Belief-Based Utility

More Realistic Preferences

Next 3 lectures: improving assumptions about preferences:

- Belief-Based Preferences
- Reference-Dependent Utility, Risk Preferences, News Utility
- Social Preferences
Belief-Based Utility

In psychology for very long, and more recently in formal economics, researchers contemplate preferences that depend directly on beliefs.

- Not $U(c)$, where $c$ is “physical” / “experienced” / outcomes
- But $U(c, p)$, where $p$ is (current or recent) beliefs about something.
- Care about beliefs not solely for “instrumental” reasons.
- Differs from how beliefs enter choice under expected-utility.
  - In EU: Beliefs over utility, not utility over beliefs
  - Linearity of $p$ matters a lot behaviorally
    - EU is weight assigned to different eventualities
    - Not description of states of mind
- Normatively compelling when weighting eventualities
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- Whether food you just ate is *truly* poisonous or unhealthy, will have an important effect on your well-being down the line.
- But your *beliefs*, even if not true, affect your well-being *now*.
  - If *think* food poisonous, you’d be in (very unhappy) distress.
  - If *think* food fattening, guilt or negative anticipatory utility.
  - If *think* food not exploitatively produced, be happier.
- Putting the *p* in utility is the next big trend.
  - Making that prediction a while, but now conferences on b-b utility, annual psycho-games conferences, etc.
- Utility maximization, much like old.
- But some difference with old-style modeling.
  - E.g., looser connection between correct beliefs and happiness?
  - Time-consistency issues requires researchers cope ...
    - a) emotionally, and
    - b) technologically.
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Examples where well-being and choice importantly influenced by beliefs.

- Ego utility/self-image/identity
- Anticipation and dread
- Disappointment and pleasant surprises
- Social status and envy etc.
- Health anxiety (and attitudes towards testing)
- Social image—what do others think of us?
- Sports, movies, novels, news (before vs. after results known).

In each: happiness mediated by our (true or false) beliefs about world.

- My view: **most** preferences are belief-based.
  - Food for (later) thought: includes all choice-set-dependent prefs.
- Obsession with b-b preferences *not* widespread in BE.
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Classical economic issue:

- Unemployment.
- Classical assumptions → hard to generate big individual cost of unemployment.
- Intuition, and (non-decisive) happiness evidence suggests:
  - effect on well-being greater than captured by economic models.

We have not had the formal apparatus to deal with:

- Self-image consequences of being unemployed.
- Social-image consequences of being unemployed.
- Anxiety of becoming unemployed.
  - Not merely behavioral (spend less, no vacations, etc.).
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Example to frame thinking: 

- For a long time, thought probably no 3-day vacation.  
- Then one day find out that probably will (80%),  
- and then confirmed as 100% likely when it happens.  
- Belief evolution:
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Utility in time?

- Will talk about real-time “happiness” without choice.

Stay calm!

- This will have implications for choice.

Utility if above beliefs? Could be:
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Note: As said earlier, treating beliefs and utility as real.  

- Now we’re going to assume ... wait for it ... time is real!
- Uncontroversial, and completely standard ... sort of.
  - We don’t *quite* say in much formal economics when you experience utility.
  - So some of our models are going to be not quite PEEMish.
  - E.g., present bias takes more of a stance about moments of experience.
  - A central component of doing good is to understand and embrace the “time stamping” of utility.
  - Here, and in present bias, elsewhere, be careful writing down the consumption profiles.
  - E.g., getting $ and durable goods is *future* consumption, not current;
    - And having anticipation or anxiety over current consumption is *past* utility.
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Or could be:  

4 3 2 1 0

Or could be:  

4 3 2 1 0
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Or could be (my personal vote):

4
3
2
1
0

↑

↓

* H H H
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So what?

- Why care about the timing or reason for enjoying a vacation? 
  - Often: We don’t. All captured by utility(vacation).
  - Reduced form probably best for “remembered utility”.

But can matter for various reasons. Three are:

- Use direct happiness data iff our theories specify timing of utility. (Not topic these lectures).
- Beliefs/information matter even when behavior is unaffected.
- Affects choice: including time inconsistency, commitment, etc.
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Suppose planning vacation:

- Have anticipatory preferences for holidaymaking only.
- $10,000 Club Medic holiday package, total anticipatory utility plus consumption and remembered utility well worth $10,000.
- But without anticipatory utility, not nearly worth it.
- Can/must buy months in advance.

Situation A: All but $50 is fully refundable if 24 hours in advance.

- What would a fully rational person (as I define it) do?
- She would/would not (cross out one) buy the package, and then she would/would not (cross out one) go on the vacation.
- And so:
  - She would not buy the package, then would not go on the vacation.
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If fully rational and have the specified preferences, you won't sign up under Policy A, because you'll cancel, and know you'll cancel, and won't get anticipatory utility after all.

"Fully rational" defined:

- Dynamically optimal, anticipating correctly own conduct.
- But not the beliefs that make you happiest.
- With b-b preferences, the two are different.
  - Remember: not the same under classical EU

Situation B: Contract allows no refunds.

- What would a person do?
- Buy package? Go on vacation?
  - She would buy the package, and then she would go on the vacation.
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Predictions in A vs. B do/do not (cross out one) violate classical assumptions about preferences?

- This does violate classical axioms/assumptions about preferences.
  - Chose plan "No Buy" from \{No Buy, Go, Cancel\} in Situation A.
  - "Go" from \{No Buy, Go\} in Situation B.
  - (And worse off in Situation A)

- This should/should not (cross out one) freak you out?
  - This should not freak you out.

- Violating such an axiom should/should not (cross out one) thrill you?
  - It should not thrill you.

- Be interested in realism, insight, and importance of assumptions.
  - (Not sure of realism, importance this example)

- “De gustibus” philosophy in its purest and most legitimate form:
  - anticipatory preferences described here are perfectly coherent;
  - we should not arrogantly dismiss them to satisfy our own axioms
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Lessons from this example:

- Generates choice-set-dependent preferences.
- Correct beliefs vs. happiness-inducing beliefs?
  - If believed would go through with it?
- Welfare effects, choice-set effects, must be handled with care.
- Making predictions:
  - The real way to do it ... optimal consistent plans.
Extra slides contain model of consumption & savings with anticipatory preferences...

