Introduction to Behavioral Economics.

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October 28, 2016

This handout[1] summarizes the lectures slides. Please note that the handout is not very useful if you do not attend the class.

Homepage: http://www.igorasanov.com/teaching.html

Literature:

! Davis, Douglas D., and Charles A. Holt. Experimental economics. Princeton university press, 1993..

- Bardsley, Nick. Experimental economics: Rethinking the rules. Princeton University Press, 2010.

Requirements

Seminar

- Presentation (5-10 minutes), completion of mandatory reading and active participation in discussion of the papers during the seminar (Not more than 20% missed seminars without a good reason)

Seminar Paper. Choose one of those two.

I. Design of the experiment (max. 1 person):

1. Statement of the problem
2. Literature review **04.11.16**
3. Formal model
4. Expected results **02.12.16**
5. Description of the results
6. Instructions **13.01.17**

II. Reproduction of the experimental data analysis (max 2 person):

1. Get the data **28.10.16**
2. Reproduce the data analysis **02.12.16**
3. Compare results with results of the paper **16.12.16**
4. Make a report. **13.01.17**

Data for replication

1. Check **for experimenal paper in economics** from top journal that is intresting for you. For instance: American Economic Review, Econometrica, Quarterly Journal of Economics, Journal of Monetary Economics, Review of Economic Studies.
2. Check if the data available.
   (a) Check the data on the site of the journal.
   (b) Check on the site of **the corresponding author** of the paper.

(c) For Journals from *Elsevier* Publishing company you can check it here: https://datasearch.elsevier.com//

3. If data is not available, ask yourself, how much this paper is interesting for you?
   - Not very much → 1.
   - Very much → Write **a very polite letter** to the corresponding author.
4. Get the data and start replication of **all tables from** the paper.

Writting Style

! Zinsser, William. On writing well. HarperCollins Publishers, 1991.

- Thomson, William. A guide for the young economist. MIT Press, 2001.
- Strunk, William. The elements of style. Penguin, 2007.
- MOOC. Writing in Science: http://online.stanford.edu/course/writing-in-the-sciences

Contents

1 Motivation

1.1 Replication Crises

Survey of 1500 scientists by the Journal *Nature* (2016) show that 70% scientists failed to replicate other scientists experiments – **get the same results as others**.

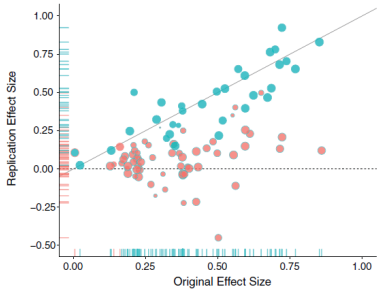
Reasons:

- Fraud (see retractionwatch.com)
- Misconduct: *P*-hacking, selective reporting ... (Ionnides, 2005, Bruns and Ioannidis, 2016, Ioannidis et al., 2016)
- Careless: Failure to reporoduce statistical analysis (see replication wiki)

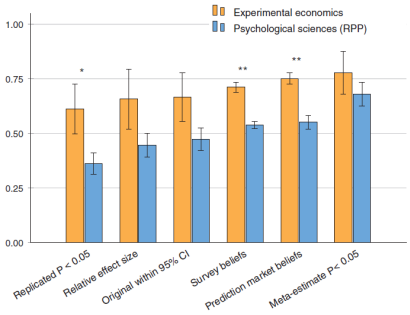
  ...

The relevance of the problem vary across disciplines, but **psychology is at the heart of the controversy:**

- Only 36% of experiments were replicated (Nosek et al., 2015).



Source: Nosek et al., 2015



Source: Camerer et al., 2016

Why?

1.2 Foundations of Behavioral Economics

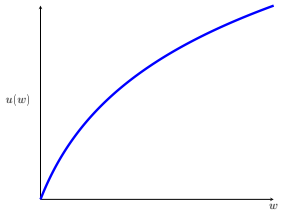
1.2.1 Early Days

Saint-Petersburg paradox, Bernoulli (1738)

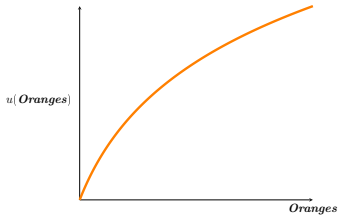
A casino offers a lottery, L for a single player in which a fair coin is tossed at each stage. The pot starts at 2 dollars and is doubled every time a head appears. The first time a tail appears, the game ends and the player wins whatever is in the pot.

$$E(L) = \frac{1}{2} \cdot 2 + \frac{1}{4} \cdot 4 + \frac{1}{8} \cdot 8 + \frac{1}{16} \cdot 16 + \cdots = +\infty \tag{1}$$

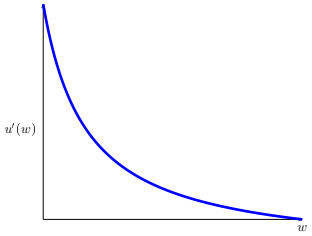
→ Foundations of the expected utility theory – expected utility is monotonically decreasing with wealth, w e.g. $U(w) = \ln(w)$.



