Classroom Experiment 1:
Economic Lessons of the LUPI Game

經濟學實驗一：從 LUPI 彩券看何謂經濟學

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Economic Lessons of the LUPI Game (從LUPI 彩券看何謂經濟學)

- Swedish Lottery in 2007 (瑞典LUPI 彩券)
- Lowest Unique Positive Integer (LUPI) Game
  - 最小唯一者勝的賽局
- Choose a positive integer from 1 to 100
  - 請選擇 1 到 100 之間的一個正整數
- Win if choose the Lowest but Unique number
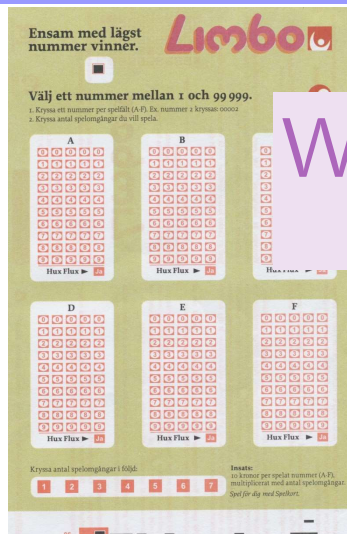 - 誰選到最小且沒有其他人選的數字就贏了!
- Prize? (贏家的獎勵?)

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Choose a positive integer from 1 to 100 (請選擇 1 到 100 之間的一個正整數)

ⓘ Start presenting to display the poll results on this slide.

Economic Lessons of the LUPI Game (從LUPI 彩券看何謂經濟學)

Limbo
Ensam med lägst nummer vinner.

Välj ett nummer mellan 1 och 99 999.

▸ Swedish Lottery in 2007 (瑞典LUPI 彩券)

Want to Try Again?
(再來一次?)

to 100

▸ 請選擇 1 到 100 之間的一個正整數

▸ Win if choose the Lowest but Unique number

▸ 誰選到最小且沒有其他人選的數字就贏了!

▸ Prize? (贏家的獎勵?)

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Try Again! Choose a positive integer from 1 to 100 (再來一次! 請選擇 1 到 100 之間的一個正整數)

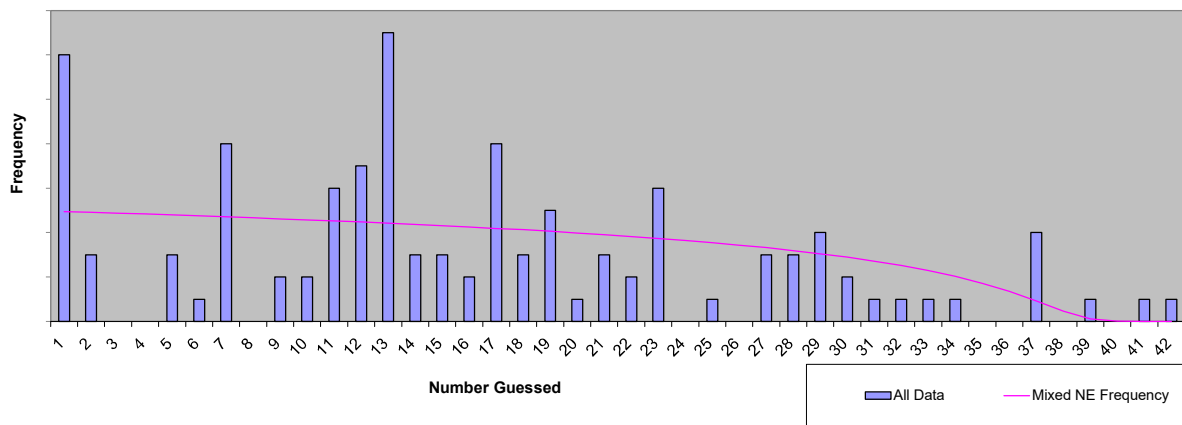ⓘ Start presenting to display the poll results on this slide.

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Last Chance! Choose a positive integer from 1 to 100 (最後一次! 請選擇 1 到 100 之間的一個正整數)

ⓘ Start presenting to display the poll results on this slide.

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2012 Principles Class LUPI Experiment

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Economic Lessons of the LUPI Game (從LUPI 彩券看何謂經濟學)

1. A Set of Rules (= Institution) (一套遊戲規則)
   ‣ Either explicit or implicit (潛規則) (可以是明文規定或不成文的潛規則)
2. Individuals Optimize (個人決策謀求最佳化)
   ‣ Because people respond to incentives! (因為人們對誘因有反應!)
3. You Need to React to Others Optimizing (其他人也在最佳化，所以你要因應)
   ‣ Even if most users follow the rules, the designer still has to stress-test the system. (即使多數人循規蹈矩，制度設計者仍須考慮有人惡搞怎麼辦)
4. What should the aggregate data look like? (整體結果長怎樣?)
   ‣ Come up with a theory (model/graph/story)! (理論的預測為何?)

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Solving the LUPI Game Equilibrium (解出 LUPI 的均衡)

- ▸ k wins if nobody "uniquely chose 1 to $(k$ - $1)$", nor chose k
  - ▸ (選 k 贏的條件是沒有人「單獨選 1 到 $(k$ - $1)$」，而且沒有其他人選 k)
- ▸ Assume Number of Players is $\text{Poisson}(n)$
  - ▸ 假設參與人數為Poisson分佈 (平均 n)，混合策略均衡的條件是：
- ▸ Mixed Strategy Equilibrium requires:
- ▸ $\text{Pr}(\text{win} \mid \text{choose } 1) = \text{Pr}(\text{win} \mid \text{choose } 2) = ...$

$$e^{-np_1} = \left(1 - np_1 e^{-np_1}\right) \cdot e^{-np_2}$$

Nobody chose 1 (沒有其他人選1)	Nobody uniquely chose 1 (沒有人單獨選1)	Nobody chose 2 (沒有其他人選2)

Unique Poisson-Nash Equilibrium (Mixed)