- A big prediction: without commitment, consumption will be increasing over time
  - Intuition?
- And with commitment ...
  - even more increasing.
- Why from anticipating solely his future consumption utility?
  - Why not also from future anticipatory utility?
  - We’ll ignore.
Consumption & Savings with Anticipatory Preferences

Setting and Preferences

Yuki will live for 3 periods, has $y$ to spend over that time (no interest), seeks to maximize his (undiscounted) lifetime utility $U^1 = u_1 + u_2 + u_3$.\(\Rightarrow\)

- In period $t$, “consumption utility“ $m_t$ that depends on $c_t$.\(\Rightarrow\)
- Also gets utility from anticipating his future consumption utility.\(\Rightarrow\)
- Why from anticipating solely his future consumption utility?\(\Rightarrow\)
  - Why not also from future anticipatory utility?\(\Rightarrow\)
  - We’ll ignore.
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Attempt to model this:

\[ u_1 = m(c_1) + \varphi[m(c_2) + m(c_3)] \]
\[ u_2 = m(c_2) + \varphi[m(c_3)] \]
\[ u_3 = m(c_3) \]

where \( \varphi \geq 0 \) is relative concern for anticipatory utility.

Question: what is *incoherent* about such preferences?

- \( u_1 \) cannot depend on \( c_2 \) or \( c_3 \). Only **beliefs** about \( c_2, c_3 \).
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2nd attempt to model:

- $u_1 = m(c_1) + \varphi E_1 \{ m(c_2) + m(c_3) \}$
- $u_2 = m(c_2) + \varphi E_2 \{ m(c_3) \}$
- $u_3 = m(c_3)$

where $E_t \{ m(c_\tau) \}$ is period-$t$ expectations of period-$\tau$ cons. utility.

Would want more complete version of this if there is uncertainty.

When beliefs deterministic, shorthand:

- $u_1 = m(c_1) + \varphi [ m(\tilde{c}_2^1) + m(\tilde{c}_3^1) ]$
- $u_2 = m(c_2) + \varphi [ m(\tilde{c}_3^2) ]$
- $u_3 = m(c_3)$

where $\tilde{c}_t^\tau$ are Yuki’s period-$t$ beliefs about period-$\tau$ consumption.

What will Yuki do?
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**Candidate** solution: Yuki solves

\[
\text{Max } c_1, c_2 = m(c_1) + (1 + \varphi) m(c_2) + (1 + 2\varphi) m(y - c_1 - c_2).
\]

- E.g., if \( m(x) = \ln(x) \), then
  
  \[
  c_1^{**} = \frac{1}{3 + 3\varphi} y, \quad c_2^{**} = \frac{1 + \varphi}{3 + 3\varphi} y, \quad c_3^{**} = \frac{1 + 2\varphi}{3 + 3\varphi} y
  \]

- How do these depend on \( \varphi \)?
  - Respectively decreasing, independent of, and increasing in \( \varphi \)
  - Intuition?

- If \( \varphi = 1 \), then:
  
  \[
  c_1^{**} = \frac{3}{18} y, \quad c_2^{**} = \frac{6}{18} y, \quad c_3^{**} = \frac{9}{18} y
  \]

- Match for evidence?
Is this what Yuki will do? 

- Claim: we have under-specified features of the environment.
  - We need to say when Yuki is making (committed) choices.

- Situation 1:
  - Yuki fully rational and can commit, then yes.

- Situation 2:
  - Yuki fully rational and cannot commit, then only 1 of the 6 is right.

E.g., if $\varphi = 1$, then
## Belief-Based Utility

**Can Commit** | **Cannot Commit**
--- | ---
$c_1^*$ | $\frac{3}{18}y$ | $\frac{3}{18}y$
$c_2^*$ | $\frac{6}{18}y$ | $\frac{5}{18}y$
$c_3^*$ | $\frac{9}{18}y$ | $\frac{10}{18}y$

What is interesting?  

- Consumer more period 2 with commitment than without!  
- Why does commitment increase period-2 consumption?  
  - Because assumed anticipation is over future consumption utility alone (and not future anticipatory utility), happier looking forward to smoothed consumption than back-weighted consumption.  
- But in period 2, this is no longer a consideration.
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Reasons increased consumption profiles besides anticipatory? 
- Precautionary savings
- Backward-looking habit formation

Reasons we may rarely see increasing consumption? 
- Present bias... consumption smoothing may be self-control problem.
- Because... anticipatory isn’t quite right.
  - It is naturally mis-ID for its cousin, news utility.
  - Disappointment and surprise utility
    - must balance anticipation with threat of disappointment.
- Reminder: models should own all their implications
  - Anticipatory utility makes some strange ones.
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Aside: Different approaches to investigating b-b preferences:

- Combine assumptions about the psychology, the informational environment, and researchers’ methods.

Some approaches:

1. "Willful" violations of LIE
2. Self-signaling and forgetting
3. Altruistic Revealed Preferences
   - How do we manage the utility of others?
   - KR (non-RD!), finally starting to use it as a method in experiments.
4. Non-linearity in probabilities, fully-rational/Bayesian

- Approach 1 has gained some (surprising) traction ...
- Approaches 2 most common in recent formal models.
- Approaches 1-3 are in fact often formally quite similar.
- We’ll look at Approach 4 ...
  - the least convincing!
- But examing Approach 1 ...
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- Back to anticipatory utility: What if Yuki can fool himself into believing lifetime income \( y \) is something else?
- What might he tell himself?
  - Choose to be optimistic to consume anticipation.
- How well-being of such "rationally irrational" beliefs compare to stuck-with-rationality utility?
- But ... what if Yuki can tell himself other stories?
  - Like that he earns lots of interest rate on his savings?
  - Or wonderful afterlife if maximize true lifetime utility.
- Fundamental Theorem of Optimal Distortion of Anticipatory Prefs:
  - If no restrictions on distortions, why not choose beliefs to maximize both anticipatory preferences and “direct-consumption” utility?
  - It is no sin to make ‘ancillary assumptions’. It is a necessity. But those are unfamiliar assumptions—and entirely driving results.
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Ego Utility

Kőszegi (2006a, 2006b) and others: how one feels about oneself.

