Experimental Economics: methods & topics

Week 1 and 2

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This course

"Taking a course in experimental economics is a little like going to dinner at a cannibal's house.

Sometimes you will be the diner, sometimes you will be part of the dinner, sometimes both."

Theodore Bergstrom and John H. Miller

This course

It's all about choices

As experimentalists:

- What type of experiment should we conduct?
- What do we decide regarding the design, subject pool, incentives, procedures?

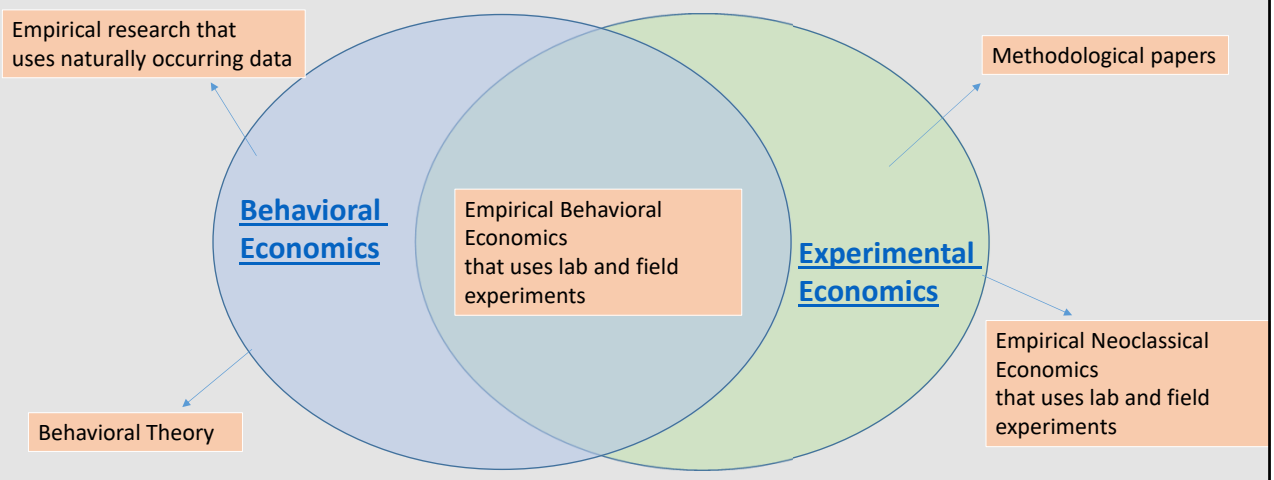
As economic agents/human beings:

- How we decide as human beings in markets, in strategic interactions and social dilemmas, and in individual settings?

Outline

- Experimental vs. Behavioral Economics
- Brief History of Experimental Economics
- Experiments:
  - Markets
  - Games, Social dilemmas and Social Preferences
  - Field Experiments

Experimental vs.(and) Behavioral Economics



Behavioral Economics

Is the study of economic decision-making by individuals and institutions **assuming that the individuals are influenced by social, cognitive, and emotional factors**

Behavioral Economics Research

Mitton, Todd, Vorkink, Keith, and Wright, Ian (2018). **Neighborhood effects on speculative behavior.** *Journal of Economic Behavior & Organization*, vol. 151, pp. 42 – 61.

Ernst Fehr Klaus M. Schmidt (1999). **A Theory of Fairness, Competition, and Cooperation.** *The Quarterly Journal of Economics*, Volume 114, Issue 3, pp. 817–868

Experimental Economics

Is the application of **experimental methods** to study **economic questions**.

Is an **empirical tool** that allows the study of how individual's decision and behaviour are affected by various (testable) factors in a *controlled* environment.

Experimental Economics

An example:
Theory: Sub-game perfect equilibrium (Selten, 1965)
Experiment: A simple bargaining game with 2 players (*Guth, Schmittberger and Schwarze, 1982)*:

- Player 1 makes a proposal for how a sum of money is to be split between players 1 and 2.
- Player 2 then either accepts, implementing the proposal, or rejects, in which case the interaction ends with zero payoffs for each.

What is SPE?
What do you think happens in the experiment?

Experimental Economics

The results show…

- A marked contrast between theory and experiment

  - The experimental evidence suggests that **our simplest theories of bargaining leave some aspects of behaviour unexplained**.