唯一Poisson
混合策略均衡
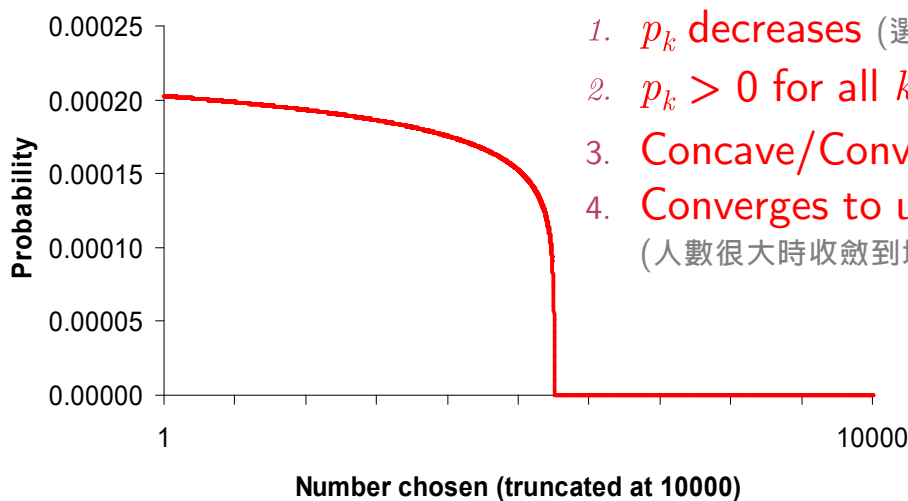
1. p_k decreases (選k的機率遞減)
2. $p_k > 0$ for all k (所有數字都選到)
3. Concave/Convex (凸函數/凹函數)
4. Converges to uniform if n large (人數很大時收斂到均勻選擇)

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Economic Lessons of the LUPI Game (從LUPI 彩券看何謂經濟學)

5. Does empirical data match the theory? (實證資料是否支持你的預測?)
   ▸ Collect data to see the big picture (蒐集資料來看「整個社會」的結果如何)

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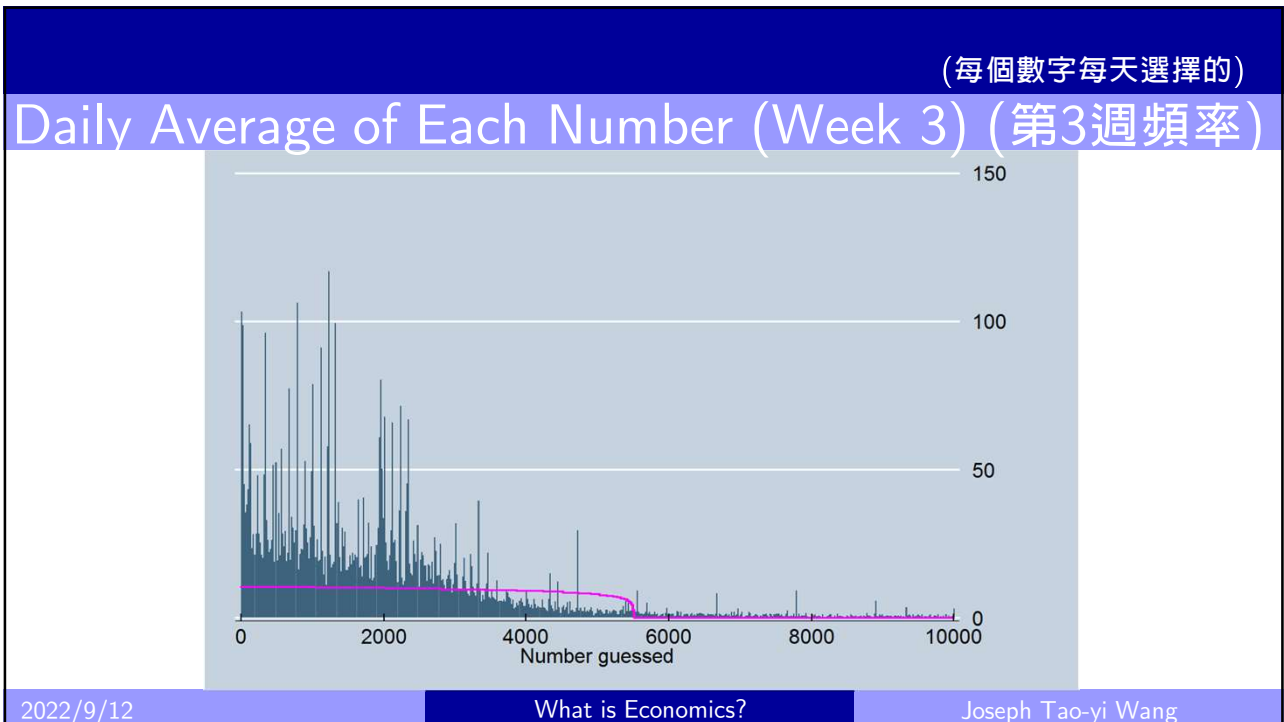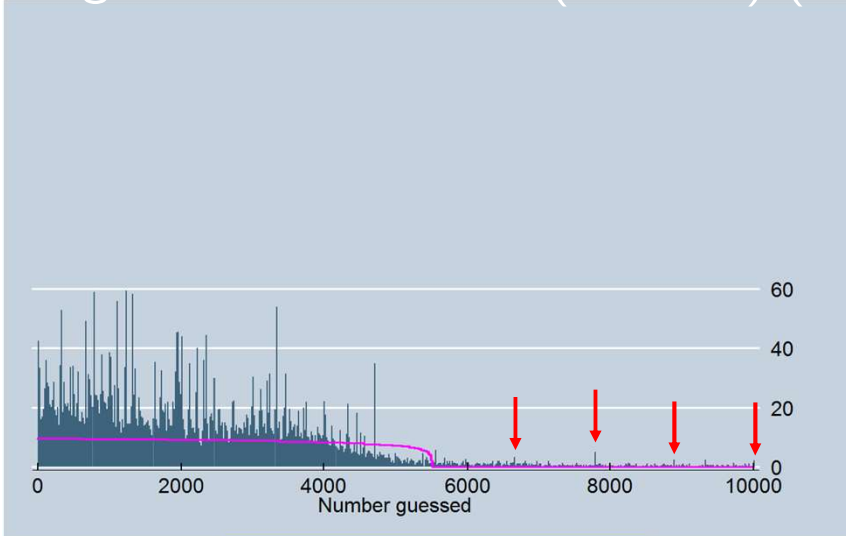