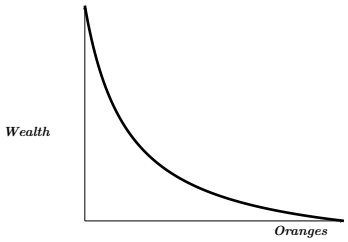
If it works for wealth, shall it generalize to other things?



What if we look at the margin? → Marginal Revolution (1862)



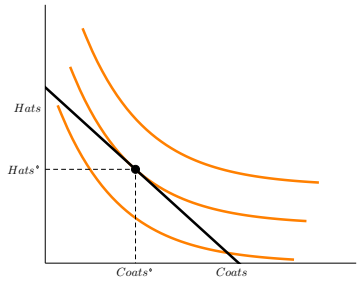
→Indifference curves



Shall we test it?

Estimation of Indifference Curves, Thurstone (1931)

Subjects make a large number of hypothetical choices between bundles of goods e.g. hats and coats.



Wallis and Friedman Critic (1942)

"It is questionable whether a subject in so artificial an experimental situation could know what choices he would make in an economic situation . . . "

"For a satisfactory experiment it is essential that the subject give actual reactions to actual stimuli. . . "

→ It is a standard to focus on generalsability (External and internal validity): formal theory, neutral instructions, anonimity, different subjects.

Rausseas and Hart Answer (1951)

Subjects had to make a choice between actual breakfast type that they will have to eat.

→ It is a standard *to incentivize* subjects: Monetary reward.

→ It is a standard *to not decieve.*(Emergent property)

1.2.2 Rise of Game Theory

Theory of Games and Economic Behavior, Neumann and Morgenstern (1944):

1. Refinement of expected utility theory
2. Theory of interactive behavior (Strategic Interaction)

Problems:

1. Allais Paradox (1953), Ellsberg Paradox (1961).
2. Prisoner's Dilemma (Dresher and Flood, 1950).

1.2.3 Allais Paradox

Choice between two gambles

1. 100 millions with 100% chance.
2. 500 millions with 10% chance; 100 millions with 89% chance; 0 with 1% chance
   Other gamble:
3. 100 millions with 11% chance; 0 millions with 89% chance
4. 500 millions with with 10% chance; 0 millions with 90% chance.

Theory: If $A > B$ then $C > D$.

Actual Choice: If $A > B$ then $C < D$.

→ People are risk-averse.

1.2.4 Ellsberg Paradox

Suppose you have an urn containing 30 red balls and 60 other balls that are either blue or orange. You don't know how many blue or how many orange balls there are, but that the total number of blue balls plus the total number of orange equals 60.

Choice between two alternatives

1. You receive 100 if you draw a red ball.
2. You receive 100 if you draw a blue ball.
   Other gamble:
3. You receive 100 if you draw a red or orange ball.
4. You receive 100 if you draw a blue or orange ball.

Theory: If $A > B$ then $C > D$.

Actual Choice: If $A > B$ then $C < D$.

→ People are ambiguity - averse.

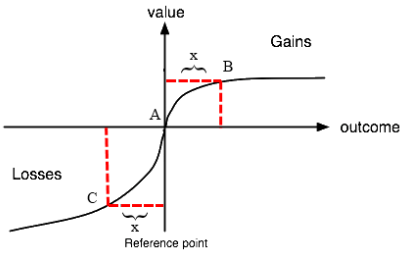
1.2.5 (Cumulative) Prospect Theory

- People value things with respect to certain reference point e.g. again, wealth, w.
- They value losses higher than gains (Tversky and Kahneman, 1972, 1992)

→ accounts for the risk, ambguity aversion and other biases.

→ resolve St.-Petersburg Paradox.

So What?



1.2.6 Prospect Theory: Application

Example: Enhancing the Efficacy of Teacher Incentives Through Loss Aversion (Fryer, Levitt, List and Sadoff, 2012).

