Intro to Practical Econometrics

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Applied Statistics and Econometrics 2
ECON GA-1102.031 / ECON GA-1102.032

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This Class

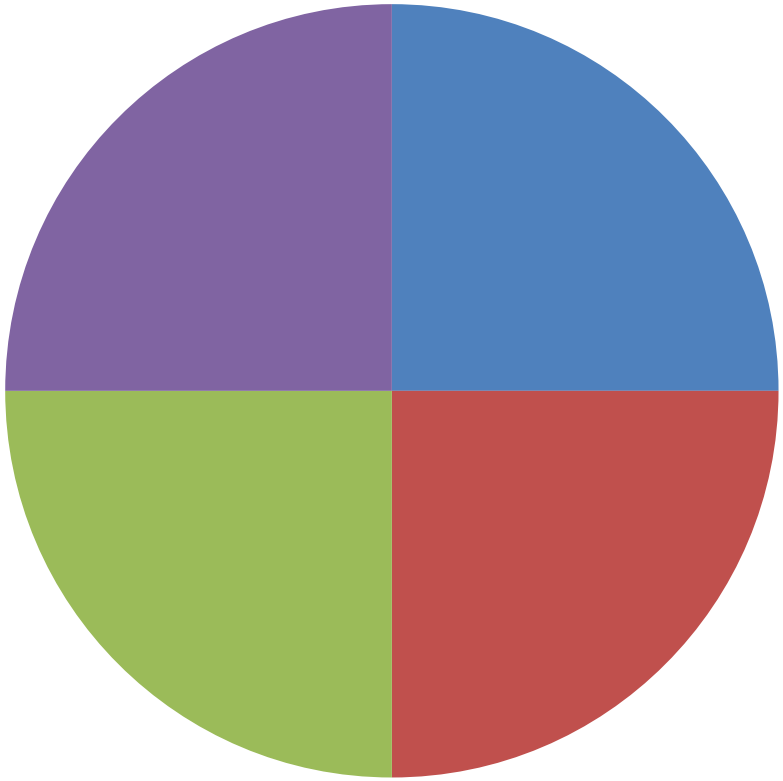
Lab = Enhanced Recitation

- Recitation
  - Review theory
  - Solve exercises to complement theory, homework
- Empirical work in R
  - Complement lecture
  - Research project
- Answer your questions – resuscitation

Office hours

- No formal office hours but available by email
- Last half hour of class for 1 on 1 discussion or research group meetings
  - by appointment or “walk in”

Class structure



1. Recitation (exercises)
2. Emprical work in R
3. Your questions
4. Individual meetings

Research Project

Intro: Motivation

One of the priorities of this course is to guide you into producing your own research by the end of the semester

- Great opportunity to explore a topic of interest
- Apply the econometric methods you learned
- Excellent topic of discussion for job interviews

Intro: Logistics

- Groups of 3 to 5 students (same lab section)
- Important dates:

Project Requirement	Date Due
Group Signup	Feb 6
Problem Statement	Feb 27
Model Description	Mar 27
Final Report	**May 14**

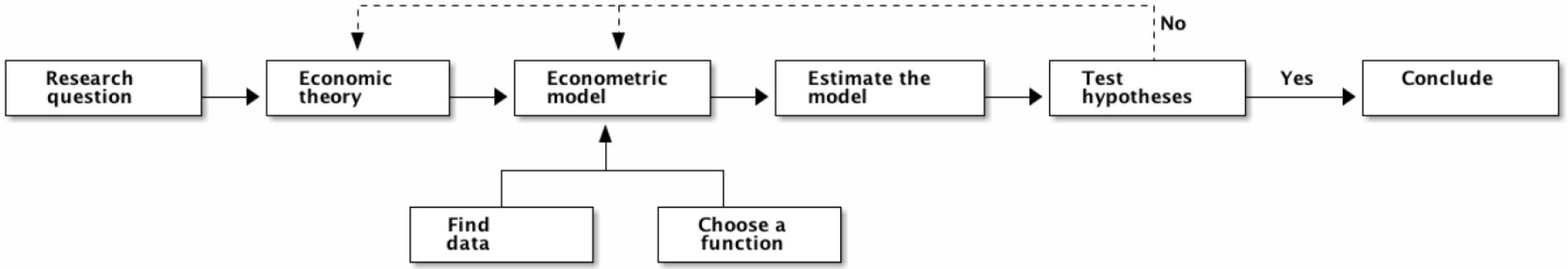
- Details in the *Instructions for Term Project* handout