(每個數字每天選擇的)

Daily Average of Each Number (Week 1) (第1週頻率)

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（每個數字每天選擇的）

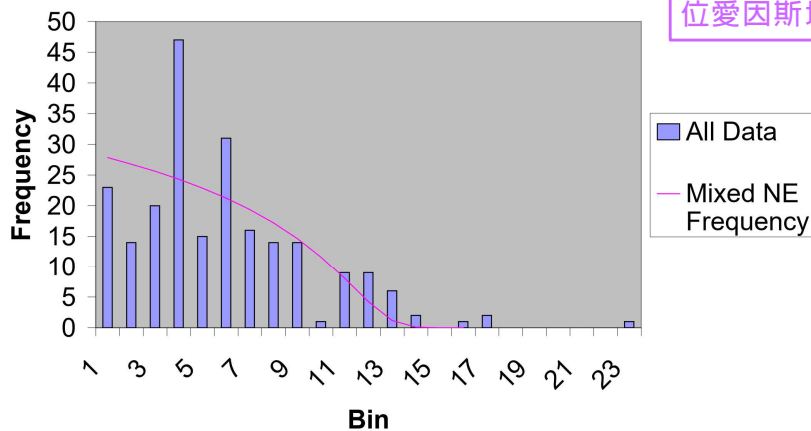# Daily Average of Each Number (Week 3) (第3週頻率)

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（每個數字每天選擇的）

Daily Average of Each Number (Week 5) (第5週頻率)

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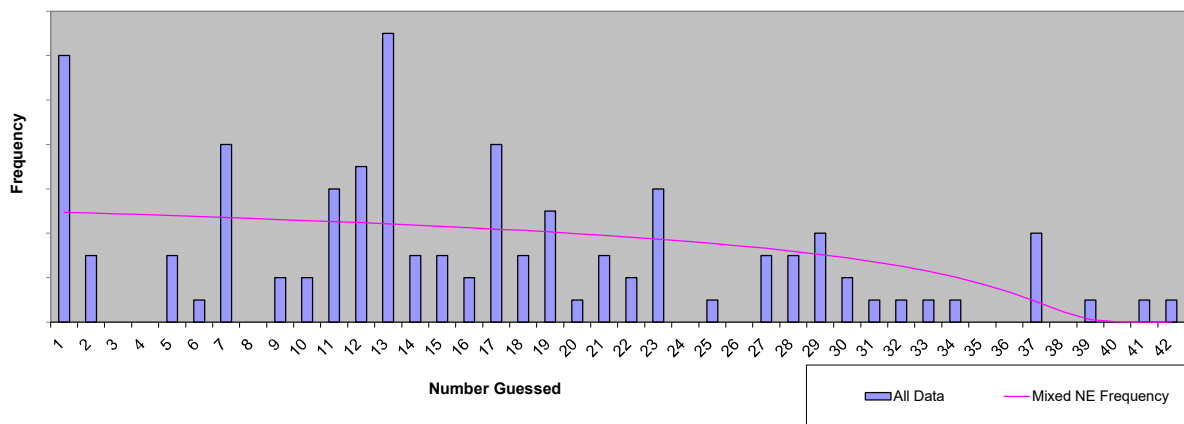
7
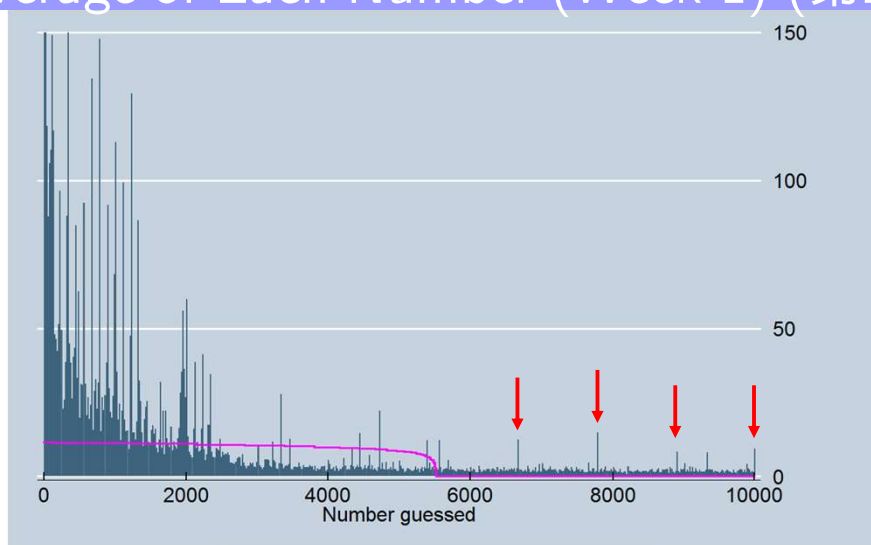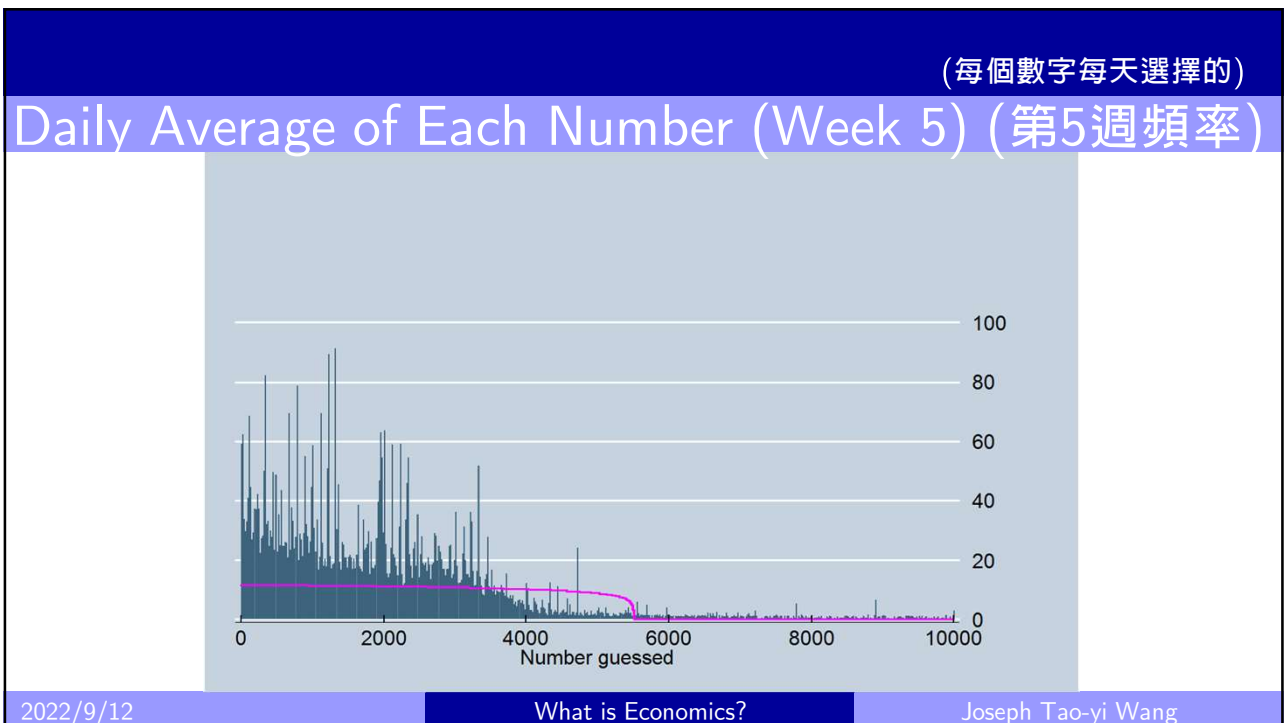
（每個數字每天選擇的）
Daily Average of Each Number (Week 7) (第7週頻率)

