Introduction to Game Theory

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About me

- Ph.D. in Economics at Cornell University
- Postdoc at Caltech for 2 yrs
- Assistant Professor at the University of Mannheim for 4.5 yrs
- Joined SKKU on Feb 2022.
- Studying topics at the junction of public economics and political economy using microeconomics tools, including game theory and lab experiments.

Game?

- A situation where several players make *strategically interdependent* decisions: Your action depends on what others do, and their actions also depend on what you do.
- Several players' strategic behaviors lead to different outcomes.
- Examples abound: poker, chess, sports(*), online games(*), negotiations, bargaining, auctions, contracts, contests, partnerships, international relations, trade agreements, regulations, procurement, electoral campaigns, etc.

  (*: those are reasons why some non-Econ students get mistakenly interested in...)

Example: Prisoner's Dilemma

You have heard of it somewhere. Two suspects are separated into individual rooms. They cannot communicate with each other.

Prisoner's Dilemma

Suspect 1 \ Suspect 2	stays silent	betrays
stays silent	(4, 4)	(0, 5)
betrays	(5, 0)	(1, 1)

What's the use of it in real life??

Example: Split or Steal

Watch the video of Steven and Sarah. [This Link] (3'45"–6'45")

Example: Split or Steal

Watch the video of Steven and Sarah. [This Link] (3'45"–6'45")

This is similar to the Prisoner's Dilemma.

Split or Steal

Steven \ Sarah	Split	Steal
Split	(50K, 50K)	(−1, 100K)
Steal	(100K, −1)	(0, 0)

Example: Team Project

You and another student are paired as a team. Both have very limited time for either individual study or team project. You cannot communicate with the teammate, and you will never meet him/her again in the future. Contribution to the team project benefits both teammates.

Individual study or team project?

Student 1 \ Student 2	Team	Ind
Team	(B+, B+)	(D, A+)
Ind	(A+, D)	(B-, B-)

"Life is not that simple like that..."

I know. We simplify the life as much as possible to make the key conflict of interest distinct. Here are other frequently-used static games: These are not the exact representation of the real-life situations, but they do capture the essence of them.

Matching Pennies

P1 \ P2	Heads	Tails
Heads	(1,-1)	(-1,1)
Tails	(-1,1)	(1,-1)

Battle of the Sexes (BoS)

P1 \ P2	Bach	Stravinsky
Bach	(3,1)	(0,0)
Stravinsky	(0,0)	(1,3)

Stag Hunt

P1 \ P2	Stag	Hare
Stag	(3,3)	(0,2)
Hare	(2,0)	(1,1)

Hawk-Dove (Chicken)

P1 \ P2	Hawk	Dove
Hawk	(-2,-2)	(4,0)
Dove	(0,4)	(2,2)

How to analyze the game?

- Some games are easy to see the "outcome" of the game or what's going to happen. Most of them are not.
- Consider Rock-Paper-Scissors. Even in this simple game, you can't tell what's going to happen.
- We rely on some solution concepts. The most famous one is called a Nash equilibrium.

Nash equilibrium

- In words, a Nash equilibrium (NE) is a list of each player's strategy such that each player does not have an incentive to deviate from the equilibrium strategy given that others are following the equilibrium strategy.
- You may want to imagine a stalemate situation: "I stick to the current action because you play that way, and you stick to your current action because I play this way."
- A typical course starts from the description of NE in a simple game to a more complicated description of more-demanding versions of NE in more complicated games. (Subgame-Perfect Nash equilibrium for a sequential game; Bayes Nash equilibrium for a game with incomplete information; Perfect Bayesian equilibrium for a sequential game with incomplete information; etc.)

NE is not a description of how we arrive at it.

One misunderstanding: "NE is the result of the most reasonable thought processes."

Imagine this situation.

- Three students prefer restaurant A over restaurant B.
- They simultaneously call which restaurant to go for lunch. The restaurant called by two or more students is where they will end up having lunch.
- $\{A, A, A\}$ is a NE.
- Somewhat counterintuitively, $\{B, B, B\}$ is also a NE.

A digression: Let's play an actual game, with a prize!

