Behavioral Economics

Lecture 1: Choice under Uncertainty
Part (b): Evidence that Contradicts the Standard Model

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Our Outline

Ellsberg Paradox (Ellsberg 1961)

Suppose an urn contains 90 balls:

- 30 of the balls are red.
- The other 60 balls are black or yellow, in unknown proportions.
- One ball will be drawn randomly from the urn.

Question 1:

Option A: You win $100 if the ball is red.

Option B: You win $100 if the ball is black.

Question 2:

Option C: You win $100 if the ball is either red or yellow.

Option D: You win $100 if the ball is either black or yellow.

The Paradox: The combination of choosing A over B and D over C violates expected utility — in particular, violates that people form *stable subjective beliefs*.

Allais Paradox (Allais 1953)

	Option (A)	Option (B)
Question 1:	\$1 million with prob. 1	\$1 million with prob. 0.89 \$5 million with prob. 0.10 \$0 with prob. 0.01

	Option (C)	Option (D)
Question 2:	\$1 million with prob. 0.11 \$0 with prob. 0.89	\$5 million with prob. 0.10 \$0 with prob. 0.90

Allais Paradox (Allais 1953)

Question 1:

Option (A)		Option (B)	
\$1 million	with prob. 1	\$1 million	with prob. 0.89
		\$5 million	with prob. 0.10
		\$0	with prob. 0.01

Question 2:

Option (C)		Option (D)	
\$1 million	with prob. 0.11	\$5 million	with prob. 0.10
\$0	with prob. 0.89	\$0	with prob. 0.90

The Paradox: The combination of choosing A over B and choosing D over C violates expected utility.

Allais Paradox (Revealed)

Question 1:

	Option (A)		Option (B)
		$1 million	with prob. 0.89
$1 million	with prob. 0.89	$5 million	with prob. 0.10
$1 million	with prob. 0.11	$0	with prob. 0.01

Question 2:

	Option (C)		Option (D)
$0	with prob. 0.89	$0	with prob. 0.89
$1 million	with prob. 0.11	$5 million	with prob. 0.10
		$0	with prob. 0.01

Evidence from Kahneman & Tversky (1979)

A few details on the evidence:

- Asked students and faculty to respond to **hypothetical** choice problems, originally in Israel, later replicated at Stockholm and Michigan (note: median net monthly income in Israel $\approx$ 3000).
- Series of binary choices between two prospects; no more than a dozen problems per questionnaire; usual techniques of varying order of questions and positions of choices.
- Their notation eliminates $0 outcomes — e.g., "(4000,.8)" means 4000 with probability 0.8, 0 with probability 0.2.

“Subproportionality”

Problem 3	Option (A)	vs.	Option (B)
$[N = 95]$	$(4000, .8)$		$(3000, 1)$
Problem 4	Option (C)	vs.	Option (D)
$[N = 95]$	$(4000, .2)$		$(3000, .25)$

"Subproportionality"

From these and similar examples, Kahneman & Tversky conclude that preferences exhibit "subproportionality":

- When comparing a larger/less-likely reward to a smaller/more-likely reward, if we scale down the probabilities proportionally, the person becomes more and more likely to choose the larger/less-likely reward.
- ***Formally*:** If $(y, pq) \sim (x, p)$ then $(y, pqr) \succ (x, pr)$.

  where $y > x > 0$ and $p, q, r \in (0, 1)$

“Reflection Effect”

Problem 7 $[N = 66]$	$\underline{\text{Option (A)}}$ $(6000, .45)$	vs.	$\underline{\text{Option (B)}}$ $(3000, .90)$

Problem 7′ $[N = 66]$	$\underline{\text{Option (C)}}$ $(-6000, .45)$	vs.	$\underline{\text{Option (D)}}$ $(-3000, .90)$

“Reflection Effect”

From these and similar examples, Kahneman & Tversky conclude that preferences exhibit a “reflection effect”:

- Preferences over losses are the opposite of preferences over equivalent gains.

- Moreover, in general, they see risk-averse behavior over gains and risk-loving behavior over losses (except for small probabilities).

“Isolation Effect”

Problem 10: Consider the following two-stage game. In the first stage, there is a probability of .75 to end the game without winning anything, and a probability of .25 to move into the second stage. If you reach the second stage you have a choice between

$$(4000, .80) \qquad \text{and} \qquad (3000, 1).$$

Your choice must be made before the game starts, i.e., before the outcome of the first stage is known.

Note: we can collapse this to

“**Problem 10**” : $[N = 141]$	$(4000, .2)$	$(3000, .25)$

"Isolation Effect"

"**Problem 10**": $[N = 141]$	$(4000, .2)$ [22%]		$(3000, .25)$ [78%]*
Problem 3: $[N = 95]$	$(4000, .8)$ [20%]	$\prec$	$(3000, 1)$ [80%]*
Problem 4: $[N = 95]$	$(4000, .2)$ [65%]*	$\succ$	$(3000, .25)$ [35%]

“Isolation Effect”

Problem 11: You get 1000 for sure. In addition, choose between

$$(1000, .5) \qquad \text{vs.} \qquad (500, 1)$$

Problem 12: You get 2000 for sure. In addition, choose between

$$(-1000, .5) \qquad \text{vs.} \qquad (-500, 1)$$

“Isolation Effect”

From these and similar examples, Kahneman & Tversky conclude that people exhibit an “isolation effect”:

- People ignore seemingly extraneous parts of the problem — in particular, they tend to disregard shared components.

