Tools for the analysis of international economic relations

Indices and changes

International Economics

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Link to updated version

Bibliography:

- Serrano Pérez (2009). *Entorno Económico: Instrumentos para su análisis*. Editorial Pirámide.
  Chapter 1

Topics

Estimates

Changes

Motivation: **salary by occupation**

- Why would I want to know?
  - Workers: to decide what to work on
  - Businessmen: to estimate costs by type of work
  - Government: to exercise policies in this regard
- How could it be known with 100% certainty?
  - Asking salaries of 100% of the workers
  - Repeating question every so often (in case they change)
- How do we effectively approximate it?
  - Surveying a representative sample of workers
  - Repeating the survey from time to time (in case they change)

- How do we understand what is happening in the world?
  - Some phenomena are measurable
    - → e.g., *temperature, distance, income*
  - But it is not always feasible to make measurements
    - → e.g., *how much does each person in Barcelona weigh?*
  - But, information can be **key** to make decisions
    - → e.g., *how much do Economics graduates earn?*

Estimates: approximations to measurements

- Derived from samples
- Based on statistical techniques
- Not necessarily aspire to be the *true value*
- Aspire to be a good approximation to the *true value*

A little history

In 1662 the English mathematician John Graunt did something unprecedented:

he attained to **find out the population of London**

He took data on deaths per family from parishes

(rather than going to all households)

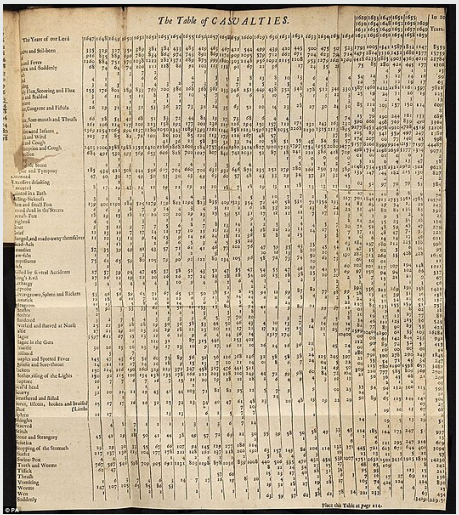
Data said: 3 annual deaths for every 11 families

Since he know the annual number of deaths, he could extrapolate the number of families:

13,000 x 11/3 = 48,000

And from there the number of inhabitants:

48,000 x 8 = 384,000


The Table of CASUALTIES.

Example

The Economy:

Can we **estimate total production**?

Statistics

- Statistics: quantitative measurements derived from a sample
  - Mean (average):
    - → sum of all values divided by the total number of values
  - Median:
    - → value that occupies central place among all, *when these are ordered in increasing order*
  - Mode:
    - → most repeated value

Examples: Cañas drank in 2023 by 9 students

	Cañas
Ada	350
Bruno	200
Carmen	150
Didac	50
Emily	200
Farah	380
Gaizka	500
Haitham	450
Ingrid	420

- Total Cañas: 2700
- Total People: 9
- Mean: 300

Examples: Cañas drank in 2023 by 9 students

	Cañas
Ada	350
Bruno	200
Carmen	150
Didac	50
Emily	200
Farah	380
Gaizka	500
Haitham	450
Ingrid	420

Table in increasing order

	Cañas
Didac	50
Carmen	150
Bruno	200
Emily	200
Ada	350
Farah	380
Ingrid	420
Haitham	450
Gaizka	500

Median: 350

Examples: Cañas drank in 2023 by 9 students

	Cañas
Ada	350
Bruno	200
Carmen	150
Didac	50
Emily	200
Farah	380
Gaizka	500
Haitham	450
Ingrid	420

Number of repetitions

Cañas	#
50	1
150	1
200	2
350	1
380	1
420	1
450	1
500	1

Mode: 200

Returning to salaries by occupation...

