Lessons Chapter 15: Prospect Theory

1. Prospect Theory Features Decreasing Sensitivity and Loss Aversion

- Lottery represents uncertain outcomes

$$L = \{x_1, p_1;\ x_2, p_2;\ x_3, p_3;\ \ldots; x_n, p_n\}$$

- Example: Startup lottery

$$L = \{-64, 0.50;\ 900, 0.50\}$$

- Utility function incorporates decreasing sensitivity and loss aversion

$$u(x) = x^{\mu} \text{ for } x \geq 0$$

$$u(x) = -\lambda \cdot (-x)^{\mu} \text{ for } x < 0$$

  - Decreasing sensitivity: $\mu < 1$
  - Loss aversion: $\lambda > 1$
- Figure 15.1 Utility Function for Prospect Theory
- Widget 15.1: Prospect Utility Curves

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2. Certainty Equivalent Measures WTP to Play a Lottery

- Utility value is weighted sum of outcomes

$$v(L) = p_1 \cdot u(x_1) + p_2 \cdot u(x_2)$$

  Startup example ($\lambda = 2$, $\mu = 0.50$)

$$v(L) = -\frac{1}{2} \cdot 2 \cdot 64^{1/2} + \frac{1}{2} \cdot 900^{1/2} = -8 + 15 = 7 \text{ utils}$$

- Certainty equivalent translates utility value into dollar value

$$u(c(L)) = v(L)$$

$$u(x) = x^{1/2} \implies x = u^2 \text{ or } c(L) = v(L)^2$$

$$c(L) = v(L)^2 \implies c(L) = (7)^2 = \$49$$

- Figure 15.2 The Startup Lottery with Prospect Theory

- Widget 15.2: Measures of a Mixed Lottery

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3. Risk Aversion from Decreasing Sensitivity & Loss Aversion

- Risk aversion
  - Risk Aversion: $c(L) < m(L)$
  - Startup lottery: $c(L) < \$418$
- Risk premium: $r(L) = m(L) - c(L)$
- Figure 15.3 Risk Aversion and the Risk Premium
- Risk neutrality: $c(L) = m(L) \quad \Rightarrow \quad r(L) = 0$
- Figure 15.4 Risk Neutrality
  - $u(x) = 10 \cdot x; \quad \lambda = 1$
  - Risk neutrality from linear utility and no loss aversion

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4. Experiments Reveal the Values of Key Parameters

- Loss aversion
  - Tversky et al: $\lambda = 2.25$
  - Abdellaoui et al: $\lambda = 1.79 \rightarrow 4.80$
  - Sokol-Hessner et al: $\lambda = 0.41 \rightarrow 3.91$; mean $\lambda = 1.40$
- Decreasing sensitivity to gain

  I'll flip a coin. If it's heads, I'll give you \$100. If it's tails, I'll give you nothing. Or, we can forget about flipping the coin, and I'll give you \$20 for certain. It's your choice--a coin flip with equal chances of \$100 or nothing, or \$20 for sure.

  - Estimating value of μ for gain

$$\mu = \frac{Log(p)}{Log(c) - Log(x)}$$

  - Example

$$\mu = \frac{Log(0.50)}{Log(25) - Log(100)} = 0.50$$

- Decreasing sensitivity loss

  I'll flip a coin. If it's heads, you pay \$100. If it's tails, you pay nothing, and your tax liability disappears. Or, we can forget about flipping the coin, and you pay \$50 for certain. It's your choice--a coin flip with equal chances of paying \$100 or nothing, or pay \$50 for sure."

  - Estimating value of μ for gain

$$\mu = \frac{Log(p)}{Log(-c) - Log(-x)}$$

  - Example

$$\mu = \frac{Log(0.50)}{Log(25) - Log(100)} = 0.50$$

- Widget 15.3: Compute the Values of Your Utility Parameters

- Bisection method for decreasing sensitivity
    - Find midpoint of two extremes
    - Figure 15.5 Bisection Method for Stimulus-Response Calculations
    - Results

$$perceived\ sweetness = (sugar\ concentration)^{0.60}$$

$$perceived\ warmth\ of\ a\ large\ patch\ of\ skin = (skin\ temperature)^{0.70}$$

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5. Rat Behavior is Consistent with Prospect Theory

- Thirsty lab rats chose between certain and uncertain water rewards
    - Flashing lights for the probabilities of the uncertain rewards
    - Auditory clicks for volumes of water for certain and uncertain rewards
- Results
    - Decreasing sensitivity: $\mu = 0.54$.
    - Loss aversion: $\lambda = 1.66$.
- Figure 15.6 Value Function for Rats
- Substantial variation in risk preferences across rats
    - For small number of rats, $\mu > 1$
    - For 44% of the rats, $\lambda < 1$