

# Preferences over Menus

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March 19 2008

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- "*Solution*": assume expected utility, a particular functional form of preferences over lotteries. Could even assume particular functional forms, e.g.  $\ln$ .

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  - Modeling: We want to know if this is a good model so the axioms and revealed preference approach help test it and elicit the utility function.

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  - That's still not saying the process has to be right.
  - But we seem to like SOSD as a definition of risk aversion in part at least because it relates nicely to the representation. So we must think the representation means something. Why not define risk of a lottery by variance? Or, if we thought risk aversion evolved from winner-take-all games, it would be probability of getting highest outcomes, which isn't even transitive.

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    - Perhaps not—should find "revealed preference" test for that.

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- Remark: Menus are acts, specifically incentive compatible acts where in each state (not observed) the person chooses their preferred outcome. So "just like" Savage/A-A (except not rich enough so far)

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- Non uniqueness (that is hard to understand and troublesome for comparative statics);
- Monotonicity implies that the only unforeseen contingencies are those where I am in control. What about concerns about states where the wrong thing happens?

# Examples of issues with Kreps' model

## Additivity

- $V(x) = \int_S \max_{b \in x} u(b, s) d\mu(s)$  or  $V(x) = w(\max_{b \in x} u(b, s))$ ,  
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$$u(b, s) = \begin{array}{ccccc} & & s_1 & s_2 & s_3 \\ c & 2 & 1 & 1 & \\ f & 1 & 2 & 1 & \\ v & 1 & 1 & 2 & \end{array}$$

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- $\{c, f, v\} \succ \{c, f\} \succ \{c, v\} \sim \{f, v\} \succ \{c\} \sim \{f\} \sim \{v\}$ .

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- Similar to subjective probabilities: are we bothered by on-uniqueness? Does this example cast doubt on using additive model? "As if" or real?

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$\mu_1$	2	5	-3	1	0
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- In both cases the signs of the coefficients are determined holding fixed the state space.

# Examples of issues with Kreps' model

- Can't identify how many states are "bad" and how many are "good".
- 

	$s_1$	$s_2$	$s_3$	$s_4$	$s_5$
$c$	0	1	0	1	0
$f$	1	0	0	2	2
$v$	2	0	1	0	1

$\mu_1$	2	5	-3	1	0
$\mu_2$	-1	6	0	0	3

- So  $S_1 = \{s_1, s_2, s_3, s_4\}$  and  $S_2 = \{s_1, s_2, s_5\}$ . Both yield the preferences

$$\{c, f\} \succ \{c, f, v\} \succ \{c, v\} \succ \{c\} \succ \{f\} \succ \{f, v\} \succ \{v\}$$

- In both cases the signs of the coefficients are determined holding fixed the state space.
- Identify the signs with fixed state space, but changing the state space *forces* the signs to change.

# Subjective states with random lotteries and without monotonicity

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would satisfy IR:  $x \sim \text{conv}(x)$ . But if have "hedging" desire over unforeseen contingencies then might strictly prefer  $\text{conv}(x)$ .

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- **Axiom:** Add set betweenness:  $x \succeq y \Rightarrow x \succeq x \cup y \succeq y$

- Overwhelming temptation

$$\begin{aligned}
 V(x) &= \max_{\beta \in \arg \max_{\beta' \in X} v(\beta')} U(\beta) \\
 &= \max_{\beta \in B_v(x)} U(\beta), \quad B_v(x) \equiv \arg \max_{\beta' \in X} v(\beta')
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- *Complaints:* Too restrictive; misses interesting forms of temptation.

# Temptation

## Multiple temptations

- $\{b\} \succ \{b, c\}, \{b, p\} \succ \{b, c, p\}.$

broccoli, candy, potato chips



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- The latter can be due to regret (more on that later) or due to menu effects. E.g., broccoli, ice cream, frozen yogurt:

$$\{b\} \sim \{b, f\} \sim \{b, i\} \succ \{b, f, i\} \sim \{f, i\} \sim \{f\} \succ \{i\}$$

We assume no menu effects (follows from independence axiom) and that menus don't tempt.