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Are We in the LUPI Game Equilibrium?
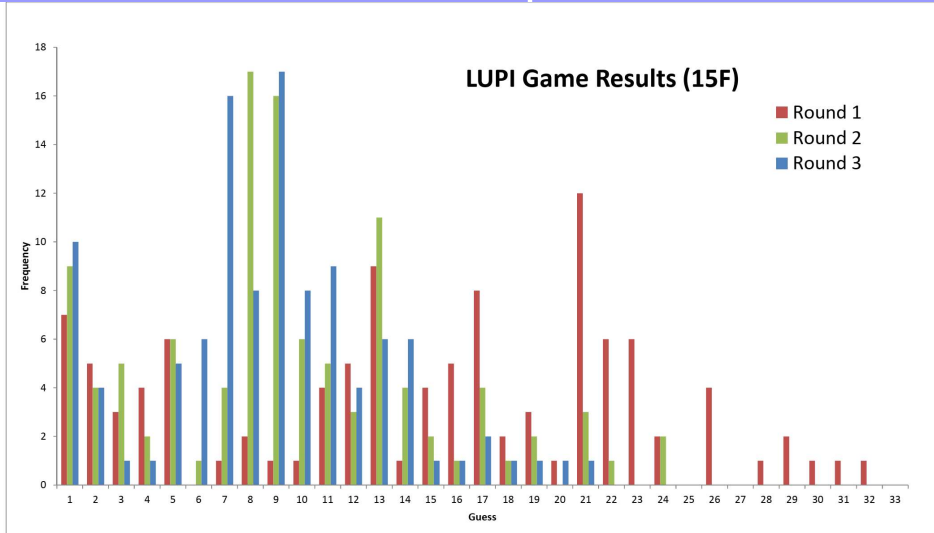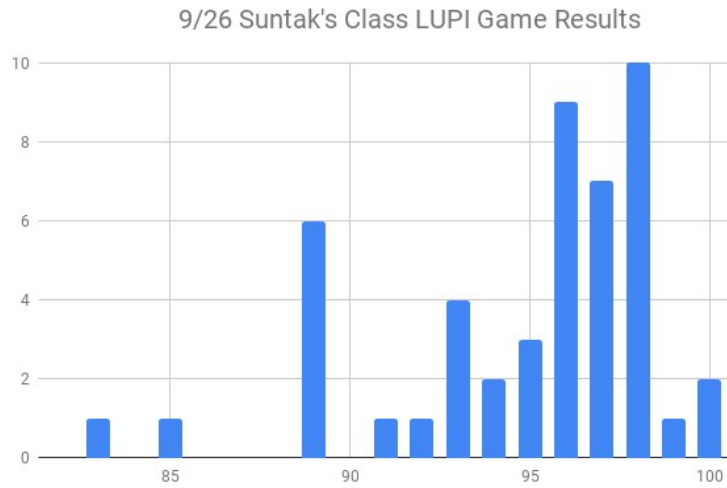
Fall 2007 Principle Class LUPI Experiment

這個課堂實驗中，有一位愛因斯坦計畫得主喔！

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Are We in the LUPI Game Equilibrium?

The LUPI game (09F): Round 1-10

Are We in the LUPI Game Equilibrium?

The LUPI game (09F): Round 11-25, two winners (1-50, 51-100) per round

Are We in the LUPI Game Equilibrium?

Fall 2010   frequency

What is Economics?

Are We in the LUPI Game Equilibrium?

2012 Principles Class LUPI Experiment

What is Economics?

Are We in the LUPI Game Equilibrium?

LUPI Game Results (15F)

Are We in the LUPI Game Equilibrium?

Fall 2017 Principles of Economics

Classroom Experiment I_round 3
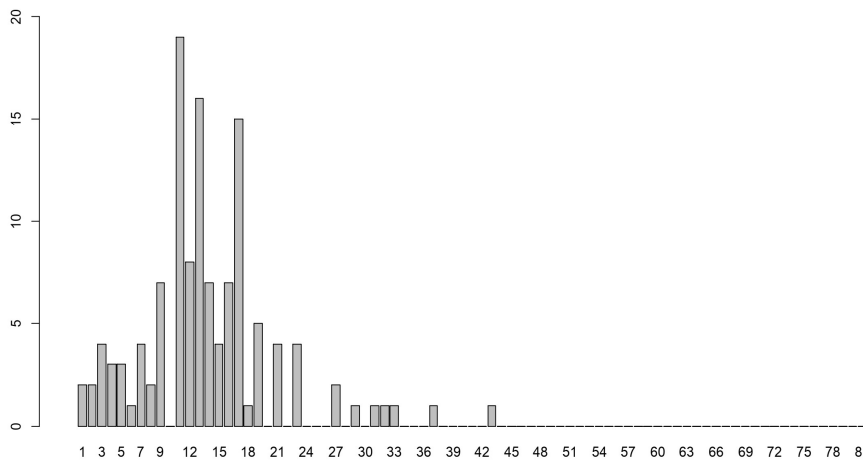
More LUPI Data (Largest Unique)

9/26 Suntak's Class LUPI Game Results

Are We in the LUPI Game Equilibrium?

