Introduction to Bounded Rationality

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Introduction

- So far: covered the 'rational model' in (excruciating) detail
- Today we will cover our first 'behavioral' topic: Bounded Rationality
  - Overview
  - Some stylized facts we may want to explain
- Discussion of 'Imperfect Perception', which we will be our focus

- Standard model:

$$C(A) = \max_{x \in A} u(x)$$

- If this is wrong, two ways to go:
  1. Modify objective
  2. Modify constraints

- Most of behavioral economics concerned with approach 1
- Bounded rationality concerned with approach 2
- Optimal behavior within some additional constraints

What is Bounded Rationality?

- Costs to acquiring or processing information
  - E.g. Simon [1955], Stigler [1961], Sims [2003]
- Limits on reasoning
  - E.g. Camerer [2004], Crawford [2005]
- Thinking Aversion
  - E.g. Ergin and Sarver [2010], Ortoleva [2013]
- Bounded memory
  - E.g. Wilson [2002]
- Automata
  - E.g. Piccione and Rubinstein [1993]
- Semi-Rational Models
  - E.g. Gabaix et al. [2008], Esponda [2008], Rabin and Vayanos [2010], Gabaix [2013].
- Heuristics
  - Tversky and Kahneman [1974], Gigerenzer [2000]

Advantages and Disadvantages of Bounded Rationality

- Advantage:
  - Can 'microfound' behavioral models - explain how behavioral phenomena can change with the environment
- Disadvantages:
  - May be wrong!
  - What is correct constraint?
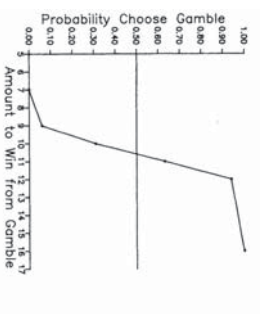 - Regress issue

What Might We Want to Explain With Bounded Rationality

- Random Choice
- Status Quo Bias
- Failure to Choose the Best Option
- Salience/Framing Effects
- Too Much Choice
- Statistical Biases
- Compromise Effect

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Random Choice (Mosteller and Nogee 1951)

- Gamble is $\frac{1}{3}$ probability win amount and $\frac{2}{3}$ loss of 5c
- Each bet offered 14 times

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Status Quo Bias/Inertia (Madrian and Shea 2001)

- Observe behavior of workers in firms that offer 401k savings plans
- Two types of plans
  - Opt In
  - Opt Out
- Average take up after 3-15 months of tenure
  - Opt In: 37%
  - Opt Out: 86%
- Effect reduces with tenure
- Also an effect on those not automatically enrolled

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Failure to Choose the Best Option (Caplin, Dean, Martin 2011)

4	3	20	15	8

2	13	11	8	10

Failure to Choose the Best Option (Caplin, Dean, Martin 2011)

4+6+10-11-23+9

3+9-17-99+102-6+15

20-27+7-19+2+3-5

15-5-5+6+16+17-20-9

8+8+9-13-9-6+7

2+3+6-11-14+9+10

6+18-19-55+70

11+2-5+7-8-9+10

8+9+10-11+8+2+6-32

10-9+17-23+10+2+15

Choice Objects

- 6 treatments
  - 2 × complexity (3 and 7 operations)
  - 3 × choice set size (10, 20 and 40 options)
- No time limit

zero

Round
2 of 30

Choose one

Current selection:
four plus eight minus four

zero
three plus five minus seven
four plus two plus zero
four plus three minus six
four plus eight minus four
three minus three plus one
five plus one minus one
eight plus two minus five
three plus two minus five
four minus two minus one
four plus five minus one

Finished

Results

Failure rates (%) (22 subjects, 657 choices)

Failure rate

Set size	Complexity	
	3	7
10	7%	24%
20	22%	56%
40	29%	65%

Results

Average Loss ($)

Average Loss ($)

Set size	Complexity	
	3	7
10	0.41	1.69
20	1.10	4.00
40	2.30	7.12

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Salience (Chetty, Looney and Kroft, 2009)

- Experiment in supermarket
- Posted prices usually exclude sales tax
- Post (in addition) prices including sales tax
- Reduced demand for these good by about 8%
- Archival data shows that, for alcohol, elasticity with respect to sales tax changes order of magnitude less that elasticity with respect to price changes

Salience (Chetty, Looney and Kroft, 2009)

TABLE 3
Effect of Posting Tax-Inclusive Prices: DiD Analysis of Mean Quantity Sold

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Too Much Choice (Iyengar and Lepper 2000)

- Set up a display of jams in a local supermarket
- Two treatments:
  - Limited choice – 6 Jams
  - Extensive choice – 24 Jams
- Record what proportion of people stopped at each display
- And proportion of people bought jam conditional on stopping

Too Much Choice (Iyengar and Lepper 2000)

- Slightly more people stopped to look at the display in the extensive choice treatment:
  - 60% Extensive choice treatment
  - 40% Limited choice treatment
- Far more people chose to buy jam, conditional on stopping, in the Limited choice treatment
  - 3% Extensive choice treatment
  - 31% Limited choice treatment

Too Much Choice and Simplicity Seeking (Iyengar and Kamenica 2010)

Fraction of subjects / Gamble — Limited, Extensive

Too Much Choice and Simplicity Seeking (Iyengar and Kamenica 2010)

