

Experimental Economics

Slides 2

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Fall 2026

Based in part on course materials by Sandra Maximiano



Outline for today

- ▶ Measurement models: Experimental Economics vs. Econometrics
- ▶ Types of Economic Experiments
 - ▶ Lab experiments
 - ▶ Field experiments
 - ▶ Natural experiments
 - ▶ Internet experiments

Sources of Data

Economics has long been considered a deductive science, combining theoretical considerations and observations in the real world only.

Sources of Data

	Naturally occurring	Experimental
Field	GDP, inflation, unemployment (i.e., field data from economic outcomes)	Policy experiments Representative-survey experiments Experiments outside the lab
Lab	Discovery of penicillin	Laboratory experiments in controlled environment

The empirical method: the importance of control

Naturally occurring field data — direct observations of the real world — may suffer from several problems:

- ▶ selection,
- ▶ endogeneity,
- ▶ attrition,
- ▶ ...

The data are not collected in a controlled environment.

The empirical method: the importance of control

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

independent variable $\longrightarrow$ outcome

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Treatment effect

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Treatment effect

To identify the treatment effect, we need to establish the **counterfactual**.

Counterfactual

Suppose that after the midterm I decide to stop using slides. And suppose, on average, grades improve.

What can you say?

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Suppose that after the midterm I decide to stop using slides. And suppose, on average, grades improve.

What can you say?

Is there a positive effect of having no slides?

Counterfactual

Better grades could have resulted from:

- ▶ easier topics after the midterm;
- ▶ students studying more after the midterm;
- ▶ more experience with the course;
- ▶ better mood because of nicer weather;
- ▶ ...

Counterfactual

Ideal...

Have the **same student** with slides and without slides.

Ideal...

Have the **same student** with slides and without slides.

That is not possible.

Measurement models

It is intuitive to think of the empirical problem in a dichotomous way:

- ▶ outcome with treatment: $Y_i(1)$
- ▶ outcome with no treatment: $Y_i(0)$

The treatment effect for unit i can be written as:

$$\tau_i = Y_i(1) - Y_i(0).$$

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Problem: for the same unit, one of these potential outcomes is always unobserved — the missing counterfactual.

Measurement models

Economists have spent years developing approaches to the analysis of economic data to investigate **causal relationships** among variables.

The purpose is to give empirical content to economic theories and to verify or refute them.

Generate the missing counterfactual

Generating data

- ▶ CE: Controlled Experiments

Modelling naturally occurring data

- ▶ QNE: Quasi-natural Experiments
- ▶ PSM: Propensity Score Estimation
- ▶ IV: Instrumental Variables Estimation
- ▶ STR: Structural Modelling

Econometrics provides tools for modelling naturally occurring data.

Controlled Experiments

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

Controlled Experiments

With random assignment, the population Average Treatment Effect can be estimated as:

$$ATE = E[Y(1)] - E[Y(0)]$$

or, in the experiment,

$$\widehat{ATE} = \bar{Y}_T - \bar{Y}_C,$$

where $\bar{Y}_T$ is the average outcome of the treated group and $\bar{Y}_C$ is the average outcome of the control group.

Natural Experiments

A natural experiment considers the treatment itself as an experiment and finds a comparison group to mimic the control group.

It can identify treatment effects when randomization is not possible — often for ethical or practical reasons — and when selection into treatment is not the main concern.

Natural Experiments

A common strategy is to compare changes in outcomes for the treated group with changes in outcomes for the untreated group:

$$\text{Treatment effect on the treated} = (\bar{Y}_{T,after} - \bar{Y}_{T,before}) - (\bar{Y}_{C,after} - \bar{Y}_{C,before}).$$

Natural Experiments

Assume data exist for two periods. The Difference-in-Differences estimator is:

$$\hat{\delta}_{DiD} = (\bar{Y}_{T,after} - \bar{Y}_{T,before}) - (\bar{Y}_{C,after} - \bar{Y}_{C,before}).$$

- ▶ $\bar{Y}_{T,after}$: mean outcome for treated group after treatment
- ▶ $\bar{Y}_{T,before}$: mean outcome for treated group before treatment
- ▶ $\bar{Y}_{C,after}$: mean outcome for untreated group after treatment
- ▶ $\bar{Y}_{C,before}$: mean outcome for untreated group before treatment

Quasi Natural Experiments: Examples

Smoking ban in Helena, Montana

- ▶ Smoking ban from June 2002 to December 2002.
- ▶ Heart-attack rates dropped by 40% while the ban was in effect.
- ▶ Potential confound: heart-attack rates were already declining.

Nuclear weapons testing

- ▶ Partial Nuclear Test Ban Treaty, 1963: atmospheric nuclear testing prohibited.
- ▶ Compare people born before and after 1963, for example to study cell replacement rates in human tissues.

Natural Experiments: Examples

Decentralization of university admission to German law schools (Julia Horstschräer) Study the effect on:

- ▶ number of first-year students;
- ▶ number of unassigned university places;
- ▶ drop-out rates.

The number of first-year students increased and the number of unassigned places decreased after decentralization. Drop-out rates were not significantly affected.

Natural Experiments: Examples

Decentralization of university admission to German law schools

Empirical strategy

During the reform process, admission to all law schools except the ones in the largest German federal state of North Rhine-Westphalia was decentralized. Therefore, I use the regional variation over time between law schools in and outside of North Rhine-Westphalia for identification. As a second control group, I employ medical schools because admission to medical schools was centrally administered over the entire observation period. Important to note is that both changes induced by the decentralization process first, the abolishment of the central clearinghouse and, second, the abolishment of admission restrictions are considered by my analyses.

