Applied Micro-Econometrics,Fall 2023

Lecture 0: Introduction

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Introduction: A Scientific Framework of Rational Knowledge

Question #1: Student's Performance and Class Size

- A Classical Issue in Economics of Education: Is there a gap of students' performance between large-size classes and small-size classes?

- Turn it into an empirical or policy question:

  - What is the quantitative effect of reducing class size on student achievement?

  - Like by 5 student per class? or 10?

Question #2: Discrimination in Employment

- Discrimination is the situation where people who are presumed to be *equally productive or have equally productive capacity*, get treated differently by the market.

- Because of their gender, their religion, sexual orientation or the color of their skin, whatever even though these characteristics are irrelevant for the purpose being considered.

  - Racial Discrimination for housing loans.

  - Gender Discrimination in labor market

  - Hukou Discrimination in China

- To see if there is a difference in the probability of being denied for otherwise identical applicants and, if so, whether this difference is large or small.

Question #3: Cigarette Taxes and Smoking

- A major public health concern worldwide.

  - medical expenses of caring for those made sick by smoking.

  - nonsmokers breathe secondhand cigarette smoke.

- Basic economics says: cigarette prices go up, consumption will go down.

- But by how much? If the sales price goes up by 1%, by what percentage will the quantity of cigarettes sold decrease?

- The percentage change in the quantity demanded resulting from a 1% increase in price is the price elasticity of demand.

- The economic theory can never provide the numerical value.

Question #4: How Will Stock Market Head?

Prediction of the Google Stock Price using the Prophet
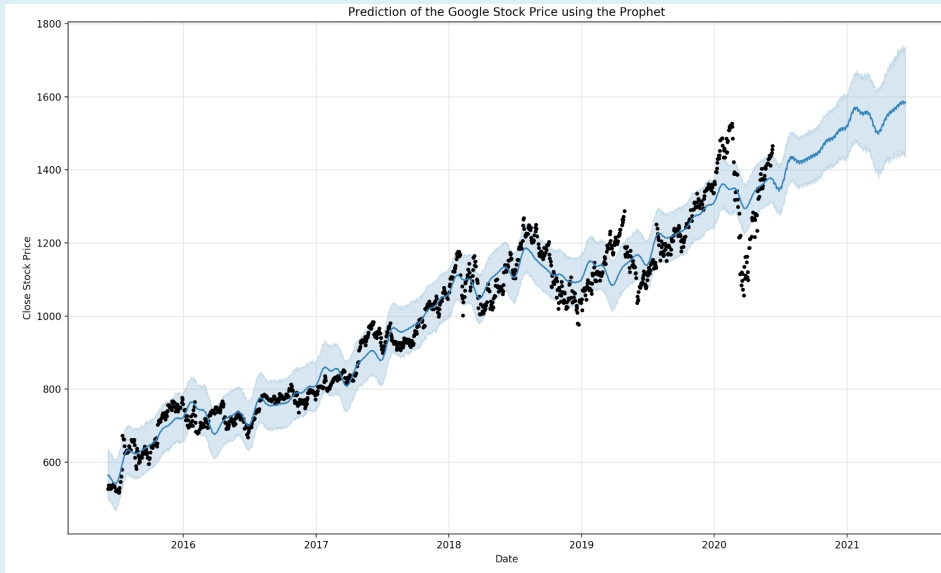
- It seems that people always want a sneak preview of the future.

  - What will sales be next year at a firm that is considering investing in new equipment?

  - Will the stock market go up next month, and, if it does, by how much?

Questions need both quantity and quality answers

- **Other Similar Questions**:

    - Air pollution and Health?

    - Credit regulation on housing price

    - Coupon on products sales

    - Trade War...

    - Pandemic...

- Living in an unprecedentedly complex and dynamic world, we need to make decisions by

    - **Rational cognition**(理性认知)
    - **Scientific predicition**(科学预测)

A Scientific Framework for Rational Cognition

How to obtain rational knowledge(judgment)?

- Anecdotes(轶事）or Intuition(直觉)

- Theory(理论/逻辑推理）

  - Systematical methodology: Hypothesis, Logical deduction...
    致癌物

- Empirical evidence（经验证据）

  - statistical inference from data.

An Example: Smoke and Mortality

- Anecdotes(轶事）or Intuition(直觉）

  - eg. "My grandmother smoked two packs a day and lived until she was 95 years old."

- Theory

  - Because Cigarettes contain carcinogens(致癌物) such as nicotine, tar, and formaldehyde(尼古丁、焦油、甲醛等), then...

- Empirics

  - Collecting data through experiments or surveys, and then use statistical or econometrical methods to verify whether and how cigarettes can harm our health.

Classical Question: Human Capital v.s Signal

- A common phenomenon in labor markets can be observed across countries.

  ○ Higher education, Better pay!

- Two classical theories to explain

  ○ **Human Capital**: Education improves work productivity.