- We do so here in the context of ego about skill/talent.
- Nascent research: "social preferences" as self & social image:
  - (Related papers: Andreoni on warm glow; Bernheim on conformity; Rabin on moral preferences vs. moral rules; Benabou & Tirole; Grossman; Andreoni & Bernheim; moral wiggle room)

Status

- We like to think we are:
  - good economists,
  - good curlers, and
  - good looking.

- And most of all:
  - good people.
We’ll do Approach 4 now.

- Based on Koszegi (2006)
- Person will make choices as to whether acquire information.
  - Certainly the conceptually easier case.
  - Such models of Bayesian self-persuasion pre-date models of Bayesian other-persuasion.

Alternative (won’t do):

- "Self-signaling": By actions or information want to convince future self something different about yourself than now know.
  - Reduces to a classical two-person signaling situation, but still a conceptual challenge.

Similar dichotomy in social preferences:

- Rabin (1995) moral-rules approach non-linear
- Recent signaling models.
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There are two types of people in the world:

- Those good at widget-making, and those who are not.

Henrik has utility function \( u = w - e + \varphi \sqrt{p} \), with parameter \( \varphi \geq 0 \),

- where \( w \) is his income,
- \( e \) is his effort costs of widget-making,
- \( p \) is his believed probability that he is good at widget-making.

Notice the embedding:

- If \( \varphi = 0 \), “classical”, purely instrumental prefs.
- If \( \varphi > 0 \), Henrik has “ego utility”.
- (But is it Peemish? What do we have ego about?)
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Notice the non-linearity of \( u = w - e + \varphi \sqrt{p} \).

- No reason to expect linearity.
- Henrik is “information-averse”: concave in \( p \) → he prefers to have less information rather than more.
  - Henrik prefers beliefs .7 to 50/50 chance of having beliefs .6 or .8.
  - He’d of course prefer beliefs .8 to beliefs .7.
  - But Bayesian approach says cannot choose .8 over .7.
- Classical economics: people weakly prefer more information to less.
  - So information aversion is simplest marker of b-b preferences.
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Suppose Henrik has priors $\bar{p} \in [0, 1]$ good at widget-making.

If he works, $e = k > 0$, and he finds out for sure whether good.

- If good, $w = 1$;
- if bad, $w = \alpha < 1$.

If no work, $e = 0$, $w = 0$, and he learns nothing.

Utility from widget-making: $u = \bar{p}[1 + \varphi \sqrt{1}] + (1 - \bar{p})[\alpha + \varphi \sqrt{0}] - k$.

Utility from non-widget-making: $u = \varphi \sqrt{\bar{p}}$.

For what values of $\bar{p}$, $\varphi$, $\alpha$, $k$, will Henrik work?

If $\varphi = 0$ — classical, non-belief-dependent preferences — then

- If $k$ is low, work for sure.
- more likely to work when $\bar{p}$ is higher (since $\alpha < 1$).
Belief-Based Utility

For \( k = .001, \alpha = \frac{31}{48} \), and the combinations of \( \bar{p}, \varphi \), will Henrik work?

<table>
<thead>
<tr>
<th>( \bar{p} ) and ( \varphi = )</th>
<th>( \varphi = 0 )</th>
<th>( \varphi = 3 )</th>
<th>( \varphi \to \infty )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{p} = 0 )</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>( \bar{p} = \frac{1}{9} )</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>( \bar{p} = \frac{1}{4} )</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>( \bar{p} \to 1 )</td>
<td>Yes</td>
<td>Yes</td>
<td>?</td>
</tr>
</tbody>
</table>

Fascinating things about this table?

- Despite \( k \approx 0 \), Henrik sometimes avoids work.
  - “Paying” to avoid information.
- Fixing any \( \bar{p} \neq 0, \bar{p} \neq 1 \), Henrik will not work as \( \varphi \to \infty \).
- Fixing any \( \varphi, \bar{p} \to 1 \) or \( 0 \), Henrik will work iff \( \exp(\text{wage}) > \text{effort} \).
- Non-monotonicity in \( \bar{p} \).
If $\varphi > 0$ moderate, can get: when $\bar{p}$ goes from very low to moderate, Henrik may go from working to not working. 

- Why?

Lesson emphasized by Koszegi (2006): can get negative correlation between confidence about your talent and whether undertake task.

- Protecting ego, not likely without b-b prefs
And now for a tale of love and widgets ... recall:

- If $\bar{p} = \frac{1}{4}$, $k = 0$, $\varphi = 10,000$, $\alpha = 0$ Henrik no work.

The twist: Suppose that:

- Bjorn loves Henrik and wishes him nothing but the best,
- knows whether Henrik is a good widget-maker or not,
- Henrik knows Bjorn loves him and is aware of Henrik’s widget skills,
- Common knowledge that Bjorn could communicate with Henrik,
- If and when Bjorn says something, Henrik can take job or not.

How does this tale of love and widgets end?

- Quite sadly, on average.
  - Henrik will find out whether or not he is a good widget maker.
  - Which makes him feel worse on average.
  - The logic is that of “emotional agency”:
    credible equilibria in revealing information to people with belief-based preferences.
Forget Bjorn.\implies

- Suppose that Henrik instead has preferences: $u = w - e + \varphi p^2$.\implies
  - Henrik is information-loving.\implies

- Harder to see over-gathering of information than under-gathering (since value of information always non-negative).\implies

- Henrik may take job as widget maker in situations where wouldn’t for “classical” reasons.
Belief-Based Utility

Now suppose instead that Henrik has preferences: \( u = w - e + \varphi p \).

