Learning from Data

James J. Heckman

Economics 312, Spring 2022

THE UNIVERSITY OF CHICAGO

Accuracy and Replicability of Data is
An Essential Part of Any Good Empirical Study:

Multiple Sources of Data: All Informative

- a Ethnographic studies/observer studies
- b Experiments and natural experiments
- c Cross sections, panels, time series

THE UNIVERSITY OF CHICAGO

Variety of Questions Addressed

1. Accurate descriptions of phenomena in empirical analysis (new data; re-analysis of previously used data)
   a. Surveys
   b. Experiments
   c. Creating new data sets from existing materials:
      i. text as data;
      ii. data scraping;
      iii. matching administrative data sets

2. Challenge: creating interpretable summaries of the evidence and detecting empirical regularities
   a. Displays (walls of regression coefficients are not effective, although commonly practiced): A graph is worth a thousand tables
   b. What mode(s) of inference for making and reporting studies?
   c. Correlation vs causation: which regularities are causal? What doe we mean by causal? Structural models are more complete causal models

3. Models promote understanding of evidence and contribute to consilience across studies

"Statistical information is currently accumulating at an unprecedented rate. But no amount of statistical information, however complete and exact, can by itself explain economic phenomena. *If we are not to get lost in the overwhelming, bewildering mass of statistical data that are now becoming available, we need the guidance and help of a powerful theoretical framework. Without this no significant interpretation and coordination of our observations will be possible.* **"...[S]o long as we confine ourselves to statements in general terms about one economic factor having an 'effect' on some other factor, almost any sort of relationship may be selected, postulated as a law, and 'explained' by a plausible argument."**

Frisch (1933)

THE UNIVERSITY OF
CHICAGO

Three Policy Problems:
(We Will Return to This List Throughout the Course)

P1

Evaluating the Impacts of Implemented Interventions on Outcomes Including Their Impacts in a particular environment on the Well-Being of the Treated and Society at Large.

- Objective evaluations
- Subjective evaluations
- Ex ante and ex post
- Focuses on impacts on a **particular** population
- Focuses on "Internal Validity" (aka "threats to validity")
- Common practice: focus on objective evaluations in a partial equilibrium setting (the focus of the first half of the course), not full range of outcomes of a policy

THE UNIVERSITY OF
CHICAGO

P2

Forecasting the Impacts (Constructing Counterfactual States) of Interventions Implemented in One Environment in Other Environments, Including Impacts on Well-Being.

- "Transportability;" can the policy be replicated elsewhere?
- External validity

P3

Forecasting the Impacts of Interventions (Constructing Counterfactual States Associated with Interventions) Never Historically Experienced, Including Their Impacts on Well-Being.

- Knight's challenge: Fundamental problem of knowledge
- Addressing this problem makes economics (and science) distinctive from straight statistics that simple extrapolates

- The ultimate challenge: forecasting (accurately) the effect of proposed policies never previously experienced

  ⓐ This type of analysis lies lies outside of ordinary statistics
  ⓑ At the heart of structural econometrics:
    "The existence of a problem in knowledge is that the future is different from the past. The existence of a solution to a problem requires that the future be like the past."
    – Frank Knight, "Risk, Uncertainty, and Profit" (1921).
  ⓒ What ingredients from the past can be used to predict the future? Is there an algorithm that settles this issue? A formal test statistic?

THE UNIVERSITY OF
CHICAGO

A Key Ingredient Required to Answer Knight's Challenge That Underlies All Rigorous Policy Evaluation

Structural Invariance Over the Relevant Support

- Requires economic relationships ϕ mapping ($\phi : X \rightarrow Y$) is invariant to manipulations of X
- $Y = \phi(X)$
- ϕ is a stable (to manipulations) function
- Autonomy (Frisch, 1938)

Understand Multiple Modes of Statistical Inference
That are in Use in Econometrics
(Each suggests different approaches to analyzing data)

- **ⓐ** Classical statistics (the prevalent approach in economics) and the core principle of the experimentalists
    - **ⓘ** Fisher *p*-values (focus only on null)
    - **ⓘ** Neyman Pearson: Type I and Type II errors (considers alternatives)
- **ⓑ** Bayesian methods (uses priors; model of learning)
- **ⓒ** Decision theoretic approaches
- **ⓓ** Abductive inference, including case-based approaches (loss functions dictate inference)

- Will discuss how to do each of these approaches in this course
- How to learn from empirical failures? From surprises? What is the next step?
- Should we adopt "pre-analysis plans? Classical statistical straight jackets. (See recent NBER working paper by Duflo et al.)

THE UNIVERSITY OF
CHICAGO

Contrasting Approaches to Policy Evaluation: Economics vs Statistics

Serious economists address the following questions in conducting a policy evaluation:

a. What problem(s) are being addressed? (Why are you doing the analysis?) To estimate ATE? Why is ATE economically interesting? For what problems?

b. What are the **causes** of the problems addressed?

c. What policies alleviate the causes?

d. What are costs and benefits of those policies? Benefits and costs to whom? (Social vs private benefits)

e. What are impacts of old policies in new environments?

f. What are impacts of policies never previously implemented?

g. **Beyond curve fitting:** In addressing each of these questions, economists draw on and sometimes enrich economic theory.

Statistical Approach to Policy Evaluation

- What problem(s) are being addressed? (Described statistically)
- Does a particular policy solve the problem? (Treatment effects)
- This is the focus of a lot of policy papers in contemporary economics
- **Missing:**
  - **a** What are the causes of those problems? What are the sources of treatment effects?
  - **b** What classes of policies adequately address the causes?
  - **c** What are costs and benefits of those policies? Subjective and objective functions
  - **d** What are impacts of old policies in new environments?
  - **e** What are impacts of policies never previously implemented?

THE UNIVERSITY OF CHICAGO