  ○ **Signal**: Education does not increase the productivity. It simply serves as a signal of the individuals' innate ability.

- **Question**: which one is right?

Public Policy: Minimum Wage and Unemployment

Minimum wage on a classical market
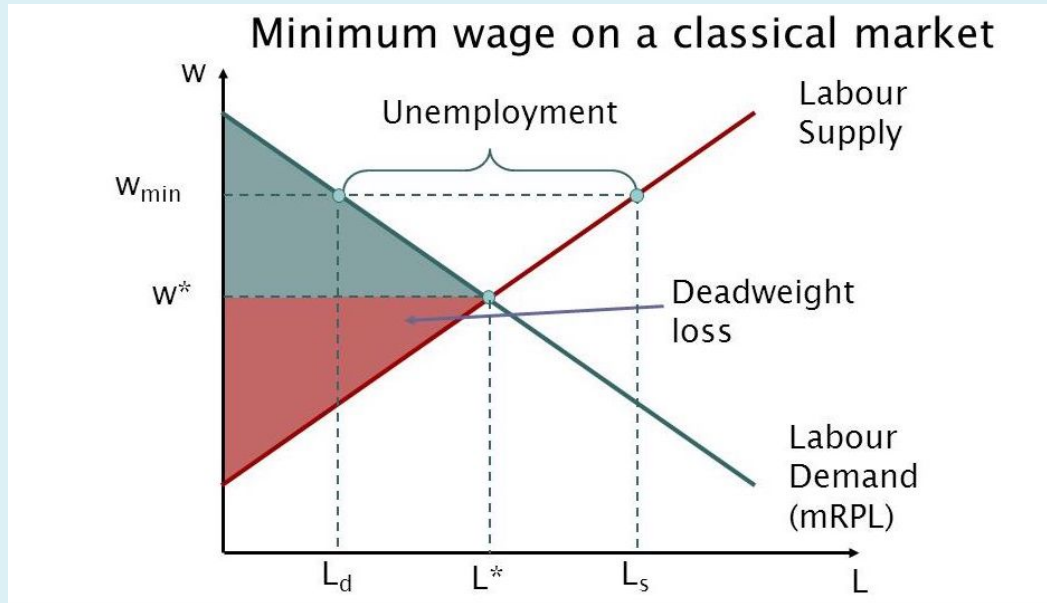
- The classical supply-demand model tell us that
  - Minimum wage will definately increase unemployment.
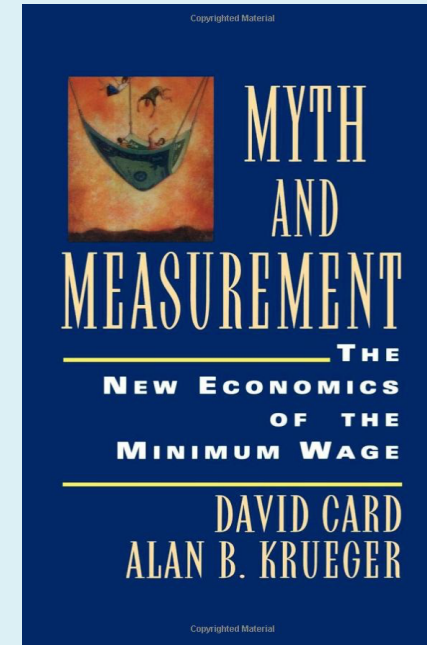
- One famous empirical evidence challenged the theory by David Card and Alan Krueger(1994)

- They found that increases in the minimum wage do **NOT** lead to job losses.

A Scientific Workflow to Analyzing

- By **Intuition**: Propose meaningful or interesting questions(It does matter or we care about)

- By **Theory**: Obtain a preliminary conclusion or proposal an hypothesis

- By **Empirics**: use data and quantitative methods to test your theory or conclusion.
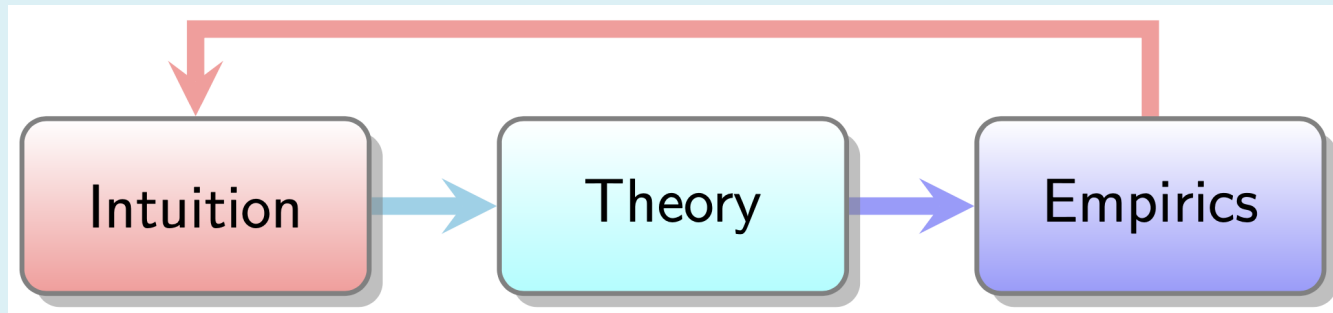
- Once we have a theory (or cause) which has been testified by empirical works, then we can manipulate the cause to obtain the effect.

