Recitation 5: Reference Dependence

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Reference Dependence: 3 Key Ingredients

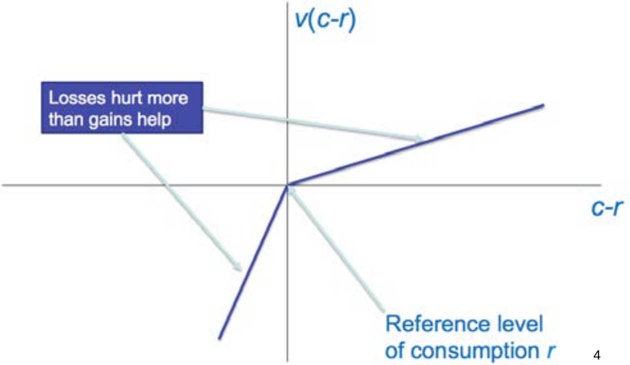
1. Utility evaluate things (consumption, ...) **relative** to something, rather than in some absolute terms. What matters is **changes** rather than levels.
2. **Loss aversion**: losses hurt more than symmetric gains help
3. **Diminishing sensitivity**: Changes far away from the reference matter less than changes close to the reference

Utility is Evaluated Relative to a Reference Point

- Typically, evidence supporting this idea are behavioral patterns of bunching near some arbitrary level
  - Examples: Marathon runners bunch around salient times, taxi drivers vary labor supply to reach daily income targets
- What is the "reference point"?
  - An expectation
  - A goal or aspiration
  - A status quo
  - A starting point
  - An anchor
- General set-up:
  - Utility is over consumption, c, relative to a reference point, r; that is, utility is over $x = c - r$
  - The function $u(x)$ may take different shapes for $x > 0$ and $x < 0$

Loss Aversion

- The idea of evaluating changes rather than levels becomes much more concrete when we add in loss aversion
- A form of reference dependence with much empirical support
- Loss aversion: losses hurt more than gains help



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Loss Aversion

- Example: if I expect my birthday check to be \$100, the util cost of a \$90 check will be greater than the util gain of a \$110 check
  - What theory of the reference point is used in this example?
  - Expectation-based reference point
  - Another possibility: anchoring on 100?

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Application: Endowment Effect

- Endowment effect: owning a good makes you less likely to trade it away
  - Widely documented empirical fact
  - Mugs experiments
  - Note: agent needs to think he owns the good - simply handing him the good if he thinks it will be taken away is not sufficient to generate endowment effects
- Loss aversion can explain it:
  - Your endowment becomes your reference point
  - The util gain you would get from the new item is less than the util cost of trading the endowment away
- Consequences e.g. for marketing:
  - Make potential consumers feel they own the good
  - Offer free returns

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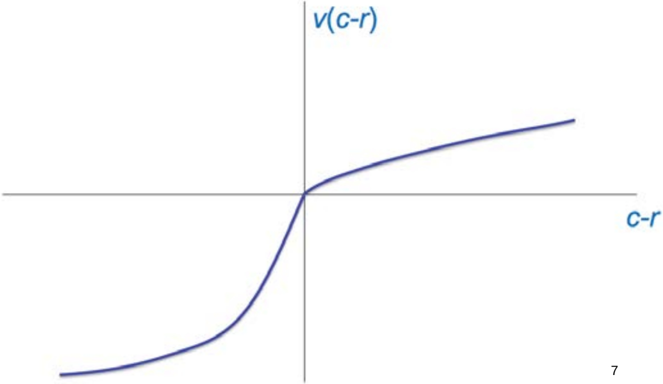
Diminishing Sensitivity

- Diminishing Sensitivity: sensitivity to additional changes in consumption should be smaller the further the changes are from the reference point
- Example: the utils cost from moving to a $100 to a $90 birthday check is greater than the cost of moving from $90 to $80



Implications: Convexity and Concavity

- Loss aversion and diminishing sensitivity implies usual concave utility in gains
- However, we have convex utility over losses
- In situations of risk, this implies risk aversion over gains and risk loving over losses
    - Helps explain empirical findings that people become risk-seeking after losses
    - Deal or No Deal? example
        - What is the reference point here?
    - Also from experiment with lotteries framed in loss domain or gain domain
        1. Here is $100. What do you think of: loosing 50 for sure vs loosing 100 with 50% probability?
        2. What do you think of winning 50 for sure vs winning 100 with 50% probability?
    - Diminishing sensitivity also means the risk-lovingness decreases once we get far in the loss domain

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Implications: Better to Loose in Batch and Gain In Small Increments

- Diminishing sensitivity implies that marginal utility is highest near the reference point
  - Intuitively, this means small changes have the highest effect there
  - A small gain implies a utility increase greater than a tenth of the utility increase from a gain ten times larger
  - A small loss implies a utility decrease greater than a tenth of the utility decrease from a loss ten times larger
- If a large consumption gain can be broken down over time, and *if the reference point adapts* after each fraction of the gain, then it's better
- And conversely for losses: frequent small losses hurt much more than a comparable one-shot loss *if the reference point adapts*
- Implication: sellers should revise prices upwards unfrequently!

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Question: Set Up

Maddie has wanted to buy several pairs of new pants, but she has not done so yet. Suppose she has reference-dependent utility over pants c_p and money c_M of the form

$$v(50c_p - 50r_p) + v(c_M - r_M), \tag{1}$$

where $v(x) = x$ for $x \geq 0$ and $v(x) = 2x$ for $x < 0$. Maddie has \$300 in cash.

- *What are r_p and r_M?*
- *What about the utility function makes her reference dependent?*

Part 1: Question

Suppose Maddie is expecting to buy two pairs of pants at \$40 each. That is, her reference point for pants is $r_P = 2$, and her reference point for money is $r_M = 220$. What is the maximum price, $p_{\max}$, at which she is willing to buy the first two pairs of pants?

