Hypotheses

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On hypothesis testing

- You learned about the scientific practice of:
  - developing hypotheses on basis of theory, previous evidence
  - the null hypothesis and alternative hypothesis
  - one-sided and two-sided hypothesis tests

- But why do some scientific papers have explicit hypotheses and others not?
- And how do research hypotheses relate to statistical hypotheses?

Deductive and Inductive research

- Deductive research:
  - begins with a theory
  - derives hypotheses from the theory
  - tests hypotheses using (new) observations
- Inductive research
  - begins with observations
  - searches for patterns in what is observed
  - sometimes: helps to inform (new) theory development
- In practice, research often involves alternating between deduction and induction

Why formulate hypotheses?

- A research hypothesis is the expected answer to your research (sub)question
  - This is equivalent to the alternative (statistical) hypothesis
  - Researchers often present just the alternative hypothesis

- Helps to be explicit and transparent on your expectations on basis of theory and/or observations (in the literature)

- Helps to structure and discipline your analysis (works like a pre-analysis plan)

- Hypotheses derived from theory help you to support, or fail to support, a theory

If you formulate hypotheses, make sure

- You formulate your hypotheses <u>before</u> the analysis (perfectly fine if you refute a hypothesis!)
- The hypothesis is <u>justified</u> on basis of theory, previous research and/or your own reasoning
- The hypothesis is testable and <u>falsifiable</u>
- The hypothesis is <u>precise</u> and clear
  - It is clear whether you're after a causal effect or a correlation
  - Indicate the direction of the association/effect
  - Define all concepts you use (conceptualization)
  - Specify how you will measure the concepts (operationalization)
- Of course, the hypothesis is <u>related to the research question</u>

Why not formulate hypotheses?

- If research is inductive or exploratory
- If there is no theory, or the theoretical prediction is ambiguous
- Disconnect between research hypothesis and statistical test
  - E.g., "education has a positive effect on income"
  - Corresponding statistical hypothesis: $H_0: \beta=0$ and $H_1: \beta > 0$
  - Stata will by default produce a two-sided test and economists almost always present two-sided tests (Stock and Watson, p. 128)
  - Two-sided test is more conservative than one-sided test (one-sided test divides the p-value by 2, so you will reject your null hypothesis more often)
- Some argue hypothesizing may invite manipulation
  - "It is a capital mistake to theorise before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts" (Doyle, 1891)

Essential principles

- A clear research question
- Do justice to the existing theories and empirical results (theoretical framework)
- Specify precisely how you will answer the research question (define concepts and specify measured variables)
- Be conscious of the implications of your research for theory and vice versa
- Not compulsory to specify hypotheses

Appendix: Example of a poor hypothesis

- "Income is related to trust"

- This hypothesis is difficult to interpret since
  - It is not specified whether the researchers talk about the macro or micro level
  - It is not specified what kind of trust is being implied
  - It is not clear whether the researcher implies a correlation or a causal effect
  - Moreover, the sign of the relationship is not specified

Appendix: Example of a better hypothesis

- "Higher levels of household income cause higher levels of trust in the government"

- This hypothesis is much clearer since
  - It is clear that the hypothesis is about the micro (household) level
  - It is specified what kind of trust is being implied
  - It is clear whether the researcher implies a correlation or a causal effect
  - The sign of the relationship is specified
- Of course, one still needs to operationalize the concepts used in the hypothesis (how are the variables measured?)