- **Problem:** Incentivize teachers to increase student achievement, though financial incentives are ineffective.
- **Idea:** Exploit loss aversion (Kahneman and Tversky, 1979,1992)
- **Treatments.**
  - "Gain" treatment – teachers receive the monetary reward that depends on performance of their students at the end of the year.
  - "Loss" treatment – teachers get 4000$ but they must return the difference between 4.000$ and their final reward if their students perform below average at the end of the year.
  - Control treatment

Results

Table 1: The Effect Of Treatment on Test Scores

	Dependent Variable	
	Thinklink Math Scores	ISAT/ITBS math Score
Loss	6.866**	6.867**
	(2.677)	(3.269)
Gain	1.263	0.228
	(2.888)	(3.402)
Observations	23111	21444

Back $\Leftarrow$ to the 1950s

1.2.7 Prisoner's Dilemma

	Cooperate	Defect
Cooperate	3,3	1,*4*
Defect	*4*,1	2,2

Table 2: Prisoner's Dilemma

10 repeated prisoners dilemmas (Selten und Stoecker, 1986).

Results:

1. Participants start with mutual cooperation (at least 4 periods)
2. One player defects
3. Cooperation breaks down during the remaining periods

Why does it matter?

1.2.8 Public Good Game

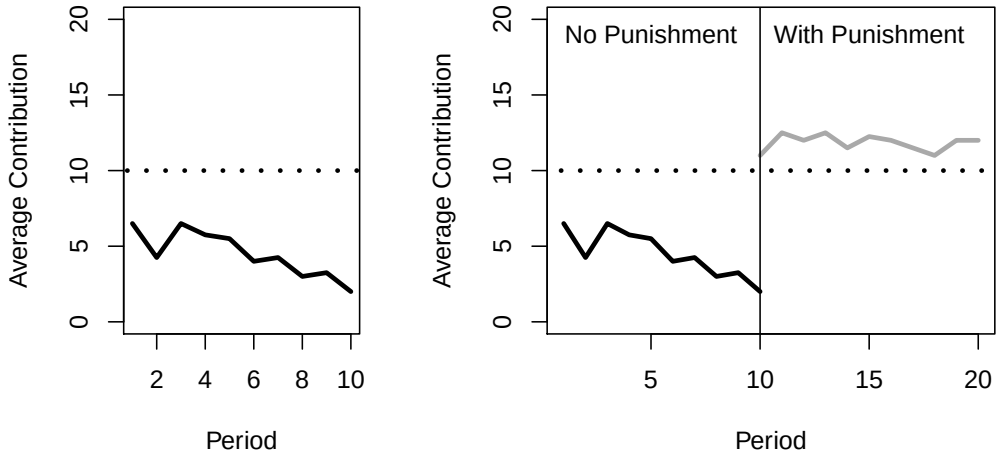
Definition

Public good – is a good that is both **non-excludable** and **non-rivalrous**.

Examples: Air, defense, knowledge, flood control systems, street lighting.

$$u_i = w_i - m_i + \frac{M}{n} \cdot \sum_{j=1}^{n} m, \tag{2}$$

where u_i – utility, w_i – wealth and m_i – individual contribution of agent i; M - multiplier, n – number of individuals, $\frac{M}{n} > 1$.



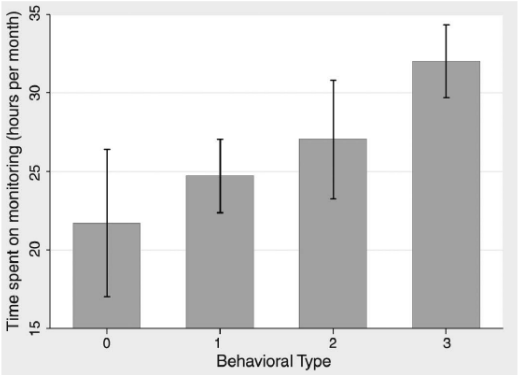
So what?

1.2.9 Public Good Game: Application

Example: Conditional cooperation and costly monitoring explain success in forest commons management (Rustagi et al., 2010)

- **Problem:** Deforostation
- **Context:** Ethiopia
- **Idea:** Forest patrol

- **Study:** Elicit conditional cooperation in Public good game.
- **Finding:** Succes of forest patrol depends on share of conditional cooperators



Source: Rustagi et al., 2010

How would you apply this knowledge?

1.2.10 Beauty Contest Game

- Each of you writes on a piece of paper down his or her name and one integer number between 2 and 100
- I collect all pieces of paper and determine the average number
- The player who is closest to 2/3 of the average wins a prize (in case of a tie the prize will be split)

"It is not a case of choosing those [faces] that, to the best of one's judgment, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences **to anticipating what average opinion expects the average opinion to be.** And there are some, I believe, who practice the fourth, fifth and higher degrees."

Keynes(1936), General Theory of Employment Interest and Money

Danish newspaper experiment (19000 people): Winning value 21.6 >> 0.