  - The importance of *reciprocity* and *fairness concerns* ➔ **Theory of Inequity Aversion Preference** (Fehr and Schmidt, 1999)

"In addition to selfish individuals, there are people who dislike outcomes that are perceived as inequitable."

Brief History

Neoclassical economics was in the first years of its existence, based on experimental research : analyses of diminishing marginal utility based on psychological findings about relationship between stimuli and sensations.

Individual choice experiments

- Daniel Bernoulli (1738) –St. Petersburg paradox
- Stanley Jevons (1871) – relationship between fatigue and muscular effort (ran the experiments to illustrate "the mode in which some of the laws forming the physical basis of economics might be ascertained")
- Louis Thurstone (1931) – elicit individuals' indifference curves from responses to binary choice problems.
- Maurice Allais -Allais Paradox (1953)

St. Petersburg paradox

Game of chance for a single player in which a fair coin is tossed at each stage.

The initial stake starts at 2 euros and is **doubled every time heads appears**.

The game ends the first time tails appears.

The player wins whatever is in the pot:

2 euros if tails appears on the first toss
4 euros if heads appears on the first toss and tails on the second
8 euros if heads appears on the first two tosses and tails on the third
(…)
2^k dollars, where *k* equals number of tosses

What would be a fair price to pay the casino for entering the game?

St. Petersburg paradox

One needs to consider what would be the average payout - **expected value**: with probability 1/2, the player wins 2 dollars; with probability 1/4 the player wins 4 dollars; with probability 1/8 the player wins 8 dollars, and so on.

$E = 1/2 \cdot 2 + 1/4 \cdot 4 + 1/8 \cdot 8 + 1/16 \cdot 16 + \cdots = \infty$

The expected win for repeated play is an infinite amount of money!

One should therefore play the game at any price.
In published descriptions of the game, many people expressed disbelief in the result, and few would pay 25 euros…

St. Petersburg paradox

Classical resolution of the paradox involved the explicit introduction of a utility function, an expected utility hypothesis, and the presumption of diminishing marginal utility of money.

In Daniel Bernoulli's own words:

"The determination of the value of an item must not be based on the price, but rather on the utility it yields…. There is no doubt that a gain of one thousand ducats is more significant to the pauper than to a rich man though both gain the same amount."

The Allais Paradox

	Lottery S	Lottery R
Treatment 1	3000 with prob. 1	4000 with prob. 0.8 0 with prob. 0.2
Treatment 2	3000 with prob. 0.25 0 with prob. 0.75	4000 with prob. 0.2 0 with prob. 0.8

Results: The Allais Paradox

	Lottery S	Lottery R
Treatment 1	**3000 with prob. 1**	4000 with prob. 0.8 0 with prob. 0.2
Treatment 2	3000 with prob. 0.25 0 with prob. 0.75	4000 with prob. 0.2 0 with prob. 0.8

U(3000)>0.8U(4000)+0.2U(0)
Multiplying both sides by 0.25
0.25U(3000)>0.25*[(0.8U(4000)+0.2U(0)]
0.25U(3000)> 0.2U(4000)+0.05U(0)
Adding 0.75U(0) to both sides
0.25U(3000)+0.75U(0)> 0.2U(4000)+0.8U(0)

Brief History

Market experiments

- Decentralized markets
- Edward Chamberlin (1948) -competitive equilibrium using induced values
- Vernon Smith (1962, 1964) -double auction

Game experiments

- Prisoners' dilemma 1950's -originally by psychologists/sociologists
- Reinhard Selten(1959) introduced oligopoly games

Brief History

- Yet, until 1980 not much was published
- **The field grew rapidly after the 1980s** in large part based on experiments that challenged the motivation attributed to theoretical agents
- Since 1990 Exp Econ methods has taken place on almost equal footing with more traditional econometric methods.
- In 2002, **Daniel Kahneman** and **Vernon Smith** were awarded the Nobel memorial Prize

Brief History

Smith: has developed novel experimental techniques to investigate traditional economic questions about the workings of markets

Kahneman: used experimental methods of his discipline to challenge economsts' conventional assumptions about rationality

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Your opinion

Why did economists accept for so long the ideia that their discipline was nonexperimental?

Why economists believed for so long that the information that experiments produce would not be useful?

The common idea that theories based on idealized assumptions (theory of perfect competition classical game theory) with its assumption of unlimited rationality provide benchmarks for understanding the real world.