Research Project: Broad Guidelines

Three ingredients of a successful research project

1. Academic rigor
   a) Understand and encompass the existing literature
   b) Innovative, yet appropriate, use of data
   c) Appropriate causal inference
2. Policy relevance
   a) Tied to new facts or trends
   b) Framed in terms of policy levers
   c) Timely
3. Broadly communicated
   a) Accessible to a wide range of audiences
   b) High potential for media coverage
   c) Partnered with policy makers

Econometric research workflow



Model should be anchored in established economic theory

Avoid data mining! Put the Econ in the Econometrics

Some (broad) theoretical frameworks:

- Supply / demand
- Consumption smoothing
- Monopolistic competition

Keep eyes open for empirical examples in your textbooks (Chiang book, Greene book)

Research Project: Data

Experimental vs. observational data

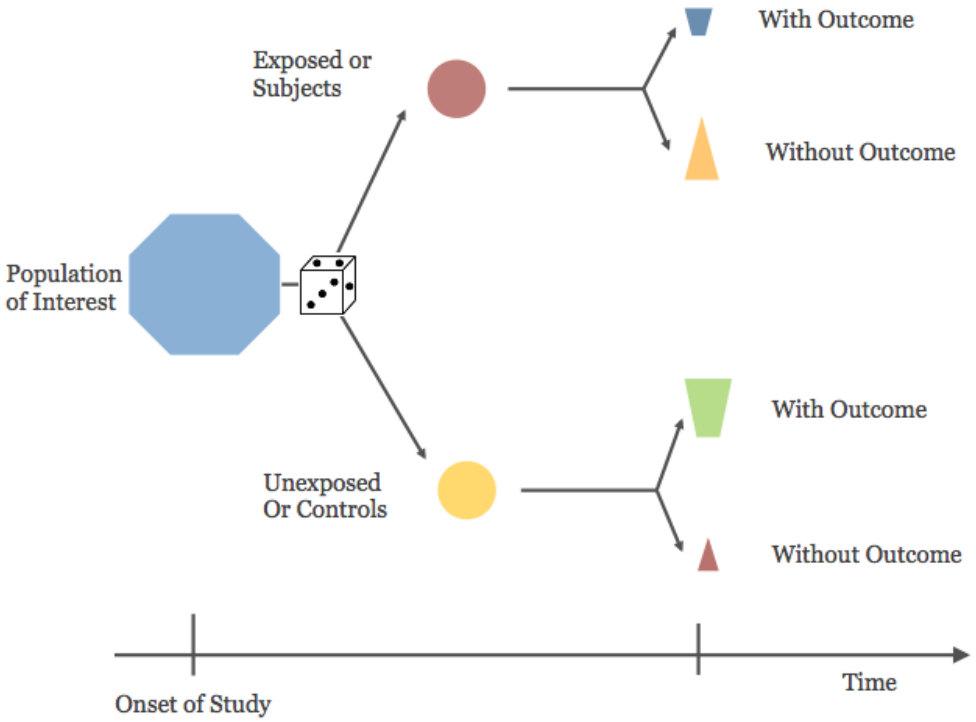
- Experimental data come from experiments designed to evaluate a treatment or policy or to investigate a causal effect

- Observational (nonexperimental) data are collected using surveys and administrative records

Experimental data: RCTs

Randomized Control Trials:

- All participants are randomly assigned into two groups.
- The control group receives no treatment (or placebo)
- The experimental group receives the treatment.
- After a follow-up period, compare the two groups



