

Methodology: Design, Procedure and Data Analysis

Joseph Tao-yi Wang

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Goals of This Lecture

- Overview of a Typical Experiment
- Answer Three Questions:
 - How good is my design?
 - How should an experiment be carried out?
 - How should I analyze my data?

3 Stages of Experimental Research

- Experimental Design
 - Before: What experiment should I run?
- Testing and Running an Experiment
 - During: How is the experiment carried out?
- Data Analysis
 - After: What does the data say?

Outline

- **Experimental Design:**
 - Goals; Control
- **Testing the Experiment:**
 - Programming the Experiment
 - Pre-testing: Pilot Studies and Simulation
- **Running the Experiment:**
 - Giving Instructions and Comprehension Tests
 - Post-Experimental Surveys
 - Handing out Payments
 - What if Something Unexpected Happens?

Outline

- **Data Analysis:**
 - Graphs
 - Summary Statistics
 - Regressions and other Basic Econometrics
 - Maximum Likelihood Estimations: QRE, Cognitive Hierarchy, level-k, EWA...
 - Out-of-Sample Prediction
 - Special Handling for Eyetracking and fMRI, etc.

Goals of Experiment Design

- **Test theory**
 - Falsify or choose between competing theories
- **Key: What is the simplest example of this theory?**
- **Replicate the field**
 - Can serve as future policy test-beds
- **Key: What is the key feature of the field situation?**
- Other goals:
 - **Exploratory:** just to see what happens
 - **Teaching:** give students hands-on experience

Goals of Experiment Design

- **What is the goal of LUPI's lab experiment?**
 - Replicate the field situation
 - Test the Poisson Nash Equilibrium prediction
- **What design choices did they make?**
 - Scale down exactly by 2000 (but 99999→99)
 - Explicitly randomize for participation
 - Simulate a Poisson distribution
 - Show only winning number
- **Which choice was for which goal?**

Controls in Experimental Design

- Neutral Language and Anonymity
 - Benchmark focusing on incentive structure
- Monetary Payment
 - People like to earn money and don't mind more
- Written Instructions
 - Public Knowledge (~Common Knowledge)
- Experimental Screen Display
 - Does top-down or left-right affect the results?

Controls in Experimental Design

- Recruiting Protocol: Any selection bias?
 - Don't want students who were taught to do X
 - Do we get the same people at different times?
 - Does ethnicity or university culture matter?
- Can we measure or assume the parameter?
 - Measure, Control or Assume...
- **Key: A good design makes treatment and control groups almost identical except "X"...**

Programming the Experiment

- Programming the Experiment:
 - Run by hand or using computer software?
- Common experimental software:
 - z-Tree: "Zurich Toolbox for Ready-made Economic Experiments"
 - j-Market: for complicated market experiments
 - j-Auction: for combinatorial auctions
 - PTB3: Matlab's Psychophysics Toolbox
 - Write your own software?

Pre-Testing: Pilot Studies

- Does a design work or not? Run it and see
 - First on fellow classmates (unpaid/paid)
 - Then on real subjects
- Pilots tell you a lot about design flaws
 - Does the program work as planned? Crashed?
 - Ask subjects "what is your strategy?" ex post
- Pilot data are NOT used in formal analysis
 - They are pre-committed "pilots"

Pre-Testing: Simulations

- Simulate Pseudo Data and Analyze Them
 - Similar procedures could be used later to
 - Generate bootstrap standard errors
 - Perform out-of-sample predictions
 - Check robustness of the econometric method
- **Will you test fail pseudo data generated by the exact given theory?**
- **Will your estimation procedure uncover the true data-generating process you used?**

Running the Experiment

- Overview of a Typical Session
 - Subjects Sign In
 - Read out Instruction
 - Ask for and Answer Questions
 - Quiz for Comprehension (if applicable)
 - Practice Rounds (not paid)
 - Real Rounds (paid)
 - Post-Experiment Survey
 - Handing Out Payments

Running the Experiment

- Read Written Instructions: Neutral, Public Knowledge
- Quiz: Test if subjects understand structure, etc.
- Post-Experimental Surveys
 - Collect demographics
 - Free Question: "What is your strategy?"
- Handing out Payments
 - Private Payments
 - Record Sheets and Administrative Records
- What if Something Unexpected Happens?

Running the Experiment

- What does the instructions of LUPI look like?
 - Are they "neutral"? Why or why not?
- What did experimenters ask after LUPI?
 - What demographics did they collect?
 - What were subjects' strategies?
- How were these data used in the analysis?

Data Analysis: Reduced Forms

- Graphs: How can you visualize the data?
- Summary Statistics
 - Averages, Median, STD, etc.
 - t-test, χ^2 test, etc.
 - Signed rank-sum test (non-parametric t-test)
- Regressions and other Basic Econometrics
 - OLS, Random Effects
 - Logit Regressions

Data Analysis: Structural Estimation

- Maximum Likelihood Estimations
 - For each parameter
 - Calculate Likelihood of seeing data
 - Find the parameter that maximizes this likelihood
- Logit-QRE: best λ (better response precision)
- Cognitive Hierarchy: best τ (aver. cog. level)
- Level-k: best "spike-logit" λ & ε (exact hits)
- EWA: best set of learning parameters

Data Analysis: Structural Estimation

- Out-of-Sample Predictions
 - Use 2/3 of the data to estimate data (MLE, etc.)
 - Obtain (MLE) parameters of the model
 - Use the estimated model to predict hold-out data
 - Prediction power: avoid overfitting
- Special Handling:
 - Eyetracking: DataViewer, Time Series, and Markov Switching
 - fMRI: E-prime, Matlab's SPM2

Data Analysis: LUPI

- What graphs did LUPI use?
- What summary statistics did LUPI use?
- Any regressions?
- How did they run MLE for QRE and Cognitive Hierarchy?
- Any out-of-sample prediction or simulation?
- Can you think of any other way they could have analyzed the data?

Conclusion

- Overview of an Experiment
 - Design, Procedure, and Data Analysis
- How good is your design?
 - What are your goals? Are they fulfilled?
- How should an experiment be carried out?
 - SOP
- How should I analyze my data?
 - Employ all state-of-the-art econometrics!
 - Create new “Experimetrics”!