$\bar{N}$ =26.51→ Winning Value: $2/3 * \bar{N}$ =17.67

1.3 Summary

- Behavioral Economics try to test human behavior
- It aims to to do it in rgiourus way based on:
  - Formal theory
  - Incentives
  - No deception
- It has direct policy applications

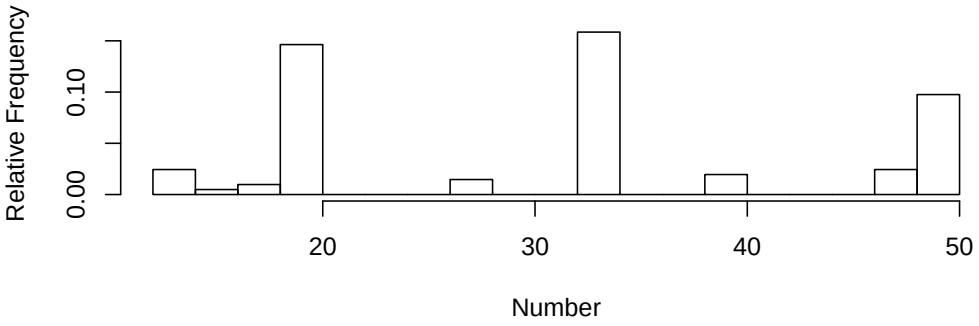


Figure 1: Distribution of Numbers, based on Nagel (1995)

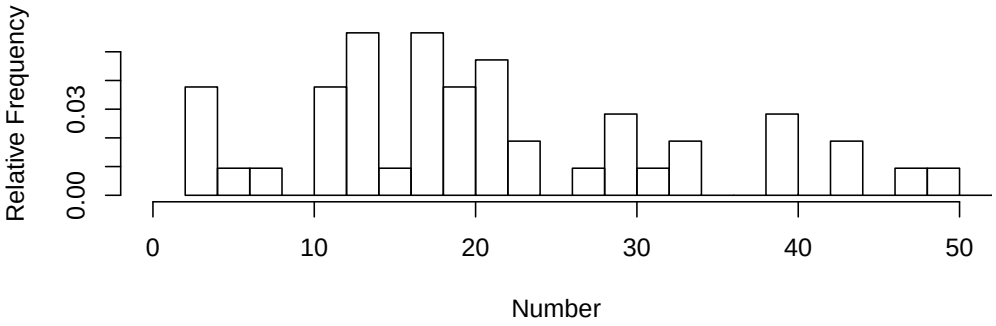


Figure 2: Distribution of Numbers, based on class room experiment with Behavioral Economics students (2016)

1.4 Exercises

1. **Motivation I:** What is the replication crises? Why?
2. **Motivation II:** What about the replication crises in psychology and experimental(behavioral) economics? What is the difference between behavioral economics, experimental economics and pschylogy?
3. **Foundations I:** What is Saint-Petersburg paradox? Bernoulli Resolution? Is it important? Why?
4. **Foundations II:** What is considered to be the first experiment in behavioral economics?
5. **Foundations III:** What is Wallis and Friedman critics of this experiment? What is the answer?

1. **Foundations IV:** What are the key principles of behavioral economics?
2. **Foundations V:** What is the Prospect Theory? Why did it develop?

3. **Foundations VI:** Is behavioral economics applied? Give example.

Dependent Variable Correct Choice	Data
Constant	-1.57 (0.30)
q	1.26 (0.51)
t	0.021 (0.0025)
q * t	0.017 (0.0029)
signal * t	-0.037 (0.0029)
signal	1.76 (0.055)
match	0.0047 (0.0021)
# obs	8760
logL	-4620

Source: Goeree et al., 2007

Table 3: Replication

	Dependent variable:
	correct
Constant	-1.57^{***}
	(0.30)
q	1.25^{**}
	(0.50)
t	-0.07^{***}
	(0.02)
Signal	1.76^{***}
	(0.06)
match	0.005^{**}
	(0.002)
q:t	0.16^{***}
	(0.03)
t:Signal	-0.04^{***}
	(0.003)
Observations	8,760
Log Likelihood	−4,619.64
Akaike Inf. Crit.	9,253.28
Note:	*p<0.1; **p<0.05; ***p<0.01

Source: Replication

2 Methodology

2.1 Methods in Economics

- **Theory:** Various types of tautology.
- **Empirical studies – Observational studies:** Various types of statistical analysis without intervention in the data generating process.
- **Experiment:** Purposeful intervention in the data generating process.

2.2 Theory

A theory is a tautology.

Properties:

- Internal correctness
- Testable
- Simple

A theory allows to make models.