If \( \varphi = 0 \), what would we observe?
- Henrik obtains information for solely for instrumental reasons.

If \( \varphi > 0 \), what would we observe?
- Henrik obtains information solely for instrumental reasons.

If \( \varphi < 0 \), what would we observe?
- Henrik obtains information solely for instrumental reasons.

LIE → Henrik’s observed taste for information entirely instrumental.
- When linear, belief-based preferences can matter a lot for well-being even when no ID in behavior.

How would Bjorn behave?
- Emotional agents can reveal b-b preferences even when linear.
  - “Altruistic revealed preference”
Conclusion:

- Recall: similar themes for self-signaling models.
- Starting (barely) to come on line as improvements to economic models.

Now turn to Reference Dependence

- Will come back to b-b preferences with a vengeance.
- Aside: Ref points everywhere... including ego utility, etc.
Reference-Dependent, News-Utility, and Risk Preferences

In virtually all physiological and psychological reactions to (e.g. temperatures), people's reactions tend to reflect adaptation, change, and contrast, rather than solely absolute levels of outcomes.

- Feelings and choice are reference-dependent:
  - $u(c_t; r_t)$, not $u(c_t)$, where $r_t$ is some reference level.
Kahneman and Tversky (1979, p. 277) stress that salience of changes from reference points is a basic aspect of human nature:

- “Our perceptual apparatus is attuned to the evaluation of changes or differences rather than to the evaluation of absolute magnitudes ... The same principle applies to non-sensory attributes such as health, prestige, and wealth.”

Not just people, but amoeba and physical systems.

- Role of contrast/comparison poster child for things economists should use to explain things, not something to be explained.

Two features of reference dependence emphasized by Kahneman and Tversky (1979) and others:

- Loss Aversion
- Diminishing Sensitivity
Prospect-Theoryish Stuff

1. Loss Aversion
People dislike losses (2 times?) more than they like comparable-size gains.

- E.g.: Vast majority turn down 50/50 lose $600, gain $700 bet
  - Not because of DMU(W).
  - Strongest such aversion involve mix gains and losses.
  - Many folk, myself included, guilty of sloppy wording, calling all modest-scale risk aversion, even when only gains, “loss aversion”.

- Monetary risk attitudes primary area in which LA explored.
- Other domains where LA important:
  - Moral/Fairness, Hippocratic Oath, Wage Cuts
  - [Endowment Effect/SQ Bias in riskless trades]
  - Disposition effects, in investments and houses.
  - Aversion to (nominal) wage and consumption declines.
  - Income-targeting
2. Diminishing Sensitivity

- People pay less attention to incremental differences when changes are further away from reference point.
- Prefer $420 for sure or 50/50 chance at $900?
- Prefer losing $420 for sure or 50/50 chance to lose $900?

Reflects big and general fact about human psychology:

- We think in terms of proportions.
Prospect-Theoryish Stuff

<table>
<thead>
<tr>
<th>Change subject: in following pairs, which “feel” like a bigger difference?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>visually 101 ft. away vs. 100 ft. away</td>
<td>1 ft. v. 0 ft.</td>
</tr>
<tr>
<td>gaining $101 v. gaining $100</td>
<td>gaining $1 v. gaining $0</td>
</tr>
<tr>
<td>losing $101 v. losing $100</td>
<td>vs. losing $1 v. losing $0</td>
</tr>
<tr>
<td>losing $101 v. losing $100 vs. losing $2 v. losing $1</td>
<td></td>
</tr>
<tr>
<td>gratification 100 days from now v. 101 days</td>
<td>gratification 0 days v. 1 day</td>
</tr>
<tr>
<td>saving $10 on $1,000 item</td>
<td>saving $10 on $20 item</td>
</tr>
<tr>
<td>carrying a suitcase 21 blocks v. 20 blocks</td>
<td>2 blocks v. 1 block</td>
</tr>
<tr>
<td>19% chance v. 18% chance</td>
<td>1% chance v. 0%</td>
</tr>
<tr>
<td>19% chance v. 18% chance</td>
<td>100% chance v. 99%</td>
</tr>
<tr>
<td>17 heads/13 tails v. 16 heads/14 tails</td>
<td>4 heads/0 tails v. 3 h/1 t</td>
</tr>
</tbody>
</table>
Prospect-Theoryish Stuff

Proportional thinking via diminishing sensitivity in the value function.

- But DS and proportional thinking the same?
  - The joy of “distinction epiphanies” ...

- Distance vs. Range?
  - DS: with $r = 0$, 1 vs. 2 in feels bigger than 91 vs. 92 in \{0, 1, 2, 91, 92\}
  - RT: 1 vs. 2 in \{0, 1, 2, 91, 92\} feels smaller than 1 vs. 2 in \{0, 1, 2\}
  - Bushong-Rabin-Schwartzstein think *some* DS really propo-thinking.
    - But some DS really DS

- Two more issues:
  - Is this really rational “experienced-utility maximization”? 
  - Seriously contradicts some intuitions/popular recent models that people pay too *much* attention to increments over bigger ranges.
Prospect-Theorystuff

Modeling Reference-Dependent Utility

- Fixing $r$, rational people will maximize $u(c|r)$.  
  - What is $r$?  
  - Why is it fixed?  
  - Moving on...

- Reference dependence in $u(\cdot|\cdot)$ fully rational?  
  - In principle: yes.  
  - But in fact ...  
  - Also yes.  
  - People feel pleasure and pain from gains and losses.  
  - But in ensuing lectures return to ways the influence of reference-dependent preferences not fully rational  
  - Both lead too much attention on gains and losses
Prospect-Theoryish Stuff

Traditional focus: solely on departures from the reference point. 

- Not how the reference point is formed,
- **Nor how the reference point affects utility.**

That is, analyze choice in terms of "value-function".

\[
v(c|r) \equiv u(c|r) - u(r|r).
\]

Wildly insufficient for integrating this into economics.

