Empirical Methods in Business: Modeling and Estimation – Lecture 1 Research Classification

Hang XU

Introduction to Experiments

Field Experiment

- Field Experiment and Natural Experiment
- Control Variables: Price, Sales

Identifying Causal Effects

Necessary Conditions for Experiments

- Golden Rule: Randomization of Treatment Status
  - Everyone has the same probability to be treated or controlled
- No endogenous attrition or selection issue
- No spillover effects across groups

Statistical Methods for Inferring Causality

Data Considerations

- Data cannot be randomized
- Econometric Methods: Fixed Effects, Instrumental Variables
- Importance of identifying assumptions and verifying their reasonableness

Research Questions and Data

1. Research Questions: Why is it important?
2. Data: Can the data help address the research questions?
3. Model: Data generating process (relationship between Y and X)
4. Estimation: Methods for identification

Empirical Analysis

Linear Regression Model

- Model: $Y = X\beta + \epsilon$
- Ordinary Least Squares (OLS) Estimator
  - $\hat{\beta} = (X'X)^{-1}X'Y$
  - Conditions: No perfect multicollinearity, errors have zero mean

Complementarity and Substitutability

- Complementarity: Implementation of one practice increases the marginal return to other practices
- Substitutability: Implementation of one practice decreases the marginal return to other practices

Example: Olympic Games Analysis

Research Question

- How do population and GDP per capita affect the number of medals won by a country?

Model Specification

- Model 1: $\text{Medals}_i = \beta_0 + \beta_1 \text{Population}_i + \beta_2 \text{GDP per capita}_i + \epsilon_i$
  - Control for competition level and other factors
- Model 2: $\text{Medals}_i = \beta_0 + \beta_1 \text{Population}_i + \beta_2 \text{GDP per capita}_i + \beta_3 (\text{Competition})_i + \epsilon_i$

Mixed Effects Model

- Captures the total effect of competition
- Example: $T_i = \alpha + \beta_1 \text{Population}_i + \beta_2 \text{GDP per capita}_i + \epsilon_i$

Prediction and Model Validation

Predictions

- Example: Predict medals based on the model
- Use known values for Population and GDP per capita to estimate future medals

Equation Solving

- Solving the equation systems to get predictions

Conclusion

- Summary of key points
- Importance of considering assumptions in econometric models

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Appendices (if any)