$ | $1, -1$ |