- Before returning to the full model
- Start by framing evidence in terms of that approach
  - Misses how people also care about absolute levels.
  - But **also** misses, not just what \( r \) is, but \( \partial u(c|r)/\partial r \)
  - Big time crucial for both welfare and dynamic behavior.
Reference Dependence and Risk: Round 1:

- Assume people maximize expected value of $u(c|r)$.
- I tend to ignore non-linear probability weights.
  - Mostly simplicity
  - Partly skepticism.
  - Most traumatizing picture in all of economics!
  - Overweight low probabilities...except when ignore
- Others also have downplayed.
- But it’s making a comeback...
  - Largely because it should (I was/we were wrong)
  - Employs 2nd-most traumatic picture.
- Ignoring non-linear probability weights: “reference-dependent Von Neumann-Morgenstern preferences” (RD-VNM prefs):
  - For each $r$, people maximize $\int p(c) u(c|r)$.
Prospect-Theoryish Stuff

Assumptions A0-A4 (K&T (1979), formalized by BMR (1999)):

- **A0.** \( v(x) \) continuous, differentiable for all \( x \neq 0 \), \( v(0) = 0 \).
- **A1.** \( v(x) \) is strictly increasing.
- **A2.** If \( y > x > 0 \), then \( v(y) + v(-y) < v(x) + v(-x) \).
- **A3.** \( v''(x) < 0 \) for \( x > 0 \) and \( v''(x) > 0 \) for \( x < 0 \).
- **A4.** From \( x > 0 \) direction, \( \lim_{x \to 0} \frac{v'(-x)}{v'(x)} \equiv L > 1 \).

**Implications for Risk Attitudes?** (Assume \( r = \) current wealth)

1. Person will turn down any 50/50 lose \( \$X \)/gain \( \$X \) bets. Implied by A2.
2. Is risk averse among bets involving only gains. Implied directly by A3.
3. Is risk-*loving* among bets involving only losses. Also implied directly by A3.
Prospect-Theoryish Stuff

- Implications 1 & 2 true of EU/DMU(W) model.
- Implication 3 famously inconsistent with EU/DMU(W).
  - But generates the question:
  - Huh? Insurance?
- Implication 4: Folk wisdom that first-order risk aversion is inconsistent with EU/DMU(W).
  - But hugely important, not just a limit result.
DMU(W) does not help explain Modest-Scale Risk Aversion

- Virtually none of aversion to risks involving little chance of gaining or losing more than (say) $10,000 can be explained.

What mean by EU/DMU(W) “does not help”? 

- Not that it is missing factors.
- Rather: for modest stakes, capturing very little.
- Not that EU/DMU(W) model wrong ... all models are wrong.
  - For this question, it has virtually zero explanatory power.
  - It predicts virtual risk neutrality.
  - Just because all useful models are false (because all models are false), doesn't mean that all false models are useful.

EU/DMU(W) does help for large stakes... main story.
Four final comments (for now) on risk prefs:

1. People are in general averse to modest-scale risks. And sometimes risk-loving. Rarely risk-neutral.

2. Modest-scale risk aversion is an important topic for economics. Extended warranties, aversion to deductibles, fixed-rate plans, etc. are market-driving, institution-driving behaviors.

3. Risk aversion neither simplifying assumption nor done for generality. It is one of the most results-driving assumptions in all of economics Ubiquitously added as necessary “complication”

4. We don’t want to get rid of the $u''(w) < 0$ assumption. Among most intuitive, compelling, important assumptions we make!
Four final comments (for now) on risk prefs:

1. People are in general averse to modest-scale risks.
   - And sometimes risk-loving.
   - Rarely risk-neutral

Example from Sydnor (2010) on housing insurance:

<table>
<thead>
<tr>
<th>Deductible</th>
<th>Premium</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1000</td>
<td>$504</td>
<td></td>
</tr>
<tr>
<td>$500</td>
<td>$588</td>
<td></td>
</tr>
<tr>
<td>$250</td>
<td>$661</td>
<td>X</td>
</tr>
<tr>
<td>$100</td>
<td>$773</td>
<td></td>
</tr>
</tbody>
</table>

With average claim rate (3.7%), paid $157 for an expected savings of $28 — very risk-averse!
2. Modest-scale risk aversion is an important topic for economics.

- Extended warranties, aversion to deductibles, fixed-rate plans, etc. are market-driving, institution-driving behaviors.
- Dismissal of lab evidence as only involving small stakes has reached a whole new aesthetic height in this area:
  - "...but would they be risk averse for small stakes for large stakes?"

3. Risk aversion neither simplifying assumption nor done for generality.

- It is one of the most results-driving assumptions in all of economics.
- Ubiquitously added as necessary “complication”
- Shortcomings current model are sufficiently severe — and sufficiently solvable — that it is worthwhile for economists to investigate additional determinants of risk attitudes.
4. We don’t want to get rid of the \( u''(w) < 0 \) assumption. 

- Among most intuitive, compelling, important assumptions we make! 
- Far more well-being out of the first $5$ million you spend in life than the last $5$ million.
Aside: there are many measures of risk attitudes. 

- Most common measure of risk aversion used is the coefficient of relative risk aversion, \( \frac{-wu''(w)}{u'(w)} \), where \( w \) is a measure of “wealth”.
  - Macroeconomists measure CRRA on huge stakes as somewhere in the single digits or low double digits.
  - Experimentalists measure CRRA on small stakes in single digits.

- DMU(W) pretty well calibrated after all?

- Problem: using different measures of wealth.
  - Which is to say, different definitions.
  - “Wealth” is defined as earnings from the experiment alone.
  - Other papers use monthly income, lifetime wealth, or current assets.

- If same definition used
  - 5 orders of magnitude differences.
Prospect-Theoryish Stuff

Integrating Prospect Theory ...

Kőszegi and Rabin (2006, 2007, 2009) clarifies, modifies, and extends PT with the goal of making the theory of reference-dependent preferences more conducive to general application within economics.

- The theory came out of years of teaching without a satisfying, consistent, and applicable model of reference dependence.

