Behavioral Economics

Topic 1: Choice under Uncertainty

Lecture 8: Reference-Dependent Preferences

Professor Bushong

MICHIGAN STATE UNIVERSITY

Taking Stock

Last class: Applications of prospect theory

Today:

- Very briefly: newer model of prospect theory that emphasizes reference points
- Review for Exam 1

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Logistics:

- Exam 1 is Thursday!
- Reminder: 1 page of double-sided notes is allowed (and calculator)
- Practice Problems posted
- Problem Set 2 due — please review detailed answers posted after class
- First place to start when studying: understand problems from P-Sets, practice, class

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Preferences are:

$$\text{Total Utility} = [\, m_A(x_A) + v_A(x_A|r_A) \,] + [\, m_B(x_B) + v_B(x_B|r_B) \,]$$

- $m_A(x_A)$ is intrinsic utility for good A, and $m_B(x_B)$ is intrinsic utility for good B.

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- $v_A(x_A|r_A)$ is gain-loss utility for good A, and $v_B(x_B|r_B)$ is gain-loss utility for good B.

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- Assume a "universal gain-loss function" $\mu(z)$ such that the gain-loss utilities are:

$$\begin{aligned} v_A(x_A|r_A) &= \mu(\ m_A(x_A) - m_A(r_A)\ ) \\ v_B(x_B|r_B) &= \mu(\ m_B(x_B) - m_B(r_B)\ ) \end{aligned}$$

- $\mu(z)$ takes form of the Kahneman-Tversky value function. But we'll focus on the special case:

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- $\mu(z)$ takes form of the Kahneman-Tversky value function. But we'll focus on the special case:

$$\mu(z) = \begin{cases} \eta z & \text{if } z \geq 0 \\ \eta\lambda z & \text{if } z < 0 \end{cases} \qquad \text{with } \lambda > 1.$$

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$$u(x|r) = \begin{cases} x + \eta(x - r) & \text{if } x \geq r \\ x + \eta\lambda(x - r) & \text{if } x < r \end{cases} \qquad \text{with } \lambda > 1.$$

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Example: Two goods, shoes (c) and money (w), with intrinsic utilities:

$$m_c(c) \equiv \theta \cdot c$$

$$m_w(w) \equiv w$$

Recall: Gain-loss utility is $v_i(c_i|r_i) = \mu(\; m_i(c_i) - m_i(r_i)\;)$, where

$$\mu(z) = \begin{cases} \eta z & \text{if } z \geq 0 \\ \eta\lambda z & \text{if } z \leq 0 \end{cases}$$

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$$u(\theta|r_s) = \begin{cases} \theta + \eta(\theta - r_s) & \text{if } \theta \geq r_s \\ \theta + \eta\lambda(\theta - r_s) & \text{if } \theta < r_s \end{cases} \qquad \text{with } \lambda > 1.$$

Total utility from $(\theta, w - p)$ when expecting (r_S, r_m) is

$$U((\theta, w - p)) = u(\theta|r_s) + u(w - p|r_m)$$

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	$r_c = 0$	$r_c = 1$
$c = 0$	0	$-\eta\lambda\theta$
$c = 1$	$\theta + \eta\theta$	θ

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$$\text{Buy when Utility(Buy)} \geq \text{ Utility(Not)} \Longleftrightarrow p \leq \frac{1+\eta\lambda}{1+\eta}\theta.$$

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Kőszegi & Rabin (2006)

Because $\lambda > 1$ implies $\frac{1+\eta\lambda}{1+\eta} > \frac{1+\eta}{1+\eta\lambda}$, there are three cases:

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- E.g., $\theta = 100$, $\eta = 1$, $\lambda = 3$:
  - If $p < 50$, then always buy, if $p > 200$ then never buy, if p in between 50 and 200, whether you buy depends on your expectations

Point: If the reference point depends on expectations, then, even in the same situation, a person might exhibit different outcomes depending on which set of self-fulfilling expectations he happens to have.

Kőszegi & Rabin (2006) Example

Suppose there are two goods, candy bars (c) and money (m). Paige has initial income I, and she is deciding whether to buy 0, 1, or 2 candy bars at a price of p per candy bar. Paige's total utility is the sum of her candy-bar utility and her money utility, and her intrinsic utilities for the two goods are:

$$w_c(c) \equiv \begin{cases} 0 & \text{if } c = 0 \\ \theta_1 & \text{if } c = 1 \\ \theta_1 + \theta_2 & \text{if } c = 2 \end{cases} \qquad \text{where } \theta_1 > \theta_2$$

and $w_m(m) \equiv m$

Kőszegi & Rabin (2006) Deterministic Example

(a) If Paige were a standard agent who only cares about her intrinsic utilities, how would she behave as a function of the price p? In other words, for what prices would she buy zero candy bars, for what prices would she buy one candy bar, and for what prices would she buy two candy bars?