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- Violates SB:  $\{b, c, p\}$  is strictly worse than  $\{b, c\}$  and  $\{b, p\}$

# Uncertain temptations

DLR (2001), Stovall (2007)



	$u$	$v_1$	$v_2$
$b$	3	2	2
$c$	0	0	6
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$$V(x) = \frac{1}{2} \sum_{i=1}^2 \max_{\beta \in x} [u(\beta) - c_i(\beta, x)]$$
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- **Axiom:** Weak set betweenness: If  $\forall \alpha \in x, \beta \in y \alpha \succeq \beta$  then  $x \succeq x \cup y \succeq y$

# Uncertain costly temptations and overwhelming temptations



$$\begin{aligned} V(x) &= \int \left( \max_{\beta \in x} [u(\beta) + v_s(\beta)] - \max_{\beta \in x} v_s(\beta) \right) d\mu(s) \\ &\quad \int \left( \max_{\beta \in x} [u(\beta) + Kv_s(\beta)] - \max_{\beta \in x} Kv_s(\beta) \right) d\mu(s) \\ &\rightarrow \int \max_{\beta \in B_{v_s}(x)} u(\beta) d\mu(s) \end{aligned}$$

- But in fact for all  $\mu$  there exists  $\hat{\mu}$  st.

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- If we think of GP as representing a new "behavioral" feature—costs to resisting temptation—we see that they lead to same (commitment) behavior as uncertain overwhelming temptation. This suggests differences less inherent to this feature. Also may suggest comparative statics on which to focus and dynamic models for overwhelming temptation.

# Uncertain temptations

## Uncertain strength of temptation



$$\{b, y\} \succ \{y\} \quad \text{and} \quad \{b, c, y\} \succ \{b, c\}.$$

Rather have a chance of sticking to her diet rather than committing herself to violating it so  $\{b, y\} \succ \{y\}$ .

But if the temptation of the ice cream is unavoidable, it's better to also have the frozen yogurt around.

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- This violates a more subtle combination of set betweenness and independence.

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- Desire for commitment:  $\exists \alpha \in x, \alpha \succeq x$
- Negative set betweenness:  $x \succeq y \Rightarrow x \cup y \succeq y$ .

# Regret

Sarver (2007)

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$$V(x) = \max_{\beta \in x} [(1 + K) \sum u(\beta, s) p(s)] - K \sum \max_{\beta \in x} u(\beta, s) p(s)$$

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- **Axiom:** *Dominance:* If  $\{\alpha\} \succeq \{\beta\}$  and  $\alpha \in x$  then  $x \succeq x \cup \{\beta\}$

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- Interpret  $\alpha x + (1 - \alpha) y$  as resolving after choice and "requiring" contingent choice, and contrast this with a lottery over menus,  $\alpha \circ x \oplus (1 - \alpha) \circ y$  resolving after choice, that does not require contemplation. The latter is better, and it is also reasonable to assume it is no better than  $x$  since  $x \succeq y$ . (They do this to avoid explicitly introducing lotteries over menus.) Here we have a subjective states space  $S$ , state-dependent utility functions  $u$ , possible subjective information partition about the state,  $\mathcal{G} \in \mathbf{G}$ , and a cost function over information partitions. (Independence forces indifference to contingent planning.)



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$$V(x) = \max_{\mathcal{G} \in \mathbf{G}} \left( \sum_{E \in \mathcal{G}} \left[ \max_{\beta \in x} \sum_{s \in E} u(\beta, s) \mu(s|E) \right] \mu(E) - c(\mathcal{G}) \right)$$

A drawback to this representation is its lack of uniqueness; they show that there is a more refined notion of a costly contemplation model that is pinned down.

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- Epstein and Kopylov enrich the choice set: menus of acts.
- Yields subjective "beliefs" over states, and decision maker suffers the temptation is to use wrong beliefs later. They get "cold feet".  
Knowing this decision maker commits ahead of time.

$$V(\xi) = \max_{f \in \xi} \left( p \cdot u(f) + k \min_{q \in Q} (q \cdot u(f)) \right) \\ - \max_{f \in \xi} k \left( \min_{q \in Q} (q \cdot u(f)) \right) \\ , p \in Q$$

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- This yields a more robust notion of uniqueness, not relying on EU.
- This approach also can be used to characterize

$$W(P) = \int_X \left( \int_{2^S} \max_{\beta \in x} \min_{s \in \sigma} u(\beta, s) d\mu(\sigma) \right) dP(x),$$

$\mu$  a probability over sets of states



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  - costs to resisting temptation and uncertain overwhelming temptation have same commitment behavior
- In the overwhelming representation the problem facing a decision maker with negative states is exactly a principle-agent problem, and in that sense this class of models can be analyzed using standard techniques to identify the form of commitments that will be chosen and what arrangements a seller would offer (Della Vigna and Melamed, Eliaz and Spiegler, ...Amador, Werning and Angeletos use a version to study decision makers facing a temptation to over consume with a concern that flexibility might be necessary).