Like a good map, a good model provides a **simple**, and, hence, **inaccurate and imprecise** representation of the world.

"**A good model** in economic theory, like a good fable, **identifies a number of themes and elucidates them**. **We perform thought exercises that are only loosely connected to reality** and that have been stripped of most of their real-life characteristics. However, in a good model, as in a good fable, **something significant remains**." Rubinstein (2006)

Theory makes a predictions – How to test them?

2.3 Observational Studies

Samuelson and Nordhaus, (1985) Principles of Economics:

" **Economists** ... cannot perform the controlled experiments ... because **they cannot easily control other important factors**. Like astronomers or meteorologists, they generally **must be content largely to observe**"

→ Economists use observational studies without possibility to control for *all* important factors.

Why do we want to have a control?

Competing Theories: Theory of Storks (Traditional) vs. Theory of Sexual Reproduction (Promoted by Medical Society)

Empirical tests (Neyman, 1952; Höfera et al., 2004):

1. Significant correlation between number of storks and births number.
2. No correlation between deliveries in hospital buildings and the stork population.

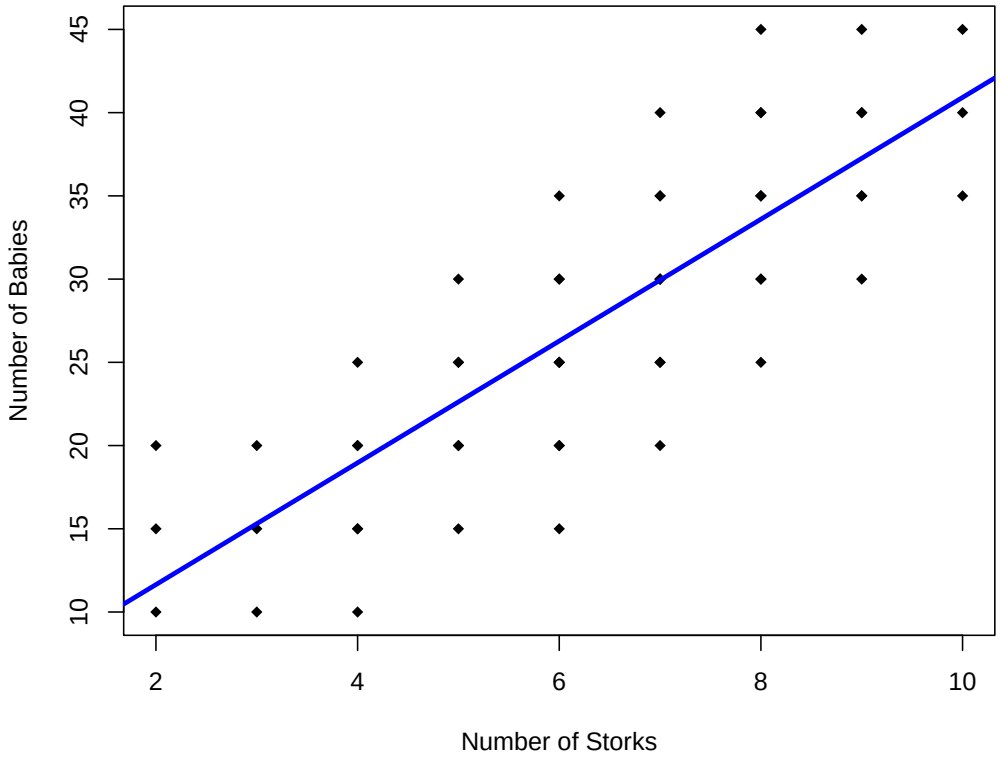


Figure 3: Relation between number of babies and storks (Neyman, 1952).

Would you vaccinate your kid?

2.4 Fundamental Problem of Casual Inference

Road Not Taken

"Two roads diverged in a yellow wood,

And sorry **I could not travel both**

And be one traveler, long I stood

And looked down one as far as I could

To where it bent in the undergrowth;

...

Two roads diverged in a wood, and

I took the one less traveled by,

And that has made all the difference."

Robert Frost, 1920

Source: inspirably.com

Holland, (1986) Statistics and Causal Inference

Casual effect of $T_i = 1$ on unit i (relative to $T_i = 0$): $Y_{1,i} - Y_{0,i}$

The problem: It is impossible to observe the value of $Y_{1,i}$ and $Y_{0,i}$ on the same unit, therefore, it is impossible to observe the effect of $T_i = 1$ on unit i.

