# Introduction to the Economics of Development

## 3. How to answer questions like a (development) economist

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## This lecture

- The Econs methods of arguing.
- What I'm expecting in the small group paper.
- Some baseline maths.
- Some baseline econometrics.

# The Econs method of arguing

## The Econs method of arguing

- We will develop this more as we go on, here I just give a very high-level overview.

- Basic structure of economic (and most other) research.
  - Define an interesting question.
  - Construct a thesis (an answer).
  - Defend your thesis with evidence.

- Evidence can take three forms
  - Discursive. Argue with prose and appeal to the literature.
  - Abstraction. Theoretical, often fairly mathematical reasoning.
  - Empirical. Bring data to the question.

- The best (and most) research combines all three.

## The basic structure of research

- Define an interesting question.
  - Don't be too ambitious or boring.
  - Too ambitious: How do we solve global poverty?
  - Too boring: Are people in Benin on average poorer than those in France?

- Construct a thesis.
  - An iterative process, often changes with the evidence.
  - Be as specific as the evidence allows.
  - Don't oversell! The answer must match the evidence.

- Defend your thesis with evidence.
  - The strength of evidence is key, but it is more important that the three pieces match.
  - A combination of discursive, abstraction, and empirics is best — but not necessary (esp. abstraction).

# The small group paper

## What I'm expecting from the small group paper

- Apply the basic structure described above, but obviously at a smaller scale.
- Abstraction and Empirics are not necessary (or sufficient) to achieve good marks, but they might help...
- Groups of 3 to 5.
- Choose one of the questions covered in the course — answer some small part of it.
- Around 2,000 words.
- You can use data, provide some figures etc. You can use some abstraction and modeling but be warned, this is hard to do well.
- You have to come up with a question and thesis on your own, but can re-use evidence from others.
- You have 4 weeks to complete the project Nov 15th to Dec 13th 12:00 noon. Late submission $= 0$, no excuses.
- Your group will meet once with me and once with Justin in the first and third weeks.

## The paper, some practicalities

- Submit a word document. Times new Roman font size 12 line spacing 1.5 default margins.
- 1,500 to 2,500 words.
- In English only.
- I expect you to cite relevant literature and include a bibliography. Copy how it is done in the papers we read during the course.
- Do not plagiarise (not citing someone is plagiarism). Papers will be put through plagiarism detection software.
- Hannah Ameye's slides :)

# Some baseline maths and econometrics

## Prior knowledge quick-quiz

- Q1: At what age did you stop studying maths?
- Q2: Do you know the answer to this question: If $x_i \sim N[\mu, \sigma^2]$ then $\mathbb{E}[x_i] = ?$
- Q3: Do you know what a regression is?
- Q4: How would you interpret $\beta$ in the following regression: $\ln(y_i) = \beta \cdot \ln(x_i) + \varepsilon_i$.
- Q5: What is the answer to this question: $\frac{d}{dx}\frac{(3x+1)^2}{x} = ?$
- Q6: Are you familiar with the terms OLS and 2SLS?

## Some baseline maths — What do you need to know

1. Foundations of optimisation.
2. Foundations of statistics for economics.

Disclaimer: You probably need to know more than this.

## Foundations of optimisation

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- Easy problem: I have €10 and like chocolate bars. Each chocolate bar costs €4. How many chocolate bars should I buy?
- Slightly harder problem: I have €10 and like chocolate bars. I like each chocolate bar slightly less than the previous one. Each chocolate bar costs €4. How many chocolate bars should I buy?
- Diminishing marginal returns!

## Foundations of optimization, let's get serious

- Much harder problem: I have €10. I like chocolate bars and apples. I like each chocolate bar slightly less than the previous one. Each chocolate bar cost €4, and each apple cost €1. How many chocolate bars and how many apples should I buy?

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- We need to be more precise. Enter the utility function.

$$u = U(c, a) = 2c^{0.5} + a$$

- Budget constraint: $4c + a = 10$.

- How many apples and chocolate bars do we buy?

## Foundations of statistics for economics

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- The problem: we only have a sample of data from $P$.
- Data: $\{x_1, x_2, \cdots, x_N\}$ sample of size $N$.
- How did we get these $x$'s — iid (independently and identically distributed).
- What is a distribution? $x_i \sim U[0, 1]$.
- Question: Does a distribution describe the sample or the population?

