IR 611: Multivariate Analysis

Benjamin Graham
Plan for Today

• Introductions
  – Your motivations/objectives for this course
  – A bit about POIR methods training
• Context and Course objectives
  – Pedagogy
• Business and logistics
• Establishing the research design context
• A little probability
Quantitative vs. Qualitative Research

• This distinction is WAY overhyped
  • Bad quantitative research lacks nuance and context
  • Bad qualitative research lacks rigor and generalizability
• In truth, we have a broad spectrum of methods

• Your selection of method should always be question driven
  • OK, but I can’t become an expert in every method...
  • That’s what co-authors are for
Training for Your Research Agenda

• Step 1: Enough training in all the core methods of the field so that:
  • You can read intelligently
  • You can look at a question and know the right method to use
• Step 2: Pick your research area
• Step 3: Get more specialized training in the most appropriate method
The Efficient Research Portfolio

• Dissertation (and 1st book or flagship article): Use the methods you know best to the central question of your research agenda

• Articles in your core topic area where a co-author executes on the methods side and you write the theory

• Articles outside your core topic area where you execute on the methods side and your co-author writes the theory
Why quantitative training is so awesome

• Math is scary. Stats is hard.
• Fewer people get the training, so your skill set is more valuable
  • Applies both inside and outside academia
• Because its hard, you want to learn from a class (to start).
• Stats is new
  • So senior people don’t know it
  • And there are still a lot of questions no one has gotten to yet
• Data is rapidly becoming cheaper to collect and store
  • The scarce complement is people who can make meaning from that data
POIR Methods Training

• This is the only required quant class
• Morris Levy- maximum likelihood and related topics
• Take anything James Lo teaches
• Interdisciplinary social science methods training.
Course Objectives

• 1. Enable you to read quantitative research intelligently
• 2. Teach you about linear regression and some of its variants
• 3. Enable you to manage and manipulate datasets for large-n research projects
• 4. Provide you skills for self-teaching or working with co-authors using more sophisticated techniques in the future
• 5. Improve your knowledge of R to facilitate items 2-4
Notes on Pedagogy

• Where I can, I will try to flip the classroom

• This means web videos at home
  • Will post soon for next 2 weeks

• Simulations, demos, examples, Q&A, and labs
Business and Logistics

• Any problems enrolling?
• I run this course off my USC website
  • Dropbox for homework assignments
  • E-mail me if you need a dropbox invite sent to a non-usc e-mail
• The syllabus is a work in progress
  – Some readings will change
The Paper

• 40% of your grade is a final replication paper

• Why replicate?
  – Learn by doing
  – Possible first publication
  – Because the field needs it
The Scientific Method

- **The scientific method has four steps**
  - 1. Observation and description of a phenomenon or group of phenomena.
  - 2. Formulation of a theory to explain the phenomena.
    - Key concept: Induction
  - 3. Derivation of hypotheses that make falsifiable predications about new observations.
    - Key concepts: falsifiability and “out of sample tests”
  - 4. Performance of multiple tests of these hypotheses by multiple research teams.
    - Key Concept: Replicability

- If the experiments bear out the hypothesis it may come to be regarded as a theory or law of nature
Types of Studies (1)

• **Descriptive**: To observe and describe the world around us. E.g., *The Origin of Species*
  – World War I killed a whole lot of people

• **Relational**: Designed to examine the relationship between two or more variables.
  – e.g. the democratic peace

• **Causal**: Designed to determine whether one or more variables causes or affects one or more outcomes.
Induction and Deduction

• Induction

Descriptive Study

Observation

Relational Study

Pattern

This is your puzzle!

Theory
Induction and Deduction

• Deduction

- Theory
- Hypothesis
- Observation
- Confirmation or Refutation
Social science theories are usually causal

• The pattern we observe can usually be described as a relationship between two things
  • Democracy and interstate war
• The dependent variable is the outcome we are trying to explain
• The independent variable is another item that we think causes the outcome in question
Why are we fixated on causation?

• Because we want to change the world
• A causal theory tells you what lever to pull

• We want to improve normatively bad outcomes
  • Save the world
• We want to alter the behavior of others or ourselves
  • Make someone vote for me
  • Stop someone from harming me
The big picture

- Theory
- Research
- Observation
- Action
- Deduction
- Induction
- Implementation
Deductive theory testing is a Growth Industry

• Program evaluation
  • Public Sector
  • Private sector
    • for profit
    • not for profit
• Ideally, the evaluation is built into the implementation in the first place.
Purely Academic Research

- Academics may go back and forth without moving to implementation:
  - Induction creates theory
  - Deduction tests it. Then we revise the theory and test it again. And we do it again.
Research Design

• When quantitative research is done badly, research design is often at fault
  – A parameter is estimated well, but the parameter doesn’t mean what the research thinks it means

• But this class is focused on what comes after the research design is in place
  – Focused on correctly estimating parameters of interest
Is a project/topic feasible?

- Does your dependent variable vary?
- Can we define and measure everything that needs to be defined and measured?
- If the study involves some condition, can we define it? Can we be sure we'll recognize it when we see it?
  - What is improved human welfare?
  - What is political competition? How do we observe it?
  - What is crop yield--what gets harvested or what makes it to market, or both? What are sales--what gets manufactured or what gets into the hands of the consumer?
  - What's the difference between civil war and other wars?
Measurement

• Are we measuring what we think we're measuring?
• How should we choose among different measurement techniques?
• Can measurements be made consistently?
• How accurate are the measurements?
• If there are errors in the data, are they random?
• Do we have missing data? If so, are those missing completely at random?
Collecting Your Own Data

• All of the relevant data must be collected. If a critical piece of data cannot be obtained, perhaps the study should not be undertaken.

• It is equally important to guard against collecting data unrelated to the research question.
Using Other People’s Data

• User beware
  – Read the codebook.
  – Talk to the authors of the data if you have questions.
  – Take this as seriously as if you were writing the codebook yourself
  – Spend some time getting to know the data, one variable at a time
Causal Variables/Treatments

• What is a causal variable/treatment?
• Treatments must be clearly identified
• It is possible that multiple things cause the observed effects
  – What makes someone vote for Obama?
  – How would we know that age increases probability of voting for Obama?
Types of Studies

• The typical study can be classified into one of two types:
  – observational studies (non-experimental)
  – Intervention studies (experimental)

• The distinction is based on whether an intervention is involved, that is, whether the investigator changes some aspect of subjects' behavior.
Experiments = Easy Analysis

• If we have randomization, the stats are simple
  – Difference in means test
• The farther we are from an experiment, the more complicated the statistics
The Order of Things

- You have done a fair amount describing a single population
- We’ll begin by comparing two (or more) populations on a single dimension
- Then we’ll move to comparing multiple populations on multiple dimensions
Ways to Be A Good Student

• Watch the videos & read with intention
  – Write down your questions and bring them in
• In class, two useful statements are always
  – I don’t get it
  – I don’t get how I would use this
• Do the homework yourself
• Pick a paper that is actually useful to you