RCTs: advantages

The gold standard for causal inference

- Randomization minimizes selection bias
- Ensures that the only systematic difference between the control treatment group is the treatment itself, with the effects from other confounding factors eliminated

RCTs: disadvantages

- **Cost**: Called "the gold standard" because expensive (in money and time)
- **Ethics**: Especially in social science, we cannot impose some treatment due to ethic concerns

Observational data: advantage

Readily available:

Public databases

- Federal Reserve Economic Data https://fred.stlouisfed.org/
- US Census https://www.census.gov/en.html
- US Bureau of Labor Statistics https://www.bls.gov/
- US Economic Accounts https://www.bea.gov/data
- Penn World Tables https://cid.econ.ucdavis.edu/pwt.html
- IMF https://www.imf.org/en/Data OECD: https://data.oecd.org/

Replication data sets

- openICPSR https://www.openicpsr.org/openicpsr/repository/
- Harvard Dataverse https://dataverse.harvard.edu/

Author personal website

Paid Haver Analytics, Bloomberg, FactSet, Markit, CapitalIQ

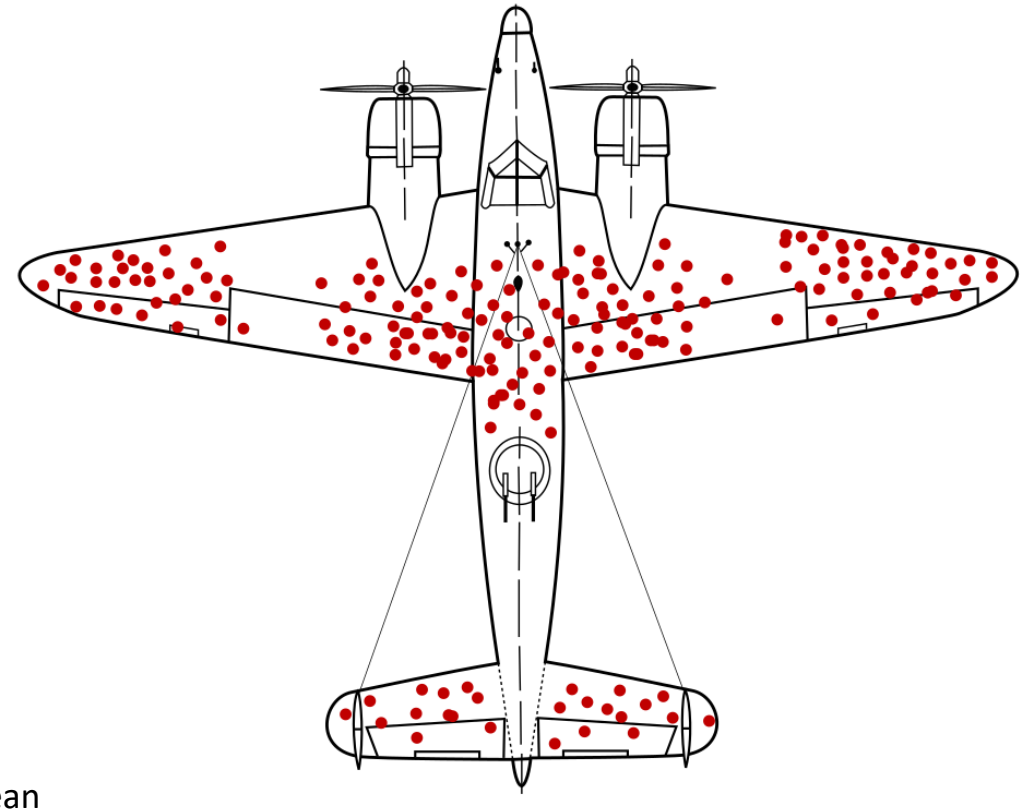
Curated datasets

- R datasets https://vincentarelbundock.github.io/Rdatasets/articles/data.html
- Data and Story Library https://dasl.datadescription.com/datafiles/

Observational data: disadvantage 1

Choices already baked in: Know your data collection methodology!

