

# Economic Theory and Psychological Data

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# Choice-Based Testing of Psychological Models

- ▶ From last time, recall

$$K^{ANX}(p) \equiv \Delta^{ANX} p^2 + (1 - \Delta^{ANX})p.$$

where  $\Delta^{ANX} = \alpha^{ANX} - \beta^{ANX}$ .

- ▶ For signals  $s(\delta) \in S$ ,  $s(\delta) \succsim s(\tilde{\delta})$  iff,

$$\delta^2 \Delta^{ANX} \geq \tilde{\delta}^2 \Delta^{ANX}$$

- ▶ Note that sign of  $\Delta^{ANX}$  determines shape of  $K^{ANX}(p)$ .
  - ▶ Strictly concave if  $\Delta^{ANX} < 0$ : no information chosen in this case.
  - ▶ Strictly convex if  $\Delta^{ANX} > 0$ : information chosen in this case..

# Choice-Based Testing of Psychological Models

- ▶ PEU illustrates difficulties of using standard choice data.
- ▶ Model a surprise party: Outcome A is party, B is no party,
- ▶ The prior belief that a party will be thrown is  $\pi$ .
- ▶ Opposite psychology from anxiety: pessimistic beliefs make the party more enjoyable if thrown, lower disappointment otherwise.
- ▶ In terms of beliefs and states,  $(0, A)$  is best: good news and very surprising. Similarly,  $(1, B)$  is worst since no party and disappointment.

$$u^{SURP}(0, A) = 1; u^{SURP}(1, B) = 0.$$

# Choice-Based Testing of Psychological Models

- ▶ Fill in the remainder of the function, capturing benefit of pessimism in simple linear form,

$$\begin{aligned}u^{SURP}(p, A) &= 1 - \alpha^{SURP} p; \\ u^{SURP}(p, B) &= (1 - p)\beta^{SURP},\end{aligned}$$

with  $\alpha^{SURP}, \beta^{SURP} \in (0, 1)$ .

- ▶ To assess interest is signal, mirror anxiety and compute  $K^{SURP}(p)$  as,

$$K^{SURP}(p) \equiv (\beta^{SURP} - \alpha^{SURP})p^2 + (1 - 2\beta^{SURP})p + \beta^{SURP}.$$

# Choice-Based Testing of Psychological Models

- ▶ Consider the following set of values:

$$\beta^{SURP} = 0.15; \alpha^{SURP} = 0.35; \alpha^{ANX} = 0.1; \beta^{ANX} = 0.5.$$

In this case,

$$\begin{aligned}K^{ANX}(p) &\equiv -0.4p^2 + 1.4p. \\K^{SURP}(p) &\equiv -0.2p^2 + 0.7p.\end{aligned}$$

- ▶ Two entirely psychologies cannot be differentiated in terms of choice of information
- ▶ In this case, anxiety and surprise look identical in standard data.

## Other Applications

- ▶ Where they do differ is in terms of the “Concerned Expert.”
- ▶ Recall the subtle feature whereby payoff depends on beliefs.
- ▶ Looks like a psychological game a la GPS.
- ▶ Turns out that it is not quite: need to pin down out of equilibrium play before putting down payoffs
- ▶ Can show in that game:
  - ▶ If rejection of information due to anxiety about a bad outcome, pass on good information
  - ▶ If rejection of information due to desire to be surprised, suppress.

# Mindless

- ▶ Can use this to understand GP critique of behavioral economics in Mindless Economics
- ▶ GP illustrate ideal method of economics and psychology with Kreps and Porteus RP model of non-instrumental information choice
  - ▶ Can model in prize-state structure of PEU model
  - ▶ Axioms produce a function  $K(p)$  that is strictly monotone: looks like “belief based utility”
  - ▶ Can generate exactly the same behavior in terms of choice/rejection of signal as does PEU
- ▶ The key difference between KP and PEU lies in the domain on which the model is based
  - ▶ PEU is based on  $X$ , the space of lotteries over “belief-state” prizes in  $Z$ ,
$$Z = \{(p, \theta) \mid 0 \leq p \leq 1, \theta = A, B\},$$
where  $p \in [0, 1]$  is the probability of state  $A$  and  $\theta$  is the outcome that eventuates.
  - ▶ KP is based on “lotteries over lotteries”- space  $L^2 \subset X$

- ▶ Recall that generic element  $F \in X$  lists  $K$  belief-outcome lotteries  $(p_k^F, \theta_k^F)$  and  $q_k^F \geq 0$ ; with  $(p_k^F, \theta_k^F) \in Z$  all  $k$  and with  $\sum q_k^F = 1$ . Write,

$$F = [(p_1^F, \theta_1^F) \circ q_1^F; \dots; (p_k^F, \theta_k^F) \circ q_k^F; \dots; (p_K^F, \theta_K^F) \circ q_K^F].$$