The ideia is that the knowledge of the real world can be organized by cataloging its imperfections relative to the theory. If one sees the theory in this light, the whole idea of testing it may seem misplaced.

Experimental Economics

Experimental Economics

- Industrial Economics
- Law Economics
- Gender Economics
- Information Economics
- Public Economics
- Game Theory
- Macro Economics
- …

The purpose of experiments

(Smith, 1994; Al Roth, 1995 in Kagel and Roth)

Test theory:

- Efficiency wage theory (Akerlof)
- Expected Utility -Allais paradox

What is a fair test of a theory?

- Should a theory be judged only within the domain in which it is intended to apply? (Friedman 1953)
- **Duhem-Quine problem:** Theories must be applied to be tested
  if the predictions of the theory fail:
  is it a problem of the theory or of the application?

The purpose of experiments

Equilibrium selection:

Observe behavior in cases where theory makes **unclear predictions**

Theory: if players are sufficiently patient then any amount of cooperation is sustainable in an infinitely repeated prisoner's dilemma

→ run an experiment to know how much cooperation occurs

The purpose of experiments

Find empirical regularities

Search and establish "stylized facts" as a basis for new theory:

Subjects do not use backward induction in some games

→ development of the theory of cognitive hierarchy

Observe behavior in cases where theory makes **no predictions**

Do emotions matter?

The purpose of experiments

Stress testing (test effect sizes):

Contributions to a public good are around 30% above the Nash prediction in many experiments using groups of 4 subjects.

Stress test: Do contributions converge to the equilibrium if group size increases?

The purpose of experiments

Accurate measurement of variables of interest:

Use experiments to **measure risk and time preferences** and test whether these measures explain saving decisions in the field

The purpose of experiments

Orient/advice policy makers:

Use experiments to study the effect of different forces in complex situations where theory is impractical or nonexistent

- Test performance of different auctions in order to sell spectrum rights.
- Test ways to regulate a privatized electricity market.
- Test the effects on worker motivation of various compensation schemes

The purpose of experiments

Replication of previous work:

Replication is important to check internal and external validity

The purpose of experiments

Teaching economics:

- Interactive experiments get the whole class involved and push students to think actively rather than passively.
- Help to learn better some economic concepts

Games economists play

The empirical method: the importance of control

The empirical method: the importance of control

Economics has been mostly regarded as a non-experimental science:

Researchers have had to rely exclusively on **naturally occurring field data**, that is, direct observations of the real world.

Data may suffer from some problems : selection, endogeneity, attrition,…**the data is not collected in a controlled environment**

Sources of Data

	Naturally occuring	***Experimental***
Field	•GDP •Inflation •Unemployment rate (field data from economic outcomes)	• Policy experiments • Experiments as part of representative surveys • Experiments conducted outside the lab
Lab	Discovery of Penicillin	**Laboratory experiment In a controlled environment**

The empirical method: the importance of control

To establish whether an independent variable influences the dependent variable (outcome)

➔ **treatment effect**

➔ need to establish counterfactual.

Counterfactual

Example: Suppose that after the midterm I decide to stop using slides.

And, suppose, on average, the grades improved

What can you say?

Is there a positive effect of having no slides?

Counterfactual

Better grades could have resulted from:

- Easier topics after midterm
- Students may have studied more after midterm
- More experience with the course
- Better mood because of nicer weather
- (…)

Counterfactual

Ideal…

Have the same student with and without slides…

That´s not possible

Measurement models

It's intuitive to think of the empirical problem in a dichotomous way

Y_1 = outcome with treatment
Y_0 = outcome with no treatment

$T = \{1\ if\ treated, 0\ if\ not\}$

Treatment for unit i can be measured as: $\tau_i = y_{i1} - y_{i0}$

Problem: missing counterfactual: τ_i is unknown

Measurement models

Economists have spent years developing approaches to the analysis of economic data - **investigate casual relationships among variables** - , with the purpose of giving empirical content to economic theories and verifying them or refuting them.

CE	NE	PSM	IV	STR

CE: Controlled Experiments
NE: Natural Experiments
PSM: Propensity Score Estimation
IV: Instrumental Variables Estimation
STR: Structural modeling

Controlled Experiments

Controlled experiments are the **most convincing** method of creating the counterfactual since they directly construct a control group via ***randomization***.