(see Abraham Wald, survivorship bias, selection bias, truncation, censoring)



Source: Martin Grandjean

Observational data: disadvantage 2

"Treatment" is not randomly assigned so difficult to estimate causal effects

Much of econometrics dedicated to dealing with causality using observational data

Causal Inference

Regression

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

$Y =$ dependent variable
$X =$ independent variable
$\varepsilon =$ other factors (aka "error term")

$$\text{Lifespan} = \beta_0 + \beta_1 \text{RedWineConsumption} + \varepsilon$$

Wealth as possible confounder (wealthy people likely to drink wine but also likely to get better health care)

$$\text{LungCancer} = \beta_0 + \beta_1 \text{SmokingTobacco} + \varepsilon$$

Ronald Fisher (a smoker himself) argued on the side of tobacco companies about possible confounders (genetics etc)

- Regression can be useful but be careful not to interpret causally
- The most we can say is that “X is associated with Y”
- Or “a one unit increase in X is associated with a β_1 increase/decrease in Y”

Causal effect

- Causal effect - the effect on an outcome of a given action or treatment as measured in an ideal RCT
- The concept of the **ideal randomized controlled experiment** does provide a theoretical benchmark to define causal effects in research design
- Sometimes nature helps - natural experiments (quasi-experiments) provide randomization

Methods

- Difference in Differences – Greene Ch. 6
- Instrumental Variables – Greene Ch. 8

Difference in Differences

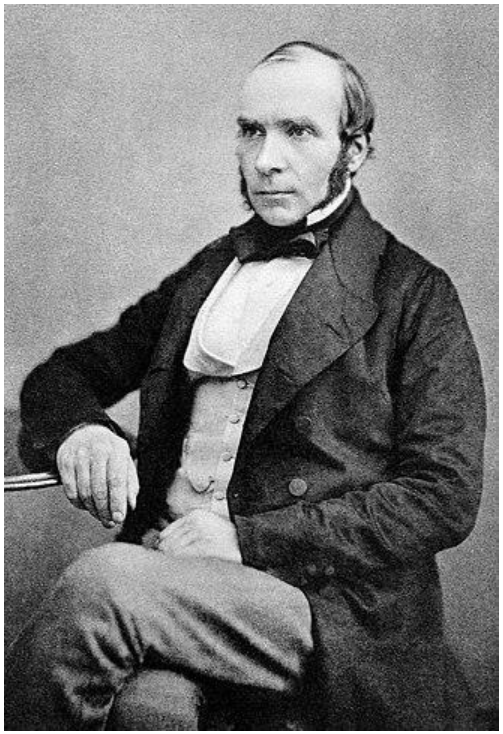
Jon Snow

("Game of Thrones" character)