Grand Conceit: Because we (jointly) do two things, Derive reference point from preferences and environment, and derive gain-loss utility from reference points and consumption utility,

- aim at universal formula for constructing reference-dependent preferences from existing (non-reference-dependent) models.
- Not quite there, but many contexts close to improved predictions with zero degrees of freedom added to the models:
Prospect-Theoryish Stuff

First premise: **People don’t care solely about gains and losses.**

- People don’t just react to the sensation of gaining or losing a mug; they care whether they have a mug to drink from.
- Don’t just enjoy sensation of $-gain: they like more to spend.

**Certainly worse for economics to ignore this classical consumption utility then ignoring gain-loss utility.**

- Integrate “gain-loss utility” component of prospect theory with “consumption utility” studied by economists in fact relate the two strongly.
- Prospect theory best interpreted as silent on consumption utility, rather than saying it doesn’t exist.
- But the silence a fundamental barrier in many applications.
Prospect-Theoryish Stuff

Combine Absolute & Contrast Utilities.

Imagine breaking down the \( u(c|r) \) function:

\[
u(c|r) \equiv m(c) + n(c - r|r),
\]

where

- \( m(c) \) is “consumption utility”, and
- \( n(c - r|r) \) is “gain-loss utility”.

So far, this decomposition is just an interpretation in our heads.

- Substance to this breakdown given by further structure.
- Actually, dimension-by-dimension.
  - Will suppress dimension notation
Prospect-Theoryish Stuff

We’ll assume that $n(0|\omega) = 0$ for all $\omega$, and $n(c - r|\omega)$ obeys A0 to A4. 
- Note that $u(c|c) \equiv m(c)$.
- $m(c)$ is how you feel about outcome that matches reference point.
- Utility matches classical in settings where consume at reference levels!
Prospect-Theoryish Stuff

What is odd about assuming $n(\cdot|r)$ meets A0-A4?

- Behavioral evidence on shape $u(c|r)$, not $n(\cdot|r)$.
- What we see is influenced by shape of $m(c)$.

Claim: Often okay to assume $m(c)$ is $\approx$ linear, when $c - r$ is small.

- When $m(c)$ is not linear for even small changes ...
  - we predict in fact prospect theory $v$-function will not hold.
  - we are happy with that prediction.
  - And when talking about big changes, we are very happy with that prediction.

In fact, wrong framing...
Reflecting common intuition, Kőszegi and Rabin (2006) propose:

- gain-loss utility is proportional to changes in consumption utility.

Specifies that \( n(\cdot) \) is tightly related to \( m(\cdot) \):

- How people feel about gaining or losing the mug is related to how they feel about having the mug to drink from.

Specifically:

- \( n(c - r | r) \equiv \mu(m(c) - m(r)) \), where \( \mu(x) \) is a “universal gain-loss function” meeting properties A0-A4.
- \( m(\cdot) \) as the argument helps us address the shape-of-\( m(\cdot) \)-based exceptions to A0-A4.
- **Big** prediction of including the model:
  - Attitudes towards uncertainty at different wealth levels proportional to marginal utility at those wealth levels.
Although limited by the separability assumptions, by a need to specify relevant dimensions, and cardinal interpretation of $m(\cdot)$, this comes close to saying:

- Once you specify the reference point, we can propose a zero-degrees-of-freedom alternative prediction to classical reference-free models.
- Include news utility, implications for things like precautionary savings.
Stochastic Reference Points

Koszegi & Rabin (2006) also introduce a new issue (and an alternative approach to that taken by others) in modeling reference dependence.

- Clear once we consider beliefs to be the reference point, need to know what happens with a stochastic reference point.
- If a person is endowed with a lottery? What is the reference point?
- If reference point is probability measure $G$ over $\mathbb{R}$, and consumption drawn according to probability measure $F$, then utility

\[
U(F|G) = \int \int u(c|r) dF(c) dG(r).
\]
E.g. if endowment is $\frac{1}{3} / \frac{1}{3} / \frac{1}{3}$ lottery $0, $50, or $100, then getting $50 assessed as loss relative to $100, gain relative to $0, and wash relative to $50:

$$U(\$50|\text{lottery}) = \frac{1}{3} u(50|0) + \frac{1}{3} u(50|50) + \frac{1}{3} u(50|100).$$

- This model of “mixed feelings” crucial to some of the risk-preferences stuff, less crucial in other contexts.

- It matches a strong intuition, and (unbeknownst to me!) massive literature:
  - When endowed with a lottery, selling price $\approx$ expected value
  - Takes work to see why this supports stochastic reference points.
  - But it does.
“Mixed feelings” implicitly contradicts common decision-theoretic cousins to this approach.

- Those models assume implicitly that the reference point for stochastic outcome is its (recursive) certainty equivalent.
- Dynamic-consistency, non-cycling, “resulting-property axioms” may force no-mixed-feelings-allowed property.
- But no psychological logic suggesting must be the case.
What is the Reference Point?

- Literature historically fluctuates between imprecision and status quo.
- Typical approach to this issue is in Tversky and Kahneman (1991):

  “We assume that the decision maker has a definite reference state \( X \), and we investigate its impact on the choice between options. The question of the origin and the determinants of the reference state lies beyond the scope of the present article. Although the reference state usually corresponds to the decision maker’s current position, it can also be influenced by aspirations, expectations, norms, and social comparisons.”
So what is the reference point, already?

- Usually assumed to be status quo,
- or recent consumption,
- but often much vaguer.

“What is the reference point?” both example of and metaphor for BE battles.

- Does BE tell you a new reference point in every new situation?
- Response to clearly true but underspecified, underformalized theories is to more carefully specify and formalize, not dismiss.
- But worry about limited applicability, limited discipline was legit.
**Prospect-Theoryish Stuff**

**So what is the reference point?**

Candidates:

1. "Status quo ante"
2. Recent consumption or endowments
3. Aspirations/goals
4. Your neighbors
5. **Expectations**

Discuss later why 1 and 2 might really be 5.

