Keynesian Beauty Contest

by Jasmine Yang
Players: all of you

Rules of the game:
- Choose an integer among 0, 1, 2, ..., 100
- No one is able to observe others’ numbers before he can choose his
- Outcome: Whoever chooses the number that is closest to $\frac{1}{3} \times \text{Average of all numbers}$ wins

The important task in this game is to anticipate what others will do.

What do you expect to happen?
Why?
What would a rational and well-informed person do?
Let’s Play the Game: Beauty Contest

survey.ubc.ca/surveys/fsl/keynesian-beauty-contest/

Keynesian Beauty Contest

Choose an integer between 0 and 100

You win if you choose the number closest to 1/3 times the average of all numbers
Why is this game named Beauty Contest?

New York Times, October 5th, 1913

Nowhere is the spirit of the times more quickly and definitely reflected than in the type of American girl. The gentle feminine woman of frills and furbelows was crowded aside by the dominant, vigorous athletic girl. She, in turn, gave way to a new type—the bachelor girl, who reflected freedom from convention and the desire to stand alone.
Every one has an ideal of this Girl of To-day. The New York Times wants to make that ideal real. It is seeking the girl who typifies The Girl of To-day. So we invite every one to send in the photograph of the girl who best represents this modern spirit.

From these photographs expert judges, artists who have made fame by their portrayal of the American girl, will select the twenty-nine photographs which are most typical of the present-day American girl. From these twenty-nine photographs one will be chosen by the judges as distinctively the most typical of all—the actual embodiment of the ideal Girl of To-day. All of these photographs are

➢ To win the prize, applicants had to guess what others think of as the most typical of the American girl
Based on Bob Shiller’s NYT article on September 3rd, 2011
August 4th, 2011: U.S stock market fell by 5 percent
August 5th, 2011: S&P downgraded the U.S. long-term debt in an unprecedented move
August 8th, 2011: U.S. stock market fell by another 7 percent
In successive days, +4.7 percent, -4.4 percent, +4.3 percent (but without significant news)
“Why did investors react so strongly to the rating change, which, after all, was merely the opinion of a few analytics on a committee?”
“Why did the market swing so much day to day, even when there was no significant news?”
For an answer listen to Keynes who drew analogy between the beauty contest and the stock market in his book “The General Theory of Employment, Interest and Money”
In Keynes’ version of beauty contest,

- 100 photographs of faces were displayed
- Readers were asked to choose the six prettiest
- The winner would be the reader whose list of six came closest to the most popular of the combined lists of all readers

The best strategy is not to pick the faces that are your personal favourite

It is to select those that you think others will think prettiest (if everyone except you is naive)

If you think no one is naive, then you need to go on a level deeper (pick the faces that you think others will think still others will think are prettiest)
Let’s Talk About How You Chose Your Numbers

➢ Anyone want to talk about how they chose their numbers?
Let’s think about this game

The rule is to “guess” the 1/3 of the average of the number that everyone chose

What is the largest the average can be? When can that happen?

When everyone chooses 100, then the average is...

If the average is 100, then $1/3 \times \text{(Average)} = 33.33$

If you have thought this much, what should we conclude?

The largest the target (that is, $1/3 \times \text{(Average)}$) can be is 33.33

Therefore, I should not choose a number that is greater than or equal to 34 (because the closest integer to 33.33 is 33)
So if you want to maximize your payoff, or in other words if you are rational, you should not choose a number $\geq 34$

What about everyone else other than you?

Let’s assume that
- Everyone else understands the game and payoff
- Everyone else is rational, i.e., wants to maximize his/her payoff

If we are willing to assume these two things, then what can we conclude?
- That is, everyone else will not choose 34 or larger
- Now this is getting interesting!
Rationality: Levels of Reasoning

<table>
<thead>
<tr>
<th>Assumptions About What A is/knows</th>
<th>A’s action</th>
<th>B’s action</th>
<th>Assumptions About What B is/knows</th>
</tr>
</thead>
<tbody>
<tr>
<td>If A is rational and knows the structure of the game</td>
<td>Choose ≤33</td>
<td>Choose ≤33</td>
<td>If B is rational and knows the structure of the game</td>
</tr>
<tr>
<td>If A knows B is rational and knows the structure of the game</td>
<td>Choose ≤11</td>
<td>Choose ≤11</td>
<td>If B knows A is rational and knows the structure of the game</td>
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<tr>
<td>If A knows B knows A is rational and knows the structure of the game</td>
<td>Choose ≤4</td>
<td>Choose ≤4</td>
<td>If B knows A knows B is rational and knows the structure of the game</td>
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<td>If A knows B knows A knows B is rational and knows the structure of the game</td>
<td>Choose ≤1</td>
<td>Choose ≤1</td>
<td>If B knows A knows B knows A is rational and knows the structure of the game</td>
</tr>
<tr>
<td>If A knows B knows A knows B knows A is rational and knows the structure of the game</td>
<td>Choose 0</td>
<td>Choose 0</td>
<td>Fully Rational: Nash Equilibrium is 0</td>
</tr>
</tbody>
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- Level 0: No consideration for how others will select
- Level 1: People will choose randomly
  - say the average of all numbers is 100
  - $\frac{1}{3} \times 100 = 33.33$
- Level 2: $\frac{1}{3} \times 33.33 = 11.11$
- Level 3: $\frac{1}{3} \times 11.11 = 3.703$

....
The Financial Times invited people to play the same game (except that 2/3 is used instead of 1/3 in 1997 and 2015)

The average of the guesses: 17.3, the winning guess: 12