- ▶ Let  $L = \{(p, A) \circ p; (p, B) \circ 1 - p \mid 0 \leq p \leq 1\} \subset X$  be the set of such lotteries over “belief-state” prizes.
- ▶ Also interest in  $L^2 \subset X$ , lotteries over  $L$ .
  - ▶ To describe  $H \in L^2$  list possible lotteries  $L(p_k^H)$ , and their probabilities  $q_k^H \geq 0$ ; with  $L(p_k^H) \in L$  all  $k$  and with  $\sum q_k^H = 1$ . Write,

$$H = [L(p_1^H) \circ q_1^H; \dots; L(p_k^H) \circ q_k^H; \dots; L(p_K^H) \circ q_K^H].$$

- ▶ Other members of  $X$  not personally feasible, such as:  $[(0.5, A) \circ 0.9; (0.5, B) \circ 0.1] \in X$ .
  - ▶ May be strategically feasible
  - ▶ Thought experiment preferences in the spirit of Savage

- ▶  $L^2$  exhausts private choice possibilities
- ▶ PEU domain contains fantasies, e.g. a guarantee that a currently uncertain future will turn out well
- ▶ The larger domain accounts for ambiguity of interpretation of PEU: there is none in KP
  - ▶ Also accounts for ability to model empathic decisions: not all bad!

# Mindless

- ▶ KP capture behavioral effect of psychology without any explicit modeling of psychology
- ▶ For GP fact that psychological measurement irrelevant in KP is virtue
- ▶ G&P propose “ring-fencing” new non-choice “psychological data” that is flooding in
- ▶ Use for inspiration not model fit

# Choice-Based Testing of Psychological Models

- ▶ Just like PEU, other behavioral choice theories incorporate psychological intuitions
  - ▶ Simon [1955]: satisficing as “plausible” process
  - ▶ Strotz [1956]: Restricting future choices and self control
  - ▶ Kahneman and Tversky [1977]: Heuristics and biases
  - ▶ Kahneman and Tversky [1979]: Prospect theory
  - ▶ Loewenstein [1987]: Delay and anticipatory feelings

# Choice-Based Testing of Psychological Models

- ▶ Just like PEU, not phrased in terms of behavior directly
  - ▶ Add a model of choice and derive implied behavior to fit to choice data
- ▶ But testing is non-definitive due to existence of other explanations
- ▶ This has led to search for other forms of evidence to buttress non-standard theories
  - ▶ I call this “Psychological data” and believe it to be of massive importance
- ▶ What to measure, how to measure it, and how to relate it to theory is the central feature of my research
  - ▶ That is neuroeconomics as I understand it

# Psychological Data

- ▶ The possible value of non-standard data is general
  - ▶ Payne, Bettman and Johnson [1988] use Mouselab to understand heuristics
  - ▶ Kahneman and Krueger [2006] uses surveys to measure happiness
- ▶ Now neuroeconomics adds even richer data
  - ▶ McClure, Laibson, Loewenstein, and Cohen [2005] use brain scans to study self control
  - ▶ Glimcher & Kable on discounting
  - ▶ Bayer & Glimcher, Daw and others on dopamine, learning and utility
  - ▶ Camerer on levels of processing
  - ▶ Phelps & Schotter on auctions

# Psychological Data

- ▶ This raises deep questions
  - ▶ Few of the models of choice tested by PBJ are rich enough to predict mouse clicks
  - ▶ No economic models extend directly to the neuroscientific evidence
- ▶ Is there even a common language to describe these data?
- ▶ If not part of the theory, how can they support the theory?
- ▶ How can specific brain activation support a theory of self control?
- ▶ Note PEU is better than most in this respect, but:
  - ▶ What are most important psychological states?
  - ▶ Are they really susceptible to measurement?

# Mindless

- ▶ G & P argue “structuralism” important to prevent unified field turning into prior-based fiefdoms
- ▶ G & P propose reviving spirit of revealed preference:
  - ▶ Phrase psychological theories in terms of choice alone
  - ▶ Implicit support for axiomatic methods
  - ▶ Implicit support for optimization

# Mindless

- ▶ There is great virtue in the RP method of modeling.
- ▶ The labor theory of value said prices not related to utility  
“diamond-water paradox”
- ▶ Paradox disappears if one looks at the margin.
- ▶ DMU explains low prices of commodities in high supply.
- ▶ The hunt was on for U, and to confirm DMU
- ▶ The ordinal revolution killed the search for utility
- ▶ Pareto recognized that logic of choice depends only on ordering, not on the scale