LUPI Game Results (Principles 19F)

Economic Lessons of the LUPI Game (從LUPI 彩券看何謂經濟學)

5. **Does empirical data match the theory?** (實證資料是否支持你的預測?)
   - ‣ Collect data to see the big picture (蒐集資料來看「整個社會」的結果如何)
6. **Can individual differences be explained?** (資料中個別差異能否解釋?)
   - ‣ Unlike the Bible, economic theory can change (理論有改進空間嗎?)

Choose Birth Year (and 2007)? (出生年度與當年度特別多)
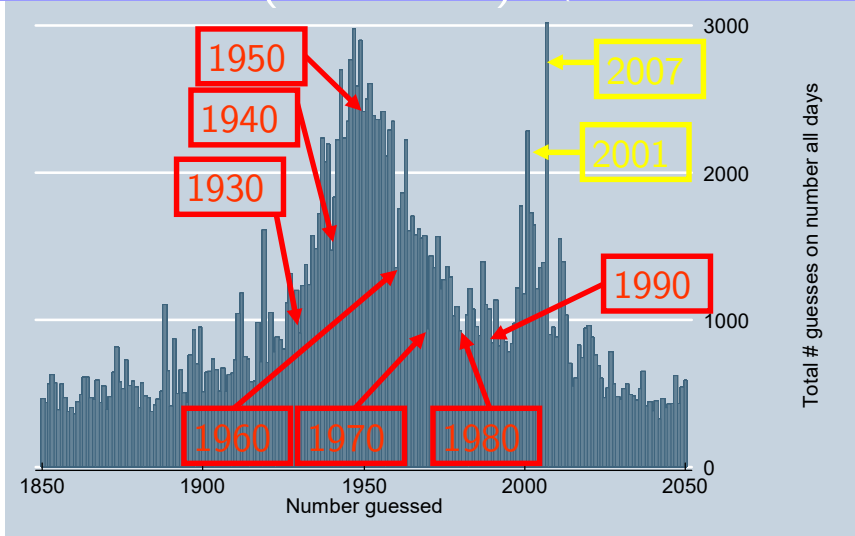
「上有政策，下有對策」

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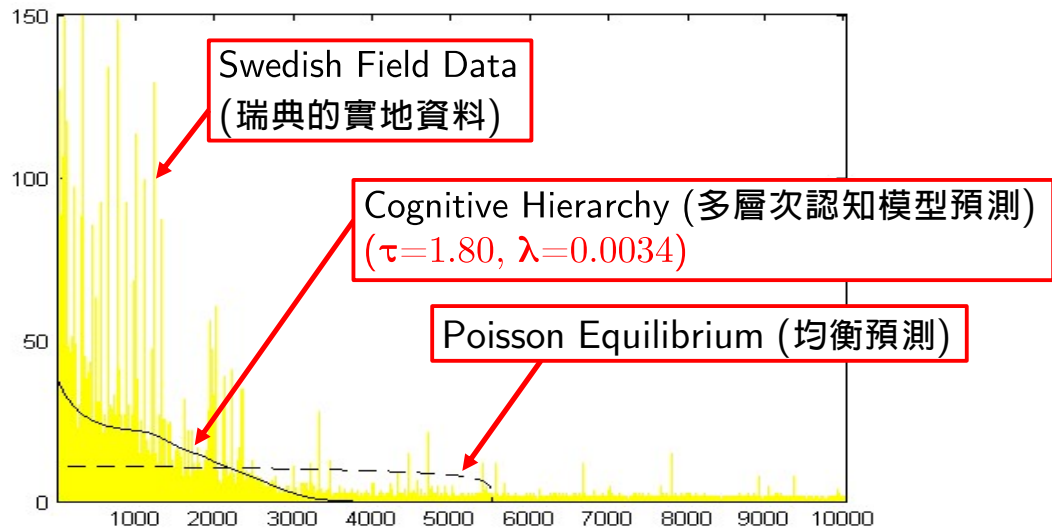
(模仿學習模型 vs. 實地)
Imitation Learning vs. Field Data - Day 3 (第3天資料)