INE makes salary estimates every four years:

Salary by occupation in Spain - 2018

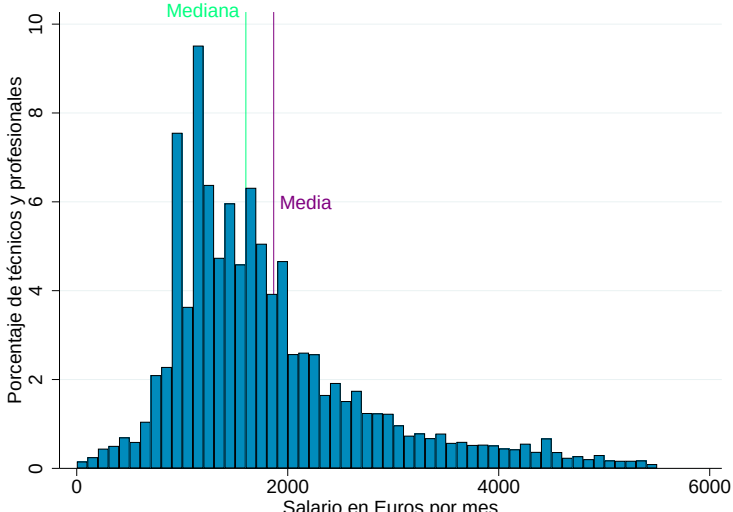
Occupation	€ / month
Directors and managers	2,267
Technicians and professionals	1,867
Office, without attention to the public	1,259
Office, with attention to the public	1,088
Restaurants and commerce	986
Other services, not qualified	804
Manual, not qualified	1,099

Source: Encuesta de Estructura Salarial 2018 - INE

The **average** of 'technicians and professionals' earned $1{,}867€$ per month

- What **NO** does that mean?
  - All technicians and professionals won $1{,}867€$ per month
  - All technicians and professionals won *more* that restaurant and commerce workers
  - All technicians and professionals won *less* that directors and managers
- What does that mean?
  - the sum of all salaries of technicians and professionals divided by the total number of technicians and professionals is $1{,}867€$ per month

Salary by occupation in Spain - 2018



Source: Encuesta de Estructura Salarial 2018 - INE

Topics

Estimates

Changes

Basic concepts

- Many times it is relevant to understand how much a measurement changed
  - It is important to consider what the **initial level** was
  - It may be interesting to understand what the change is like in **relative terms**

Example 1

Prices in Bar A

Year	Price		
	Bravas	Caña	Menú
2017	3	0.75	6.5
2018	3	1	7.5
2019	3.5	1	7
2020	3.5	1	7.5
2021	4	1.5	8
2022	4.5	1.75	9.5
2023	5.5	2	11

Which product rose the most in price?

- The menú rised €4.5
  (from €6.5 to €11)
- The bravas increased €2.5
  (from €3 to €5.5)
- The caña rised €1.25
  (from €0.75 to €2)

Example 1

Prices in Bar A

Year	Price		
	Bravas	Caña	Menú
2017	3	0.75	6.5
2018	3	1	7.5
2019	3.5	1	7
2020	3.5	1	7.5
2021	4	1.5	8
2022	4.5	1.75	9.5
2023	5.5	2	11

Which product rose the most in price?

- The menú increased by 69%
  ($€4.5$ starting in $€6.5$)
- The bravas rised by 83%
  ($€2.5$ starting in $€3$)
- The caña increased by 167%
  ($€1.25$ starting in $€0.75$)

Example 2

Price change of the main companies in Spain

Source: Yahoo Finance

Is it a relevant increase?

- We should compare it
  - in **historical perspective**
  - with **other relevant countries**

Example 2

Price change of the main companies in Spain

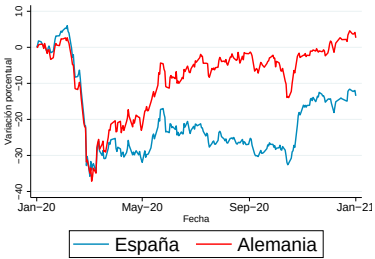
Source: Yahoo Finance

Historical perspective

- The increase in May-June is much smaller than the decrease in February-March

Example 2

Price change of the main companies



Source: Yahoo Finance

International comparison

- The Spanish recovery is much smaller than the German one

Measurements of changes

Change rate (CR)

$$\Delta = \left(\frac{X_1 - X_0}{X_0}\right) = \left(\frac{X_1}{X_0} - 1\right)$$ with X_i being the value at time $t = i$

- **Relative** change in the value of a magnitude between two moments in time
- Expressed in **percentage terms**

Index (I)

$$I(\%) = \left(\frac{X_1}{X_0}\right) \cdot 100$$ with X_i being the value at time $t = i$

- Relationship between the value of a magnitude **in reference to a base moment**
- Value at base moment is assigned a value of 100

Measurements of changes

Time reference of the change

- **Many** time units can be used for analysis
- Choice depends on
  - nature of the variation
  - object of analysis

Rate	Reference
Year-on-Year	Change from the same period last year
Quarterly	Change from previous quarter
Cumulative annual	Change from beginning of calendar year

Is it better to use year-on-year or quarterly rates for GDP?

