Methodology of Experiments

Slides Partially Adapted, with permission, from Steffen Huck (UCL)
Phases of an Economic Experiment

1. Research Question
2. Experimental Design
3. Recruitment of Subjects
4. Explanation of the Rules
5. Play
6. Payments
7. Analysis
8. Writing up
1. Research Question

- You should **always** start with a research question.
- Think clearly what you want to study.
- Research question always before observing data. New questions? New designs?
- Replications are valid and needed.
- Ask yourself which Methodology is best to study your question at hand: Theory? Empirical Data? Experiments?
- Why an Experiment?
Laboratory experiments as part of empirical research

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<th>Happenstance</th>
<th>Field</th>
<th>Laboratory</th>
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<td>Rate of inflation</td>
<td>Discovery of Penicillin</td>
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<td>Welfare-to-work</td>
<td>Ultimatum game</td>
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Why experiments?

- Control. Precise measurement.

- True exogeneity such that causes may be isolated. This can be difficult with happenstance data because explanatory variables may be highly correlated.
Why laboratory experiments?

- Relatively cheap.
- Laboratory, staff, money to pay subjects.
- Legal issues. Welfare-to-work experiments would probably not be feasible in some countries because of equal-treatment acts.
2. Experimental Design

- Think of the best experimental design for your research question.
- Inspiration from others is valid, but think twice before setting on a design.
Typically, you want to conduct an experiment to find out about the effect of just a few variables.

For example, how does the number of bidders in an auction affect revenue? Or, how does the auction format affect revenue?

Focus variables.

But at the same time there are unavoidably lots of other variables that may or may not affect your data.

Nuisance variables.

What is focus and what nuisance may depend on the purpose of your study. For example, the sex of your subjects.
A good experimental design helps you:

- to sharpen the effects of your focus variable.

- to disentangle the effects of different focus variables.

- to minimize the effects of nuisance variables.
Direct control: Constants and treatments

- In a lab you can directly control many variables. Examples: *The amount subjects have to split in a bargaining game. Demand and cost functions.*
- Controlling these variables makes the difference between experimental and happenstance data.
- You can keep these variables *constant* or *vary* them.
- The ones you vary are your treatment variables.
- The more treatment variables you have, the more you might learn about these variables but at the same time your experiment will be more expensive.
Validity of laboratory data

- **Two issues:**
  - **Internal validity:** Do the data permit correct causal inferences?
    That’s a matter of good design.
  
  - **External validity:** Can we generalize from lab to field?
    The experimentalist’s traditional answer to this is: We *should*.
    That’s the idea of **parallelism**.
Parallelism

- How do you deal with somebody who tells you what’s going on in a laboratory is not relevant for the field outside?
  - You tell them that that’s what they told Galileo, too.

- The idea is that you should start with the assumption that things carry over. When somebody questions this, you take his specific argument and try to test its validity in your laboratory.

- For example: Friedman and Sunder mention the number of traders in laboratory asset markets.
Avoid confounded treatments

- Suppose you are interested in the revenue of two auction formats with different numbers of bidders.
- Two treatments:
  1) First-price sealed-bid auction with 4 bidders.
  2) English auction with 10 bidders.
- What’s wrong here?
  - Effects will be confounded. You only learn about the interaction; nothing about the two variables on their own.
- Never change two variables at the same time!
  *Vary all treatment variables independently.*
- Factorial design.
Indirect control: Randomization

- How to deal with nuisance variables that may or may not be observable.
- The key is they should not be confounded with your focus variables.
- Examples:
  - Changing institutions in a long experiment --- fatigue;
  - role assignments --- early and late comers; etc.
- This can be avoided by randomization.
Friedman & Sunder advice on disposition of variables

- Control all variables that are controllable.

- Control focus variables as treatments.

- When you suspect that a nuisance variable interacts with a focus variable, try controlling the nuisance variable as a treatment.

- Otherwise control nuisances as constants.
Between- vs. within subject design

- In economics, two different treatments typically require a sequence. This means that in a within-subject design you can confound experience with the focus variable.

- Either have sequence as a treatment or randomize.

- Within-subject designs are often prone to confounding effects. But they can be more elegant and cheaper than between-subject designs.
3. Recruitment of subjects

- Recruit without false promises
- Subject data base is extremely precious resource.
- Record subjects’ history!!! (In particular, if you do more than one session or related studies at a later point in time).
- The problem of no-shows
- Be NICE to your subjects. Pay show-up fee if you have over recruited. Think airlines.
Which Subjects?

- Students vs Professionals

- **Advantages of students**: accessibility, convenient recruiting, low opportunity costs, steep learning curves, lack of exposure to confounding material.

- **Disadvantages of students**: something to prove, contamination, low income.