- But I think 3 is definitely about 5 many cases.
  - But see Pope, Simonsohn, etc.
- And 4, comparing ourselves to neighbors, may be very real ...
  - but in a lot of data confounded big time with 5.
- And now, lately, "experience", a variant of (2), has made a big comeback in some intellectual neighborhoods ...
  - But it’s clearly about expectations, except for a disastrous degree of free.
The Reference Point as Expectations

- Assume reference point is the probabilistic beliefs about outcomes ("expectations" in shorthand)
- Hence the idea of stochastic reference points
- Close the model by assuming beliefs obey "rational expectations"

Expectations do not determine the reference point completely

- Example of an exception: sensory experiences, such as changes in brightness and temperature.
But I would argue expectations are predominant.

- Raises all sorts of issues and complications.
- But we argue that some of the ‘complications’ are exactly right — we can reconcile things that are variously:
  - inconsistent with classical EU but consistent with classical PT,
  - inconsistent with classical PT but consistent with classical EU, and
  - inconsistent with both.
“Disappointment aversion” by Bell, Loomes and Sugden, others, then axiomitized by Gul (1992) and others, pre-cursor of this approach.  

- One theme of B-B approach: timing is crucial.  
  - Delays in realizations of choices matter a lot, and would need to be added to language of the choice-set-based theories.  
  - But how long a person expected the choice set before making a committed choice also matters a lot.  

- KR model has degree of freedom, about how quickly reference point adjusts to new expectations.  
  - But research exploring ongoing.  

- Central premise: different to choose from \( \{(0.5, -250; 0.5, 0), -100\} \) when  
  - a moment ago you thought your choice set was probably \( \{$0\} \) versus  
  - if you’ve known this was your choice set for quite some time.
Evidence + Intuitions: And great classic experiment, oversimplified:

  - Obvious econometric issues ... hardly exogenous what people expect and what they achieve.
  - Replication by Mcgraw, Mellers, and Tetlock (2005)

- Unexpectedly losing $50, or a mug you expected to keep, are losses.

- Gaining $50 unexpectedly or getting mug unexpectedly are gains.
  - *But* spending $50 you planned to spend?
  - Losing a mug you planned to sell?
  - Getting $50 allowance you get every week?
  - Getting delivery of mug long anticipated?
Prospect-Theoryish Stuff

Given preponderance of theory, interpretations, and evidence saying status quo is reference point, *how can we say not the status quo?*

- Ignoring is **not** an answer!
  - Stop claiming your model fits by ignoring when it doesn’t!

- Answer 1: Most evidence on surprises: status quo = expectations.
  - (rationally or psychologically) expect to maintain the status quo.
  - E.g., owning a mug often connotes to us that we will be in possession of it tomorrow. (this is cheating)

- Answer 2: In fact, often wording obscures things.
  - E.g., wage cuts are not decreases in wealth ... they are (surprise) decreases in the rate of increase of wealth!
  - How does an unexpectedly small wage increase feel?
Prospect-Theoryish Stuff

Shopping!

- Now: seemingly important (but largely untested) predictions about a pretty core topic in economics, consumer demand.
  - Simple example of KR (2006);
  - market analysis in HK papers, Rosato.
- “Reference-price effects” in marketing literature
  - Little emphasized seems among BE-ers studying loss aversion.
- Two dimensions, shoes and money:
  - \( m(c) = 16 \cdot \text{pairshoes} + \$ \).
  - “Intrinsic” value for shoes is $16.
  - \( \mu \) is two-piece linear, with \( \mu'_+(0) = 1, \mu'_-(0) = \lambda \).
Prospect-Theoryish Stuff

Analysis with parameter values $\eta = 1, \lambda = 3$.

- Buying at price $p$ when fully expect to face price $p$ is the optimal consistent plan iff $p \leq 16$.
- When no uncertainty WTP is “intrinsic” value for shoes.
Prospect-Theoryish Stuff

Things change dramatically when uncertainty over prices.

- Suppose beliefs: \( \text{prob}(p = p_H) = \text{prob}(p = p_L) = 0.5 \).

Some examples, with PPE behavior and utility.

- If \((p_L, p_H) = (18, 18)\), Never Buy, \(U = 0\)
- If \((p_L, p_H) = (14, 14)\), Always Buy, \(U = 2\)
- If \((p_L, p_H) = (2, 14)\), Always Buy, \(U = 2\)
- If \((p_L, p_H) = (14, 95)\), Never Buy, \(U = 0\)
- If \((p_L, p_H) = (4, 18)\), Always Buy, \(U = -1.5\)
- If \((p_L, p_H) = (1, 18)\), Buy iff \(p = p_L\), \(U = -1\)
- If \((p_L, p_H) = (4, 95)\), Buy iff \(p = p_L\), \(U = 1\)
Prospect-Theoryish Stuff

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Do you buy at $18? At $14?

- “environmental-endogeneity” principle:
  - price distribution influences your WTP.
- But theory puts limits on this (as function of \(\lambda, \eta\))
- No matter price-distribution:
  - Never buy when \(p > 32\), always buy when \(p < 8\)
- Agenda: Replace "context effects" with:
  - more fully specified utility models that endogenize and fully specify how and why a context/environment influences choice.
Prospect-Theoryish Stuff

- If \((p_L, p_H) = (18, 18)\), Never Buy, \(U = 0\)
- If \((p_L, p_H) = (4, 18)\), Always Buy, \(U = -1.5\)
- If \((p_L, p_H) = (1, 18)\), Buy iff \(p = p_L\), \(U = -1\)
- If \((p_L, p_H) = (4, 95)\), Buy iff \(p = p_L\), \(U = 1\)

Attachment effect:
- if likely price is low, think likely you'll return home with the shoes.
- Increases your WTP even when high price, to avoid loss.

Comparison effect:
- Lowering the low price decreases WTP at high prices—high price feels like a worse loss.
Prospect-Theoryish Stuff

- If \((p_L, p_H) = (18, 18)\), PPE is Never Buy.
- If \((p_L, p_H) = (4, 18)\), PPE is Always Buy.
- If \((p_L, p_H) = (1, 18)\), PPE is Buy iff \(p = p_L\).

