Econ 201: Introduction to Economic Analysis

October 14 Lecture: Game Theory and Strategic Interaction

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Daily dose of The Far Side

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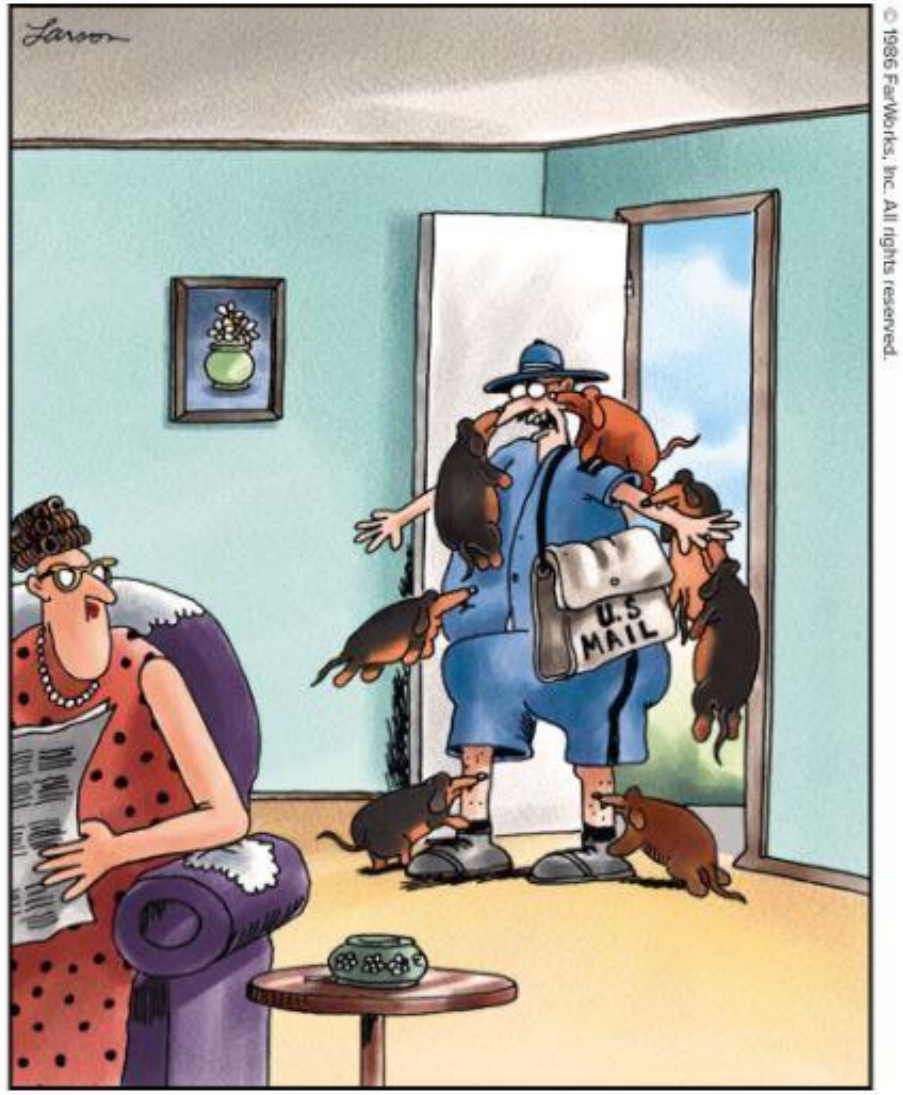
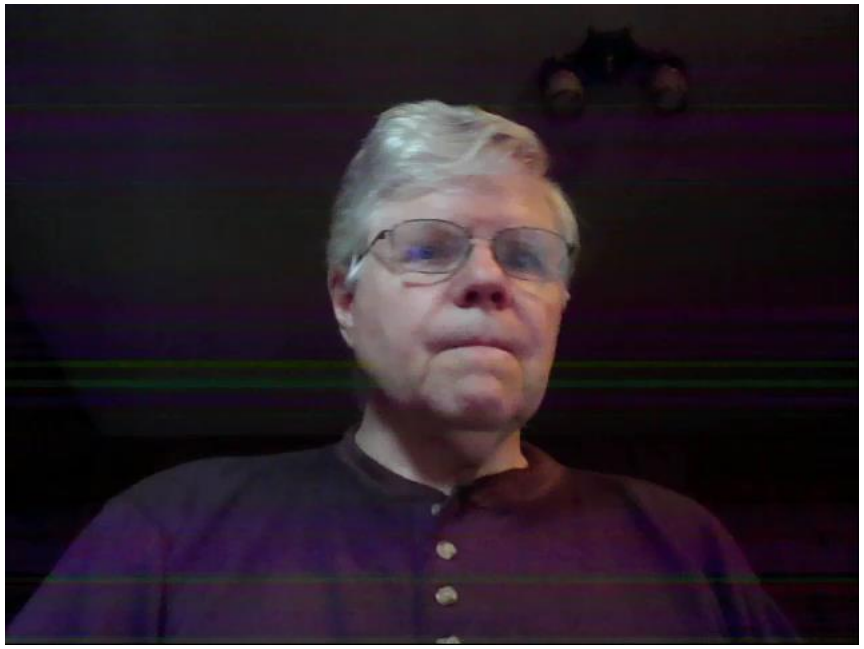


"Give me a hand here, Etta ... I got into a nest of wiener dogs over on Fifth and Maple."

