Introduction

ECON306 – Slides 0

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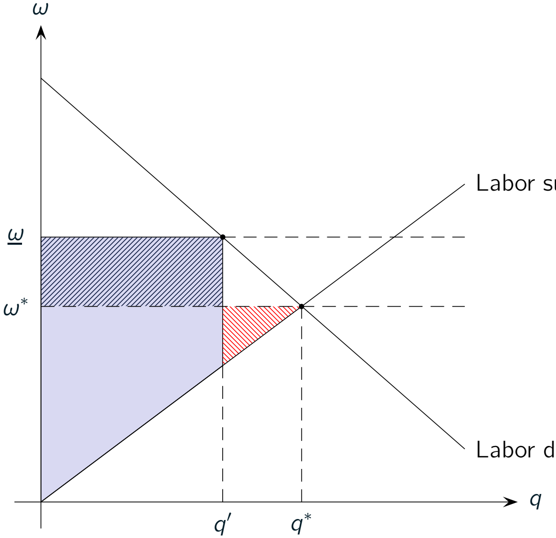
What is Econometrics?

- Etymological meaning: Measurement of economic activity

- Links economic theory with real life data
- Makes heavy use of statistics
- Predominant tool of applied Economics
- Its becoming increasingly more important with better data and computational power

Motivating example



Why Econometrics?

1. **Quantitative models**
   - When the object of study is complicated, the analysis is simplified by using mathematical language
   - Qualitative relations are less useful than quantitative relations
   - e.g. increasing prices reduces sales vs. increasing prices by 1% reduces sales by 50%

2. **Testing of hypothesis**
   - Many theoretical models imply quantitative relations
   - Karl Poper: theories should be falsifiable
   - Test whether theoretical implications hold in observed activity

3. **Predictions**
   - Science is useful as it allows to develop technology
   - Technology requires the ability to predict future events
   - Econometric forecasting helps to make better choices

Why statistics?

Human actions display certain uniformities, and it is thanks to this property alone that they can be made the subject of a scientific study. These uniformities also have another name. They are called laws.

– Vilfredo Pareto
Manual of Political Economy (1906)

We are in the position of a person who knows an object only by means of photographs. However perfect they may be, they always differ in some way from the object itself. Hence we should never judge the value of a theory by investigating whether it deviates in some way from reality, because no theory withstands or will ever withstand that test.

– Vilfredo Pareto
Manual of Political Economy (1906)

Motivating example: free fall

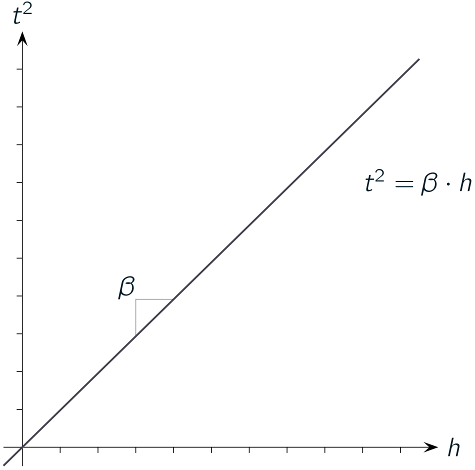
- Newton's 2nd law: $a = \dfrac{F}{m}$
- Law of Gravitation: $F = -G\dfrac{Mn}{r^2}$
- Uniformly accelerated motion from rest:

$$\begin{aligned} & x(t) = x(0) + \frac{1}{2}at^2 = x(0) - \frac{GM}{r^2}t^2 \\ \Rightarrow \qquad & t^2 = \frac{r^2}{GM}\big(x(0) - x(t)\big) \end{aligned}$$

- A simple model of free fall:

$$t^2 = \beta \cdot h$$

A simple linear model



High school replication of Galileo's experiment

	$m_1 = 55.62g$					$m_2 = 4.89g$				
h	t_1	t_2	t_3	t_4	t_5	t_1	t_2	t_3	t_4	t_5
14.38	13.4	11.1	11.7	11.5	11.7	12.2	11.2	11.6	10.9	11.8
11.14	10.4	9.3	10.4	10.7	10.2	10.6	10.8	9.7	9.3	11.3
7.90	8.7	9.3	8.5	8.5	8.7	10.5	9.7	8.1	9.9	8.2
4.65	6.0	6.8	6.7	5.8	8.3	8.3	6.5	5.8	6.7	6.6

h refers to height, measured in meters. t_i refers to fall time in the ith repetition, measured in seconds.

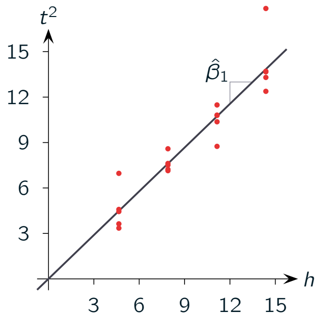
Estimating acceleration

$$\beta = \frac{t^2}{h} \qquad \rightarrow \qquad \hat{\beta} = \frac{1}{5}\sum_{i=1}^{5}\frac{t_i^2}{h}$$

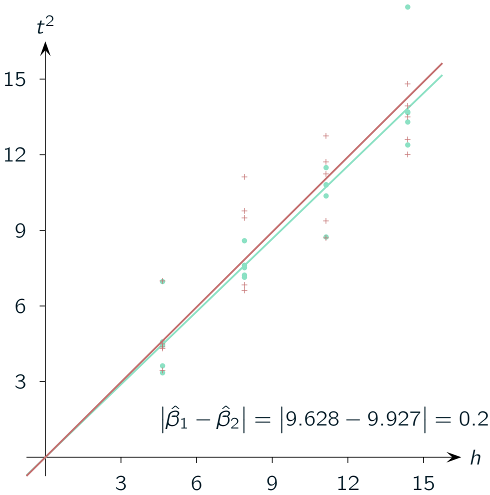
	$m_1 = 55.62g$			$m_2 = 4.89g$		
h	$\bar{t}$	$\bar{t}^2$	$\hat{\beta}$	$\bar{t}$	$\bar{t}^2$	$\hat{\beta}$
14.38	14.380	206.784	9.821	11.539	133.151	9.259
11.14	11.140	124.100	9.351	10.326	106.635	9.572
7.90	7.900	62.410	9.631	9.296	86.420	10.939
4.65	4.650	21.623	9.708	6.798	46.206	9.937
Average			9.628			9.927

h refers to height, measured in meters. t_i refers to fall time in the ith repetition, measured in seconds.

Estimated models



Testing the theory



$$\left|\hat{\beta}_1 - \hat{\beta}_2\right| = \left|9.628 - 9.927\right| = 0.299 \approx 0$$

The scope of this class

- Analyzing quantitative relationships between economic variables from empirical data

- Estimation: quantification of the relations
- Inference: testing hypothesis

- We only consider simple linear models assuming classical assumptions
- The methodologies described are the core of more complicated/general analysis

The focus of this class

- This is a very applied class
- We will not go deep into Econometric theory

- Instead, we will focus on the methodology for actual applied work
  - Finding data sets
  - Choose specifications
  - Interpreting results
  - Describing and presenting results

Course outline

1. Review of probability and statistics
2. Estimating linear models: ordinary least squares
3. Inference in linear models: hypothesis testing

4. Model specification
5. Some concerns when relaxing classical assumptions

6. Endogeneity bias and instrumental variables
7. Binary models and/or time series (time permitting)