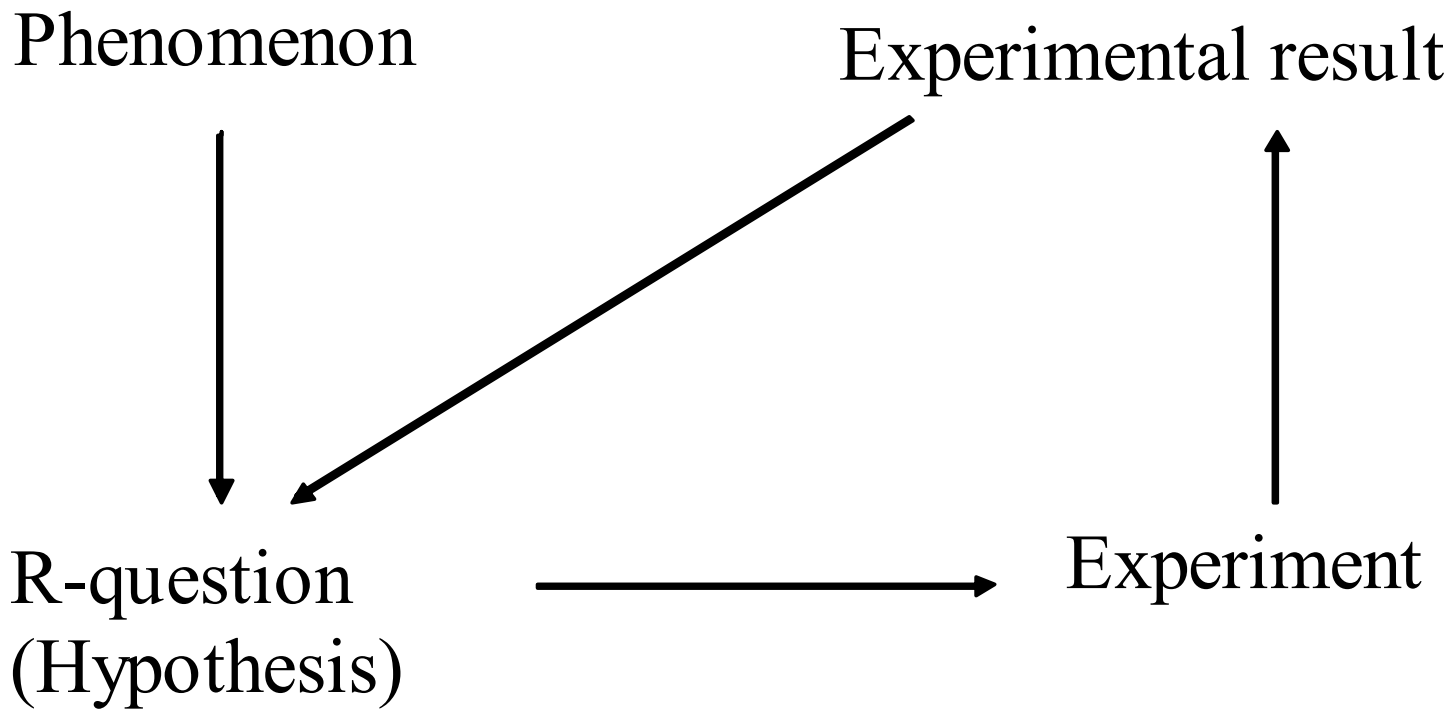
How to do experiments
(a personal view)

Economic phenomenon, hypothesis and experiment



Steps

- Questions
- Design
- Hypotheses
    - Standard
    - Alternative
- Preparing the experiment
    - Instructions
    - Computer program
    - Procedural details
- Running the experiment
- Data analysis
- Writing the paper and presenting the results

What is a good experiment?
Seven questions by Shyam Sunder

1. What is the question financial economics that you would like to have answered after the experiment? (Your answer should be a single sentence with a question mark at the end.)
2. What do you know already about the possible answers to the question you have stated above?
3. What are the various possible ways of finding an answer to the question you have stated above? Include both experimental as well as any other methods you know.
4. What are the advantages and disadvantages of using an experiment to find an answer?
5. What are the chances that the answer you get from the experiment will surprise you or others? What are the chances that it will change someone's mind?
6. How would you conduct the experiment? (Write down a design and instructions.)
7. Is your experimental design the simplest possible design to help answer the question you have stated?

Some expressions and technicalities

- **Treatment**: a particular condition of the experiment
  - Often a (main) treatment and a control treatment (or more)
  - Everything else kept equal, only one change
- An experiment usually consists of several **sessions**
  - In a session a group of people takes part in the experiment at a particular date and place
- **Subjects** = participants in the experiment

Across- und Within-Subject-Design

- Across-Subject-Design: Subjects participate only in one treatment
  - No order effect problems:
    - In the second treatment subjects have learned something already
    - Solution: reverse order to control for order effects
      - AB / BA Design
- Within-Subject-Design: Subjects participate in more than one treatment
  - Allows individual comparison
  - Perfect control for individual fixed effects
  - More powerful tests

- Note: Different designs require different statistical tests
- Example:
- Non-parametric tests for equality of distributions (null hypothesis)
  - Matched pairs (within subj.): Wilcoxon test
    - Stata: *signrank x = y*
  - Independent samples (across subj.) Mann Whitney testt
    - Stata: *ranksum x, by(treat)*

What are observations?