## The magic of the law of large numbers

- We want to know the mean wage among Belgian workers: $\mu$.
- We have an iid sample of size 100, $w_i$, $i = 1, 2, \cdots, 100$.
- We take the mean $\bar{w}$.
- On average this will be right!
- In particular it will be wrong :(
- How wrong could we expect it to be?
- What does $\bar{w}$ tell us about $\mu$?

## The magic of the law of large numbers

- How wrong could we expect it to be?
- Rephrase: if we took a different sample (of size 100) how different would we expect $\bar{w}$ to be?
- How about if we took 100 samples and calculated the mean of each?
- The Law of Large Numbers: So long as $N$ is large enough the distribution of sample means will follow a normal distribution.
- Normal distribution with mean $\bar{w}$ and variance $V(\bar{w})$.

## The magic of the law of large numbers

- If $V(\bar{w})$ is large relative to $\bar{w}$ then we are very unsure about $\mu$.
- We can ask more specific questions: Is it possible that $\mu = 200$?
- Remember the only data we have to answer this is $w_i$ for $i = 1, \cdots, 100$.
- Our best guess for $\mu$ with the data is $\bar{w}$. How uncertain we are about this guess is captured by $V(\bar{w})$.
- So two things matter
  1. How different is 200 from $\bar{w}$.
  2. How large is this difference relative to our uncertainty $V(\bar{w})$
- The hypothesis test is born! What matters is $T = \frac{\bar{w}-200}{V(\bar{w})^{0.5}}$

## The magic of the law of large numbers

- Lets say we find $T = \frac{\bar{w}-200}{V(\bar{w})^{0.5}} = 3$
- This means: The difference between our best guess of $\mu$ and 200 is three times how uncertain we are about our best guess of $\mu$.
- What should we conclude?
- We need to know how likely $T = 3$ is.
- To do that we need to know how it is distributed.
- We know by LLN that $\bar{w} \sim N[\mu, V(\bar{w})]$ after some algebra $T \sim N[0, 1]$.
- So how unlikely is a draw of 3 from a $N[0, 1]$ distribution?
- Very unlikely! Should happen less than 0.3% of the time!
- Conclude $\mu$ is very unlikely to be 200

## One final thing...

- This is all well and good, but to put it into practice we need to know $V(\bar{w})$.
- Let's break it down.

$$V(\bar{w}) = V\left(\frac{1}{N}(w_1 + \cdots + w_N)\right) = \frac{1}{N}\left(V(w_1) + \cdots + V(w_N)\right)$$

- Are we sure we can do the last step?
- What you need to know: Yes because data is drawn independently iid.
- $V(w_i) = \sigma^2$ because data is identically distributed iid.
- So we have: $V(\bar{w}) = \frac{\sigma^2}{N}$.
- What is $\sigma^2$?

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- What is $\sigma^2$?
- We don't know! It's a population parameter. Instead approximate with the sample analogue $\hat{\sigma}^2 = \sum_{i=1}^{N}(x_i - \bar{x})^2$.
- So we can calculate the test statistic $T = \frac{\bar{w} - 200}{\sqrt{\hat{\sigma}^2/(N-1)}}$.

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- Hardest question of today: Why $N - 1$?

## We did a hypothesis test!

- We've just done a hypothesis test.
- Using a sample of data we have learned something about the population.
- Really, whenever we do empirical economics we do some version of this simple procedure.
- We can separate the problem into two parts (i) identification, and (ii) inference.
- In English (i) How do we interpret the statistic we created? (ii) How confident are we that the statistic is an accurate representation of the corresponding population parameter?

## Quick example: regression

- Regression equation: $y_i = \beta x_i + \varepsilon_i$.
- Require data on $y_i$ and $x_i$, lets say $y_i$ = wages for individual $i$, and $x_i$ = years of completed schooling for individual $i$.
- Three questions
  1. How do we find a guess of $\beta$, call it $\hat{\beta}$, using a sample of $y_i$ and $x_i$
  2. What does $\beta$ represent, how can we interpret it?
  3. How accurate a guess would $\hat{\beta}$ be for $\beta$?
- We will mainly leave 1. and 3. to econometricians.
- What does $\beta$ represent.