Two effects sometimes go opposite directions

- No apologies; such is the stuff of classical consumer theory.
- But notice “quasi-violation” of law of demand:
  - *known* lowering of prices may decrease quantity demanded.
  - Will never happen fixing expectations
  - possibility comes from “raising expectations” for a good deal.

- Requires stochastic prices,
  - no good sense for empirical/calibrational relevance.
Prospect-Theoryish Stuff

- If \((p_L, p_H) = (18, 18)\), PPE is Never Buy. 
  - \(U = 0\)
- If \((p_L, p_H) = (4, 18)\), PPE is Always Buy. 
  - \(U = -1.5\)

Utility can be lower in PPE than never buying.

- Sometimes paying more than thought you might, or
- Sometimes not getting the good you thought you might
- Might outweigh consumption utility of sometimes getting the good at a low price.

PE consistency constraint here is in force:

- Might want commit not purchase, can’t resist low prices.
Prospect-Theoryish Stuff

Punchlines of this approach:

- Departures from classical predictions iff surprise or uncertainty.
- when uncertainty, environment influences (induced) preferences!
- Some desirable plans not consistent ...

Reinterpretation of the endowment-effect evidence.

- The endowment effect is commonly explained by assuming that the reference point of status quo
- ... sellers keep the mug buyers keep their money.
- Experimental protocol *arguably* induce parties to expect to keep endowment.
More natural expectations reverse endowment effect?

- In “real world,” buyers expect/hope to part with money, get good. Sellers expect/hope to lose good, get money.
- One interpretation of Plott and Zeiler (2006) and of List (2006) is that traders there have expectations of trade.
- More recent experimental evidence:
  - Ericson and Fuster (QJE): supportive that expectations play a role.
  - Heffetz and List (JEEA), similar experiment, and others, reject role of expectations
Prospect-Theoryish Stuff

Risk Preferences Revisited


Main theme:

- Replicates KT’s Prospect Theory in some identified contexts.
- And replicates classical DMU(W) in other identified contexts.
- Often corresponds to neither PT nor DMU(W).
  - Reflects intuitions of PT, but makes very different predictions than status-quo-based PT literally does.
Both “foes” and “friends” over the years seen demand for insurance as inconsistent with convexity-in-losses feature of prospect theory.

- KT have explained with probability weighting.

Certainly an aspect of risk preferences that is important.

- And some recent papers argue it is probability weighting
  - See, e.g., O’Donoghue et al

- But I also don’t think it can explain some of the taste for insurance, especially if it has to do battle with DS in losses.

- I doubt some of the identification
Prospect-Theoryish Stuff

1. Large-stake risks $\rightarrow$ classical DMU(W)
   - Depends on curvature and whether large stakes dominated by DMU(W), depends on severity of both DS and concavity of $m$.

2. Surprise, modest-scale risks $\rightarrow$ KT’s Prospect Theory
   - First-order risk aversion to ‘mixed risks’
   - Risk averse in gains, risk loving in losses.

3. Expected, modest-scale risks w/o commitment $\rightarrow$ heavy risk aversion
   - With commitment, even possible to reject dominant lotteries.
     - But improved approach of KR (2009) no longer predicts it?
   - Not risk-loving in expected “losses” — because in our model sensation of losses arises only from worse-than-expected decreases.
4. In various ways, people become less risk averse when they expect risk. 

- *But:* 

5. Expecting risk makes you very unhappy. 

- “Equilibrium risk” is always bad: the distribution of gains is identical to the distribution of losses. 

- And when can buy insurance prospectively (which is the only type of insurance...), become very risk averse.
All this talk of money raises a pretty big conceptual point.

- KR (2006) follow others in obscuring, cheating, and fudging on:

Why do people have utility over money at all?

- In classical model, money only valued for consumption.
- Legitimate object of analysis as the indirect utility function.
Prospect-Theoryish Stuff

The psychology of disappointment and elation is about news. 

- Not just contemporaneous consumption relative to expectations. 
- But about changes in beliefs about future consumption. 
- Money is ... news about future consumption.


- But: Rather than comparing outcomes to beliefs, people compare new beliefs to old beliefs. 
- Although the full implications are far more complicated, the basic intuition for what this says about money is very simple: 
- Money is future consumption so unexpected gains and losses of money are news about future consumption.
New parameter: $\gamma \equiv$ the degree to which you care about “prospective gain-loss utility” compared to “contemporaneous gain-loss utility”.

- Do revisions in beliefs before an outcome occur cause comparable sensations of gain and loss as surprises at time of outcomes?

Prior analysis all implicitly assume $\gamma = 0$.

- Depending on the context, analysis may be misleading.
Prospect-Theoryish Stuff

*Not* anticipatory utility a la Caplin-Leahy, Kőszegi, Brunnermeier-Parker.

- Our prospective gain-loss utility is about utility from *changes* in expectations of future consumption.

Difference is going to matter *a lot.* And further:

- Because people didn’t have news-utility interpretation, obvious confound in evidence with anticipatory utility.
- Ceteris paribus — fixing this morning’s expectations — obvious correlation with how optimistic you are about the future and how much more optimistic you have become about the future.
Prospect-Theoryish Stuff

Happiness (especially rich people) in September and October 2008?

- Moments in world history where rich folk less happy than poor?
  - 1789 France,
  - 1979 Iran?
  - 2008 "developed world"

- But 2008 rich still had more comfortable future than 2008 poor.
  - And surely knew it!
  - (1789 rich French folk had different future?)
  - Not anticipatory utility, but prospective news utility.

- Final twist:
  - Perhaps rational inference ... crisis even worse news for poor???
  - Utility: changes in beliefs ... not whether those beliefs rational.
Aside:

- In models of anticipatory utility, anticipated high consumption in a given period enters into the utility in all prior periods.

- “Multiple-counting” consumption?
  - Intrinsic prediction increasing consumption

- News utility does not multi-count when beliefs stable.