2.5 Experiment

Table 4: Taxonomy of Experiments (Harris and List, 2004)

	Laboratory Experiment
Controlled	Artefactual Field experiment (Lab-in-Field)
Data	Framed Field Experiment
↓	Natural Field Experiment
Naturally-	Natural experiment, Propensity score estimation,
Occuring	Instrimental Variable, Regression Discontinuity Design,
Data	Structural modeling

Laboratory Experiment:

- Controlled parameters
- Flexibel modelling
- Replication
- What-if experiments
- Many observations
- Long time-series

but

- Not field data

Field Experiment:

- Field data

but

- Uncontrolled parameters
- Expensive
- Long
- Few independent observations
- Ethical reasons

Let's suppose we want to test the hypotheis of **market equilibrium in case of perfect competition.**

- Can we do it in the field?
  → Perhaphs, not: Too many factors, no chance for intervention.
- Should we replicate the model in the lab that as much as close to reality (copy real world)?
  → No, too difficult to analyse, we have real life already e.g. we have NYSE in New York, why to duplicate it?
- Shall we test a simple model with one asset and number of traders?
  → Perhaps, yes.

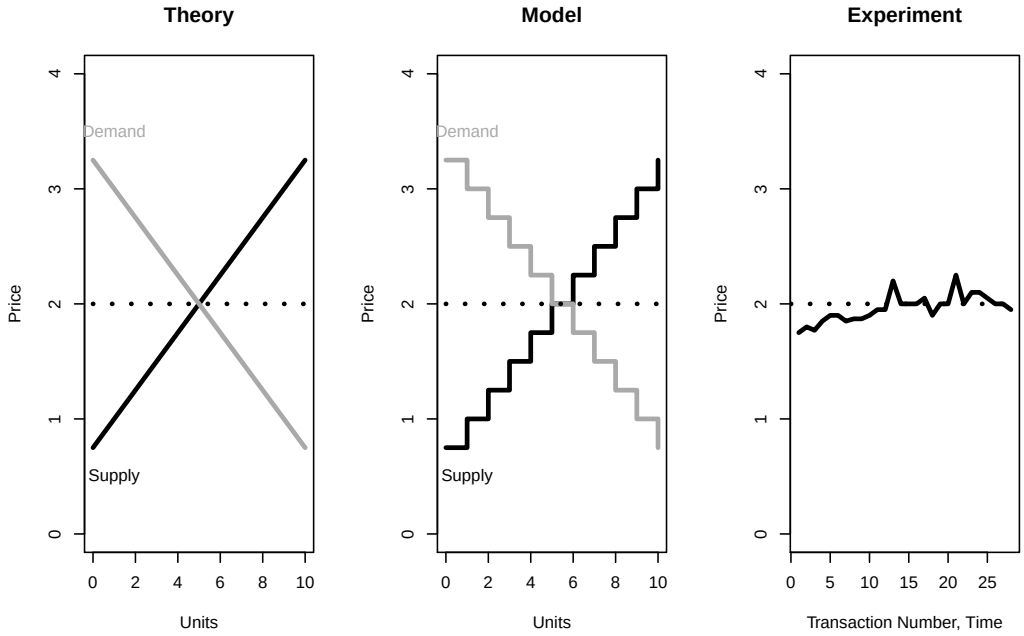


Figure 4: Market equilibrium with perfect competition (Smith, 1962)

2.5.1 External Validity

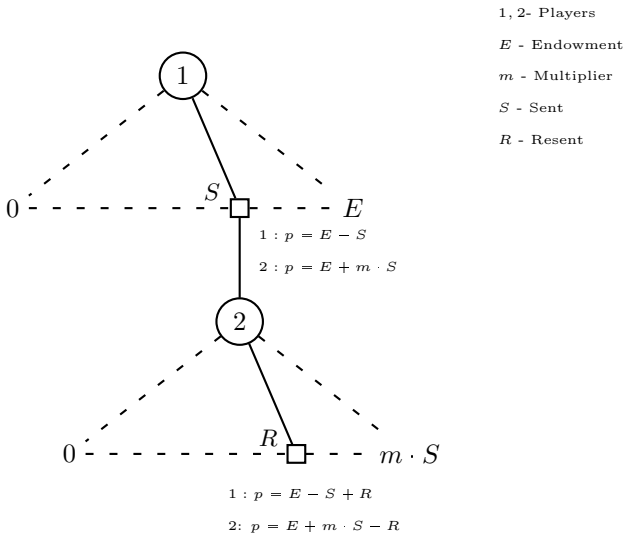
Can we generlize from experiments?

- **Problem of Induction and blame-the-theory argument:**
  - If theory is good, it should hold across domains.
    It should equally work in case of economic students, CEOs, Sangu farmers in Tanzania in the 20-21th century and for Magribi traders in the 11th century.
  - If the theory does not hold in the lab, where we control most of the theoretical assumptions, why should it work outside of the lab?
  - If there is theory for the difference between the lab and the field, we can test it in the lab.