- *Why do* $r_P = 2$ *and* $r_M = 220$ *become her reference points?*
- *Would we expect the price she is willing to pay for two pants to be above, below, or equal to* \$80*?*

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Part 1: Solution

- Let p_{max} be the maximum willingness to pay for 2 pairs
- By definition, p_{max} is the price such that she is indifferent between not buying, $(c_P, c_M) = (0, 300)$, and buying, $(c_P, c_M) = (2, 300 - p_{max})$
- Hence, p_{max} solves:

$$\begin{aligned} v(50 \cdot 0 - 50 \cdot 2) + v(300 - 220) &= v(50 \cdot 2 - 50 \cdot 2) + v(300 - p_{max} - 220) \\ v(-100) + v(80) &= v(0) + v(80 - p_{max}) \\ -200 + 80 &= 2(80 - p_{max}) \\ -60 &= 80 - p_{max} \\ p_{max} &= 140. \end{aligned}$$

Part 2: Question

Now suppose that after buying two pairs of pants at the price of \$40, unexpectedly, Maddie is contemplating buying another pair of pants. What is her maximum willingness to pay, p'_{max}, for a third pair of pants?

- *What does "unexpectedly" imply for her reference points?*
- *Should we expect p'_{max} to be above, below, or equal to \$40?*

Part 2: Solution

- $r_p = 2, r_m = 220$
- By definition, p'_{max} is the price such that Maddie is indifferent between not buying, $(c_P, c_M) = (2, 220)$, and buying $(c_P, c_M) = (3, 220 - p'_{max})$
- Hence, p'_{max} solves

$$\begin{aligned}
v(50 \cdot 2 - 50 \cdot 2) + v(220 - 220) &= v(50 \cdot 3 - 50 \cdot 2) + v((220 - p'_{max}) - 220) \\
v(0) + v(0) &= v(50) + v(-p'_{max}) \\
0 &= 50 - 2p'_{max} \\
p'_{max} &= 25.
\end{aligned}$$

Part 3: Question

Suppose the salesperson, Allan, exactly knows Maddie's preferences. To entice her, he offers her a bundle of three pants at

$$p_{\mathrm{b}} = p_{\max} + p'_{\max} - \varepsilon = 165 - \varepsilon, \tag{2}$$

where ε is very small, such that Maddie cannot resist and buys the three pairs of pants from him. If Allan had called Maddie ahead of time to tell her about the deal (i.e. p_{b}), her reference point would have adjusted to three pants. How (if at all) would her willingness to pay for the bundle upon arrival at the store have changed?

- *Should we expect her willingness to pay for the bundle to be less than, greater than, or equal to* 165*?*

Part 3: Solution

- If Allan called before the deal, then $r_P = 3, r_M = 300 - p_b$
- p_A is the price such that Maddie is indifferent between not buying $(c_P, c_M) = (0, 300)$ and buying $(c_P, c_M) = (3, 300 - p_A)$
- Hence, p_A solves

$$v(50 \cdot 0 - 50 \cdot 3) + v(300 - (300 - p_b)) = v(50 \cdot 3 - 50 \cdot 3) + v((300 - p_A) - (300 - p_b))$$

$$\begin{aligned} v(-150) + v(p_b) &= v(0) + v(p_b - p_A) \\ -300 + p_b &= 2(p_b - p_A) \\ p_A &= 0.5p_b + 150 = 232.5 - 0.5\varepsilon. \end{aligned}$$

Part 4: Question

Assume Allan can only sell one bundle of three pairs to Maddie and no other combinations. If Allan wants to maximize his revenues, what bundle price should he tell Maddie about on the phone? And what actual price should he charge upon her arrival at the store? (Assume the price over the phone and in the store can be different)

Part 4: Solution

- From part 3, we know Allan can announce p_b and charge $p_A = 0.5p_b + 150$ in the store
- To maximize revenue, Allan will announce the highest p_b he can
- He should tell Maddie the p_b that makes her indifferent between coming to the store and not
- When Allan calls, her reference point will still be for 2 pants; her maximum willingness to pay will be the sum of the prices from parts 1 and 2, \$165
- He will announce $p_b = \$165 - \varepsilon$ and charge $\$232.5 - 0.5\varepsilon$.

Part 5: Question

1. How much is Maddie willing to pay if she expects to buy 0 pants? (Assume the actual price would still be $ 40)
2. What is the lowest price would Maddie ask for if someone wanted to buy the pants after she bought them?
3. What is the difference between (1) and (2) reflect?

Part 5: Solution

5.1: From part 2, \$25

5.2:

- $r_p = 1, r_m = 260$
- Let p''_{max} be the price such that Maddie is indifferent between not selling, $(c_P, c_M) = (1, 260)$, and selling $(c_P, c_M) = (0, 260 + p''_{max})$
- Hence, p''_{max} solves

$$\begin{aligned} v(50 \cdot 1 - 50 \cdot 1) + v(260 - 260) &= v(50 \cdot 0 - 50 \cdot 1) + v((260 + p''_{max}) - 260) \\ v(0) + v(0) &= v(-50) + v(p''_{max}) \\ 0 &= -100 + p''_{max} \\ p''_{max} &= 100. \end{aligned}$$

5.3: an endowment effect

Pants, Mugs, and Pencils

Pants: key take-aways

- Reference dependence means willingness to pay changes based on expectations
- The specific type of reference dependence, loss aversion, means Maddie values the good more if she expects to have it

Pants, Mugs, and Pencils

- How are these results related to the mug-pencil example from class?
- Why do we expect people to exchange mugs and pencils?
- Why is a lack of trading consistent with an endowment effect?