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(模仿學習模型 vs. 實地)
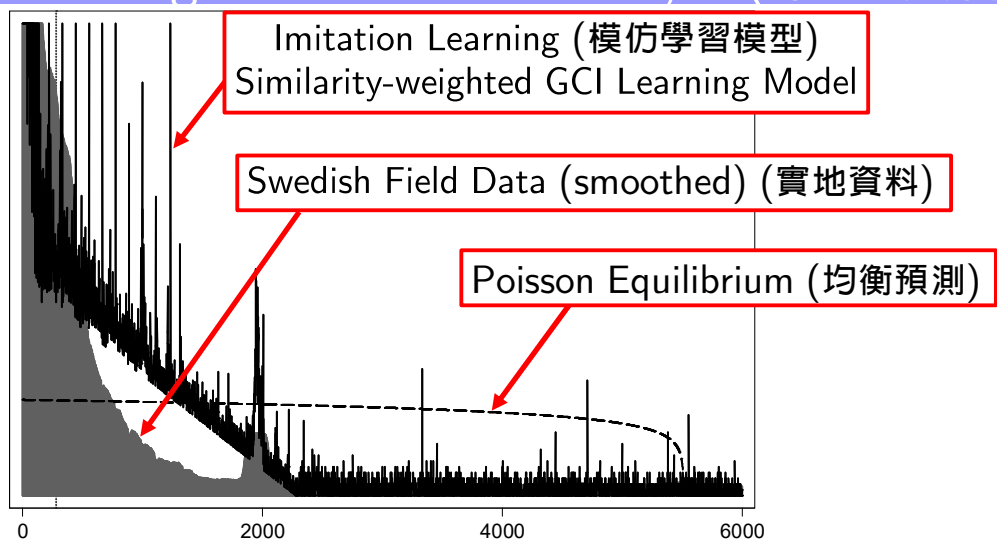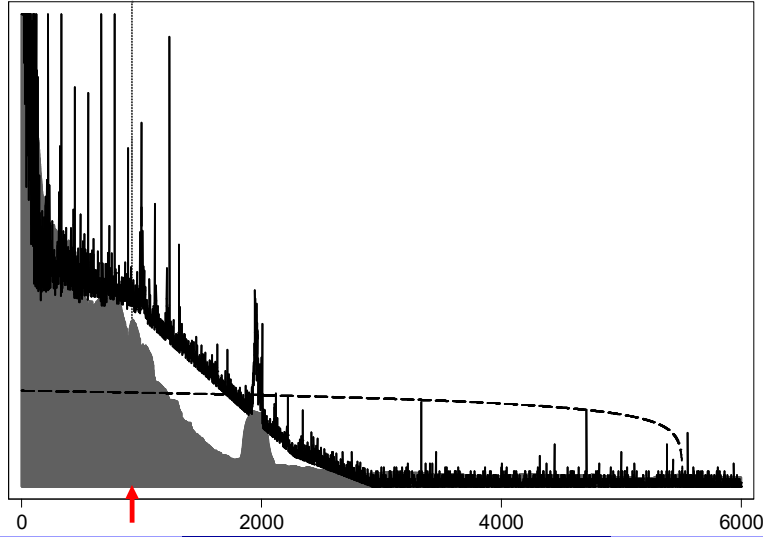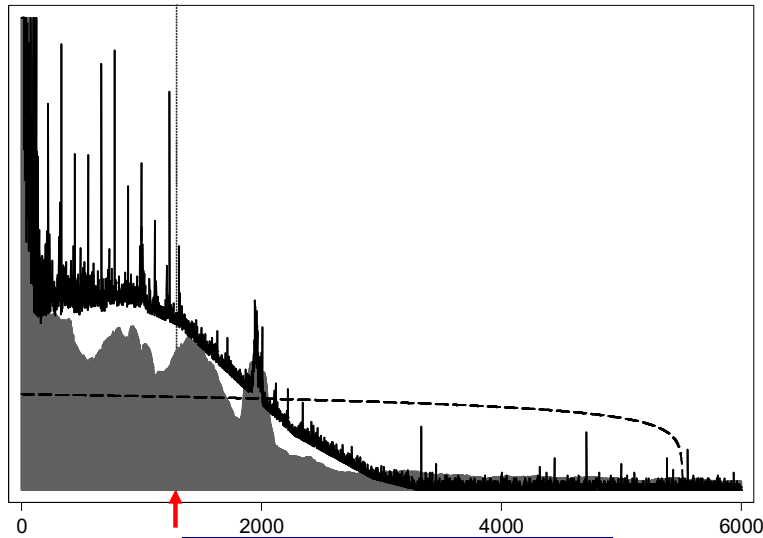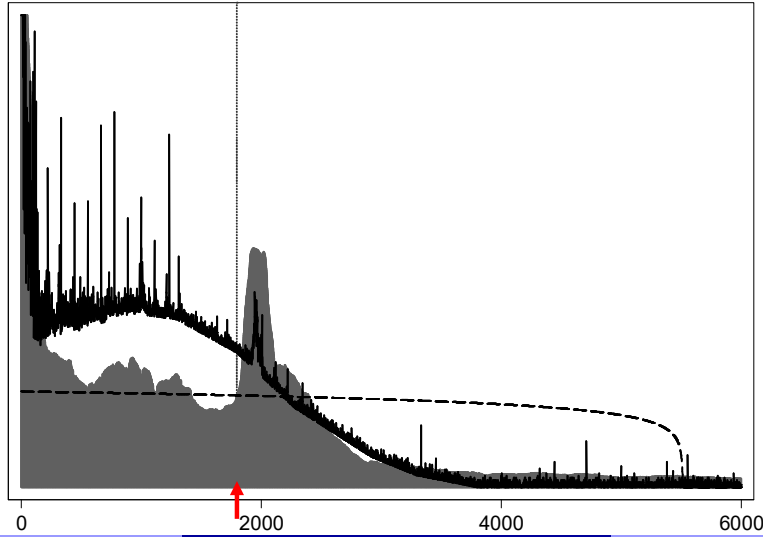Imitation Learning vs. Field Data - Day 4 (第4天資料)

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(模仿學習模型 vs. 實地)
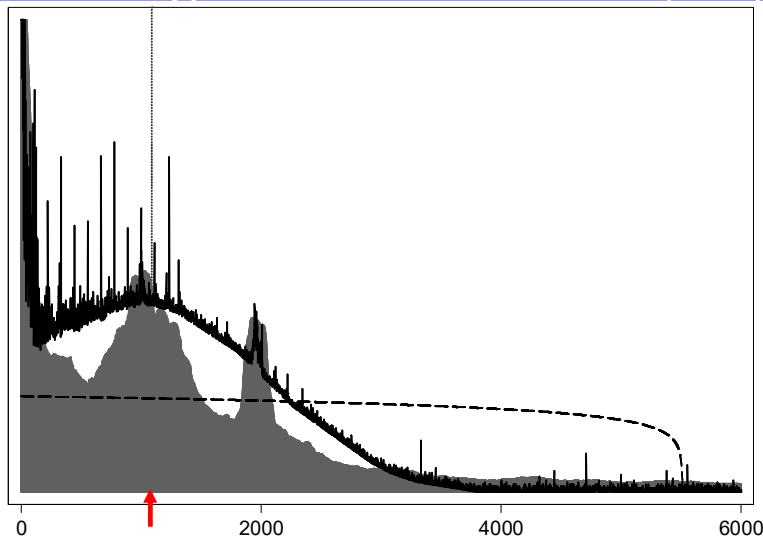## Imitation Learning vs. Field Data - Day 5 (第5天資料)