Incomplete Contracts: Investment (Trust) Game Situation: (1) Principal-agent relations, (2) Investment decision.

Results:

1. People send and send back. In lines with Maghribi traders repeated interaction (Greif, 1989)
2. Students and non-students send similar amount.
3. The behavior varies across countries. Why?



Variable name	Sent fraction (trust)	
	(1) OLS	(2) OLS
Sender endowment	0.0011	0.0012
	(0.0011)	(0.0011)
Receiver endowed	−0.1073	−0.1050
	(0.1331)	(0.1161)
Anonymous	−0.2889	−0.3722*
	(0.1993)	(0.1909)
Rate return	0.1409	0.0823
	(0.2117)	(0.1882)
Double blind	0.1306	0.1286
	(0.1433)	(0.1324)
Student	0.0931	−0.1276
	(0.1305)	(0.1518)
Both roles	0.2126	0.2058
	(0.2082)	(0.1822)
Random payment	−0.6080***	−0.6502***
	(0.1868)	(0.1802)
Strategy method	0.1747	0.1070
	(0.1377)	(0.1143)
Real person	0.3413*	0.3768**
	(0.1758)	(0.1810)
Trust		
Europe		−0.1097
		(0.1373)
Asia		−0.4959**
		(0.1934)
South America		−0.3957*
		(0.2037)
Africa		−0.5566**
		(0.2200)

Figure 5: Meta-study of the Trust game (Johnson and Mislin, 2011)

2.5.2 Internal Validity

- No systematic error
- Precision: Observation = treatment effect + treatment error +unit error + unit effect +mesurement error

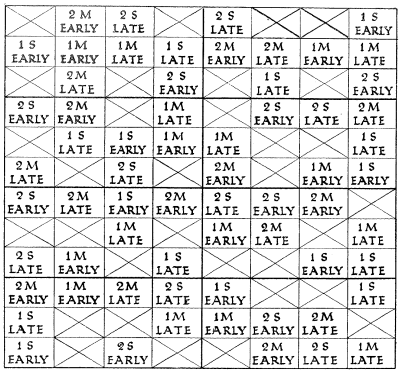
Treatment effect: Randomly assign people to the treatment and control groups in the lab.

Random assignment guarantee that treatment T is independent from potential outcome Y, hence, we can estimate the **average treatment effect**.

$$T \perp\!\!\!\perp Y \Rightarrow E[Y|T=1] - E[Y|T=0] = E[Y_{1,i} - Y_{0,i}]$$

Factorial design.

- Full factorial, F. 2^F.
  - 4 factors with two levels $\rightarrow 2X2X2X2$
  - 1 factor with 2 levels. 1 factor with 3 levels $\rightarrow 2X3$
- Partial factorial $\rightarrow$ Neglects interaction



Source: Fisher (1926)

Treatment effect: Make treatments comparable except intervention of intereset.

For instance: If one study how identity affects giving people cards of different color, in the control group people also should get the cards.

Unit error: Consider non-indepdent observations.

Subjects

- **Across subject design:** Different subjects in different treatments
  - $\rightarrow$ Rely on randomisation
  - $\rightarrow$ Control for subject specific effects
  - $\rightarrow$ More noise

- **Within subject design:** Same subjects across different tretments
  → if Treatment Control Treatment Control then also Control Tretment Control
  → Hard if number of treatmens is large

Similar with **sessions:**

- **Treatments across sessions**
  → Make sessions comparable e.g. time, day ...
  → Control for session specific effects
  → More noise
- **Treatements within the same session**
  → Indetical session noise
  → Hard if number of treatmens is large

2.5.3 Practice

1. Simple experimental structure
2. Simple, neutral instructions e.g. choose alternative Y or X
3. Real incentives / effort
4. Honesty/ no deception before, during, and after the experiment
5. Anonymity
6. Clear Script
   - Check the instructions with someone
   - Randomly assign to seats and roles
   - Control questions
   - Know how to deal with questions → Private answers
7. Consider power of the study

2.5.4 Ethical Considerations

Problem:

Syphilis inoculation project in Guatemala 1946-1948:

- 696 subjects (men in the Guatemala National Penitentiary, army barracks, men and women in the National Mental Health Hospital).
- Prostitutes with the disease were used to infect subjects, but also direct inoculation.
- Subjects then received penicillin.

Belmont Report, 1979:

1. Boundaries Between Practice & Research

2. Basic ethical principles:
   (a) Respect for Person
   (b) Benefice
   (c) Justice
3. Applications:
   (a) Informed Consent
   (b) Assessment of Risk and Benefits
   (c) Selection of Subjects

Also, consult with your Institutional Review Board.