Natural Experiments: Examples

Could be done in Portugal...

- ▶ Impact of moderating fees on utilization of emergency health care
- ▶ Impact of free textbooks for students on performance
- ▶ Impact of smoking bans inside bars and restaurants on non-smokers' health
- ▶ Impact of tuition-fee reductions on university drop-outs

Measurement methods

If controlled experiments can produce the most convincing evidence through randomization, and the statistics needed for the analysis are simple because randomization does much of the work itself. . .

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Why not use controlled experiments more often?

Measurement methods

Many questions are difficult to answer in a controlled experimental setting:

- ▶ Does GDP growth in the U.S. influence vaccination in Africa?
- ▶ Do environmental regulations alter trade, capital and factor flows?

Other disadvantages:

- ▶ internal vs. external validity;
- ▶ subject-selection problems.
- ▶ ethical issues / political backlash
- ▶ very high cost (or very small samples)

Laboratory Experiments

A lab experiment constructs a small-scale environment in which the experimenter's control should be assured in order to measure treatment effects properly.

Control and Replication

are the essence of lab experiments.

Control a variable

In practical terms, to control a variable means:

- ▶ fixing and maintaining it at some constant level;
- ▶ setting it at different levels across different interventions.

Control in Laboratory Experiments

In a laboratory experiment, a microeconomic system is created that reflects a complete and self-contained economy (Smith, 1982, 1994). Two key elements:

1. Environment

- ▶ agents' preferences;
- ▶ technology;
- ▶ initial endowments.

Control in Laboratory Experiments

The experimenter designs the institutional setting.

2. Institution (rules of the game)

- ▶ possible actions;
- ▶ sequence of actions;
- ▶ information conditions (message space);
- ▶ incentives;
- ▶ framing (language, story);
- ▶ outcomes and how allocations can be reached.

Control in Laboratory Experiments

The experimenter:

- ▶ knows what is exogenous and endogenous;
- ▶ can measure confounding variables (e.g. beliefs);
- ▶ knows the theoretical equilibrium;
- ▶ has control over treatments rather than relying on selection;
- ▶ can randomize, reducing self-selection problems;
- ▶ controls the environment and institutional conditions under which the evidence is generated.

Control over preferences

Subjects are likely to have prior characteristics and preferences that are difficult to observe.

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How can we gain control over subjects' preferences?

Control over preferences

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How can we gain control over subjects' preferences?

Use incentives!

Types of Experiments

- ▶ Laboratory experiments
- ▶ Field experiments
- ▶ Online experiments
- ▶ Experimental surveys

XLAB – ISEG

Laboratory experiments

Examples of experimental economics laboratories:

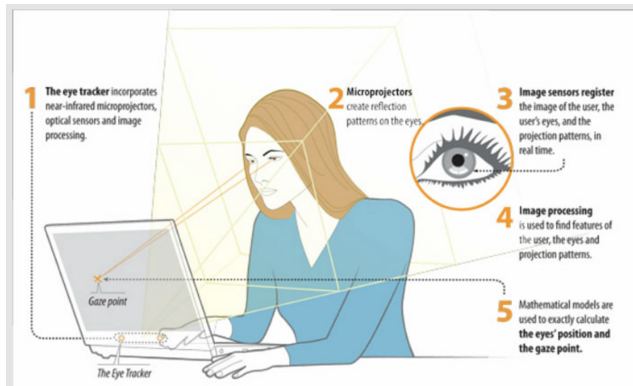
- ▶ Vernon Smith Experimental Economics Lab, Purdue University
- ▶ CREED Lab, University of Amsterdam

Functional magnetic resonance imaging



Measuring brain activity during economic decision-making.

Eye Tracking



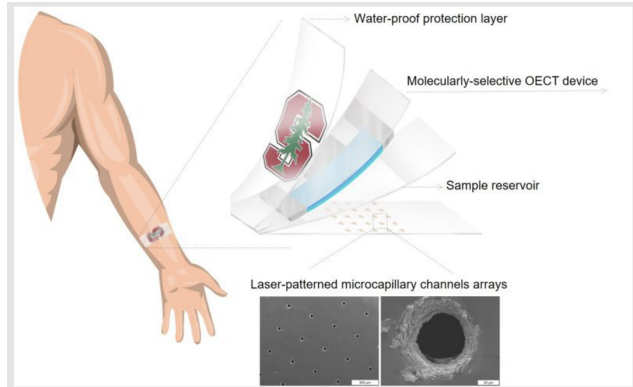
Measuring visual attention during economic decision-making.

Heart Rate Monitor



Physiological responses can complement observed choice data.

Measure sweat/stress levels



Physiological measures can provide additional information about responses to experimental stimuli.

Field Experiments



Controlled interventions conducted in naturally occurring environments.

Online Experiments

Microsoft, Amazon, eBay, Booking.com, Facebook and Google conduct large numbers of online experiments annually.

⇒ **Big Data**

Online Experiments

Specialized firms and platforms can be used to program and conduct economic experiments.

- ▶ Web-based experimental platforms
<http://expilab.com/web-economic-experiments-expilab-platform/>
- ▶ Online labor markets, such as Amazon Mechanical Turk
<https://www.mturk.com/>

Discrete Choice Experiments

Eliciting preferences through repeated choices between alternatives with systematically varied attributes.