Instructor: Scott Cunningham

Meeting Dates: Friday October 15 and Saturday October 16

Github repo:

<https://github.com/scunning1975/causal-inference-class>

Textbook:

Causal Inference: the Mixtape by Scott Cunningham. Free version at:

<https://mixtape.scunning.com>

Email: Scott Cunningham, [scunning@gmail.com](mailto:scunning@gmail.com)

Githup repo: <https://github.com/scunning1975/causal-inference-class>

**Description of class:**

Causal inference is a specialization within economics and statistics that grew out of the labor economics tradition to evaluate the causal effects of programs. While physical randomization was widely known to yield unbiased estimates of causal effects, it was not often used in economics. A wave of new labor economists starting in the late 1970s and mid 1980s changed that as they pushed for focus on exploiting quasi random assignment in natural experiments or through imposed modeling assumptions on counterfactuals. This work in conjunction with pioneering work in econometrics led to the sharpening of such research designs as instrumental variables and difference in differences. This workshop will cover foundational elements of modern practices of causal inference such as the potential outcomes model as well as discuss in detail the most common designs: regression discontinuity, instrumental variables, difference in differences, comparative case studies using synthetic control and if time permitting matching. It will be accompanied by efforts to introduce students to basic practices in programming as well as good research practices more generally.

Aims of the class:

1. To help students become more familiar with the field of causal inference
2. To empower students to apply research designs more competently to their own research
3. To direct students towards better programming practices so that they are better able to perform quantitative forms of research

**Group assignments**

We will devote 45 minutes for an RDD assignment, 45 minutes for an IV assignment, 45 minutes for a DiD assignment and 45 minutes for a synthetic control assignment.

**Software**

Most of our discussions will be in Stata. Though I have some familiarity with R, and have some code to share, most of my human capital is in Stata.

**Schedule**

Day one – Counterfactuals, RDD and IV (8 hours)

* Introductions
* Hidden curriculum material – Programming, organization, workflow and research and professional development
* Potential outcomes
  + Randomization and selection bias
  + Fisher’s sharp null (i.e., randomization inference)
* Sharp regression discontinuity
* Introduction to difference in differences
  + With and without covariates
  + TWFE and doubly robust
* Bias of TWFE with differential timing
* Weighted group-time ATT
  + Callaway and Sant’Anna
  + Sun and Abraham
* Stacking
* Robust imputation

Day two: Synthetic control and instrumental variables (8 hours)

* Introduction to difference in differences
  + With and without covariates
  + TWFE and doubly robust
* Bias of TWFE with differential timing
* Weighted group-time ATT
  + Callaway and Sant’Anna
  + Sun and Abraham
* Stacking
* Robust imputation
* Synthetic control
  + Abadie, Diamond and Hainmueller
  + Matrix completion with nuclear norm regularization
* Instrumental variables
  + Some two step estimators (Wald, two sample IV, two stage least squares)
* Just identified versus multiple instruments
  + weak and strong instruments, bias and consistency of 2SLS
  + Multiple instrument estimators: LIML, jackknife, unbiased jackknife and double selection methods
* Heterogenous treatment effects and the local average treatment effect
* Leniency designs