Quarterly (year-on-year) rates are usually analyzed for developed (developing) countries.

Year-on-year evolution

- is not affected by seasonality,
- but does not reflect the most recent trend

Quarterly evolution

- reflects what happened in the last quarter,
- but must be corrected for seasonality

Measurements of changes

Compound Growth Rate (CAGR)

$$X_n = X_0 \cdot (1 + CGR)^n$$

$$\Rightarrow CGR = \left(\left[\frac{X_n}{X_0} \right]^{1/n} - 1 \right)$$

with X_i being the value at time $t = i$,

n the number of periods

- Useful for analyzing indicators with **stable variations**

  (*e.g., demographic variables, some macroeconomic aggregates*)

- Allows you to estimate:
  - **Constant** CR at which a value must grow during n consecutive periods to reach another final value
  - Necessary time (n) to reach a final value, growing at a **constant** CR

Measurements of changes

Real and nominal terms

- Values result from prices and quantities
  - Price changes affect value changes
- **Deflate**: transform nominal magnitude into real terms
  - Eliminates the price effect
  - Different price change indicators can be used

Term	Reference
Nominal	Values at current prices. Does not discount price changes.
Real	Values at constant prices. Discounts price changes.

Measurements of changes

Real and nominal terms

- *Price indices*

  Relationship between price level and base period

  $$IP_{1,0} = \left(\frac{P_1}{P_0}\right) \cdot 100$$ with P_i being the prices at time $t = i$

- *Implicit deflators*

  $$IP = \left(\frac{M_{nominal}}{M_{real}}\right) \cdot 100$$ with M being values for the same period

- *Inflation rate*

  Relative change between two moments in time

  $$\Delta P = \left(\frac{P_1 - P_0}{P_0}\right) = \left(\frac{P_1}{P_0} - 1\right)$$ with P_i being the prices at time $t = i$

Base changes in the indices do not alter the variation rates

The base periods of the indices are usually changed

the value 100 is transferred to another period,
and the index is adjusted in the remaining periods

The change is made with a **cross-multiplication**

$$IP_{i,j} = \left(\frac{IP_{i,k}}{IP_{j,k}}\right) \cdot 100$$

For example:

$IP_{5,1}$	250
$IP_{3,1}$	125

$$IP_{5,3} = \left(\frac{IP_{5,1}}{IP_{3,1}}\right) \cdot 100 = \left(\frac{IP_{5,1}}{IP_{3,1}}\right) \cdot 100 = 200$$

The index values change, but the **change rate remains the same**

$$\Delta P_{5,3} = \left(\frac{IP_{5,1}}{IP_{3,1}} - 1\right) = \left(\frac{250}{125} - 1\right) = 100\%$$

$$\Delta P_{5,3} = \left(\frac{IP_{5,3}}{IP_{3,3}} - 1\right) = \left(\frac{200}{100} - 1\right) = 100\%$$

Measurements of changes

Contribution to growth

- We know the variation of **subcomponents** of many indicators
  (e.g, consumer price index, GDP, foreign trade)
- It is useful to know which subcomponents explain, and to what extent, the aggregate changes
  We can approximate it by observing the variations of the components
  We need to know the **weight of each subcomponent** to obtain exact measurements

$$M = m_1 + m_2 + \dots m_z$$
$$\Rightarrow \Delta M = \Delta m_1 \left(\frac{m_1}{M}\right) + \Delta m_2 \left(\frac{m_2}{M}\right) + \dots \Delta m_z \left(\frac{m_z}{M}\right)$$

with m_z being the subcomponent z of M,

Δm_z being the CR of m_z