Experimental Economics Term 2

An Introduction

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Experimental Economics

An Introduction

Me: Duarte Gonçalves

Term 2: Tuesday 9:00-10:50, DH B03 Ricardo LT.

Goal: understand better how people make choices in strategic settings.

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For whom? Anyone interested in

- doing experimental work or theory;
- importing insights from experimental methodologies to field work.

Strategic Interaction

Game Theory is all around:

- Investment decisions: buy/not buy stock; value of stock depends on others' decisions; speculative attacks.
- Politics: designing voting rules and the agenda.
- Firm competition and industrial organisation: pricing strategies by firms are analysed by game theoretic models to determine collusion.
- Auction theory (branch of game theory): spectrum auctions.
- Public economics: procurement policies.
- Evolutionary game theory: cancer treatment research.
- School choice: students choose strategically; other students' choices affect their outcome.
- Organisational economics: delegation of decision power within a firm or organisation.
- Education economics: outcomes and degree of competition in grading schemes.
- ⋮

Strategic Interaction

Goals: understand how people choose in strategic settings and why.
Counterfactual analysis, accurate comparative statics, better predictions.

- Which predictions/comparative statics hold and which don't.
- Which models work best and when.
- What leads particular model assumption/feature to fail.
- Uncover stable regularities (about which benchmark models might be silent).
- Examine underlying mechanisms.

All models are necessarily wrong. Goal is *not* to find special case in which model breaks, but to seek and explain robust behaviour patterns.

Experimental Economics: Term 2

Workload: Required of everyone.

Paper Presentations: On a weekly basis, every member of the class will be required to work in a group of at most 3 people to prepare a **15 minute** presentation on an assigned paper.
One group will be selected at random to give the presentation at the start of the class.

Project Presentations: Last 2-3 lectures (depending on # groups) are going to be on a new research project related to class materials.
Allowed to work in groups of at most 3 people.
Motivation, model sketch, target results, design/data + discussion.
Deadline: 27 January - group formation and tentative topics.

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Introductions: name, year, research interests, anything else you'd like to add.

Overview

1. Refresher of Key Concepts

2. A Positive Approach

3. A Hands-On Methodological Approach

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Normal-Form Games

A **normal-form game** is a tuple $\Gamma = \langle I, S, u \rangle$ where

- **Set of Players:** $i \in I$.
- **Strategy Space:** $s_i \in S_i$
- Strategy profile: $s \in S := \times_{i \in I} S_i$; $s_{-i} \in S_{-i} := \times_{j \in I: j \neq i} S_j$.
- **Payoff Function:** $u = \{u_i, i \in I\}$, $u_i : S \to \mathbb{R}$.

Interpretation: players have preferences over outcomes and each strategy profile s pins down an outcome (potentially the same outcome).

Write $u_i(s) = u_i(s_i, s_{-i})$.

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Y is **mutual knowledge** = all players know Y

Y is **common knowledge** = all players know Y, all players know that all players know Y, all players know that all players know that all players know Y, etc.

Game of complete information: all aspects of the game are common knowledge.

Assume that all games are of complete information; later we'll discuss games of incomplete information.

Normal-Form Games

Strategies

- **Pure strategy** $s_i \in S_i$.
- **Mixed strategy** $\boldsymbol{\sigma}_i \in \Sigma_i := \Delta(S_i)$; $\boldsymbol{\sigma} \in \Sigma := \times_{i \in I} \Delta(S_i)$; $\boldsymbol{\sigma}_{-i} \in \Sigma_{-i} := \times_{j \in I : j \neq i} \Delta(S_j)$.
- Write $\boldsymbol{\sigma}(s)$ for $\prod_{i \in I} \boldsymbol{\sigma}_i(s_i)$.
- **Expected payoff** $u_i : \Sigma \to \mathbb{R}$ (slight abuse of notation)
- $u_i(\boldsymbol{\sigma}) := \mathbb{E}_{\boldsymbol{\sigma}}[u_i] = \sum_{s \in S} \boldsymbol{\sigma}(s) u_i(s) = \sum_{s \in S} \prod_{j \in I} \boldsymbol{\sigma}_j(s_j) u(s)$.

Interpretation: u_i as Bernoulli index; players EU maximisers.

Refresher of Key Concepts

Definition

(i) σ_i **strictly dominates** σ_i' iff $u_i(\sigma_i, \sigma_{-i}) > u_i(\sigma_i', \sigma_{-i})\ \forall \sigma_{-i}$.

(ii) σ_i is **strictly dominant** iff it strictly dominates every other σ_i'.