Quantitative Answers to Quantitative Questions

- Many decisions in economics, business and government hinge on understanding the relationship among variables in the world around us.

  - Economic and manage theories may provide clues about the direction of the answer.

  - But making decisions require quantitative answers to quantitative questions.

- Therefore, we have develop a framework and find a practical method that provide

  - a numerical answer to the question

  - a measure of how precise the answer is.

- It is the job of **Econometrics** and **Machine Learning**

Introduction to Econometrics

Econometrics: A little bit history

- The term is attributed to

    - **Ragnar Frisch(1895-1973)**: 1969 Nobel Prize co-winner（the first year for Economics)

- Although the term coins by a combination of economics and metrology, it is special enough in social science and science at that time.

"Econometrics is by no means the same as **economic statistics**. Nor is it identical with what we call general **economic theory**, although a considerable portion of this theory has a definitely quantitative character. Nor should econometrics be taken as synonymous with the application of **mathematics** to economics. Experience has shown that each of these three view-points, that of statistics, economic theory, and mathematics, is a necessary, but not by itself a sufficient, condition for a real understanding of the quantitative relations in modern economic life. It is the unification of all three that is powerful. And **it is this unification that constitutes econometrics**". in *Econometrica*, 1933, volume 1, pages1-2.

Econometrics: A little bit history
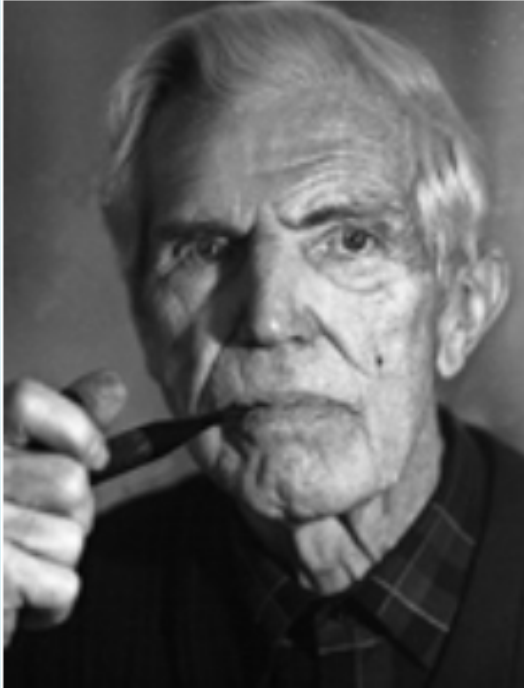
> "The method of econometric research aims, essentially, at a conjunction of **economic theory** and **actual measurements**, using the theory and technique of **statistical inference** as a bridge pier.". in *Econometrica*, 1944, volume 12, pages1-2.

- **Trygve Haavelmo(1911-1999)**

- 1989 Nobel Prize winner

Econometrics: A little bit history

James Stock(Havard)

Mark Watson(Princeton)

"Ask a half dozen econometricians what econometrics is—you could get a half dozen different answers.At a broad level, it is a science and art of using economic theory and statistical techniques to analyze economic data.", *Introduction to Econometrics,*4th edition.

Econometrics: A little bit history

- **My Own View**

  > "In general, a series of **scientific methods** to searching for economic logic from data.It could include two broad jobs

- Making a **causal inference**

  - Testing economic theories.

  - Estimating causal effects.

  - Policy evaluation.

- More and more prevalence in

  - other social science such as political science, sociology, law and education studies etc

  - and business practice, like the hottest one: Data Science.

- **Predicting and Forecasting**

  - 'Causal' prediction
  - Forecasting for future outcomes

Econometrics,Big Data and Social Science

- Social science(firstly started by Economics) has experienced two methodological **revolutions** over the past few decades. Econometrics has been playing a critical role for revolutions.

- **Credibility revolution**

  - A movement that emphasizes the goal of obtaining secure causal inferences(Angrist and Pischke, 2010)

  The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2021

  © Nobel Prize Outreach. Photo: Paul Kennedy
  © Nobel Prize Outreach. Photo: Risdon Photography
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- **Big Data revolution**

  - A movement that emphasizes that how our increasing ability to produce, collect, store and analyze vast amounts of data is going to transform our understanding of the human affairs. (Schonberger, 2013)

  Viktor Mayer-Schönberger is the OII's Professor of Internet Governance and Regulation. His research focuses on the role of information in a networked economy.

Econometrics,Big Data and Social Science

- There are many labels for what we do...

