

Basic Principles of Experimental Design

經濟學實驗設計原理

Joseph Tao-yi Wang (王道一)
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Define Economic Experiment 定義經濟學實驗

- ▶ **An Economic Experiment**
- ▶ Constructs a **controlled environment** to
- ▶ observe how **people make economic decisions** under **real incentives**, to answer
- ▶ questions raised by the researcher, testing a hypothesis or which theory matches reality
- ▶ 建構一個控制的環境，在有真實誘因的情況下，觀察人們如何做決定（經濟決策），為要回答研究者所提出的問題，檢驗哪個假說或理論比較符合現實。

4 Components of Controlled Environments

- 經濟學實驗：建構一個控制的環境，在有真實誘因的情況下，觀察人們如何做決定（經濟決策），為要回答研究者所提出的問題，檢驗哪個假說或理論比較符合現實。

▶ 4 Components: (建構控制的環境有4個要素)

1. Real Incentives:

- ▶ Choices have real consequences (真實後果或誘因)

2. A Good Control Group

- ▶ (對照組的設計)

3. Random Assignment

- ▶ (隨機分組)

4. No deception

- ▶ (完全不欺騙受試者)

Principles of Experimental Design 實驗設計原理

1. Control, Measure, or Assume (控制, 測量或假設)
2. Instructions (實驗說明)
3. Anonymity (匿名性)
4. Matching Protocols & Reputation Building (配對方式與受試者信譽)
5. Incentives (金錢誘因)
6. Order Effects (不同實驗的先後次序)
7. Controlling Risk Tastes (控制風險偏好)
8. Within-Subject and Between-Subject Design (同一 vs. 不同受試者)
9. Experimentals (實驗計量)
10. No Deception (不欺騙受試者)

▶ Reference: BGT, A1.2

Control, Measure or Assume 控制/測量/假設

- ▶ **Control** (控制)
 - ▶ Taking an action to affect a variable's value (主動賦予該變因的參數值)
 - ▶ "Induced" value theory (賦予參數理論)
- ▶ **Measurement** (測量)
 - ▶ Measure the value of a variable (測量該變因的參數值)
 - ▶ Via various methods (see below) (用下頁所列不同方法)
- ▶ **Assumption** (假設)
 - ▶ Pseudo-control (直接假設該變因的參數值)
 - ▶ Accept a maintain hypothesis about the value of a variable

Control, Measure or Assume 控制/測量/假設

- ▶ **Methods of Measurement (測量方法):**
- ▶ Psychometric measures (surveys) (心理測驗/問卷)
- ▶ Risk-aversion measures (certainty equiv) (風險偏好)
- ▶ Probability judgments (scoring rules) (主觀機率判斷)
- ▶ Information acquisition (mouse/eye-tracking)
 - ▶ 資訊取得：滑鼠追蹤或眼球追蹤
- ▶ Psychophysiological measures (測量心理生理學上的反應)
 - ▶ fMRI (功能性磁振造影), GSR (皮膚電阻反應), PDR (瞳孔放大反應), EEG (頭皮腦電波), etc.

Instructions 實驗說明

- ▶ Tell subjects what they need to know (告知所需資訊)
- ▶ **Public Knowledge (公共知識):** (來自公開朗讀說明)
 - ▶ Established by reading instructions out loud
- ▶ How much to reveal? (要告訴受試者多少?)
 - ▶ Entire payoff structure (default) (完整告知報酬如何決定)
 - ▶ Since we're not sure what subjects would think about what they are not told (不知道他們會怎麼解讀未揭露的資訊)
- ▶ Withhold some information: Study how people/markets learn under limited information
 - ▶ (不告知某些資訊：用以研究人們或市場如何在有限資訊下學習探索)

Anonymity 匿名性

- ▶ Who's Who? Subject behavior can change knowing opponent's identity due to
 - 見面三分情? 受試者的行為會因為知道對方是誰而改變，因為
 - ▶ Appearance, gender, (長相外貌、性別)
 - ▶ Fear of retaliation, etc. (害怕被報復等等)
- ▶ Use the anonymity case as a benchmark
 - (因此，我們通常用匿名實驗來當作基準實驗)
 - ▶ Measure opponent characteristics (appearance) and compare to benchmark
 - 要研究這些變因時，可以測量對方特質(例如長相多好看)，同時把它們顯示給受試者看，然後把實驗結果和基準實驗作比較