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(模仿學習模型 vs. 實地)
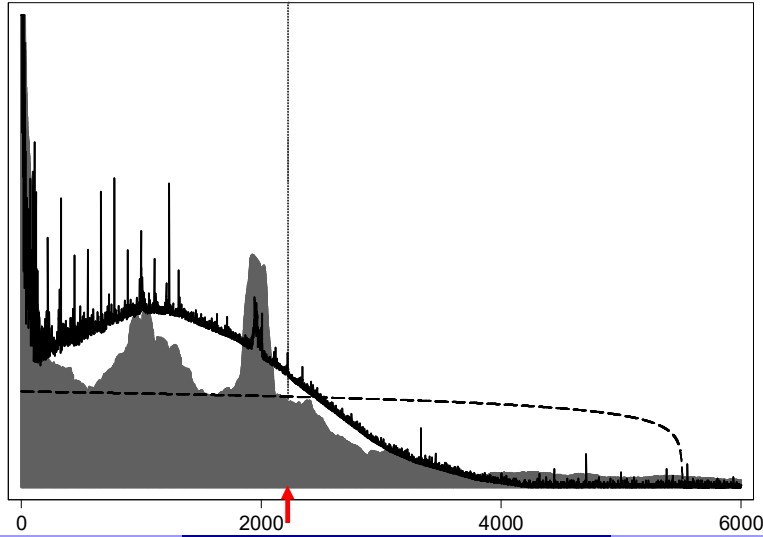## Imitation Learning vs. Field Data - Day 6 (第6天資料)

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(模仿學習模型 vs. 實地)
Imitation Learning vs. Field Data - Day 7 (第7天資料)

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(模仿學習模型 vs. 實地)
Imitation Learning vs. Field Data - Day 14 (第14天資料)

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(模仿學習模型 vs. 實地)

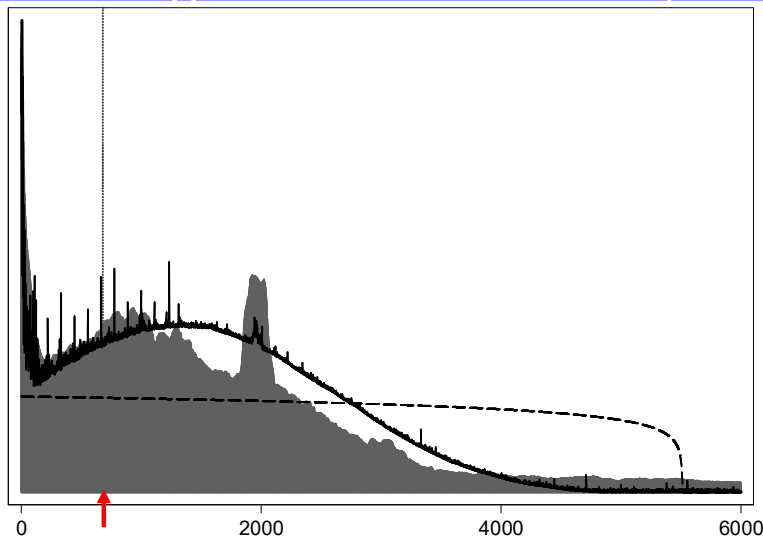# Imitation Learning vs. Field Data - Day 21 (第21天資料)

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(模仿學習模型 vs. 實地)

Imitation Learning vs. Field Data - Day 28 (第28天資料)

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Imitation Learning vs. Field Data - Day 35 (第35天資料)
(模仿學習模型 vs. 實地)