    - Econometrics

    - Statistics

    - Data Mining/Big Data/Data Science

    - Machine Learning(ML)

    - Artificial Intelligence(AI)

- Along this spectrum, you move from heavy focus on what things you are measuring (what real phenomena they correspond to) to a more practical **useful is true** pattern discovery approach.

- The **similarities** are much bigger than any distinctions.

Why and Who should take the course?

Why Econometrics is so important?

- Several Common Questions about Econometrics?

    - Why we should study econometrics?

    - How is studying econometrics helpful in understanding social science?

    - Especially, can one excel in the economics without learning econometrics?

- The answer to the last question is simple.

    - NO! because one hardly to learn modern economics without the knowledge of econometrics.

- Econometrics is one of three core courses required in almost every economics department worldwide.

Why Econometrics is so important? Sub-fields

- **Theoretical Econometrics**

    ◦ It is concerned with methods, both their properties and developing new ones.

    ◦ It is closely related to mathematical statistics, and it states assumptions of a particular method, its properties etc.

    ◦ We could call theoretical econometricians as the **producer** of econometrics.

- **Applied Econometrics**

    ◦ More orientated to applied work, such as choice of technique and interpretation of research finding.

    ◦ But it should be also based on a solid conceptual foundation and some practical experiences plus a little bit skills of computer.

    ◦ Most of us are the **consumers** of econometrics.

- It is so overwhelming in all applied field today such as Labor, Development, Industrial, Public and International Trade, etc.
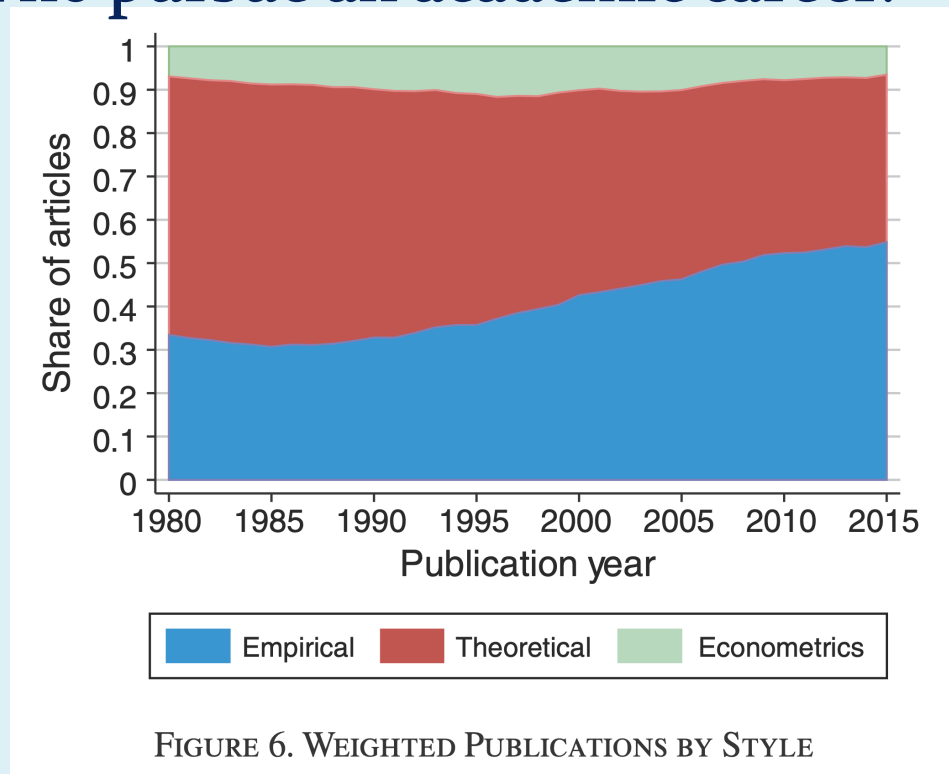
Why take the course?
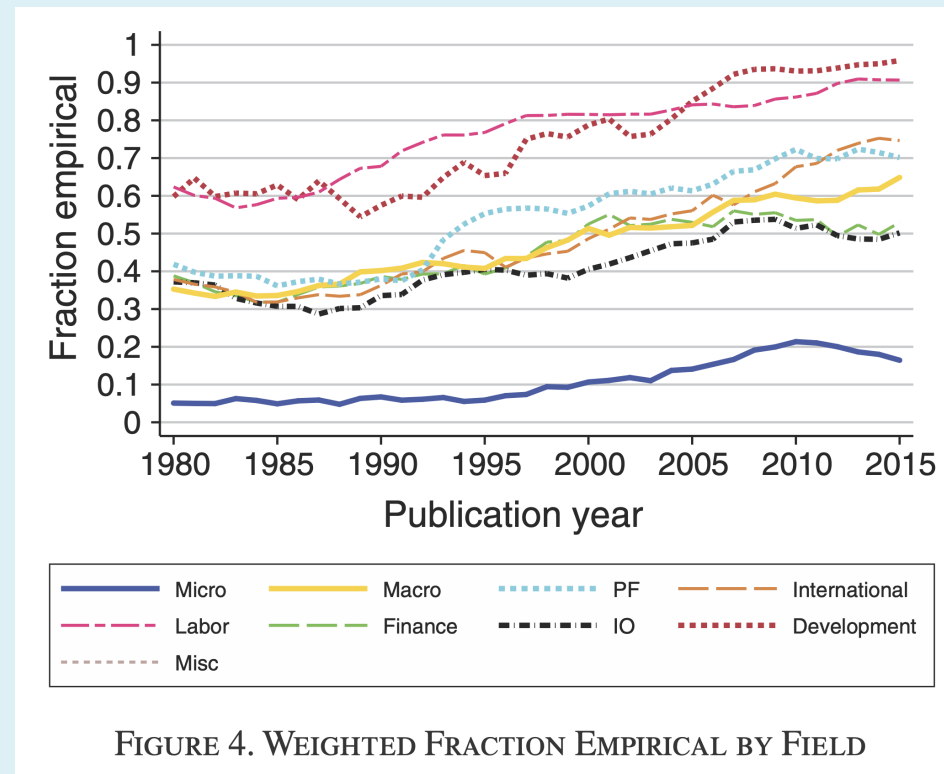
The Purpose of the course

