Notes on Empirical Methods in Business
Lecture 1: Introduction and Research Classification

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1 Introduction

During the first year of my PhD, I have taken a course on Empirical Methods in Business: Modeling and Estimation taught by Prof. Tat Chan from WUSTL. This course is designed to provide students with a comprehensive understanding of the most commonly used empirical methods in business research. The main topics of the course can be seen in section 3. I mainly used handwritten notes when I was taking the lectures, which is hard to formalize. As a PhD researcher specializing in empirical studies, it is necessary to have a clear understanding of common empirical methods. Therefore, I review the course content and summarize it in a more formal way to help others who are interested in empirical methods in business research.

Worth to mention that, my notes are mainly based on what prof. Tat Chan's lecture notes, **but all the faults in the notes are mine**. I will try my best to make it accurate and clear. If you find any mistakes or have any suggestions, please feel free to contact me.

2 Research Classification

Traditional classifications in empirical research:

- Controlled data: Lab, AFE, FFE

  - Field experiment: AFE (artefactual field experiment), FFE (framed field experiment)
  - Lab experiment

- Naturally occurring / observational data

  - Natural experiment: NE, NFE (natural field experiment[1])
  - Market data: IV, PSM, STR (Structural modeling)

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[1] Field experiment that happens naturally, and people do not realize the experiment they are in.

Identify the <u>causal treatment effects</u> has been the main focus of empirical research in business.

- The golden rule for identification: **Randomization of treatment status**.

  - $y_i = \alpha + \gamma T_i + \epsilon_i$, where T_i is the treatment status.
  - Randomization makes $E(\epsilon_i | T_i = 0) = E(\epsilon_i | T_i = 1)$
  - Thus, γ can identify the causal effect of treatment.

- No endogenous issues:

  - People cannot quit or switch the groups;
  - No spillover effect:
    - ▷ Across sides: two-sided platform, sellers and buyers switch – no reverse causality;
    - ▷ Across groups in one side: individuals in each group do not aware they are treated or controlled. i.e., no information spillovers.

Market data cannot be randomized, so we need to use other methods to identify the causal effect of treatment:

- Statistical methods: Approximating the experiments: e.g., DiD

- Econometric methods:

  - Control methods
  - Instrument variables
  - Structural models

Many researchers focus more on fancy methods, ignoring the data and assumptions, making the story less reliable. Questions need to think before digging into the research:

- What is the data? Can it help identify the causal effects?

- What are the identification assumptions? Are they reasonable?

4 key components in empirical research:

- **Research Questions**

  - Why are your research questions important?
  - What is the use for business/consumers/regulators?
  - What is your contribution to the literature?

- **Data**

  - Can your data help address your research questions?

- **Model**

  - What is Y? What are your X's?

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- What is the relationship between Y and X's?
- What is the data generating process (DGP)?
- How does your model address your research questions?

- **Estimation**

  - OLS / NLS? MLE? Method of moments? Other more advanced methods?
  - What is the identification of model parameters?

In the main content of this note, I will focus more on modeling and estimation part. Given the research question and data, how to build up the model, what are potential issues of the model, and how to estimate the parameters are the interests.

3 Main Methods Covered

- Issues in Regressions

  - Specification
  - Multicollinearity
  - Heteroskedasticity
  - Endogenity

- Endogenity Solutions

  - Instrument Variables
  - Panel Data with Fixed Effects

- Treatment Effect and Causal Inference

  - Introduction Treatment Effects
  - Causal Inference Methods
    ▷ Matching
    ▷ Propensity Score Matching
    ▷ Inverse Probability Weighting
    ▷ Difference-in-Differences
    ▷ Synthetic Control
    ▷ Synthetic Difference-in-Differences
    ▷ Regression Discontinuity

- Choice Model

  - Binary Choice Model
  - Multinomial Choice - Ordered
  - Multinomial Choice - Non-Ordered
  - Nested Logit Model

- Others

- Selection Model
  - Tobit Model
  - Others