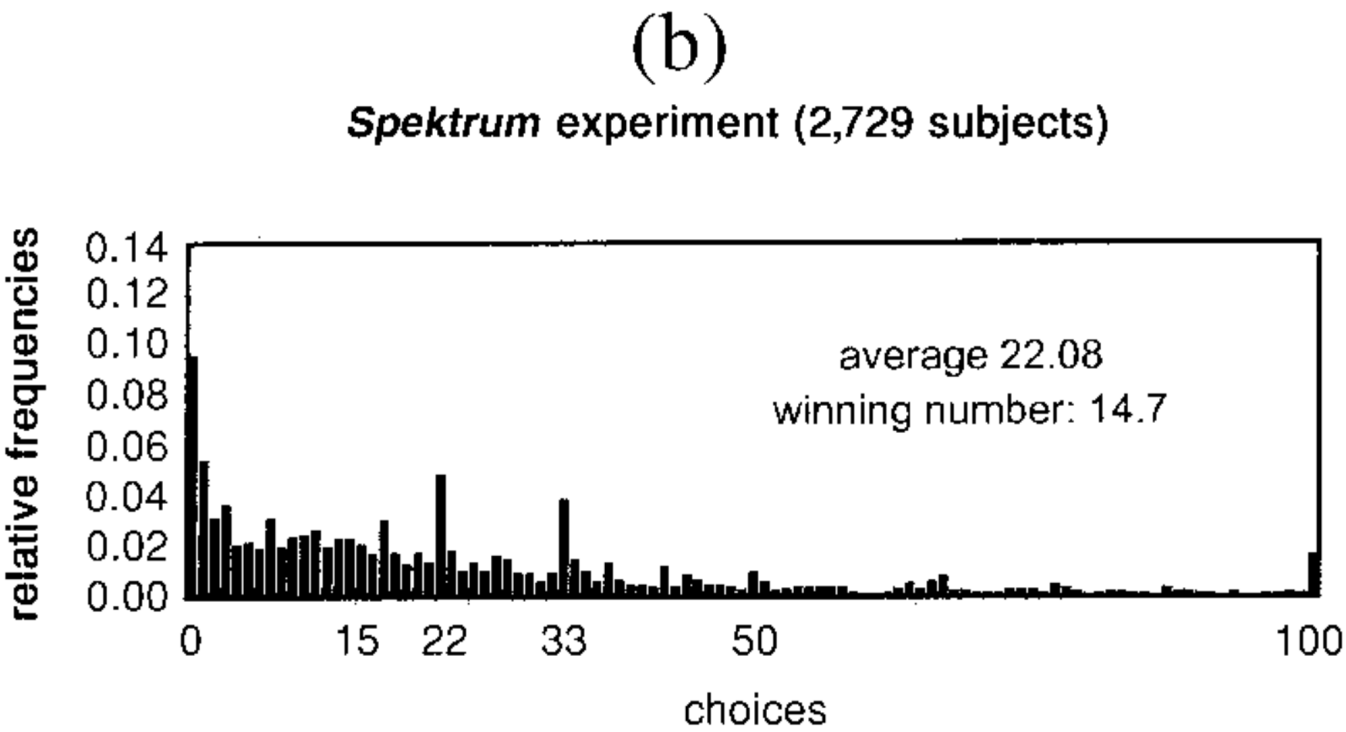
or type this url: https://tinyurl.com/2024FSeminar

People may not play NE

- The unique NE of the "guess 2/3 of the average" is for everyone to submit 0.
- Given that everyone randomly submit a number between 0 and 100, the average will be 50. The 2/3 of 50 is about 33.33.
- Given that everyone submits 33.33, the 2/3 of the average is 22.22.
- 2/3 of 22.22 is 14.81, of which 2/3 is 9.88, and so on...
- (Those who submitted 0 are smart...but poor. Consider coming to a grad school!)

People may not play NE

Another evidence with a larger sample



Source: Bosch-Domènech et al. (2002 AER), a part of Figure 1

Why do we study games when people don't play that way?

Reason 1

- It still works as a benchmark. In many situations, the equilibrium predictions are along with what we observe, especially when the players are non-human entities (e.g., firms and computers.)
- A 1-year-old baby cannot tell whether [2x3=7] is wrong. You know it is wrong because you understand how the multiplication operator works.
- To figure out that people don't act in a way that they are supposed to play, you should know first what they are supposed to play.

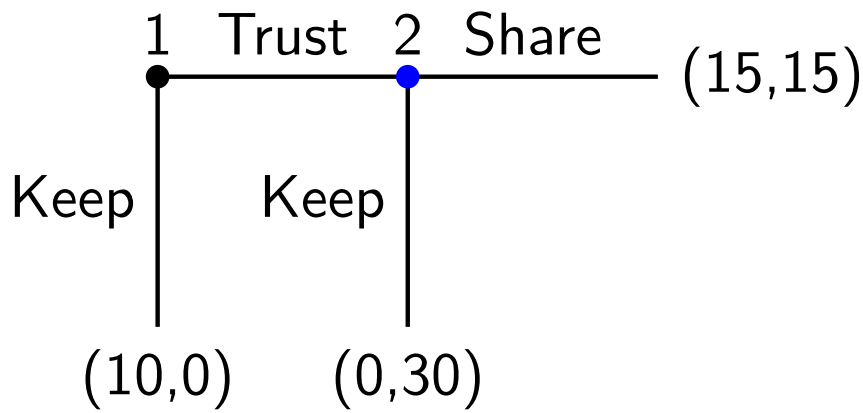
(If time permits) Another game: Top-two pay auction

- A common-value prize, say, 10,000 Won.
- The highest bidder gets the prize for the bidding price. The second-highest bidder has to pay the bidding price for nothing.
- A minimum bid increment is 500 Won.

Why do we study games when people don't play that way?

Reason 2

- The discrepancy between theory and our observations by itself helps us understand human behavior better.
- Scientifically, that's the starting point of new research. (For example, level-K theory.)
- Empirically, that provides some characteristics about the population. (Global Preference Survey)



{Keep, Keep} is the unique SPE, but not in reality.