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(b) Now suppose that Paige behaves according to the Koszegi-Rabin model. In other words, in addition to intrinsic utilities, she also cares about gain-loss utility, where the gain-loss utility for each good is derived from the universal gain-loss function:

$$\mu(z) = \begin{cases} \eta z & \text{if } z \geq 0 \\ \eta\lambda z & \text{if } z \leq 0 \end{cases}$$

If Paige expects to buy no candy bars, how would she behave as a function of the price p? In other words, for what prices would she buy zero candy bars, for what prices would she buy one candy bar, and for what prices would she buy two candy bars?

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- If consume lottery $X \equiv (x_1, p_1; \ldots; x_N, p_N)$ given reference point r, then "expected" total utility is

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Example: If $X = (200, \frac{1}{4}; 0, \frac{3}{4})$ and $r = 100$, then

$$U(X|r) = \frac{1}{4}u(200|100) + \frac{3}{4}u(0|100).$$

Specific case with $\eta = 1$ and $\lambda = 3$:

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Specific case with $\eta = 1$ and $\lambda = 3$: $r = 100$ implies $U(X|r) = -75$ and $r = 0$ implies $U(X|r) = 150$.

Kőszegi & Rabin (2007)

Another Example: Suppose lottery $A = (y, 1)$ for some y between 0 and 200 and lottery $B = (200, \frac{1}{2}; 0, \frac{1}{2})$. Suppose the person expects A (i.e., y for sure). Which lottery will they pick if given the choice?

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$$U(B|y) \;=\; \frac{1}{2}u(200|y) + \frac{1}{2}u(0|y) \;=\; \frac{1}{2}[200 + \eta(200 - y)] + \frac{1}{2}[0 + \eta\lambda(0 - y)]$$

Specific case with $\eta = 1$ and $\lambda = 3$:

$$U(B|y) \;=\; \frac{1}{2}[200 + (200 - y)] + \frac{1}{2}[0 + 3(0 - y)] \;=\; 200 - 2y$$

Result: choose B if $y < 66.67$, otherwise stick with A.

Kőszegi & Rabin (2007)

Additional twist: you might expect a lottery, in which case the reference point would be a lottery.

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$$U(X|R) = \frac{1}{4}\left[\frac{1}{3}u(200|150) + \frac{2}{3}u(200|50)\right] + \frac{3}{4}\left[\frac{1}{3}u(0|150) + \frac{2}{3}u(0|50)\right]$$

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$$U(X|R) = \frac{1}{12}u(200|150) + \frac{1}{6}u(200|50) + \frac{1}{4}u(0|150) + \frac{1}{2}u(0|50).$$

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Consider choice

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$$A \equiv (y, 1) \text{ with } y \leq 100 \qquad \text{vs.} \qquad B \equiv \left(\, 200, \frac{1}{2}\,;\, 0, \frac{1}{2}\,\right)$$

Case 1: Suppose expect lottery $A \Longrightarrow$ reference point is $r = y$:

$$\begin{aligned} U(A|r) &= y + [0] \\ U(B|r) &= 100 + \left[\tfrac{1}{2}\eta(200 - y) + \tfrac{1}{2}\eta\lambda(0 - y)\right] \end{aligned}$$

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$$\text{Choose } A \text{ if } y \geq \frac{1 + \eta}{1 + \frac{1}{2}\eta + \frac{1}{2}\eta\lambda} 100 \equiv \bar{y}_1.$$

Kőszegi & Rabin (2007)

Case 2: Suppose expect lottery $B \Longrightarrow$ reference point is $R = (\ 200, \frac{1}{2}\ ; 0, \frac{1}{2}\ )$:

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Note: $\bar{y}_2 > \bar{y}_1$ — expecting risk makes you less risk averse!

- Intuition: When expect risk, even certain outcomes involve gains and losses, and thus they lose part of their advantage relative to risky outcomes.

Application: Labor Supply of Taxicab Drivers

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  - Simple intuition: efficiently allocate your work effort.
- They test this prediction on NYC cab drivers.

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Hence, they take their unit of observation to be a day — in particular, they estimate a daily wage equation:

$$\ln H_t = \gamma \ln W_t + \beta X_t + \varepsilon_t$$

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In words, the standard model predicts positive wage elasticities, but they find negative wage elasticities.

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Their explanation is income targeting driven by loss aversion:

- one-day time horizon for decision making.
- reference point is a daily income target.
- losses relative to the target loom larger than gains.

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He first provides several critiques of Camerer et al (*QJE* 1997):

- There is a "division bias" — Camerer et al attempt to correct for it, but there are good reasons to doubt their correction.
  - "Division bias": wages are calculated as earnings divided by hours, but hours are endogenous.
  - $\rightarrow$ Negative bias in wage elasticity estimates.

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- After cutting the data in a different way, he finds that it is not so clear there is more inter-day variation in the wage than intra-day variation in the wage.

Main point: There is a better approach that gets around these problems: instead of estimating usual wage regressions, estimate a probit optimal-stopping model.

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[And now for a little econometrics!]

