

Econ 211

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Failure of Standard Solution Concepts in Beauty Contest Game

- ▶ Clearly Nash equilibrium does not hold
- ▶ Many players even choose dominated strategies
- ▶ Yet clearly subjects are not playing (completely) randomly

Iterative Thinking

- ▶ For illustration, let $p = \frac{1}{2}$
- ▶ Suppose that we believe all other players to be completely naive, and thus guessing randomly. What should we guess?
 - ▶ The average guess will then be 50, so we should guess $50p = 25$
- ▶ However, we might realize that the other players will see this logic. Then what should we guess?
 - ▶ We should play $25p = 12.5$
- ▶ We might then realize that the other players will see this logic. Then what should we guess?
 - ▶ Thus we should play $12.5p = 6.25$
- ▶ We can repeat ad infinitum
- ▶ What is the limit of this process? Note that we can keep doing this until we hit 0

New Solution Concept: Level k

- ▶ Define recursive set of strategies:
 - ▶ Level 0: Naive or non-strategic play
 - ▶ Guessing randomly in guessing game, but other assumptions make sense in other games
 - ▶ Level 1: best-respond to level 0
 - ▶ Level 2: best-respond to level 1 . . .
 - ▶ Level k : best-respond to level $k - 1$
- ▶ New solution concept: players will select one of the level k strategies, typically for $k = 1, 2$, or 3
- ▶ Note that Level k converges to NE as $k \rightarrow \infty$

Level k Predictions in Guessing Games

- ▶ Note that level- k predicts we should see behavior cluster at 50 , $50p$, $50p^2$, and so on
- ▶ Examining the data from Nagel (1995), we see
 - ▶ $p = \frac{1}{2}$: clusters at 25, 12.5
 - ▶ $p = \frac{2}{3}$: clusters at 33, 22
 - ▶ Also note cluster at 67: what is going on here?
 - ▶ $p = \frac{4}{3}$: clusters at 67, 88

Another Kind of Guessing Game

- ▶ Suppose you are playing with a partner
- ▶ You and your partner both submit guesses between 1 and 19
- ▶ Your payoffs:
 - ▶ Always get your guess in dollars
 - ▶ If your guess is exactly 3 less than opponent's guess, you get an additional bonus of 50 dollars
 - ▶ If your guess is exactly equal to opponent's guess, you get an additional bonus of 25 dollars

Analysis

- ▶ What is L_0 guess?
 - ▶ Non-strategic play in this game is to guess 19
- ▶ L_1 ?
 - ▶ Best response to 19 is to guess 16
- ▶ L_2 ?
 - ▶ Best response to 16 is to guess 13
- ▶ What is/are NE?
 - ▶ Level k converges towards guessing 1
 - ▶ If both guess 1, neither player can profitably deviate
 - ▶ Getting payoff $1 + 25 = 26$
 - ▶ Raising guess to x will get payoff $x \leq 19$
 - ▶ Same for 2 and 3
 - ▶ Thus NE are $(1, 1)$, $(2, 2)$, and $(3, 3)$
- ▶ Are any guesses dominant or dominated?
 - ▶ Guessing 17, 18 or 19 dominated
 - ▶ No dominant strategies

Summary

- ▶ Solution concepts make predictions about what strategies will be played:
 - ▶ Nash Equilibrium: mutual best response
 - ▶ Dominant strategy: always a best response
 - ▶ Dominated strategy: never a best response
 - ▶ Level k : iterative best responses
- ▶ In experiments, we see that people
 - ▶ do not always play Nash
 - ▶ sometimes choose dominated strategies
 - ▶ often play $L1$, $L2$, or $L3$