Introduction to Financial Models
Lecture 04: Surprises & Paradoxes III

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- If people maximize expected value, they should be willing to pay any finite amount to play

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- This amounts to $\operatorname{E} U(X) \approx \$1.39$, explaining why people would only pay a small amount

The Expected Utility Hypothesis

Mathematical Formulation

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- For power utility, $\gamma = 1$ corresponds to logarithmic utility (by L'Hôpital's rule)

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  - A risk-averse person would pay to avoid this gamble
  - The **risk premium** π is the maximum amount they would pay:

$$U(w - \pi) = \mathrm{E}\, U(w + \widetilde{X}) \tag{1}$$

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- For small risks, we can use Taylor expansion

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- Substitute into the risk premium formula (1) $U(w-\pi) = \mathrm{E}\,U(w+\widetilde{X})$,

$$U(w) - \pi U'(w) = U(w) + \frac{1}{2}U''(w)\,\mathrm{var}\,\widetilde{X} \implies \pi = \frac{1}{2}\left(-\frac{U''(w)}{U'(w)}\right)\mathrm{var}\,\widetilde{X}$$

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  - This axiom is violated in several famous paradoxes

Allais Paradox

- Game A

$$X = \begin{cases} 101 & \text{prob. } 0.33 \\ 100 & \text{prob. } 0.66 \\ 0 & \text{prob. } 0.01 \end{cases} \qquad Y = 100 \;\; \text{with prob. } 1$$

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- A single ball is drawn from the urn

Ellsberg Paradox (Cont'd)

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$$X = \begin{cases} 100 & \text{if red} \\ 0 & \text{if yellow or black} \end{cases} \qquad Y = \begin{cases} 100 & \text{if yellow} \\ 0 & \text{if red or black} \end{cases}$$

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$$\frac{2}{3} \cdot U(100) + \frac{1}{3} \cdot U(0) > (1-p) \cdot U(100) + p \cdot U(0)$$

$$\Longrightarrow \left(\frac{1}{3} - p\right) \cdot U(0) > \left(\frac{1}{3} - p\right) \cdot U(100) \quad (5)$$

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- Won the Nobel Prize in Economics in 2002 (Kahneman; Tversky had passed away)

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- Mathematical representation:

$$V(\text{prospect}) = \sum_i \pi(p_i) \cdot v(x_i)$$

where $v(x)$ is the value function and $\pi(p)$ is the probability weighting function

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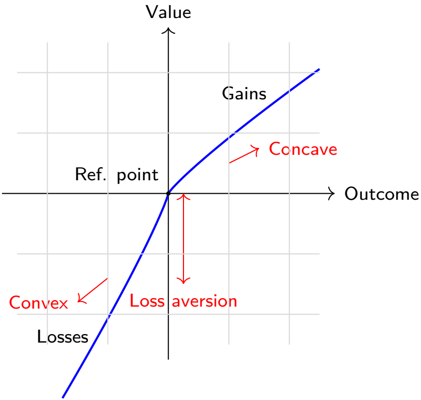

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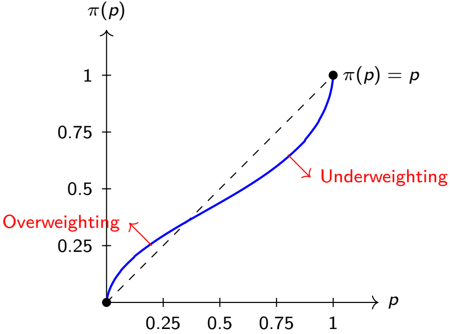

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  - The shift in preferences demonstrates that people are risk-averse for gains (saving lives) but risk-seeking for losses (avoiding deaths)

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  - People pay significant premium for "peace of mind" (certainty)

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  - Not found in cultures with limited private ownership (Apicella et al., 2014)

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    - Mortality frame: Only 50% chose surgery

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    - Self-control problems
    - Skill vs. chance attributions
    - Ambiguity attitudes distinct from risk attitudes
  - Loewenstein (1999): "Visceral factors" often overwhelm cognitive evaluations
  - Multiple competing behavioral models for different contexts:
    - Regret Theory (Loomes & Sugden, 1982)
    - Disappointment Theory (Bell, 1985)
    - Rank-Dependent Utility (Quiggin, 1982)
    - Security-Potential/Aspiration Theory (Lopes, 1987)
- Empirical Challenges:
  - Some effects diminish with experience or market discipline (List, 2003)
  - Individual-level predictions often less accurate than aggregate patterns
  - Substantial heterogeneity in behavioral responses
  - Some studies fail to replicate classic findings (Plott & Zeiler, 2005 on endowment effect)

Critiques and Limitations of Prospect Theory III

- Simplicity vs. Reality Tradeoffs:
  - Theory omits important factors in real decisions:
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  - Cultural variations in behavioral patterns (Henrich et al., 2001)