Matching Protocol/Reputation 配對方式/信譽

- ▶ Random matching (random switch)
 - ▶ Empirically kills repeated game effects
 - ▶ 隨機配對：每回合重新洗牌，實證上可除去重複賽局效果
- ▶ Mean-matching (play with everyone)
 - ▶ 與所有人配對：每個決定都跟其他每個人各配對一次
- ▶ More strict matching protocols: (更嚴格配對方式)
- ▶ Non-repeat matching (meet only once)
 - ▶ 不重複配對：整個實驗中只跟每個對手配對一次，所需實驗參與者人數的魔術數字是2的n次方，因為能做 $2^n - 1$ 回合不重複配對
- ▶ Non-contagion matching (no chain-of-influence)
 - ▶ 不污染配對：整場沒有「我跟你配、你再跟他配，最後我遇到他」的情形

Incentives 真實誘因

- ▶ Hypothetical vs. Real Money Decisions
 - ▶ Difference b/w economic & psychological experiments
 - ▶ 假設性問題 vs. 「玩真的」：經濟學實驗和心理學實驗一大分野
- ▶ Assumption behind money payments:
 - "Everybody likes having more money and nobody gets tired of having more of it." 使用金錢報酬只需要一個行為假設：
「每個人都喜歡獲得更多金錢，而且多多益善(沒有人會覺得拿太多)」
- ▶ Cost of deviation without real money is 0
 - ▶ 只是假設性問題的話，亂講亂選沒有成本
- ▶ Paying money reduces variation & outliers
 - ▶ 故金錢報酬會降低亂選的噪音，減少極端的特例

Incentives 真實誘因

- ▶ Pay Less vs. Pay More (付得少/多是否影響結果?)
- ▶ Comparison studies not done often enough
- ▶ Expensive to double/triple the payments
 - 有一些人做這種比較的實驗，但還不夠多，因為把報酬乘倍很貴
- ▶ Some experiments done in poor countries
 - (不過仍有些實驗會特別到貧窮的國家去做)
- ▶ Vietnam (越南：試字率高、人民卻很窮、鮮少遷徙)
- ▶ Few results that disconfirm theory have been overturned by paying more money
 - 這些少數重複實驗結果顯示：如果原本的實驗結果不支持理論預測，多付錢也大概不會讓實驗結果變得合乎理論的預測

Incentives 真實誘因

- ▶ Flat Maximum Critique (「作什麼都沒差」)
- ▶ Is it worthwhile (high stakes) to think hard?
 - 值得想得更深入嗎? (重賞之下必有勇夫, 沒勇夫表示賞金不夠?)
- ▶ EX: Costless to deviate from $(1/3, 1/3, 1/3)$ in rock-paper-scissors (例如: 「剪刀石頭布」不按照均衡策略 $(1/3, 1/3, 1/3)$ 來做沒有損失, 因為不管出什麼報酬都相同)
- ▶ No ideal solution yet... (尚未有很好的解決辦法, 不過...)
- ▶ Design steep marginal incentives
 - 可以設計得讓「邊際誘因」很高
- ▶ Modest effect on high stakes anyway
 - 高獎金對結果的影響雖不是0, 但也沒那麼大

Order Effects 不同實驗的先後次序

- ▶ AB: A came first; B came second
 - ▶ Is this why we see different behavior?
 - ▶ AB即「先做實驗A, 再做實驗B」
 - ▶ 行為的改變是否只是因為先後次序不同?
- ▶ Try BA and include order dummies in analysis
 - ▶ 必須也做BA(次序反過來), 然後在資料分析的時候加上次序的虛擬變數(dummies)來檢驗是否有影響
- ▶ What if ABC?
- ▶ ACB/BAC/BCA/CBA/CAB or simplify design
 - ▶ 有ABC怎麼辦?
 - ▶ 做ACB/BAC/BCA/CBA/CAB或簡化實驗設計