In this case, the population average treatment effect is given by:

$$\tau = y_1^* - y_0^*$$

y_1^* : treated average outcome after the treatment
y_0^* : non-treated average outcomes after the treatment

Natural Experiments

- Considers the treatment itself as an experiment and finds a comparison group to mimic the control.
- Identify treatment effects in cases randomization is not possible but selection is not an issue
- τ is measured by comparing the difference in outcomes before and after for the treated with the before and after outcomes for the non-treated: treatment effect on the treated.

Natural Experiments

Assume data exists for two periods (DiD):

$$\tau = [y^*_{t1} - y^*_{t0}] - [y^*_{u1} - y^*_{u0}]$$

where

y^*_{t1} is the mean outcome for the treated group after the treatment
y^*_{t0} is the mean outcome for the treated group before the treatment
y^*_{u1} is the mean outcome for the untreated group after the treatment
y^*_{u0} is the mean outcome for the untreated group before the treatment

Natural Experiments

Examples:

Smoking ban in Helena, Montana from June 2002 till December 2002

- Heart attacks rate dropped by 40% while the smoking ban was in effect
- Confounding effect: the heart attack rates were already in decline

Nuclear weapons testing

- Partial nuclear testing ban treaty, 1963 → atmospheric nuclear test forbidden
- Compare people born before 1963 and after 1963, for instance to check the rate of replacement for cells in different human tissues.

Natural Experiments

Examples:

Decentralization of university admission to German law schools (Julia Horstschräer)

Study the effect on the number of first-year students, the number of unassigned university places, drop-out rate

the number of first-year students increased and the number of unassigned places decreased after the decentralization. This effect is mainly driven by enabling law schools to abolish admission restrictions. Drop-out rates are not significantly affected by the decentralization process

Natural Experiments

Examples:

Could be done in Portugal…

- Impact of moderating fees on utilization of emergency heath care
- Impact of free textbooks for students on performance
- Impact of smoking ban inside bars and restaurants on non-smokers health
- Impact of tuition fee reduction on university drop-outs

Propensity Score Matching

- Make non-experimental data “experimental data”
- Identify treatment effects in cases of **selection on observables**

Estimation procedure:

- Estimate $\Pr(treated)$ via probit/logit model
- Define a matching algorithm to estimate missing counterfactual for each treated observation
- Calculate average treatment effect for the treated
- Balancing

Propensity Score Matching

Example (Maximiano)

The effect of firing a soccer coach on team´s performance

Firing is not independent of performance…

Instrumental Variables

- Allows estimation when explanatory variables are correlated with the error term - **reverse causation; omitted variables; measurement error**
- Identify treatment effects in cases of **selection on unobservables**

Instrumental Variables

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Instrument:

- Correlated with the endogenous regressor conditional on the other variables
- Independent of the error term

Instrumental Variables

Example: Vietnam War draft (Angrist et al. 1990)

Important economic questions: what determines earnings.
Evaluate the effects of military service on lifetime earnings.

The military service is an endogenous variable →correlates with some unobservable characteristics

Approximate random assignment of the Vietnam War draft lottery, and used it as an instrumental variable associated with eligibility (or non-eligibility) for military service.

Because many factors might predict whether someone serves in the military, the draft lottery frames a natural experiment whereby those drafted into the military can be compared against those not drafted because the two groups should not differ substantially prior to military service.

Results: the earnings of veterans were, on average, about 15 percent less than the earnings of non-veterans.

Instrumental Variables

Example: The Returns to Medical School: Evidence from Admission Lotterie (Ketel et al. 2016)

Admission lotteries to estimate the returns to medical school in the Netherlands.

Results: data from up to 22 years after the lottery, we find that in every single year after graduation doctors earn at least 20 percent more than people who end up in their nextbest occupation.

Structural Estimation

- Allows estimation of deep structural parameters of theoretical models (uses techniques like GMM and maximum likelihood)
- Contrasts with partial equilibrium relationships provided by reduced form estimation
- Relies heavily on assumptions

Measurement methods

If controlled experiments can produce **the most convincing evidence of randomization**

and the **statistics needed for the analysis are simple** because randomization does the work itself…

why not use controlled experiments more often?

Measurement methods

1. Many questions are difficult to answer in this setting

Does the GDP growth in U.S. influences vaccination in Africa?

Do environmental regulations alter trade, capital, and factor flows?

2. Other disadvantages: internal vs. external validity; subject selection problems