- To **build a bridge** from learning courses to doing research

    - Inquire about some basic instruments and some latest development in the empiricist's toolbox.

    - Read classical papers to develop a good understanding(or taste) and identify potential research topics.

    - Utilize the knowledge and skills you have acquired to propose your own research topics.

- Help yourself enjoy to learn some new ideas in an empiricist's mindset

Why take the course?

Who pursue an academic career:

FIGURE 6. WEIGHTED PUBLICATIONS BY STYLE

Angrist et al(2017)

FIGURE 4. WEIGHTED FRACTION EMPIRICAL BY FIELD

Angrist et al(2017)

- The proportion of empirical studies in Economics is increasing more and more.

Why take the course?

Who enter industry job market

- Who want to work in industry: mastering econometrics may help you **get a good job!**

- A lot of internet giants even hire economists to lead their special R&D department. Such as

  - Google,Microsoft,eBay,Baidu,Alibaba,Tencent,Tiktok

- **Data Scientist** is the hottest job in consulting, business areas as well as financial industry right now.

Who enter industry job market: Apple Job Wanted

Economist/Core Data Scientist
Apple · Beijing, Beijing, China

Apply ↗   Save   ...

Key Qualifications

Strong background in statistics or econometrics, regression analysis, causal inference, time series analysis, GLM, logistic regression, probability theory, regularization, interest in machine learning algorithms

Develop internal visualization and modeling tools to facilitate data-driven decisions

Present results and other analytical findings to business partners

Strong statistical background and experience with causal inference, time series analysis (e.g. ARIMA, exponential smoothing, time series regression methods etc.), forecasting, and data analysis

Experienced R/Python programmer also proficient in other languages important to the ETL data pipeline (e.g. SQL)

Experience with data visualization packages (e.g. ggplot2, plotly) and advancing multiple projects at once on a tight schedule

Ability to share results with a non-technical audience

Experience in bayesian statistics and modeling (e.g. bayesian structural time series, dynamic linear models)

Advocate and practitioner of version control and reproducible code

Excellent verbal and written communication skills, in both Mandarin Chinese and English

Description

• Work with various teams to understand business problems and provide business solutions

• Build models to causal impact of new programs release across different scenarios

• Develop internal visualization and modeling to facilitate data-driven decisions

• Present results and other analytical findings to business partners

Education & Experience

• PhD in Economics or related fields

• M.S. in related field with 5+ years experience applying econometric models to business problems.

Why take the course?

Who find a job in public sectors(shang'an movement)

- To be honest with you, the course does not help you succeed in the examination.

- However, in the long run, it provides valuable knowledge and skills that offers a broader understanding of the subject matter and enhances your critical thinking abilities.

