

Introduction to Financial Models

Lecture 03: 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 $E U(X) \approx \$1.39$, explaining why people would only pay a small amount

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 - 2 Subjective valuation (utility) of those outcomes

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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:

$$U(w - \pi) = E U(w + \tilde{X}) \quad (1)$$

Risk Aversion and Risk Premium II

- For small risks, we can use Taylor expansion

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

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

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 - **Continuity:** If $L_1 \succeq L_2 \succeq L_3$, then there exists a probability $p \in [0, 1]$ such that $L_2 \sim pL_1 + (1 - p)L_3$

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 - This axiom is violated in several famous paradoxes

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- Game A

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- A single ball is drawn from the urn

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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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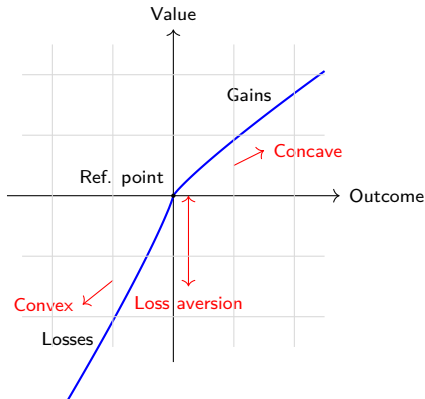
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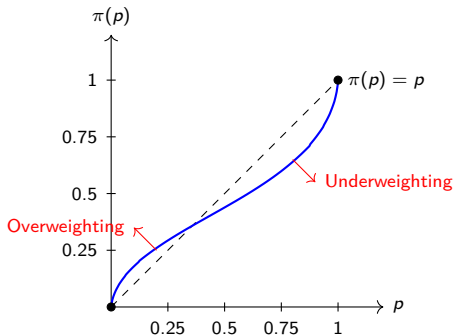
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- Real-world applications:
 - Explains demand for low-deductible insurance policies

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$$\begin{aligned}\pi(0.001) &> \pi(0.000) + \pi(0.001) - \pi(0.000) \cdot \pi(0.01) \\ &\approx \pi(0.000) + \pi(0.001) \cdot (1 - \pi(0.01))\end{aligned}$$

- Real-world applications:
 - Explains demand for low-deductible insurance policies
 - Insurance with exclusion clauses perceived as much less valuable

Key Findings: Probabilistic Insurance

- Probabilistic Insurance experiment (Kahneman & Tversky, 1979)
 - Regular insurance: Pay premium to fully eliminate risk
 - Probabilistic insurance: Pay half premium, but 1% chance insurance doesn't cover the loss
 - Expected utility theory: Probabilistic insurance should be attractive
 - Reality: Most people strongly dislike probabilistic insurance
- Experimental evidence:
 - Scenario: Regular insurance costs \$200 to protect against 0.1% risk of \$100,000 loss
 - Probabilistic insurance option: Pay \$100 premium, but 1% chance insurance is void
 - Would need 95% discount (not 50%) to make people indifferent
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- Real-world applications:
 - Explains demand for low-deductible insurance policies
 - Insurance with exclusion clauses perceived as much less valuable
 - People pay significant premium for "peace of mind" (certainty)

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 - Median selling price: \$7.12
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 - Choosers behaved like buyers, not sellers
 - Rules out alternative explanations (income effects, transaction costs)

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

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 - Effect persisted even after consumers tasted the identical product

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 - Strongly violates standard economic assumptions

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 - Only applies when gamble offers possibility of complete recovery
 - Otherwise, prior losses typically increase risk aversion ("snake-bit" effect)

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- Base Rate Neglect Experiment (Kahneman & Tversky, 1973):
 - Participants given personality descriptions of individuals randomly selected from group of 30 engineers and 70 lawyers
 - Asked to estimate probability each person was an engineer
 - Results: Estimates primarily based on how stereotypically "engineer-like" the description was

Beyond Prospect Theory: The Representativeness Heuristic

- Representativeness Heuristic: Judging probability by similarity to stereotypes
 - People assess probabilities based on resemblance to mental prototypes
 - Neglect relevant statistical information (base rates, sample sizes)
 - Focus on "matching" characteristics rather than probability principles
- The Linda Problem (Tversky & Kahneman, 1983):
 - Description: "Linda is 31, single, outspoken, very bright. Philosophy major. Concerned with discrimination, social justice. Participated in anti-nuclear demonstrations."
 - Question: Which is more probable?
 - A: Linda is a bank teller
 - B: Linda is a bank teller AND active in the feminist movement
 - Results: 85% of participants chose B as more probable
 - Conjunction fallacy: $P(A \text{ AND } B)$ cannot exceed $P(A)$
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 - Prior probabilities (base rates) of 30/70 largely ignored

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