Gamble #	If heads	If tails
Extensive condition		
1	$5.00	$5.00
2	$4.50	$7.75
3	$4.00	$8.25
4	$3.50	$8.75
5	$3.00	$9.50
6	$2.50	$10.00
7	$2.00	$10.50
8	$1.50	$11.25
9	$1.00	$11.75
10	$0.50	$12.50
11	$0.00	$13.50
Limited condition		
1	$5.00	$5.00
2	$3.50	$8.75
3	$0.00	$13.50

Fraction of Subjects

Gamble

Legend: Limited / Extensive
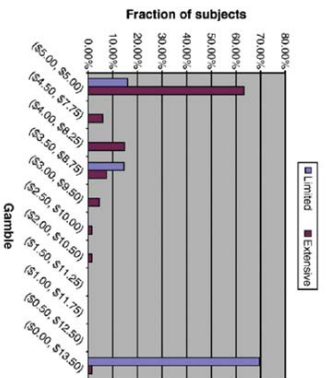
Too Much Choice and Simplicity Seeking (Iyengar and Kamenica 2010)

Extensive condition

Gamble #	If	If	If	If	If	If
1	$0.00	$0.00	$0.00	$10.00	$10.00	$10.00
2	$1.50	$9.25	$8.75	$7.00	$0.75	$1.25
3	$4.25	$5.50	$9.75	$8.50	$0.00	$0.75
4	$1.00	$2.00	$6.75	$7.50	$5.75	$6.75
5	$5.50	$1.00	$0.75	$6.50	$7.50	$4.75
6	$0.00	$0.00	$8.75	$2.75	$9.75	$8.00
7	$9.75	$3.00	$7.00	$0.50	$0.50	$1.50
8	$9.50	$1.50	$6.50	$2.50	$3.25	$10.00
9	$5.50	$8.50	$3.25	$0.00	$8.50	$2.50
10	$9.25	$7.75	$3.75	$2.00	$3.25	$2.00
11	$1.25	$4.50	$8.50	$8.75	$4.50	$0.75
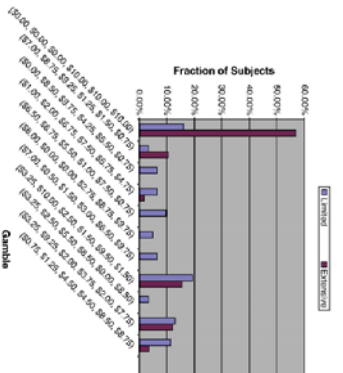
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# Gambler's Fallacy (Croson and Sundali 2005)
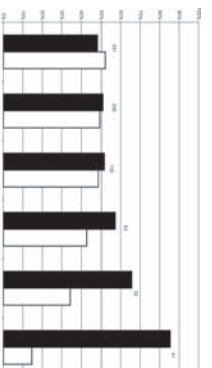
- Proportion of Gambler's Fallacy bets in casino gambling

Hot Hands Fallacy (Offerman and Sonnemans 2000)

- Two types of coin
  - 'Fair': Independent
  - 'Unfair': Repeat last outcome with probability 70%
- Prior distribution: 50/50
- Subjects observe 20 coin flips, then report probability of unfair coin

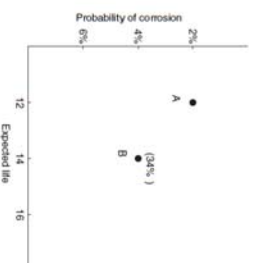## Gambler's Fallacy (Croson and Sundali 2005)
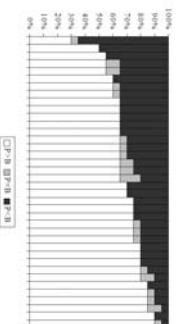
- For each subject, proportion that overestimate probability of unfair coin
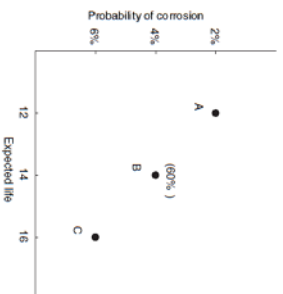
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Compromise Effect (Simonsen 1989)

Imperfect Perception and Information Acquisition

- We are going to focus of models of bounded rationality in which the DM does not necessarily internalize all available information

- They may have a 'perceptual state' which is different from the externally available information

- This is different from most standard models

  - DM has perfect perception (e.g. know what is in their choice set)
  - Or we know what they do not know (e.g. state of the world)

- In general there may be a gap between what **we** know as the researcher and what the **DM** knows

  - Shopper may not look at all available options
  - Buyer may not perfectly perceive the quality of a car

- This can lead to choce 'mistakes' from the point of view of an external observer
  - Choose an inferior option
  - Make wrong choice given state
- These mistakes may be 'optimal' given information costs and constraints

- We will consider two types of unawareness

1. 'All or nothing'
  - Alternatives are either completely understood, or nothing is known
  - E.g. Consideration sets, sequential sets
  - Good description when there are a large number of simple alternatives
  - Examples:
    - Caplin, Dean and Martin [2011].
    - Masatlioglu, Nakajima and Ozbay [2012]
    - Manzini and Mariotti [2014]

- We will consider two types of unawareness

1. Models of partial learning

  - States of the world Ω with prior μ
  - Choice over actions $a : \Omega \to \mathbb{R}$
  - Choose an information structure

    - Set of signals: $\Gamma(\pi)$
    - Probability of receiving each signal γ from each state ω: $\pi(\gamma|\omega)$

  - Choices can be conditioned only on the information structure
  - Good description when there are a smaller number of more complicated alternatives
  - Examples

    - Sims [2003] (Rational Inattention)
    - Matejka and McKay [2015]
    - Caplin and Dean [2015]