- It benefits your career, as well as our people, our country, and the world.
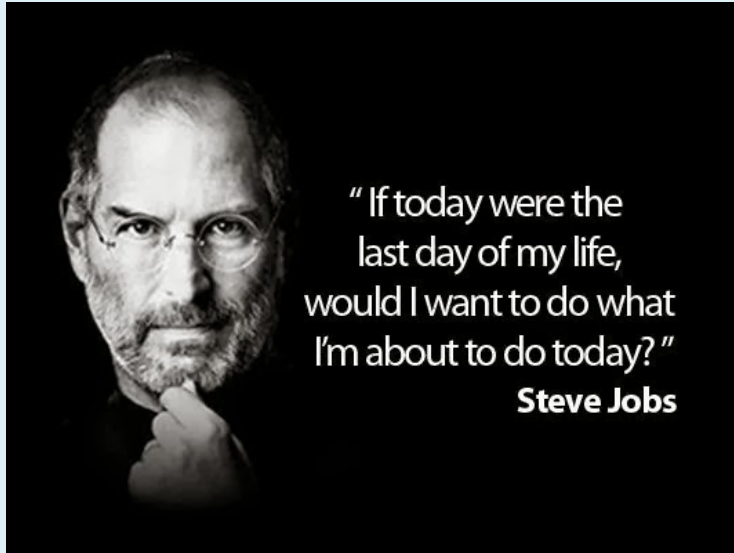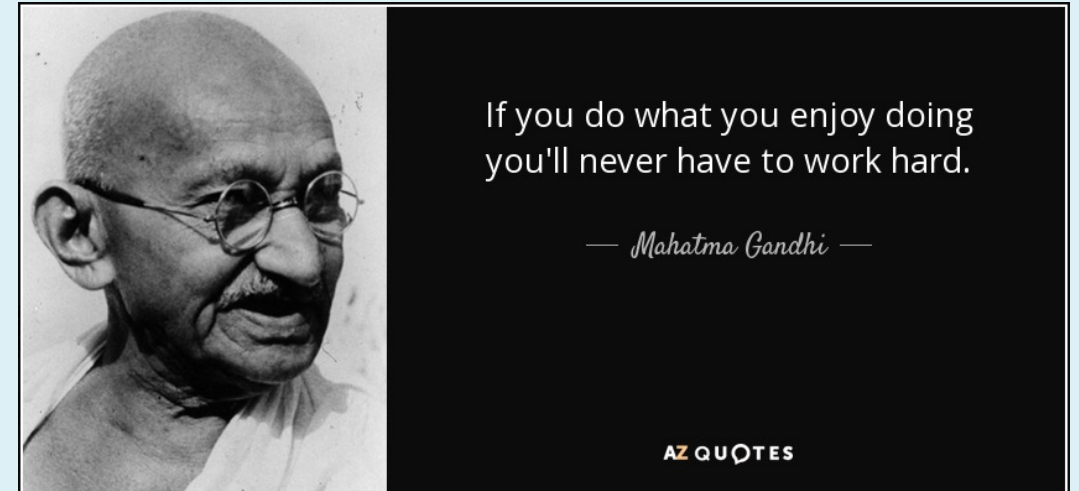
Why take the course?

Who look for fun

- The course cannot be a boring and demanding variant of a mathematics course, but an interesting and enjoyable class.

- Help yourself enjoy life by adopting an empiricist's mindset in your daily activities.

  - have novel ideas or new perspectives about our world.

  - Econometrics is kind of a bible or philosophy of empirical economists.

- covering several interesting and insightful stories like

  - Eg. Crime and Abortion in *Freakonomics* written by Steven Levitt.

  - Eg. What is the value to be the president's son(or daughter)? in *Economic Gangster* written by Raymond Fisman and Edward Miguel.

Whoever and Whatever

Whoever you would like to be or whatever you want

"If today were the last day of my life, would I want to do what I'm about to do today?"
Steve Jobs

If you do what you enjoy doing you'll never have to work hard.

— Mahatma Gandhi —

AZ QUOTES

- Every choice you make has an opportunity cost,try your best to make a wise one.

- Enjoy doing something seriously and cultivate a special quality for yourself!

Hard and Soft Skills

You COULD learn or improve several important skills during your graduate studies.

- Hard Skills

  - **Language**

  - **Computer**

  - **Presentation and Writing**

- Soft Skills

  - **Critical Thinking**

  - **Teamwork**

- Fortunately, you could learn/practice almost all above skills in our class.

Wrap up

- In a word, Applied Econometrics is a very important and interesting, but also a "hardcore" course.,

  - **Please think over before your take it!**

  - **Once you take it, please work hard on it!**

  - **And please enjoy working hard on it!**

Logistics to the Course

About Me

- My name is Zhaopeng Qu(曲兆鹏)

  - Position and Affiliation: Associate Professor, Institute of Population Studies, Business School.

  - Research Fields: Labor Economics and Applied Econometrics

  - Office: Room 2017, Anzhong Building

  - Tel: 83621349; Email: qu@nju.edu.cn

- **Our Course Website**: https://byelenin.github.io/MicroEconometrics/

Prerequisite

- Basic knowledge of statistics or econometrics

- Better to take a one-term course in statistics or econometrics.

- At least, comfortable with some basic concepts of probability theory and statistics, such as

    - Random variable,expectation, variance and covariance

    - Probability density function, p.d.f. and cumulative distribution function, c.d.f

    - L.L.N and C.L.T

    - OLS and other Estimators

    - Unbiased and Consistent

    - Asymptotic Normality

    - Interval estimation and hypothesis test

Main Content

- Introduction to Causal inference

    ○ Potential Outcomes and DAGs

- Review of OLS regression

    ○ Simple and Multiple OLS

- Discrete Choice and Limited Dependent variable

    ○ Multinomial choices
    ○ Sample selection

- Decomposition

    ○ Mean
    ○ Distributional

- Instrumental variable

- Regression Discontinuity

- Panel Data:

   ○ Fixed effects, DID and Event Study..