- Distinction between observation and statistically independent observation
  - Example: 5 Sessions of a market experiment with ten periods and ten trades each
  - 500 price observations
  - Only 5 independent observations (means per session, which in this case is a matching group)
  - Independent because no interaction across matching group
- If there are only few (independent) observations, experimentalists often use non-parametric tests instead of regressions

- Example:
  - 10 matching groups play public goods game, two treatments
  - Decsions: contribution level c
  - Question: Are contribution levels different across treatments?

  Regresssion
    - Stata: *reg c treatdummy, r cl(mg)*
  - Non-parametric test: take averages of the 10 matching groups, attach a treatmentdummy
    - Stata: *ranksum c, by(treatmentdummy)*

One-Shot vs. repeated observations

- Pro One-Shot
  - Strong incentives for decision
  - No strategic spillovers across periods (particularly important if „true preferences“ are to be elicited
  - Easy to perform and short
- Pro repetitions (“repeated one-shot”)
  - Learning
  - Possible to observe dynamics, e.g. convergence to predicted or behavioral equilibrium
  - More observations

Implementing repeated games (Partner design)

- Finitely repeated games
  - If only rational and selfish types and unique Nash equilibrium in stage game: backward induction.
    - If stage game has multiple Nash equilibria, "anything goes": loss of a clear prediction.
  - If multiple types (e.g., reciprocal and selfish players, many Bayesian equilibria, see Kreps et al. (1982)
- "Infinitely" repeated games
  - Implementation with the help of a termination probability
  - Problem: length of the experiment is endogenous
    - Do you want to throw dice for five hours?
    - What if after the first period the game ends?
    - Different sessions last differently long

Partner- vs. Stranger Design

- Partner (group of subjects stay together for several periods)
  - Within a group of partners you have one observation (4 "partner groups" of 4 subjects each vs. one "stranger group" with 16 subjects: 4 vs. 1 independent observation)
  - Allows analysis of strategic considerations
- Stranger (groups are recomposed randomly)
  - Similar behavior/predicition as "one-shot" but more observations
- Perfect stranger: probability of being re-matched with the same person is exactly zero (and subjects know that)

Strategy method

- Strategy method was first used by Reinhard Selten
- Idea: Instead of just playing the game, subjects are asked to indicate an action for each information set, i.e., the experimenter really elicits a strategy
- Example: Sequential prisoner's dilemma: Second mover is asked: What do you do (defect or cooperate) if first mover cooperates and what do you do if first mover defects?

- Advantages
  - More information about motivation/behavior of players
    - Figure out, e.g., that someone is a reciprocal player, even though first movers always defect
  - Information about how people would play "off equilibrium" or "off action path" (since this is not reached, you have no information how they play)
- Problems
  - Incentives are weaker, since each information set is reached only with probability smaller one
  - Hot vs. cold emotions: People might feel and act differently knowing they have reached a particular information set, compared to potentially reaching it
  - Explaining the SM to subjects is tricky (loss of understanding, control)
  - Move structure of game

- Does SM induce a different behavior relative to a situation where a subject responds to the actual move of an opponent?
  - Brandts and Charness (1998 "Hot versus Cold: Sequential Responses and Preference Stability in Experimental Games", Discussion Paper, Universidad Autonoma de Barcelona) and Cason and Mui ("Social Influence in the Sequential Dictator Game", Journal of Mathematical Psychology) report evidence indicating that the strategy method does not induce different behavior.
- Moreover: You may use SM in all your treatments, and focus on treatment differences

Role reversal

- Role reversal: Subjects act in different roles, e.g., in the ultimatum game you are a proposer and a responder
- Helps to put oneself in the shoes of the other person. If this is what you want to study, fine.

- In my view not a good procedure, because you exactly lose information about how people act in a given role
- On top: strategic considerations (e.g., ultimatum game, 2 periods)

Learning trials

- In complicated experiments (e.g., with difficult trading rules in markets) it is a good idea to have subjects try out the rules of the game, without monetary consequences
- Advantage
  - It guarantees subjects' understanding from the first paid period on
  - Allows answering "new" questions of subjects that arise after learning trials
- However
  - You lose information about the "true" first period.
  - People infer uncontrolled things from the learning trials
  - Subjects may send (costless) signals
- I would do it if the institutions are really difficult (e.g., in a continuous double auction)
- Maybe it is not necessary to play a full game (e.g., just the complicated part) and maybe it is not necessary to display all information about others' actions
- In any case: if learning trials, then in all treatments

Elicitation of beliefs

- Example
  - Prisoner's dilemma. Before they make their decisions both players are asked, what they think the other player will do, to cooperate or to defect?
- Beliefs can be very informative to understand their motivation
- Beliefs are of particular importance to check the rationality of decisions
- Problems
  - Experimenter-Demand–Effect (you may make people think about stuff they would not have thought about)
  - Directs focus on particular problems, e.g., guessing game!
  - Desire to be consistent: people state beliefs to "match" their actions (e.g., someone defects and states the other person will defect also)

Pay beliefs?