vs

John Snow

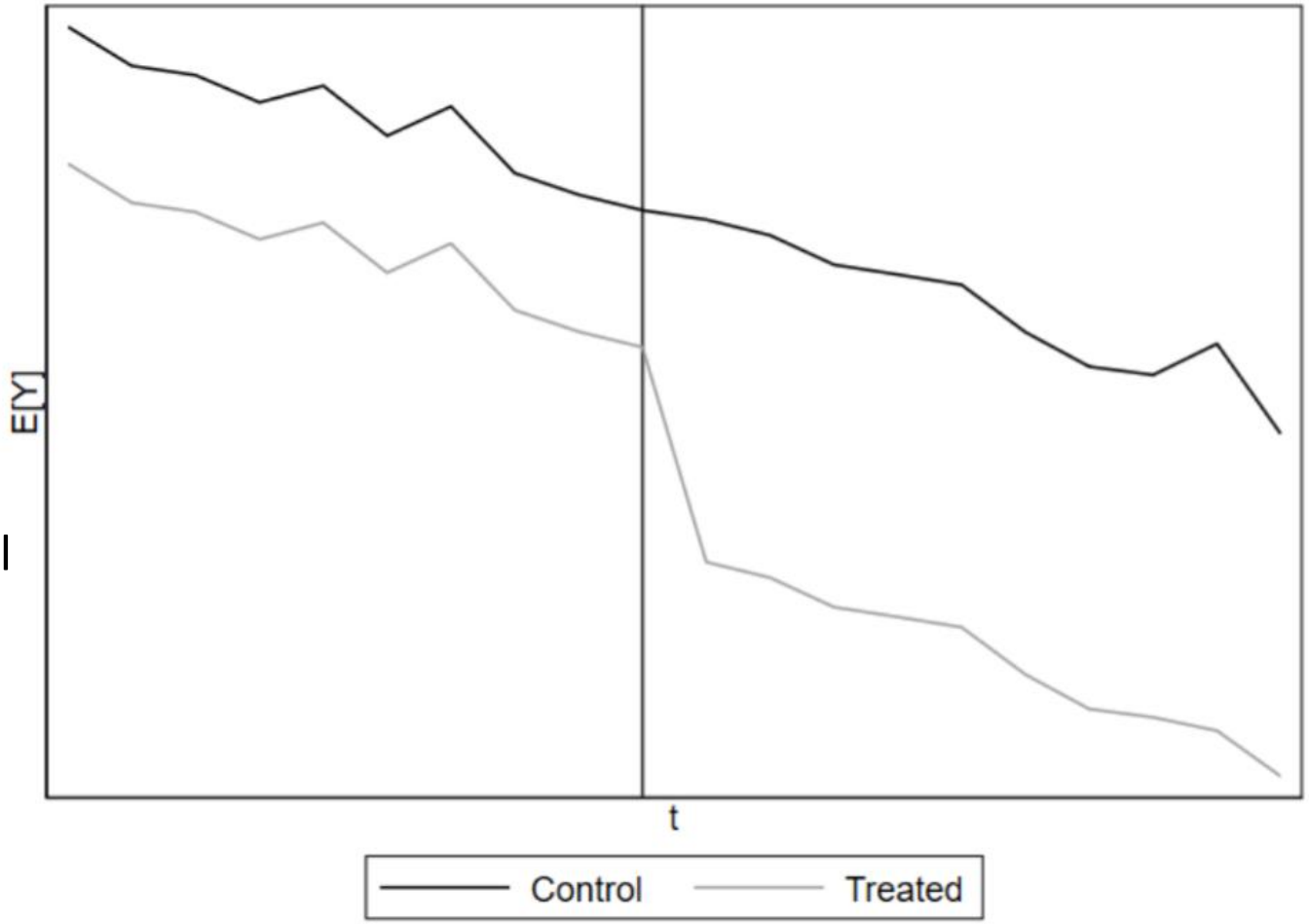
(Father of epidemiology)



Source: Wikipedia

Difference in Differences

- John Snow 1850s – cholera incidence vs. water provider
- Card and Krueger (1994) – NJ, PA unemployment level vs. min wage



Difference in Differences

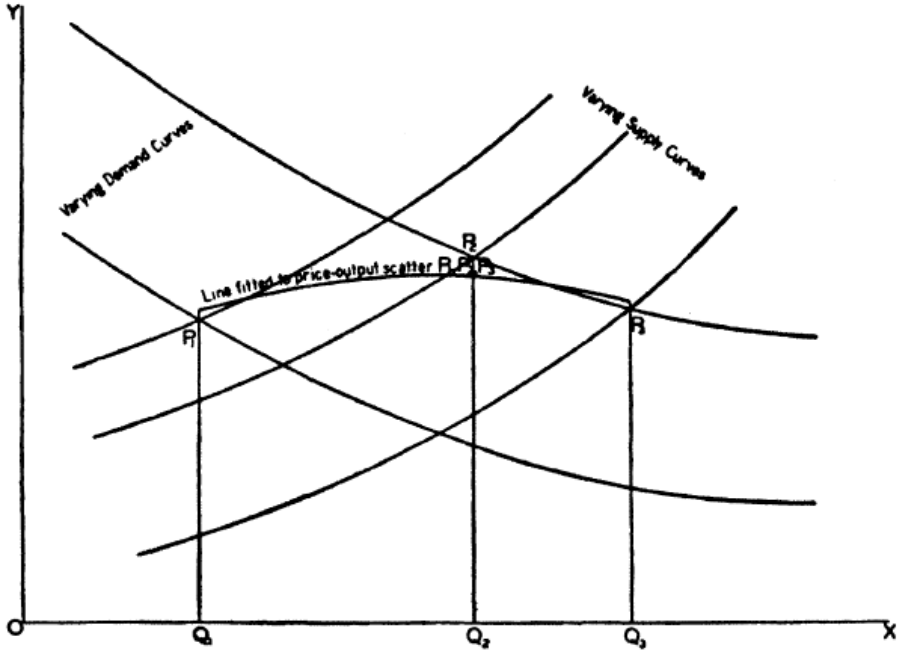
- Sources of randomization:
  - Local governments change policy (marijuana, pay-day loans, min. wage)
  - Jurisdictions hand down legal rulings (abortion)
  - Natural disasters (wildfires in California, hurricanes in Louisiana)
  - Firms lay off workers

