Applied Data Analytics

Data analysis — Interpretation challenges

Two-sided selection

Hans-Martin von Gaudecker and Aapo Stenhammar

Causality as a two-sided selection problem

- Interested in the effect of study choice on entry wages
- X_i: Study economics or business administration
- Y_i: Entry wage

Outcomes

	Choice: Econ	Choice: Bus admin	Y_i | Econ	Y_i | Bus admin
Alice	False	True	.	53,000
Bob	True	False	52,000	.
Charlie	False	True	.	45,000
Derek	False	True	.	67,000

Potential outcomes = Counterfactuals

	Choice: Econ	Choice: Bus admin	Y_i | Econ	Y_i | Bus admin
Alice	False	True	?	53,000
Bob	True	False	52,000	?
Charlie	False	True	?	45,000
Derek	False	True	?	67,000

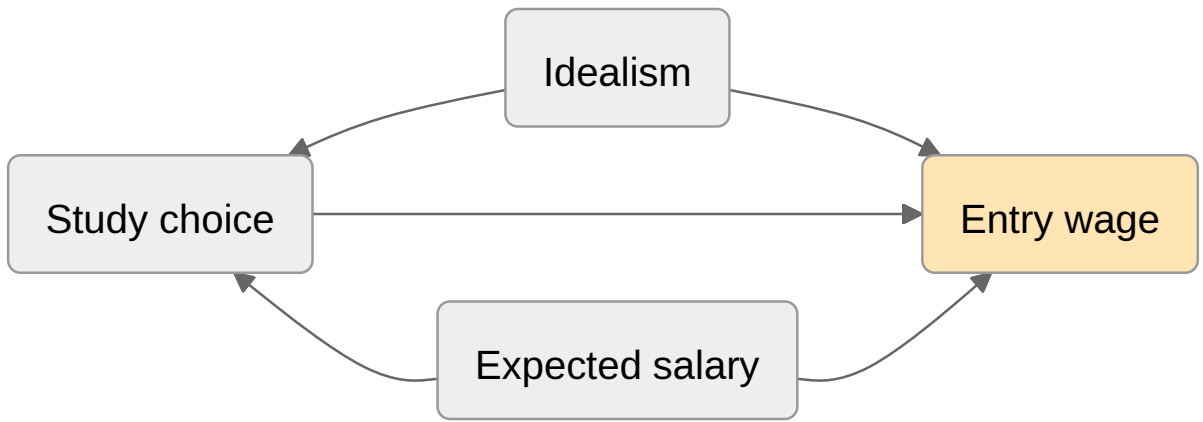
Comparing means

	Choice: Econ	Choice: Bus admin
$\bar{Y}$ | **Econ**	52,000	.
$\bar{Y}$ | **Bus admin**	.	55,000

Why don’t we observe the two missing values?

Model of selection into type of study!

Selection model



Selection model

$$Y_i = \alpha + \beta \text{Bus admin}_i + U_i$$

$$\bar{Y}|\text{Econ} = \alpha \qquad + \bar{U}|\text{Econ}$$

$$\bar{Y}|\text{Bus admin} = \alpha + \beta + \bar{U}|\text{Bus admin}$$

No contradiction:

$\bar{Y}|\text{Econ} < \bar{Y}|\text{Bus admin}$ **and** $\beta < 0$

Consequences

- We can never observe the causal effect at the individual level

  Always need some reduction operation

- Comparing means only makes sense if selection is random, i.e.

$$\bar{U}|\text{Econ} = \bar{U}|\text{Bus admin} = 0$$

- When thinking about causal effects, always define the population of interest
  - All people who study economics? Economics or business administration?
  - All people with Abitur?
  - All people born in 2005?