Textbooks
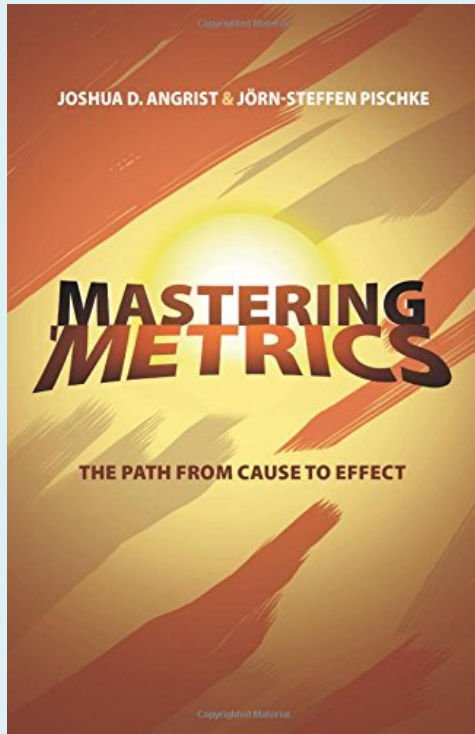
- Joshua D. Angrist & Jorn-Steffen Pischke, (2014). Mastering 'metrics: The Path from Cause to Effect. Princeton University Press. （中译本：《精通计量：从原因到结果的探寻之路》，格致出版社，2018）

Textbooks
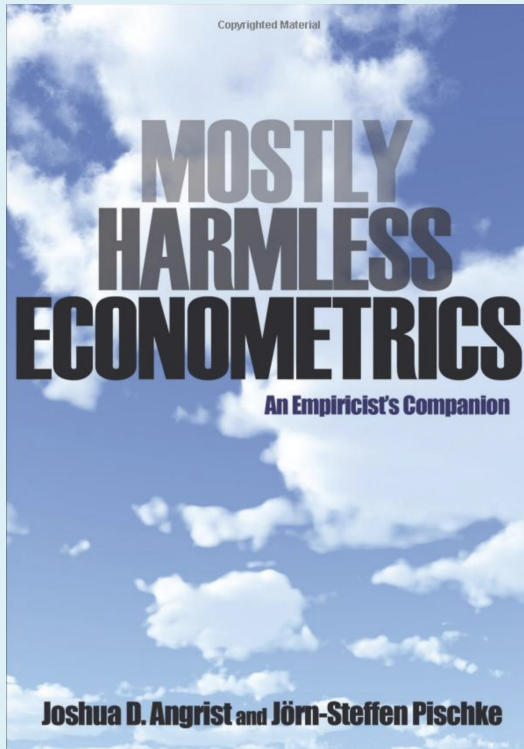
- Joshua D. Angrist & Jorn-Steffen Pischke, (2009). Mostly Harmless Econometrics: An Empiricist's Companion. Princeton University Press. （中译本：《基本无害的计量经济学》，格致出版社，2018）

Textbooks
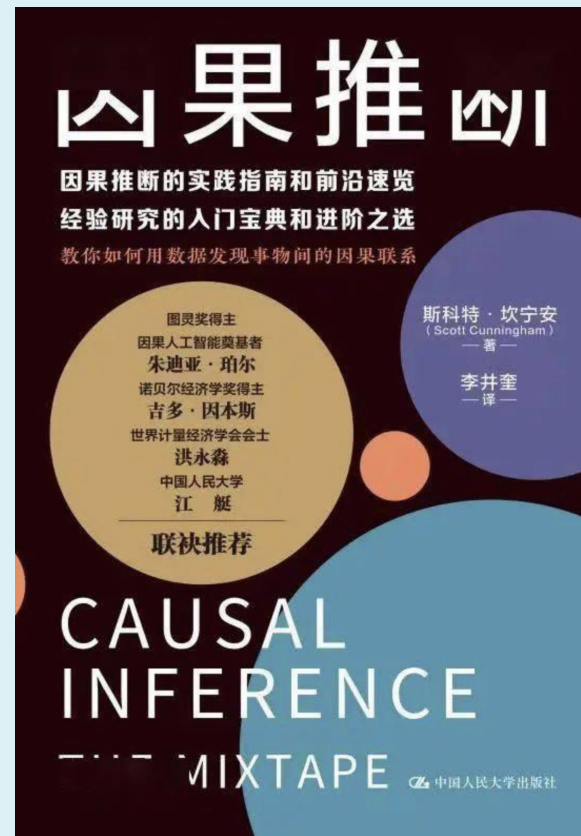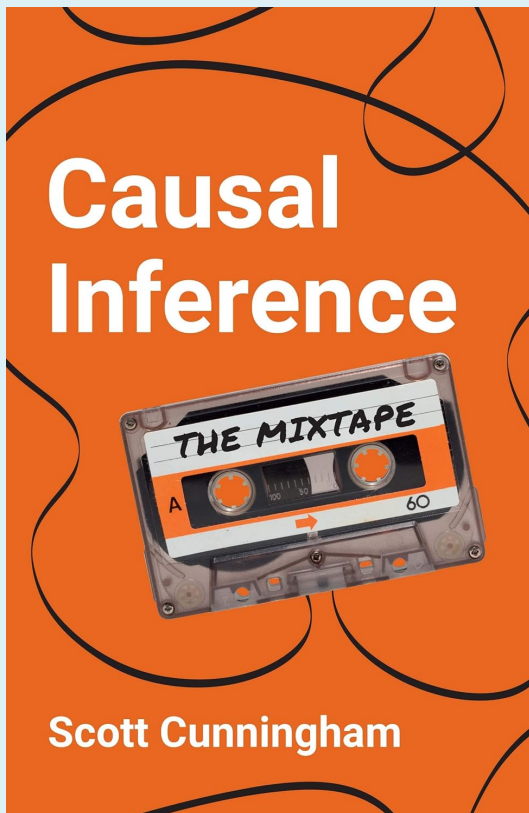
- Scott Cunningham, (2021). Causal Inference: The Mixtape. Yale University Press.（中译本：《因果推断》，中国人民大学出版社，2022）