Image source: Scott Cunningham, Causal Inference: The Mixtape(2020)

Instrumental Variables

Phillip G Wright's original illustration of the identification problem

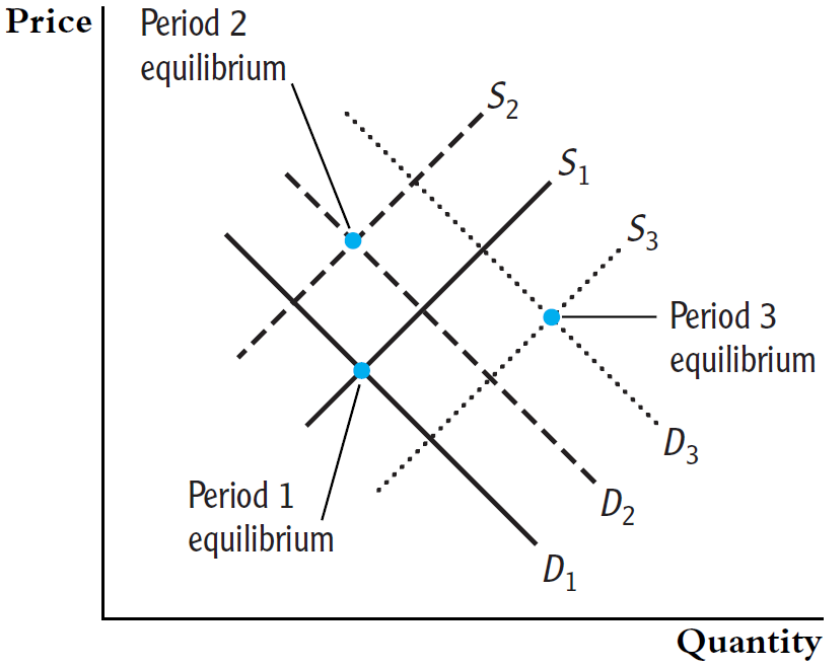
FIGURE 4. PRICE-OUTPUT DATA FAIL TO REVEAL EITHER SUPPLY OR DEMAND CURVE.

