(Theory and) Research Design

EH6105 – Quantitative Methods

Steven V. Miller

Department of Economic History and International Relations

Goal(s) for Today

1. Introduce students to the research process that separates science from non-science.
2. Emphasize some key components to a quantitative research design.

Research as Process

Scientific research is a process that entails the following.

1. Developing an empirically answerable question.
2. Deriving a falsifiable hypothesis from a theory purported to answer the question.
3. Gathering/analyzing data to test the hypothesis.
4. Rejecting or failing to reject the hypothesis.
5. Relating results to theory from which the question was drawn.

Stages of Research

0. Perspective
1. Causal theory
2. Hypothesis
3. Empirical test
4. Evaluation of hypothesis
5. Evaluation of causal theory
6. Advance in scientific knowledge

Perspective Matters

A perspective is a general orientation to the world. They're untestable because:

1. They're too broad. Empirical support will never be total.
2. Perspectives are slippery and contextual.
   - e.g. "People are rational."
3. Any empirical data observed can be interpreted to fit the perspective.

We start with perspectives because we're not blank slates.

What is a Theory?

Theories follow perspectives.

- They're systematic purported explanations of how the "world" (or part of it that interests the researcher) operates.

Theories are too abstract to be tested.

- However, they lend themselves to operationalizations of the theory's concepts.
- We end up testing the theory's predictions (or hypotheses).

Hypotheses

Hypotheses are the *falsifiable* statements.

- i.e. they are able to be “proven wrong”.
- They also entail a means of operationalization (i.e. variables).

Knowledge Accumulation

Results from empirical tests add to (or even refute) standing scientific knowledge.

- Copernicus: *On Revolutions of the Heavenly Spheres*.
- Lazersfeld et al. (1944): *The People's Choice*.

Empirical tests can culminate in **paradigm shifts**, leading to new research agendas.

Summary of the Research Process

There are different norms across different social sciences.

- Political science is mostly "mid-range", focusing on strategic constraints and instrumental rationality.
- Even within IR, you can still get a heavy dose of grand theorizing if you want it.

Perhaps political science looks more like: puzzle -> research question -> theory -> hypotheses -> analysis.

Research Does Not Prove

The research process is (mostly) a deductive exercise.

- Each stage is a consequence of the previous stage *except* for the analysis phase.
- Therein, results are compared "up" to the hypothesis to check for consistency.

As a result, we can't prove theories true.

- At the most, we say our findings are consistent with the theory.

Affirming the Consequent

Generally, our hypotheses look like forms of an argument or syllogism.

- If my theory is valid (A), my predictions about the data will be correct (B).
- If we observe B, we cannot prove A.

Affirming the Consequent

Take a simple logical example: if Zlatan Ibrahimović wins the lottery (A), he will be rich (B).

- The Zlatan is rich (B).
- Therefore, The Zlatan won the lottery (A).

We know this is not true.

- i.e. The Zlatan is rich for he is The Zlatan.

Denying the Consequent

Research can't prove a theory true, but it can disprove one.

- i.e. if A, then B. Not-B. Therefore, Not-A.

Take a simple logical example.

- If I get thrown off the Eiffel Tower (A), I will die (B).
- I am not dead (~B).
- Therefore I've not been thrown off the Eiffel Tower (yet) (~A).

If the data don't support the hypothesis, you can reject all or part of the theory.

Hypothetico-Deductivism (H-D), in a Nutshell

You may see this kind of process called "hypothetico-deductivism" (e.g. Hausman, 1990).

1. Formulate some hypothesis *H* from theory *T*.
2. Deduce prediction *P* from *H* with necessary qualifiers (e.g. "ceteris paribus").
3. Test *P*.
4. Judge whether H is confirmed or disconfirmed, contingent on *P* or ~*P*.

Emphasis and Caveats

- Good theories are akin to an extended syllogism; make your assumptions clear.
- Think of theory as like an extended syllogism.
    - If I accept the assumptions, I accept setting up the theory for an empirical test.
- Falsificationism is key; it's what distinguishes science from non-science.
- Mostly a juxtaposition to inference by induction.
- Even then: there's an inductive component here (the hypothesis evaluation).
- *"Facts" don't speak for themselves.*
    - Notice we said nothing about how we "test *P*".
- *Everything is a model*; all science is necessary simplification.
    - This is true for both theory and method.

Quantitative Research Design

Basic takeaways:

1. “Concepts” and measures
2. X, Y, and Z
3. Data as spreadsheet

Concepts and Measures

The research questions you ask may look something like this:

- How is the U.S. more "powerful" than Russia?
- Why is Europe "richer" than less-developed countries?
- Why is American politics beset with problems of "polarization" and "partisanship?"
- Why have "democracies" never fought a "war" with each other?

These are just examples, and notice I could've put scare quotes too on a few other things (e.g. "less-developed countries").

Concepts and Measures

Every discussion about politics you have is conceptual.

