

The Experimental/Observational Continuum

Section 06

Considerations for Observational Studies

Gelman, Hill, Vehtari Ch. 20.9

1. Defining “the treatment”
2. Understanding the counterfactual state
3. Temporal ordering of variables
4. Multiple treatment factors
5. Studying causes of effects
6. Thought experiment: What would the ideal experiment have been?

Define “treatment” → counterfactual states → hypothetical experiment → scientific question

Thought Experiment:

Confused? Ask yourself:

If I could have done an experiment in an idealized world, what would that experiment have looked like?

- ▶ Can help formalize previous notions, define potential outcomes, treatments, etc.
- ▶ Probably not a perfect mapping between your question and an idealized trial, but the exercise is almost always helpful
- ▶ Answers should guide how you do the analysis

Design Trumps Analysis

The Annals of Applied Statistics
2008, Vol. 2, No. 3, 808–840
DOI: 10.1214/08-AOAS187
© Institute of Mathematical Statistics, 2008

FOR OBJECTIVE CAUSAL INFERENCE, DESIGN TRUMPS ANALYSIS¹

BY DONALD B. RUBIN

Harvard University

For obtaining causal inferences that are objective, and therefore have the best chance of revealing scientific truths, carefully designed and executed randomized experiments are generally considered to be the gold standard. Observational studies, in contrast, are generally fraught with problems that compromise any claim for objectivity of the resulting causal inferences. The thesis here is that observational studies have to be carefully designed to approximate randomized experiments, in particular, without examining any final outcome data. Often a candidate data set will have to be rejected as inadequate because of lack of data on key covariates, or because of lack of overlap in the distributions of key covariates between treatment and control groups, often revealed by careful propensity score analyses. Sometimes the template for the approximating randomized experiment will have to be altered, and the use of principal stratification can be helpful in doing this. These issues are discussed and illustrated using the framework of potential outcomes to define causal effects, which greatly clarifies critical issues.