Guess 2/3 of the average

In game theory, **Guess 2/3 of the average** is a game where several people guess what 2/3 of the average of their guesses will be, and where the numbers are restricted to the real numbers between 0 and 100, inclusive. The winner is the one closest to the 2/3 average.

Equilibrium analysis

In this game there is no strictly dominant strategy. However, there is a unique pure strategy Nash equilibrium. This equilibrium can be found by iterated elimination of weakly dominated strategies. Guessing any number that lies above 66.67 is dominated for every player since it cannot possibly be 2/3rds of the average of any guess. These can be eliminated. Once these strategies are eliminated for every player, any guess above 44.45 is weakly dominated for every player since no player will guess above 66.67 and 2/3 of 66.67 is approximately 44.45. This process will continue until all numbers above 0 have been eliminated.

This degeneration does not occur in quite the same way if choices are restricted to, for example, the integers between 0 and 100. In this case, all integers except 0 and 1 vanish; it becomes advantageous to select 0 if one expects that at least 1/4 of all players will do so, and 1 if otherwise. (In this way, it is a lopsided version of the so-called "consensus game", where one wins by being in the majority.)

Experimental results

This game is a common demonstration in game theory classes, where even economics graduate students fail to guess 0.[1] When performed among ordinary people it is usually found that the winner guess is much higher than 0, e.g., 21.6 was the winning value in a large internet-based competition organized by the Danish newspaper Politiken. This included 19,196 people and with a prize of 5000 Danish kroner. [2]

The Museum of Money has an interactive flash applet of the game [3], where each given answer will be used to calculate the current outcome.

Rationality versus common knowledge of rationality

This game illustrates the difference between perfect rationality of an actor and the common knowledge of rationality of all players. Even perfectly rational players playing in such a game should not guess 0 unless they know that the other players are rational as well and that all players' rationality is common knowledge. If a rational player reasonably believes that other players will not follow the chain of elimination described above, it would be rational for him/her to guess a number above 0.

Interestingly, we can suppose that all the players are rational, but they do not have common knowledge of each other's rationality. Even in this case, it is not required that every player guess 0, since they may expect each other to behave irrationally.

Notes

[1] Nagel, Rosemarie (1995). "Unraveling in Guessing Games: An Experimental Study" (http://www.jstor.org/stable/2950991). *American Economic Review* **85** (5): 1313–1326. .

[2] **(Danish)** Astrid Schou, Gæt-et-tal konkurrence afslører at vi er irrationelle (http://politiken.dk/erhverv/article123939.ece), Politiken; includes a histogram (http://konkurrence.econ.ku.dk/distribution?id=1237&d=6655488e6252d35e705500b68a339c50) of the guesses. Note that some of the players guessed close to 100. A large number of players guessed 33.3 (i.e. 2/3 of 50), indicating an assumption that players would guess randomly. A smaller but significant number of players guessed 22.2 (i.e. 2/3 of 33.3), indicating a second iteration of this theory based on an assumption that players would guess 33.3. The final number of 21.6 was slightly below this peak, implying that on average each player iterated their assumption 1.07 times.

[3] http://museumofmoney.org/exhibitions/games/guessnumber.htm

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