- Concepts are ideas of mental constructs that represent phenomena in the real world.
- Some are simple (e.g. American partisanship). Some are complicated (e.g. corruption).

Concepts intuitively vary among units in the real world.

- Sweden is "richer" than Burundi.
- The U.S. is more "powerful" than Luxembourg.
- Kazakhstan is more "corrupt" than Norway.
- Botswana is more "democratic" than Angola.

Concepts and Measures

You want **measures** of these concepts.

- e.g. a war is typically measured as any conflict with a 1,000 or more battle-related deaths.

We seek to devise the best measure that best captures the "true" concept.

- However, there's always some slippage between concept and measure.
- We do our best to eliminate as much error as we can.

Evaluating Measures

- Systematic and random measurement error
- Validity and reliability

Systematic Measurement Error

Systematic measurement error is the bigger concern of the two.

- It can confound inference.

This was a big problem in the literature on (American) political tolerance.

- *Concept*: the extent to which individuals express a willingness to “put up with” political attitudes or behavior they find objectionable.
- *Measure*: would you allow a communist or atheist to make a speech in your community/run for office?
    - Individuals that allow this are conceived to be “politically tolerant”.

Were Americans Becoming More Tolerant?

Figure 1: Scenes from the Tenth Communist Party USA convention in Chicago (May 1938)

What Was the Problem?

Answer: they weren't. Our measure of "political tolerance" was flawed.

- By inserting "least-liked groups", we biased our measure off what we wanted.
- We were measuring ideology, religious values, or variable fear of the USSR in the Cold War, not just "political tolerance".

When we allow individuals to name their least-liked group, Americans are still as politically intolerant as they had ever been.

X, Y, and Z

Measures are variables and variables vary.

- We'll discuss levels of measurement in the next lecture.

Generally, our variables of interest are a class of X, Y, and Z.

- X: the *independent* variable(s); the "cause" of an effect.
- Y: the *dependent* variables(s); the outcome or effect of the cause.
- Z: the *control* variables; everything that can mitigate the relationship between X and Y.

The Three Types of Relationships Among X, Y, and Z

Spurious

- There is no effect of X on Y, controlling for Z.

Interactive

- The effect of X on Y depends on the value of Z.

Additive

- X and Z both independently affect Y.

Illustrating These Relationships

Assume this simple set up.

- We are interested in support (Y) for some deregulation issue.
- We believe party support (X) explains whether a respondent favors or opposes the issue.
- We also want to control for the gender (Z) of the respondent.
- We have 24 respondents where we have asked about their party support, policy support, and gender.

Our data look something like this.

Table 1: A Toy Data Set on Support for Some Policy (Y), by Party Support (X) and Gender (Z)

Party (X)	Support (Y)	Gender (Z)	Party (X)	Support (Y)	Gender (Z)
Left	Oppose	Female	Right	Oppose	Female
Left	Oppose	Female	Right	Oppose	Female
Left	Oppose	Female	Right	Oppose	Female
Left	Oppose	Female	Right	Oppose	Male
Left	Oppose	Female	Right	Oppose	Male
Left	Oppose	Female	Right	Favor	Female
Left	Oppose	Male	Right	Favor	Male
Left	Favor	Female	Right	Favor	Male
Left	Favor	Female	Right	Favor	Male
Left	Favor	Male	Right	Favor	Male
Left	Favor	Male	Right	Favor	Male
Left	Favor	Male	Right	Favor	Male

Note:

24 total respondents cast across 12 rows for sake of presentation.

A Spurious Relationship Among X, Y, and Z

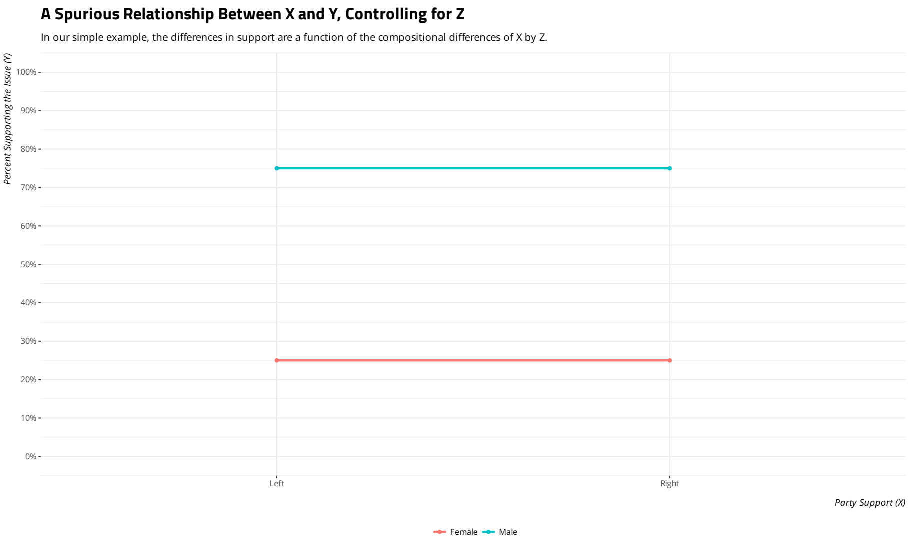
We find prima facie support for the effect of X on Y.