- Avoid doctoral students

- Trade-offs, depending on specifics of study
Professionals

- Behave often “worse”.
- Harder to motivate, confuse abstract situations with real life.
- Not much evidence in favour.
- But also not much evidence at all.
Alternative subject pools

- Experiments in developing countries (Attanasio, Barr, Cardenas, Henrich, others).
- Experiments with representative samples (Bellemare/Kroger, Fehr/Wagner).
- Experiments with survey participants
Classroom experiments

- Extremely convenient for one-shot
- But subjects may want to prove something
- Plus they may feel more empathy/sympathy towards class mates than to others they would normally interact with
- Anonymity extremely important
- Grades as reward medium
- In any case, don’t teach them the topic before (except you plan this as a treatment).
Gender

- Not much systematic evidence but a few interesting results.
- May be particularly important if interaction is face to face.
- Fairness differences have been documented (Women may be more prosocial).
- In any case, record the information.
How many subjects?

- There are two issues:
  - How many per “game”? 
  - How many altogether?

- The first depends on the theory/model you look at.
  - Simple in game experiments
  - More difficult if you test competitive markets/models with continuum of traders
How many subjects?

- How many “observations”? But what is an observation?

- The issue of dependencies.

- The conservative “German” approach: Take each “matching group” as one observation (regardless of the size of the group and of how many times subjects played).
4. Explanation of the rules

- Instructions are KEY to your experiment.

- Clarity is of utmost importance. Test them!!

- Examples? Can be dangerous …

- Statement of purpose?

- General rules: No talking etc.

- Read them aloud?
Ethics

- Human subject committees
- If you use grades, they should still reflect course performance.
- Difficult, for example, in Cournot (where sometimes the “dumbest” subject makes most money).
- NO DECEPTION!
5. Play
Pen and Paper vs. Computers

- Advantages of pen-and-paper:
  - Obvious if you don’t have a computer laboratory
  - More natural? (the issue of chance moves, random numbers)

- But: you can’t do as many repetitions as with PCs

- My advisor’s Advice: “Begin your career with a pen&paper study”….and so I did (Rey-Biel, GEB 2008).
Lab log

- Should be good practice
- Experiments should be replicable!
Lab setup

- Don’t underestimate time for preparations.
- In particular, when you have to book space.
- Registration (to keep track of subjects’ history in your data base).

- Who shall conduct your experiment? (There is no final advice. But do NOT try to influence your subjects; do NOT stare over their shoulders, etc.)

- Subject monitors (to make processes believable)
How to handle queries

- Different approaches

- My advisor’s technique: “subjects are not allowed to say/ask anything allowed because this might spoil others”.

- Think of questions like “Doesn’t that mean that I should always play X?”

- If there is anything of general interest, repeat for all.
More issues

- Dry-run periods; changes of incentives
- Recording the data: take utmost care.
- With pen&paper design your forms in a way that reduces the risk to lose data; backup your data if you use computers
- Termination: finite number of repetitions is preferable (or at least announce upper bound; otherwise you’re deceiving)
- Debriefing? (dangerous if your study continues)
6. Payments

Vernon Smith’s “Induced Value Theory”

Proper use of a reward medium (like monetary payoff) allows experimenter to induce prespecified characteristics in experimental subjects and the subjects’ innate characteristics become largely irrelevant, says the theory.

Is there any problem in this statement?
Vernon Smith’s “Induced Value Theory”

- Proper use of a reward medium (like monetary payoff) allows experimenter to induce prespecified characteristics in experimental subjects and the subjects’ innate characteristics become largely irrelevant, says the theory.

If that is true, there is nothing to measure.
Smith’s ‘axioms’

- **Monotonicity**: Subjects must prefer more reward medium over less and not become satiated.

- **Salience**: The reward must depend on choices of participants. Reward (payoff) function implements institutions (rule of the game).

- **Dominance**: Subjects’ utility depends predominantly on the reward medium and other influences are negligible.
Rewards

- Typically money, sometimes grades
- Binary-lottery technique
- Often “points” that are converted into money.
- Exchange rate must be fixed!!! (Otherwise incentives will be distorted.)
- Avoid losses/bankruptcy (comes at a price because you have less freedom in parameter choice)
7. Analysis

- Selten’s view is that you don’t need econometrics if you design your experiment well (may be harder to justify if you are concerned with external validity).

- Good knowledge of Statistics and Econometrics will give you a comparative advantage

- But...do not do fancy stuff for the shake of being fancy

- Use the technique (graphs, tests, descriptive statistics, econometrics) which best answers to your research question.
8. Writing up

- It should be the easiest part if:

  - Your research question was clear.
  - Your design is most appropriate for such question.
  - Your analysis is correct and insightful.
Structure of every experimental paper:

1. Introduction:
   - Motivation (research Question)
   - Related Literature (Highlight your novelties!)

2. Experimental design and Procedures.
   - Treatments
   - Recruitment
   - Incentives
Structure of every experimental paper:

3. Results:
   - Descriptive Statistics
   - Graphs
   - Tests and other Econometrics

4. Conclusion:
   - How your goal was achieved.
   - Suggest further research (and experiments?).