Preview of this class session

- Basic definitions and concepts of game theory
- Classic model of non-cooperative game theory: Prisoners' dilemma
- Battle of the sexes
- Game-playing strategies
- Repeated and sequential games



Games

- Situations in which agents form **interrelated strategies**
- Strategies are often formulated as **reaction functions**
  - **Dominant strategy** is a decision that is best regardless of rival's strategy
- Simultaneous vs. sequential games
- Repeated vs. one-shot games
- **Payoff matrix**
- **Nash equilibrium**
- Check-mark method
  - A, B is Nash equilibrium
  - A is dominant strategy for Row

EXAMPLE		Column decision	
		A	B
Row decision	A	✓ 100, 50	✓ 75, 60 ✓
	B	30, 60 ✓	25, 50

Prisoners' dilemma

- Two prisoners accused of crime together are interrogated separately
  - Each must decide whether or not to confess
- Prosecutor offers payoffs at right
  - –5 = five-year sentence

		Barbara	
		Confess	Doesn't
Amy	Confess	–5, –5	–1, –10
	Doesn't	–10, –1	–2, –2

Prisoners' dilemma

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  - –5 = five-year sentence
- Using check marks

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Prisoners' dilemma

- Two prisoners accused of crime together are interrogated separately
  - Each must decide whether or not to confess
- Prosecutor offers payoffs at right
  - –5 = five-year sentence
- Using check marks
- **Dominant strategy**?
- **Nash equilibrium**?
- Is this optimal?
  - For criminals or society?

		Barbara	
		Confess ✓	Doesn't
Amy	✓ Confess	✓ –5, –5 ✓	✓ –1, –10
	Doesn't	–10, –1 ✓	–2, –2

Applications of prisoners' dilemma

- **Collusion** in oligopoly
  - Both better off if both don't cheat on agreement, but each better off by cheating if other doesn't cheat
  - As with prisoners, equilibrium of non-collusion is bad for firms, but good for society
- Pricing in **Bertrand model**
  - Both better off not engaging in price war
  - Either gains if it is the only one undercutting price
- **Advertising game**
  - Both better off if neither advertises
  - Either is better off advertising (whether other does or not)

Battle of the sexes

- Movie or football match?
- I prefer football; wife prefers movie
- We both prefer to go together to whatever vs. not

		Jeff	
		Movie	Football
Suzanne	Movie	2, 1	0, 0
	Football	0, 0	1, 2

Battle of the sexes

- Movie or football match?
- I prefer football; wife prefers movie
- We both prefer to go together to whatever vs. not
- No dominant strategy
  - What I want depends on her choice
- Two Nash equilibria
  - I know which one I want, though!
- How to decide?

		Jeff	
		Movie	Football
Suzanne	Movie	✓ 2, 1 ✓	0, 0
	Football	0, 0	✓ 1, 2 ✓

Some deterministic strategies

- **Dominant strategy**
  - One decision is best regardless of rival's decision
- Maximize **expected payoff**
  - Calculate expected payoff from your best strategy for each rival decision, assign probabilities to rival decision, choose decision that maximizes expected payoff
- **Maximin strategy**
  - Choose strategy that makes worst outcome as good as possible
  - Useful if don't know opponent's behavior or choices

Mixed strategies

- Can be optimal to choose **randomly**
- Penalty kick game
  - Right-footed kicker is slightly better at kicking to her left
  - Ignore possibility of kicking down center
- Dominant strategy? No
- Nash equilibrium? No
- Random strategy is better than any deterministic strategy here
- Another famous example: Where to land at Normandy in WWII

		Goalkeeper	
	Pr of goal	Left	Right
Kicker	Left	0.7	0.9
	Right	0.8	0.6

Strategies for repeated games

- Would prisoners' dilemma be different if **repeated**?
- **Tit-for-tat** strategy: I'll confess next time if you confess this time
- **Grim** strategy: I won't confess unless you do, then I'll confess every time forever
- **Finite vs. infinite** repeated games
  - Finite games often unravel from the back if players know last period
  - Last period is one-shot game: confess is dominant strategy
  - In next-to-last period, both players know that the last period is one-shot game and that rival will confess, so both confess
  - Period before? Same thing

Sequential games

- One player moves first, then other responds
- Example: **Ultimatum game**
  - $10 to divide between two players
  - "Proposer" chooses split; "decider" says yes or no
  - Optimal proposer strategy: $9/$1 IF decider behaves rationally
- First-mover often has advantage
- One player may gain advantage by issuing **credible threat**
  - Saudi Arabia threatens to drive price way down it others cheat
  - Is this threat credible?
  - If so, then it might keep others from cheating

Review

- Game theory studies models of strategic interaction
- Commonly used in economic applications with few players (oligopoly)
- Nash equilibrium is common analytical tool
- Different types of games lead to different strategies: dominant strategy, mixed strategy, maximin strategy, credible threat, etc.

Daily diversion

Yet one more bad economist joke:

Economists are people who are too smart for their own good and not smart enough for anyone else's.

--Taken from Jeff Thredgold, *On the One Hand: The Economist's Joke Book*

What comes next?

- We next turn to markets for factors of production
  - Friday: Theory of factor demand
  - Monday: Labor markets
  - Wednesday: Capital markets
- Dairy farms revisited for Friday case
- Next “problem set” will be “economic naturalist assignment”
  - Application of microeconomics from your own life experience!