- Pros
  - Subjects have an incentive to state correct beliefs
- Cons
  - Is costly and – given a budget – goes at the cost of incentives in the decision part
  - Subjects have no incentive to state wrong beliefs anyway
  - Can pollute incentives in the experiment if people “hedge” decisions, e.g., in coordination games, see next slide

Beliefs are paid: 2 points for correct belief

Hedge strategy of player 1, e.g.: “I believe 2 plays left, and I play down“. In this case 1 earns at least 2 points

		Player 2	
		left	right
Player 1	up	2,2	0,0
	down	0,0	2,2

Paper and pencil vs. computerized experiments

- Advantages paper and pencil experiments
  - Flexibility (quickly develop new treatments)
  - Relatively low start up costs
  - Natural environment
    - Not a lab but a classroom
    - Procedures more visible and credible
      - throw dice in front of people instead of random device
      - Matching of people
- Advantages of computerized experiments
  - Better control
    - no communication among subjects
    - less interaction with experimenter
  - Running of experiment much simpler (e.g., markets)
  - Less mistakes
  - Automatic data collection

An effective design
Friedman/Sunder: Experimental Methods

- Control all controllable variables. Otherwise your data will be less informative than they could be.
- Control focus variables as treatments. Use widely separated levels to sharpen the contrasts. Use two levels and skip intermediate levels unless you are interested in possibly nonlinear effects.
- When you suspect that a nuisance variable interacts with a focus variable, consider controlling the nuisance as a treatment. Two levels often suffice.
- Control most nuisances as constants to keep down complexity and cost. Even a nuisance with large effects can harmlessly be held constant as long as its effects are independent of the focus variables' effects.
- Vary your treatments independently to maximize the resolution power of your data and to avoid confounding.

Deception

- Never cheat on subjects, even though it is tempting from a scientific point of view.
- Never!
- Why?
- First, there is a moral code among economic experimentalists not to do it.
- You will never publish a paper and people won‘t like your research.
- You will lose your reputation towards your subjects: If you lie once they will never believe you in the future. This blurs all incentives.

Hypotheses: Standard Hypothesis

- In almost all experiments you want to have a (set of) prediction(s)/hypotheses
- Traditional assumptions in game theory
  - Rationality
  - Selfishness = money maximizing
  - Both is „common knowledge“
- Determine equilibria
  - Often simple and unique prediction
  - Describes behavior often not very well
- Use the standard prediction as a benchmark

Alternative Hypotheses

- There are many good reasons to question the standard prediction, examples:
  - Bounded rationality
    - Cognitive limits
    - Rules of thumb
    - Heuristics
    - Imitation
  - Social motives
    - Altruism
    - Fairness (reciprocity, inequity aversion)
    - Status preferences
    - Preferences for efficiency
  - Emotions
    - Anger
    - Joy
    - Arousal
  - Etc.

Deriving alternative predictions

- Observations from every day life, intuition
- Previous experimental results (economics, psychology)
- Game theoretic analysis under alternative assumptions
  - Prospect Theory (risk behavior, loss aversion)
  - Fairness theories
  - Statistical game theory, quantal response (errors depend on cost of error)
  - Visceral factor perspective, emotions

Writing instructions

- Simple language
  - Simple, short and unambiguous sentences
  - Redundancies if issues are complicated
  - Consistent/uniform descriptions and framing
  - Avoid suggestive terms
    - Punishment: negative points
    - Defect: contribute nothing
- Neutral framing which helps understanding
  - Concrete framing (goods market, labor market)
    - Easy to understand
    - Problem (?): Associations from real life
  - Abstract framing
    - Avoids every day associations (does it really?)
    - Harder to understand the rules of the game
    - No control about what subjects really think

Writing instructions

- Complete description of the rules of the game
  - Sequenz of decisions
  - Interaction
  - Payoff consequences
- Different ways to explain the payoff function
  - Formula
  - Verbal explanation
  - Table
  - Figure
- Control questions
  - Check understanding
  - Knowing who is done with the instructions
  - One should not be suggestive with his examples

Recruiting subjects

- Students
  - o + easy access
  - o + relatively low opportunity costs (low costs of conducting experiments)
  - o + quick learning…
  - o +/- not much experience with the object of interest
  - o + analytical skills, quick understanding of instructions
  - o - selection effect (not representative)
- Non-students
  - o +/- experienced subjects (know institutions etc.)
  - o - Larger variance in learning and understanding
  - o - Potentially high opportunity costs (salience?)

Recruiting: What do you tell people when you invite them?

- It is not
  - A medical experiment
  - Intelligence test
  - Marketing research
- It is an economic experiment
  - Study human behavior
  - Important for understanding economic problems
- Why should you take part?
  - You can earn money (do not mention concrete amounts of money, that creates expectations and may pollute behavior)
  - Learn about an interesting method in the social sciences