- 41.67% of Left party supporters favor the proposal.
- 58.33% of Right party supporters favor the proposal.

However, there is a major **compositional difference** in the parties, by gender.

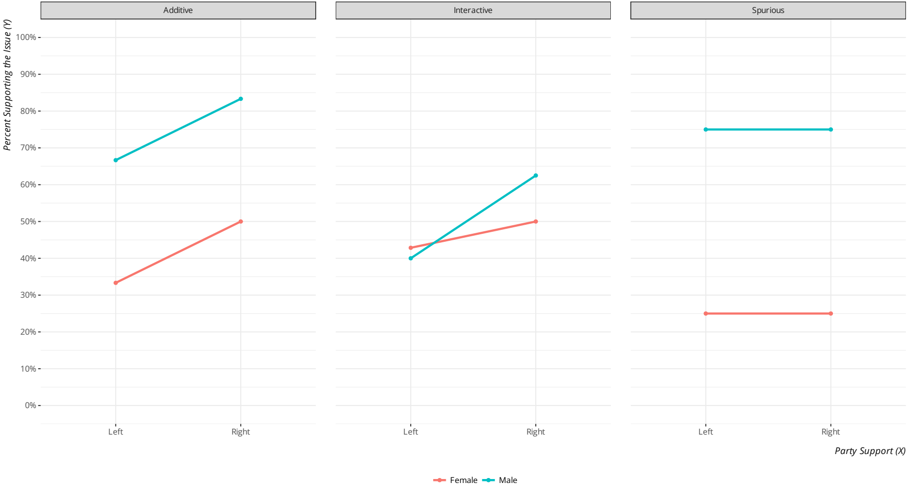
- 67% of the Left party are women, compared to 33% of the Right party.

Indeed, this simple example suggests that "controlling" for gender (Z) means there's no independent effect of party support (X) on support for deregulation (Y).


A Spurious Relationship Between X and Y, Controlling for Z
In our simple example, the differences in support are a function of the compositional differences of X by Z.
Percent Supporting the Issue (Y)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Left
Right
Party Support (X)
Female
Male

The Three Types of Controlled Relationships, Visualized

If you're arguing for the effect of X on Y, the spurious relationship is the most disappointing to get from an analysis.



Research Design and Control

Any honest research design needs to “control” for confounding effects of X on Y.

- It’s up to you to determine what exactly is (or are) Z.

Experimental designs typically get around this through **random assignment**.

- Everything else requires more work.

Quantitative Data as Spreadsheet

If it helps, think of the “data set” as a spreadsheet.

- Rows: Observations/units of analysis
- Columns: variables across all units

Often you’ll get a variable heading (i.e. column name) that is oblique code/label.

- i.e. in the next table, **`hinctnta`** is an indicator of a respondent’s household income, in deciles.
- Put in other words: never lose sight of your codebook.

An Example Data Set

Table 2: A Sample of 10 British Respondents in the European Social Survey (2018)

idno	region	immigsent	agea	female	eduyrs	uempla	hinctnta	lrscale
39	West Midlands (England)	24	90	0	9	0		5
135	South West (England)	7	61	1	10	0	7	5
142	South East (England)	14	62	1	10	0	2	3
146	Northern Ireland	19	66	1	15	0	5	6
164	Northern Ireland	13	68	0	12	0	3	
191	Northern Ireland	20	63	0	18	0	10	7
213	South West (England)	8	70	0	10	0	1	8
238	London	16	31	0	13	0	10	7
245	East of England	14	62	0	11	0	2	8
265	East Midlands (England)	15	23	1	15	0	4	0

Note:

Data: European Social Survey v. 9 [edition: 1.2]. Interviews done end of 2018/start of 2019.

What is a Unit of Analysis?

A “unit of analysis” is the type of observation under study. Common types you’ll find:

- Individuals (e.g. survey data)
- Individuals over time (common in health studies)
- Geographical units (e.g. counties, regions, sovereign states)
- Geographical units over time (e.g. most economic data you’ll find)
- Dyads [over time] (e.g. inter-state conflict data)

Always keep track of your unit of analysis too.

- Beware of the ecological fallacy.

Conclusion

Theory, hypothesis, and the scientific enterprise:

- Communicate your assumptions; acknowledge your perspectives.
- Science if simplification, and falsification.
- Theory *and* method have assumptions we make and accept/reject.
- Most research does not *prove*; you're checking for consistency.

Quantitative research design:

- Everything is a "concept"; you're trying to measure it (well).
- Assessing the effect of X on Y means controlling for Z.
- Think of the data set as just a big ol' spreadsheet.

Table of Contents