- We will play 3 rounds of a game

http://bit.ly/bMageq

case sensitive!

“Keynesian Beauty Contest”

Keynesian Beauty Contest

- We played the Keynesian Beauty Contest
- Pick an integer between 0 and 100
  - Winner is the person closest to 2/3 of average number
- In Economics, this is known as a **Simultaneous Move Game**
  - As is Rock Paper Scissors
- The typical concept used to analyse these games is the **Nash Equilibrium**

Nash Equilibrium

- Idea comes from John Nash
  - Nobel Prize in 1994
  - *A Beautiful Mind*
- Mutual Best Responses
  - What's the best thing I can do, given what you are doing?
  - What's the best thing you can do, given what I'm doing?
  - If these coincide, we have a Nash Equilibrium

Nash Equilibrium

- Thinking in terms of best responses...
  - If everyone else guesses 100
  - 2/3 of 100 = 67
    - So 67 would be my *best response*
  - If guesses are below 100
    - My *best response* is below 67
  - So I should never guess above 67
- If I should never guess above 67, then neither should anyone else!

Nash Equilibrium

- So if I know nobody will guess above 67
  - My best response is always *less than*...
  - 2/3 x 67 = 45
- Which is true for everybody!
- So if I know nobody will guess above 45
  - My best response is always *less than*...
  - 2/3 x 45 = 30
- And so on.....

Nash Equilibrium

- This procedure is known as iterated elimination of weakly dominated strategies
  - Following it gives a Nash Equilibrium
- The other way to find the Nash Equilibrium is to use *mutual best responses*
  - When is my best response x
  - Equal to 2/3 of everybody's best response
    - = x
  - x = 2/3 x
    - **Implies x = 0**

Keynesian Beauty Contest

- Experimentally, it seems like people use some kind of “iterated reasoning”
- But don't iterate all the way down to 0!
- Each time you iterate
  - You believe that your opponents are “1 level smarter”
  - And you best respond to that
- So what “level” of smart do you believe people to be?

Keynesian Beauty Contest

Nagel (AER, 1995)

- Consider a decision rule of the form
  - What is it best for me to do, if I assume everyone else is just picking a random number between 0 and 100?
    - This will give an average of 50
    - So I should pick (2/3) x 50 = 33
  - What do we get if, on average, people are this kind of "Level 1" player?
    - The **average** ends up being 33, and hence the **winning number** is 22
  - Close to what we got – **33.9 ; 22.6** !

Keynesian Beauty Contest

Nagel (AER, 1995)

- Then you see the results, and realise everyone else thought like you!
  - So you think one level deeper...
  - "Everyone else is a "Level 1" thinker, and will choose 33, so I'll choose 22!"
    - Seems sensible!
  - But again, everyone does the same, so 22 becomes the average
    - And so 22 x 2/3 = 15 is the winning number
  - We got **16.3 ; 10.6** in round 2

Keynesian Beauty Contest

Nagel (AER, 1995)

- Again, you see the results and the process repeats...
  - I'll think one level deeper in round 3
    - And choose 15
  - So does everyone else
    - And 15 is the mean so 2/3 x 15 = 10 wins
    - We got **17.2 ; 11.5** in round 3
- This type of reasoning seems to fit the data better than playing NE in every period!

Keynesian Beauty Contest

Nagel (AER, 1995)

- This pattern of data has been repeated for students and CEO's alike
- You act rationally, *conditional* on your slightly misguided beliefs about everyone else
  - A NE person has taken the “I presume that they presume that I presume that they presume....” logic to infinity
  - Which almost seems less rational!

k-Level reasoning

Nagel (AER, 1995)

- This process is called k-level reasoning
  - The person playing a random number is a Level 0 player (L0)
  - Using no level of reasoning about other people
- Most people start 1 level up from that!
  - They are Level 1 players
  - Who assume everyone else is L0
- And will then progress as more information is provided about everyone else

k-Level reasoning

Nagel (AER, 1995)

- It seems unlikely that anyone would start as a L∞ player without knowing the "correct answer" to start
  - But that is the NE idea
- You can play this online now!
- http://twothirdsofaverage.creativitygames.net/
- Why is this a "Keynesian" Beauty Contest
  - Extend this idea to the Stock Market
    - Rational Speculation....