Brief aside: There is now a large literature on “framing effects” — two ways of presenting the **exact same problem** can lead to different choices.

The isolation effect is a natural interpretation of some framing effects — because for some ways of framing a problem, certain information can **seem** extraneous.

A Theoretical Problem for Expected Utility

From Rabin & Thaler (*JEP* 2001):

A high-level fact about how risk averse people are:

- People tend to dislike risky prospects even when they involve an expected gain.
- E.g.: A 50-50 gamble of losing \$100 vs. gaining \$110.

Economists' explanation: *expected utility with a concave utility function*.

- **Big Idea:** This explanation doesn't work because expected utility implies that "anything but virtual risk neutrality over modest stakes [will manifest in] unrealistic risk aversion over large stakes."

A Theoretical Problem for Expected Utility

Suppose you have wealth \$20,000.
Suppose you turn down a 50-50 bet to win \$110 vs. lose \$100.

Further suppose you have a CRRA utility function

$$u(x) = \frac{(x)^{1-\rho}}{1-\rho}.$$

What values of ρ are consistent with you rejecting this bet?

Reject if

$$\frac{1}{2}\,\frac{(20,110)^{1-\rho}}{1-\rho} \quad + \quad \frac{1}{2}\,\frac{(19,900)^{1-\rho}}{1-\rho} \quad < \quad \frac{(20,000)^{1-\rho}}{1-\rho}$$

With a little work, one can show that rejecting the bet implies that $\rho > 18.17026$.

A Theoretical Problem for Expected Utility

Suppose you have $\rho = 19$.

Again suppose you have wealth \$20,000, and consider how you'd feel about a 50-50 bet to lose Y vs. win X?

For $Y = \$100$, accept if and only if $X > 111.1$

For $Y = \$200$, accept if and only if $X > 250.2$

For $Y = \$500$, accept if and only if $X > 1038.4$

For $Y = \$750$, accept if and only if $X > 3053.8$

For $Y = \$1000$, accept if and only if $X > \ldots$ any guesses?

Point: The degree of risk aversion required to explain your rejection of the moderate-stakes gamble implies ridiculous behavior for larger-stakes gambles.

A Theoretical Problem for Expected Utility

In fact, need not assume anything about the functional form for $u(\cdot)$. Here's another example:

- Suppose Johnny is a risk-averse EU maximizer ($u'' \leq 0$).
- Suppose that, for any initial wealth, Johnny will reject a 50-50 gamble of losing \$100 vs. gaining \$110.
- Consider a 50-50 gamble of losing \$1000 vs. gaining $\$X$.
  - What is the minimum X such that Johnny might accept?
- Answer: $X = \infty$ — that is, Johnny will reject for any X.

A Theoretical Problem for Expected Utility

Two plausible features of preferences consistent with loss aversion:

1. How you feel about absolute gambles could be somewhat insensitive to your wealth — e.g., you might reject $(101, .5; -100, .5)$ for all w.

2. At the same time, scaling outcomes proportionally need not change your preferences much — e.g., you might have

$$\begin{aligned}(12, .5; -10, .5) &\sim (0, 1)\\ (120, .5; -100, .5) &\sim (0, 1)\\ (1200, .5; -1000, .5) &\sim (0, 1)\end{aligned}$$

Logic Underlying Previous Result

Recall that expected-utility theory operates over final wealth outcomes.

Rabin (2000) identifies a feature of ANY concave utility function for final wealth outcomes.

An individual who would reject a 50-50 bet over lose 100 and gain 110 at all wealth levels would reject **all** 50-50 bets up to (-1,000 , ∞).

...think about that for a second.

...keep thinking about that. We'll come back to this later.

Point: Curvature over small stakes indicates **implausible** risk aversion at large stakes.

Intuition: The marginal utility of money must decrease extremely rapidly.

Alternate Intuition: Curves look like straight lines when you zoom in close enough.

The Calibration Theorem

Put simply: the Calibration Theorem highlights that small-stakes risk attitudes cannot come from a concave utility function over final wealth outcomes.

Barberis, Huang, and Thaler (2006) find that most MBAs at the University of Chicago turn down a gain-$550, lose-$500 coin-flip.

- These students have (or will have) huge lifetime wealth relative to this gamble.
- This implies (hilariously) large risk aversion: EU theory says same person would also turn down coin flip with stakes gain $88 trillion, lose $10,000.

  (I'm reasonably confident those students would take that gamble.)

The Calibration Theorem

Small-stakes risk aversion is intuitively plausible and we see it all the time in day-to-day behavior. How do we rationalize it?

> *Indeed, what is empirically the most firmly established feature of risk preferences, loss aversion, is a departure from expected-utility theory that provides a direct explanation for modest-scale risk aversion. Loss aversion says that people are significantly more averse to losses relative to the status quo than they are attracted by gains, and more generally that people's utilities are determined by changes in wealth rather than absolute levels. Preferences incorporating loss aversion can reconcile significant small-scale risk aversion with reasonable degrees of large-scale risk aversion (p.1288)*