2.5.5 Purpose of the Experiment

1. Testing Theory
2. Developing Theory "Speaking to theorists"
3. Theory-free what-if studies. "whispering in the ears of princes"

1. Testing Theory

1. Wind-tunnel experiment ... when
   - Theory is not informative.
   - Unclear which theory to apply.

   Engineering: How would spacecraft behave one Mars?

   Economics: How risk-averse are managers? How would positive thinking affect willingens to compete?
2. Theory-testing experiment ... when
   - Theory is inaccurate
   - Theory is imprecise

   Evolutionary Biology: Lenski's E. coli experiment (Start 1988). Different lineages of E. coli in different growth conditions (65 000 generations in 2016). → Evolution in action.

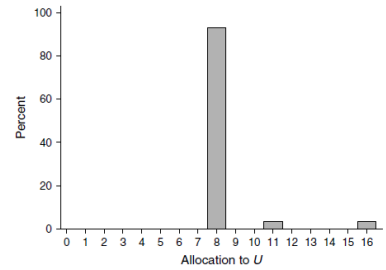
Economics: Justice Under Uncertainty (Cettolin and Riedl, 2016)

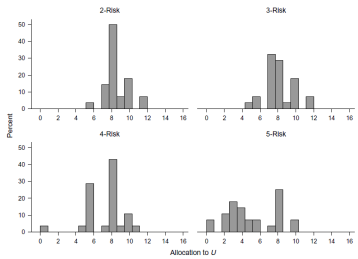
Problem: How would people allocate resources under uncertainty?

Theories: Various "imprecise" theories of justice under uncertainty e.g. EV-equality, EU-equality.

Certainty Treatment

Uncertainty Treatments





2. Developing Theory "Speaking to theorists"

Situation: Monopolist offers a good at a fixed price.

Ultimatum Game (Guth, Schmidtberger, Schwarz, 1982)

- Proposer: proposes a division of a pie
- Responder: accepts or refuses.

In case of refusal, both players receive nothing.

Subgame perfect solution: Proposer keeps (almost) all pie.

Actual behavior:

- Offer $> 30\%$
- 20% of all offers are refused

Possible Explanations of deviation:

1. Players do not understand the game, play a different (repeated) game with punishment.
2. $(\frac{1}{2}, \frac{1}{2})$ is just a focal point
3. Altruism of the proposer. Test:

Test of (1) and (2): Ultimatum game with training (Binmore, Shaked, Sutton, 1985).

Results: Partially corroborated.

Test of (3): Dictator Game (Forsythe, Horowitz, Savin, Sefton, 1994)

Result: Corroborated, but do not explain everything.

3. Theory-free what-if studies.

- Allocation of the airport slots (Rassenti et al., 1982)

→ What if one use a combinatorial auction mechanism for airport time slot allocation?

- Auctions in the internet
- Negative income tax (Ross, 1970)

Your Experiment: How would you make this world better?

1. Choose an economic problem.
2. Is there an answer to this problem?
3. How can you answer on this problem?
4. Which methods can you use?
5. What are the advantages and disadvantges of observational method in this case?
6. What are the advantages and disadvantges of the experiment in this case?
7. Would you get surprsing, useful results?

2.6 Summary

- Testing theories
- Fundumental Problem of Casaul Inference → Search of control
- Experiment: Purposeful intervention in the data generating process.
- External Validity → Generalisbility
- Interna validity → Randomisation and control of all factors
- Ethics
- What one can do?
  1. Testing Theory
  2. Developing Theory "Speaking to theorists"
  3. Theory-free what-if studies. "whispering in the ears of princes"

2.7 Exercises

1. **Methods:** What methods do we have in economics?
2. **Casual inference I:** What is the fundamental problem of casual inference?
3. **Casual inference IIa:** Correlation between ovulation and voting (Durante et al, 2013). What would you conclude?
4. **Casual inference IIb:** You find correlation between GDP per capita and the contribution to the public good game. What would you conclude?
5. **Casual inference IIc:** What do we miss in both cases?
6. **Experiment:** What are advantages and disadvantages of field and lab experiments?
7. **External Validity I:** Why do we use students for the experiment? Is it useful? Why?
8. **External Validity II:** What is principal-agent problem?

9. **External Validity III:** We see heterogeneity of behavior in trust game. You want to explain it and test your predictions in the experiment. How would you do it?
10. **Internal Validity I:** Why to randomize? What is factorial design?
11. **Internal Validity II:** When to use across (between) or within subject design? What is within session treatment?