Interesting Books for Reading

- Steven D. Levitt and Stephen J. Dubner, SuperFreakonomics: Global Cooling, Patriotic Prostitutes, and Why Suicide Bombers Should Buy Life Insurance, 2009.（中译本，《超爆魔鬼经济学》，斯蒂夫•列维特、斯蒂芬•都伯纳著，中信出版社，2010年1月。）

- Ian Ayres, Super Crunchers: Why Thinking-By-Numbers is the New Way To Be Smart, 2007. (中译本《超级数字天才》，伊恩•艾瑞斯著，中国青年出版社，2008年1月。)

- Raymond Fisman & Edward Miguel, Economic Gangsters: Corruption, Violence, and the Poverty of Nations, 2010.(中译本:《经济黑帮：腐败、暴力的经济学》，中信出版社。）

- Abhijit V. Banerjee & Esther Duflo, Poor Economics A Radical Rethinking of the Way to Fight Global Poverty, 2011.(中译本:《贫穷的本质：我们为什么摆脱不了贫穷》，中信出版社。）

- Angus Deaton, The Great Escape:Health,Wealth,and the Origins of Inequality,2015.(中译本:《逃离不平等:健康、财富及不平等的起源》，中信出版社。）

Computing Tools

- The main computing tools used in the course are Stata and R, optionally.

Stata

- Pro

- Con

R

- Pro

- Con

The Procedure

- The First Part-Lecture

  - Introduce the underlying theoretical problems briefly and focus on the empirical strategy heavily.

  - Focus on some specific examples in classical papers with interesting topics in our field.

- The Second Part: Presentation(may skipped,it depends)

  - Read some classical papers publised in top journals.

  - Every lecture we will discuss 1-2 papers.

- The Third Part: Your Own Research

  - A Research Proposal: in mid term

  - And Preliminary Results: in the end

  - Goal: A decent term paper

- Last but not least: Presentation Structure

  - Motivation

  - Literature

  - Empirical Strategy

  - Data

  - Results

The Schdual

Week	Topic	Date
3	[Lecture 0: Introduction]	9/20
4	[Lecture 1: Causal Inference in Social Science]	9/27
6	[Lecture 2: Regression Review]	10/11
7	[Lecture 3: Regression Review]	10/18
8	[Lecture 4: Decomposition]	10/25
9	*Student Presentation for Research Proposal*	11/1
10	[Lecture 5: IV and Extensions]	11/8
11	[Lecture 6: RDD and Extension]	11/15
12	[Lecture 7: Fixed Effects,DID and SCM]	11/22
13	*Student Presentation for Preliminary Results*	11/29

How to learn

- Read required and related materials before lecture.

- Get well-prepared for the presentation before the class.

- Discuss with your classmates often.

- Make good friends with data and software like Stata or R

Promise and Expectation

What I promise to offer you

- Prepare lectures as well as possible.

- One to one interaction on topics covered in the course, especially for your own topics.

- Help you start to using Stata or R to analyze some popular data sets in China.

- **A good score?**

  - **It depends on you**.

What I expect to you

- Class participation with a little bit aggressive attitude.

  - More questions, more scores!

- Self-motived learn by doing.

- Willing to apply the knowledge in practice.

Two Iron Rules

- **Don't ever cheat on your assignments!**

- **Don't ever snitch your teachers to help political repression!**

Evaluation

- Class Participation(10%)

- Midterm: A Proposal and Presentation (50%)

- Final: Preliminary Results (30%)

- Final: Draft(10%)

Welcome contact me