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- Stop when $R(\tau) \geq 0$, where $R(\tau) = \gamma_1 h_\tau + \gamma_2 y_\tau + \beta X_\tau + \varepsilon_\tau$.
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- BUT it's not clear whether this result is inconsistent with income targeting.
  - Income targeting does not imply $\gamma_1 = 0$.
  - Perhaps a misspecification of the daily-income effect.

Crawford & Meng (AER 2011)

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- There should be gain-loss utility over each dimension of consumption — here, this means over income (as usual) but also over hours worked.

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They apply the Kőszegi-Rabin perspective to this debate:

- There should be gain-loss utility over each dimension of consumption — here, this means over income (as usual) but also over hours worked.
- Take the reference point to be people's expectations about outcomes — in particular, take them to be people's average experienced outcomes.

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Their Hypothesis: Reference point is (H^e, Y^e).

- Working fewer than H^e hours generates gain utility, and working more than H^e hours generates loss utility.
- Earning more than income Y^e generates gain utility, and earning less than income Y^e generates loss utility.

Crawford & Meng (AER 2011)

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Hence, Crawford & Meng re-run the Farber (2005) estimation (with Farber's dataset), except they split the dataset into observations on "high-wage days" vs. "low-wage days".

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  - For low-wage days, $\gamma_2 > 0$ while $\gamma_1 = 0$.

Standard model predicts $\gamma_1 > 0$ while $\gamma_2 = 0$ for either case.

Crawford & Meng (AER 2011)

They find evidence consistent with their model and strongly reject Farber's analysis.

Moreover, they show that targets in hours loom larger than targets in wages, which is consistent with the theory.

Other Empirical Work

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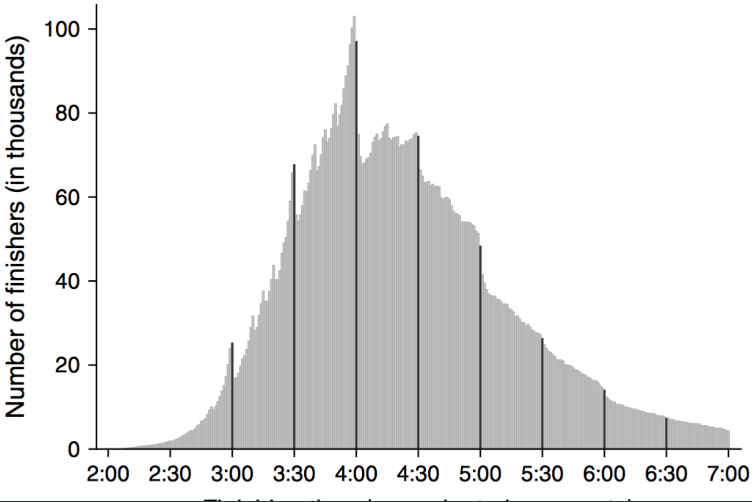
- Chetty et al. (2011) application: taxes and kinks in the tax schedule.

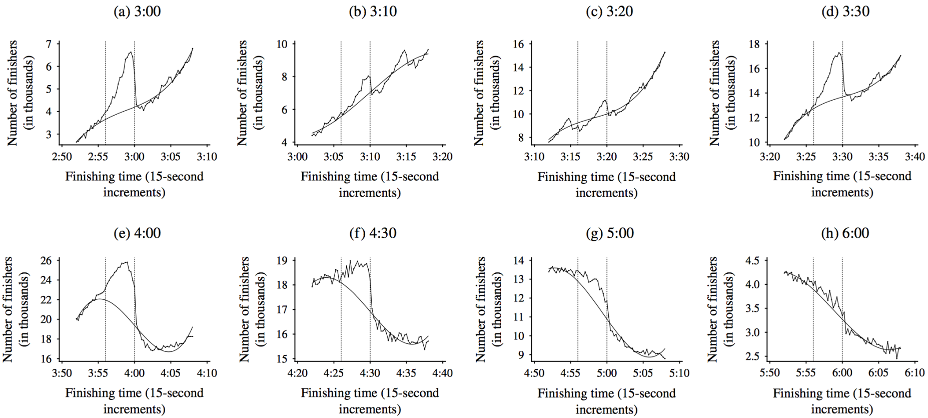
Allen et al. (2017) looks for this in marathon runners.

Allen et al. 2017 (Marathon Runners)

$(n = 9{,}789{,}093)$



Allen et al. 2017 (Marathon Runners)



Epilogue

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Expected values matter, but don't wholly determine choice.

Diminishing marginal utility (i.e., classic risk aversion in the expected-utility model) matters, but definitely does not explain most choices over risk.

Prospect theory matters, but one must be careful about what the reference point is in any given setting – it is often expectations

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We've also (sneakily) introduced a new category of utility function: **belief-based utility**.

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We will return to some other models where expectations matter!

Next Class

Today: Reference dependence

Next module: choices over time

Remember:

- Exam 1 on Thursday
- Reminder: you can bring one page of double-sided notes and calculator

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- Misleading conclusions when you fail to account for beliefs.
- ...but when you apply the "correct model", your intuitions are preserved.

BUT: there are a lot of open questions about Kőszegi and Rabin's theory. (Wanna go to grad school?)