Imitation Learning vs. Field Data - Day 42 (第42天資料)
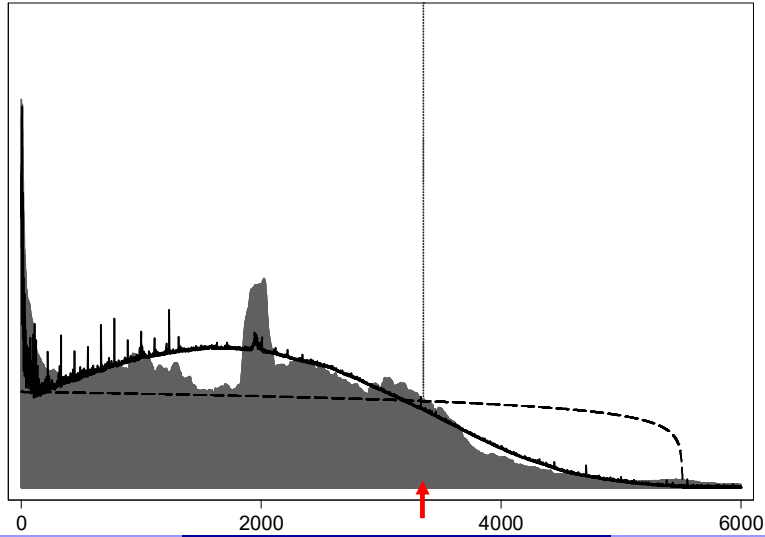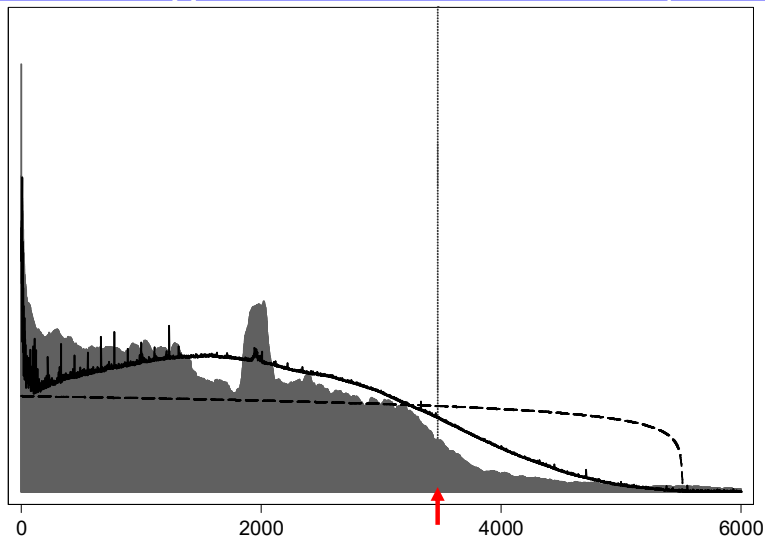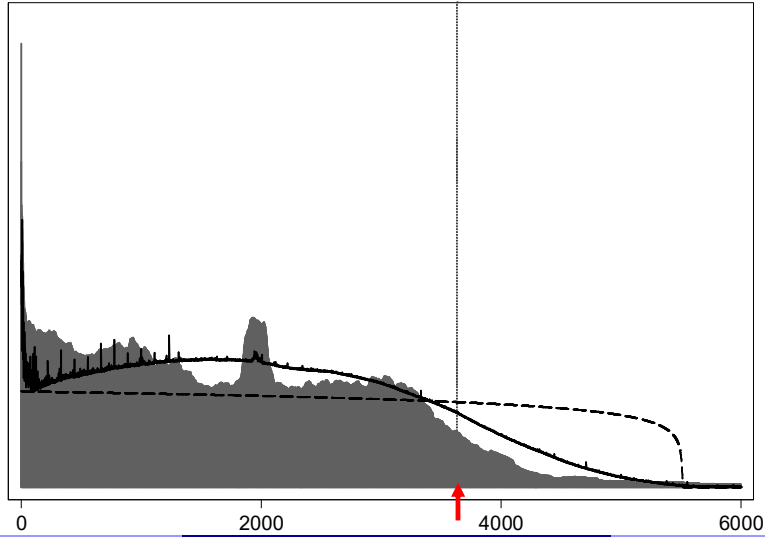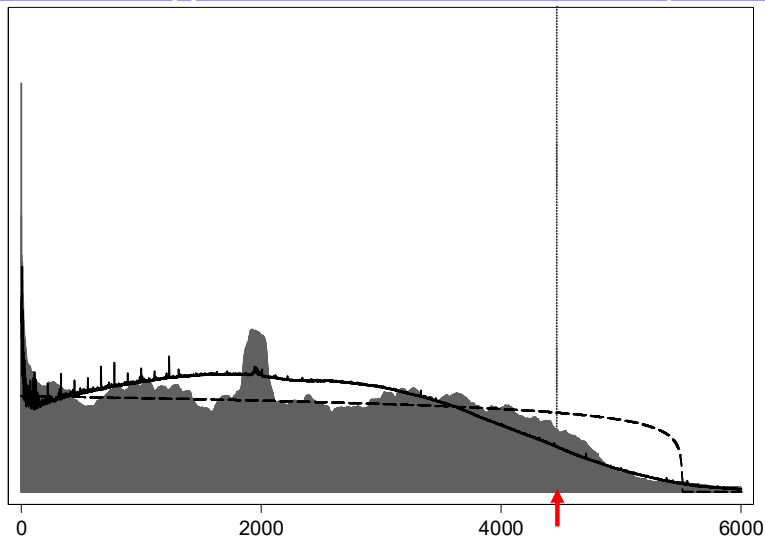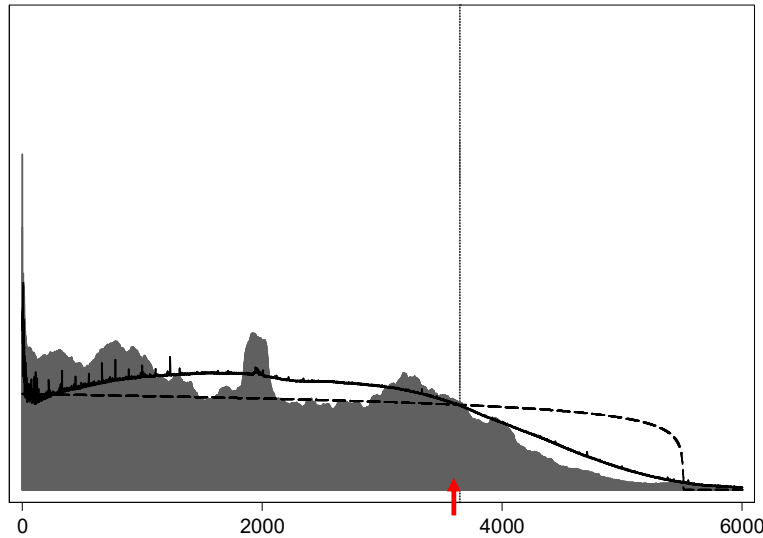(模仿學習模型 vs. 實地)

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(模仿學習模型 vs. 實地)

Imitation Learning vs. Field Data - Day 49 (第49天資料)

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Economic Lessons of the LUPI Game (從LUPI 彩券看何謂經濟學)

5. **Does empirical data match the theory?** (實證資料是否支持你的預測?)
   ‣ Collect data to see the big picture (蒐集資料來看看「整個社會」的結果如何)

6. **Can individual differences be explained?** (資料中個別差異能否解釋?)
   ‣ Unlike the Bible, economic theory can change (理論有改進空間嗎?)

7. **How can the institution be improved?** (制度有沒有可以改進之處?)
   ‣ Market Design: The Engineer Question! (市場設計: 工程師問題)

8. **Where did this institution come from?** (這套制度是哪裡來的?)
   ‣ Why are we stuck with the current system? (現況的邏輯是什麼?)
   ‣ The Historical Question (leading to humanities) (爬梳歷史通向人文)

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Conclusion (小結)

- ▸ Traditionally, resources are scarce, so economists focus on Production and Consumption: Manage Resources Efficiently
  - ▸ 舊經濟時代聚焦在資源有限，經濟學處理生產和消費: 解決資源有效運用的問題
- ▸ But in the Meta Economy, resource is no longer the focus!
  - ▸ More important are human reactions to information/institutions
  - ▸ 但在知識經濟時代，資源不再是重點! 更重要的是人們對資訊、對制度的反應
- ▸ So, Economics = For any Institution, There's a Reaction!
  - ▸ Given a set of rules, how people optimize; whether empirical data confirms theory, and to find institution origins and improvements
  - ▸ 因此，現代經濟學研究的是「上有政策，下有對策」: 在一套遊戲規則下，人們如何謀求自身最佳; 看實證資料如何印證理論，並思考這個制度如何改進、從何而來。

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Principles of Microeconomics

Exp.1: The LUPI Game

Questions about experiment 1?

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