Control Risk Preferences 控制風險偏好

- ▶ Binary Lottery Procedure: (發樂透彩券當報酬)
 - ▶ Widely used to **control** risk preferences, but not much evidence that it works (控制風險偏好的常用辦法，但沒太多證據顯示有效，且需假設人們能把複合樂透簡化為簡單樂透)
- ▶ Alternatives: (其他辦法)
- ▶ **Assume** risk neutrality (假設受試者是風險中立)
- ▶ **Measure** risk preferences (測量風險偏好)
 - ▶ Holt and Laury (2002) or Tanaka et al. (2010)
 - ▶ Choi et al. (2007); Andreoni and Sprenger (2012)
 - ▶ DOSE: Wang et al. (wp)

Within-subject vs. Between-subject 同一|不同

- ▶ **Within-subject Design** (「比較同一受試者」的設計)
 - ▶ Same subject observed in various treatments
 - ▶ Pro: More statistically powerful (優點: 統計上解釋力強)
 - ▶ Con: Possible demand effect (缺點: 可能有「要求效果」)
 - ▶ 觀察同一受試者在不同實驗環境中的反應。(可做paired t-test)
- ▶ **Between-subject Design** (「比較不同受試者」的設計)
 - ▶ Different subjects observed in each treatment
 - ▶ Norm in experimental economics (實驗經濟學標準做法)
 - ▶ Con: "Impossible" for fMRI or eyetracking
 - ▶ 觀察不同受試者在各自的實驗環境中的反應。(很難做fMRI/眼動實驗)

Experiments 實驗計量

- ▶ Econometrics customized for experiments, just like
- ▶ Econometrics is statistics customized for economics
 - ▶ 特別為實驗開發的計量方法，正如計量是為經濟學開發的統計方法
- ▶ Bottom line: Use all econometrics feasible to get the most out of your (experimental) data
 - ▶ (良心建議：請充分利用所有可能的計量工具來分析實驗資料)
- ▶ Experimental Design and Experiments sometimes look like substitutes, but they actually
- ▶ Complement each other in a good paper!
 - ▶ 實驗設計和實驗計量有時可以互相替代，因為有好的設計，簡單的敘述統計可能就夠了。但兩者相輔相成能產生最好的論文

List of Experiments 實驗計量方法列表

- ▶ Mann-Whitney-Wilcoxon Test(s) vs. T-test
 - ▶ Non-parametric test similar to (un-)paired t-test
- ▶ Regression (with random effects)
- ▶ Maximum Likelihood Estimations (最大概似估計)
 - ▶ Level-k, Cognitive Hierarchy models
 - ▶ Learning (學習理論): EWA, Reinforcement
 - ▶ Quantal Response Equilibrium (手滑反應均衡)
 - ▶ Simulate (模擬) and Estimate (估計)
- ▶ Out-of-sample Predictions (預測新的資料)
- ▶ Markov-switching (Eyetracking), SPM (fMRI)

No Deception 不欺騙受試者

- ▶ Economists do not deceive their subjects
 - ▶ (實驗經濟學家從不欺騙他們的受試者)
- ▶ Economists do not deceive their subjects
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- ▶ Economists do not deceive their subjects
 - ▶ (實驗經濟學家從不欺騙他們的受試者)
- ▶ This creates credibility (「徙木立信」)
 - ▶ Makes monetary payments “real”
 - ▶ (因而相信真的有金錢報酬)

No Deception 不欺騙受試者

- ▶ And avoids anticipation/strategic responses
 - ▶ Differs from psychologists (who use debriefing)
 - ▶ 避免預期會被騙時的鬥智反應 (心理學家只要事後說明即可)
- ▶ Can achieve most goals with better design
 - ▶ Except to study the effect of deception (Really?)
 - ▶ 所謂「需要欺騙的實驗」大多能設計另一個「不需欺騙的實驗」來達到同樣目的 (除了研究人們被實驗者欺騙時的反應)
- ▶ Let subjects act as experimenters (to see...)
 - ▶ 真有人設計實驗讓受試者扮演實驗者的角色(來看被騙時...)

Conclusion: The Gold Standards 設計十誡

1. Control, Measure, or Assume (控制, 測量或假設)
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