Continuous Strategies and Rationalizability

ECON 420: Game Theory

Spring 2018

Announcements

- Reading: Chapter 5 and 6
- Homework due next Monday
- Midterm exam next Wednesday

Continuous strategies

- So far: Games with *discrete* strategies
  - Choosing from a finite set of actions
- Many games have many (or infinite) available actions
- Can we generalize the notion of *best response* to these settings?

Price-setting game

- Suppose there are two competing restaurants (they make only one dish)
- Both firms must choose their prices p_1 and p_2
- The number of dishes each restaurant sells is $Q_i = 44 - 2p_i + p_j$
  - After a price change, half of your usual customers will leave to go to the other restaurant
- The dishes cost \$8 to make for each restaurant
- Which price should each restaurant choose?

Best response

- Profit depends on the pricing choice of the other firm
- Restaurants try to profit maximize given the price that they think the other will choose
- This pricing strategy is the *best response* of the restaurant

Can the restaurants do better?

- Suppose an outside company buys both restaurants
- The firm is now a monopolist, chooses one price for both locations
- What is the optimal price? What are the profits?

Collusion

- The pricing game is a form of a prisoners' dilemma (with continuous strategies)
- The firms could cooperate to split the monopolist profits
- But each can do better (individually) by choosing something *other* than the monopolist price
- Cooperation is *never* a best response

Limitations of NE?

Example:

- Player A: Chooses "Up" or "Down"
- Player B: Chooses "Left" or "Right"
- Payoffs (A, B):
  - Up, Left: (2 chocolates, 2 chocolates)
  - Up, Right: (1 chocolates, 1 chocolates)
  - Down, Left: (3 chocolates, 2 chocolates)
  - Down, Right: (50% penalty on midterm, 1 chocolate)

Why might we not see a NE?

- Often, player A won't choose Down, because it is risky
- Why is it risky?
  - A might think B doesn't like chocolate
  - A might be concerned the B will try to "spite" them
- These options might mean that the game is *misspecified*
  - A has uncertainty about B's payoffs

Example

		COLUMN		
		A	B	C
ROW	A	2, 2	3, 1	0, 2
	B	1, 3	2, 2	3, 2
	C	2, 0	2, 3	2, 2

Rationalization

- Suppose games are properly specified
- Nash equilibrium:
  - The choice of each player is their best response given their beliefs about what the other players are doing
  - The beliefs are accurate
- Does this mean that purely rational players will achieve the NE?

		COLUMN		
		C1	C2	C3
ROW	R1	0, 7	2, 5	7, 0
	R2	5, 2	3, 3	5, 2
	R3	7, 0	2, 5	0, 7

Rationalizability

- Multiple outcomes can be supported by rational "chains" of thought
  - Not necessarily NE
- But not *every* outcome is supported by rationality
- For instance: It is never rational to play a strategy that is *never a best response*

		COLUMN			
		C1	C2	C3	C4
ROW	R1	0, 7	2, 5	7, 0	0, 1
	R2	5, 2	3, 3	5, 2	0, 1
	R3	7, 0	2, 5	0, 7	0, 1
	R4	0, 0	0, –2	0, 0	10, –1

Rationalizability

- Note: Not all strategies that are never a best response are dominated by some other strategy
- Sometimes rationalizability can lead to a NE (but not always)

Cournot competition

- Suppose there are two fishing boats that choose how many fish to catch each day
- The local fish market buys the fish for a price $P = 60 - Y$
- Boat one has costs of 30 per fish and boat 2 has costs 36 per fish