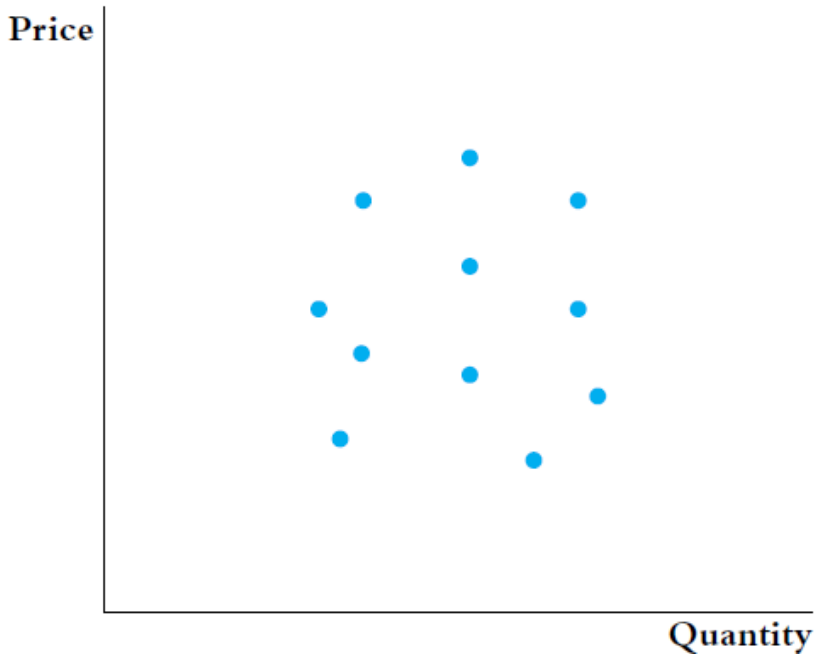


Source: PG Wright, The Tariff on Animal and Vegetable Oils (1928)

Instrumental Variables

$$\ln(Q_i^{butter}) = \beta_0 + \beta_1 \ln(P_i^{butter}) + u_i$$

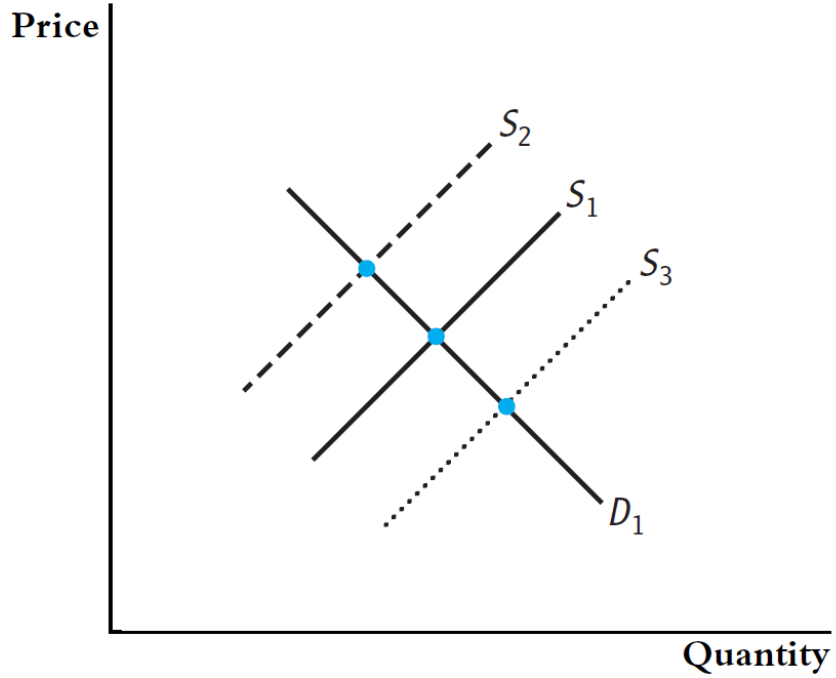




Source: Stock and Watson

Instrumental Variables

Using Rainfall as Instrumental Variable for Butter Supply



Source: Stock and Watson

Statistical Data Types

1. Cross-sectional data

- Data on different entities for a single time period are called cross-sectional data
- The sequence of each observation number is arbitrarily assigned
- Cross-sectional data can be experimental data or observational data

person	year	income	age	sex
1	2018	50	27	M
2	2018	80	38	F

2.Time series data

- Data for a single entity collected at multiple time periods
- The sequence of each record is based on the time period it happened