(iii) σ_i of player i **is strictly dominated by** strategy σ_i' iff $u_i(\sigma_i, \sigma_{-i}) < u_i(\sigma_i', \sigma_{-i})\ \forall \sigma_{-i}$.

(iv) Γ is **dominance solvable** iff a single strategy profile survives IESDS.

Remarks

(i) A mixed strategy involving a strictly dominated strategy is strictly dominated.

(ii) It suffices to check opponents' pure strategies to assess if strategy strictly dominated, but do *need to check own mixed strategies*. (Important for design!)

(iii) Order of deletion in IESDS doesn't matter.

Refresher of Key Concepts

Definition

(i) σ_i **weakly dominates** σ_i' iff $u_i(\sigma_i, \sigma_{-i}) \geq u_i(\sigma_i', \sigma_{-i})$ $\forall \sigma_{-i}$ and $\exists \sigma_{-i}'$: $u_i(\sigma_i, \sigma_{-i}') > u_i(\sigma_i', \sigma_{-i}')$.

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Refresher of Key Concepts

Definition

(i) σ_i is **best response to** σ_{-i} iff $u_i(\sigma_i, \sigma_{-i}) \geq u_i(\sigma_i', \sigma_{-i})\ \forall \sigma_i'$.

(ii) σ_i is **never a best response** if it is not a best response to any σ_{-i}.

(iii) σ_i is k**-rationalisable** if it survives k rounds of iterated elimination of 'never best responses'. It is **rationalisable** if it is k-rationalisable for all k.

(iv) σ is a **Nash equilibrium** if σ_i is a best response to σ_{-i} for all i.

Remarks

(i) Survives IESDS $\subseteq$ Rationalisable $\subseteq$ NE.

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Any ideas?

A Positive Approach

Limited Depth of Reasoning?

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- Is depth of reasoning a choice? (How) Does it depend on the setting? On stakes/incentives?
- Does adding strictly dominated actions make a difference? When?
- What kinds of patterns should we expect to be robust? More rounds IESDS $\Longrightarrow$ farther from rationalisable? Higher stakes $\Longrightarrow$ higher k-rationalisable?
- (Also: How do people behave when facing players who are more sophisticated than themselves?)

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Choosing Non-Rationalisable Actions?

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Mistakes and Reacting to Incentives?

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- Do affine transformations change anything?

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A Positive Approach

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Beliefs about Others?

Mistakes and Reacting to Incentives?

Is Decision Time Informative?

- Is time informative about beliefs and choices?
- Can it help us teasing out mechanisms?

A Positive Approach

Limited Depth of Reasoning?

Beliefs about Others?

Mistakes and Reacting to Incentives?

Is Decision Time Informative?

Learning how to Choose?

- Learning with feedback?

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Limited Depth of Reasoning?

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Mistakes and Reacting to Incentives?

Is Decision Time Informative?

Learning how to Choose?

- Learning with feedback? Without feedback? From others? Across games?
- Do choices become less noisy over time? More? Do people become surer about others' choices?
- Does learning always gets people closer to NE?

A Positive Approach

Limited Depth of Reasoning?

Beliefs about Others?

Mistakes and Reacting to Incentives?

Is Decision Time Informative?

Learning how to Choose?

Selecting Equilibrium?

- Are some equilibria more plausible than others? What determines which is most likely?
- (Unlikely we'll get there.)

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Learning how to Choose?

Selecting Equilibrium?

And more:

- Limited understanding of contingent reasoning? Overbidding, aggregating information via voting/markets, failures of backward induction, etc.

We will not have full answers for these questions. At best, we'll see limited and partial answers, conjectures, and leave lots of open questions for future research.

Any other fundamental question that piques your interest?

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A Hands-On Methodological Approach

Throughout, we'll be focused on:

1. Identification: formulating hypotheses and how to test them.
2. Design: considering trade-offs associated with different experimental designs.
3. Coding: develop stock otree code you can reuse later on.

A Hands-On Methodological Approach

Tools of choice:

- Visual Studio Code.

  Extensions: heroku-cli, Jupyter, Live Share, Excel Viewer, Git History, Live Preview.

  Also recommend: LaTeX Workshop (requires installing some LaTeX distribution, e.g., texlive), Markdown PDF, GitHub Copilot Chat.

- Python (3.14).

  Packages: numpy ($\geq$1.26), scipy, pandas($\geq$2.1), statsmodels ($\geq$0.14), random, matplotlib ($\geq$3.8), otree ($\geq$5.10), sympy, numba, lifelines.

- For hosting: Prolific (online), ELFE (in the lab).