person	year	income	age	sex
1	2018	50	27	M
1	2019	55	28	M
1	2020	60	29	M

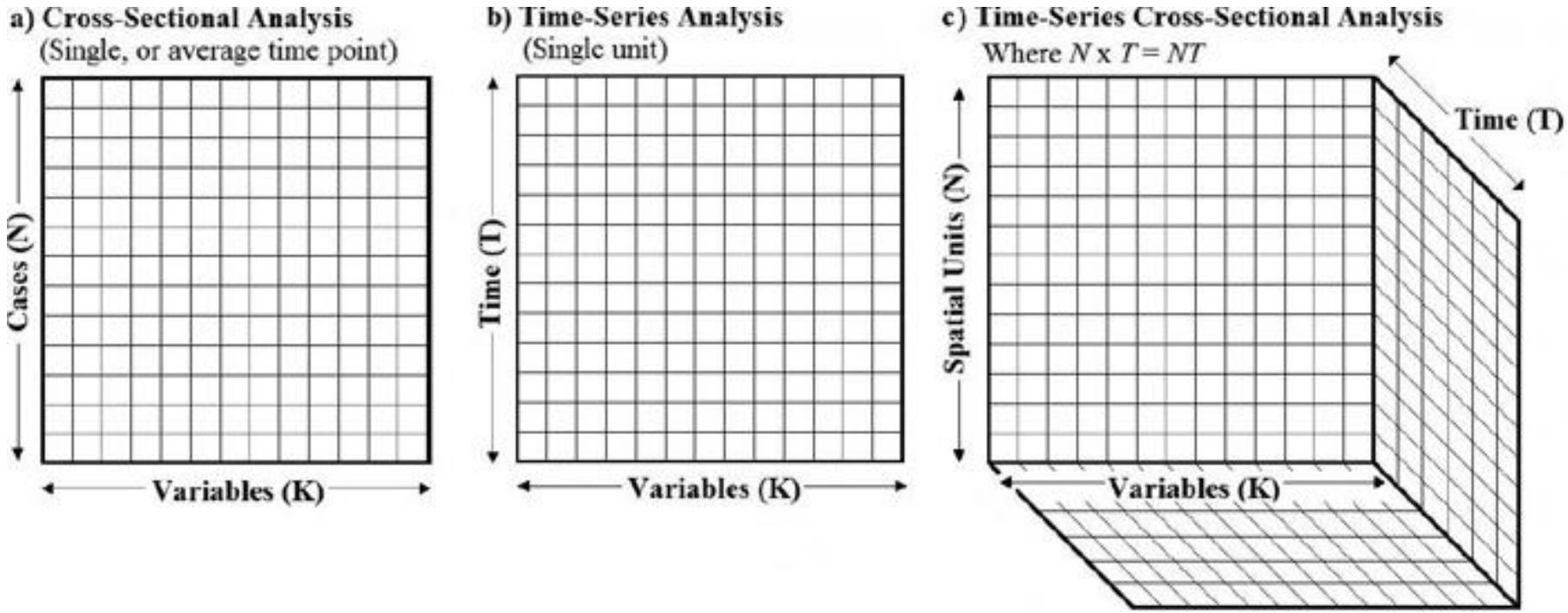
- Be careful with time series data:
  - Serial correlation, nonstationarity
  - Spurious correlation http://tylervigen.com/spurious-correlations
- Proper analysis may require knowledge of advanced methods: Vector Autoregressive models (VAR), GARCH etc.

3. Panel data

- Also called longitudinal data - data for multiple entities in which each entity is observed at two or more time periods.
- Panel data are **very useful for estimating causal effects**

person	year	income	age	sex
1	2018	50	27	M
1	2019	55	28	M
1	2020	60	29	M
2	2018	80	38	F
2	2019	85	39	F
2	2020	90	40	F

Statistical data types visualization



Summary - Research Project

- Great topic for future job interviews
- Writeup is like the empirical section of the final exam (i.e. show you've learned the material) but packaging matters (policy relevance)
- A topical research question has legs
- Econometric model should be anchored in economic theory (careful with data mining)
- Panel data better for estimating causal effects

TLDR

- **Find a good reference paper**
- **Start now!**

Next Steps

Next Steps

- Start thinking about your project - group sign-up due Feb 6

- Next week: Panel data analysis with R (may help with HW)
  - Install RStudio https://www.datacamp.com/community/tutorials/installing-R-windows-mac-ubuntu
  - Bring laptops (fully charged, few outlets in classroom)