# Mindless

- ▶ Revealed preference reverses standard logic
- ▶ Samuelson [1938] posed the question: what is the class of “as if” theories that can be supported by a particular pattern of observed choices?
- ▶ Most basic theorem characterizes choices from all subsets of a finite list of objects that can result from maximizing a CT order, or equivalently utility maximization
- ▶ Technically a small change but philosophically huge
- ▶ Connects observable choice with a theoretical construct that has clear intuitive content
- ▶ If the predicted behavior is rarely violated, then choice data per se cannot force the rejection of the theory
- ▶ Argues against “intuitive” decision procedures in favor of those that connect tightly with observable counterparts

# Mindless

- ▶ So why did economics and psychology start with intuitions?
- ▶ Follows loss of RP focus with asymmetric information and game theory
- ▶ How do I know who has what information in a game with asymmetric information?
- ▶ How do I know your out-of-equilibrium strategy?
- ▶ Is equal and immediate division a rule or the outcome of a sophisticated implicit shared understanding of the consequences of long hierarchies of alternative behaviors?
- ▶ A small step to modeling internal decision procedures

# Mindless

- ▶ Virtues and flexibility of RP theory neglected
- ▶ Focus on domain a virtue
- ▶ EU theory already illustrates psychological possibilities of this principle, as does KP
- ▶ The domain of choice sets allows rich psych.
- ▶ Kreps for flexibility
- ▶ G & P for temptation and self control
- ▶ Makes other behavioral theories look at best inelegant, at worst dangerous

# Bridging the Gap

- ▶ GP proposal seems limited in modeling emotions:
  - ▶ Misses any production function,
  - ▶ Comparative statics etc
  - ▶ strategic interactions
  - ▶ I believe methods in economics will be revolutionized over coming decades
- ▶ But the tension is real:
  - ▶ Undisciplined use of new data would fracture field
- ▶ Not all measurements will enter the evidentiary base that drives our common theories forward
- ▶ Explains importance of method

# Bridging the Gap

- ▶ My approach: must be open to all data
- ▶ But must discipline the modeling of the data
- ▶ There are profound externalities of common language
- ▶ See research as random graph, key is to leave possibility for communication
- ▶ Really important as chances arise to cross previous social science - natural science boundaries
- ▶ Methodology is needed to improve social endeavor
- ▶ In coming period methodology will drive content

## Bridging the Gap

- ▶ I am sympathetic to the GP theoretical proposal, but there is a crucial gap in their reasoning
- ▶ But their actual proposal is meaningless, since it is based on “standard choice data” .
  - ▶ GP rely on “folk” concept of choice
  - ▶ A little thought shows this to be meaningless
- ▶ In the context of a debate on behaviorism in psychology, Ericsson and Simon focused on words as chosen, not as true
- ▶ "We see verbal behavior as one type of recordable behavior, which should be observed and analyzed like any other behavior.."
- ▶ "The report 'X' need not be used to infer that X is true"

# Bridging the Gap

- ▶ The economic conception of choice is a broken link in the GP proposal
- ▶ Rely on “I know choice when I do it”
- ▶ Consciousness is therefore a key, but no clear line separates human activities into mechanistic and chosen
- ▶ Many apparently conscious choices are made routinely
- ▶ Goal of decision theory is to produce a mechanistic model of “choice”!

# Bridging the Gap

- ▶ Reinhard Selten made similar observations in a paper prepared for the Dahlem Conference May 1999
- ▶ "Much of human behavior is automatized in the sense that it is not connected to any conscious deliberation. In the process of walking one does not decide after each step which leg to move next and by how much. . . . One might want to distinguish between bounded rationality and automatized routine. However, it is difficult to do this. Conscious attention is not a good criterion. Even thinking is based on automatized routine.... "

# Bridging the Gap

- ▶ All human activities can be modeled as having been chosen from a feasible set
  - ▶ Even our pulse rate
- ▶ Minimalism is axiomatic modeling of human outputs of interest, likely including “standard” choice.
- ▶ To what extent can this ideal methodology guide a pragmatic agenda?
- ▶ Some positive evidence in remaining talks

# Bridging the Gap

- ▶ Later today: two examples with Mark Dean, Paul Glimcher, Robb Rutledge, and Daniel Martin
  - ▶ Defining feature is tight join between theory, experiment, and test.
- ▶ At the two extremes
  - ▶ One designed to tweak definition of choice
  - ▶ The other blatantly neuroeconomic

# Choice Sets as Percepts

- ▶ Biggest opening relates to subjectivity of choice set
- ▶ Utility maximization: DM does not knowingly reject superior options.
- ▶ Samuelson's RP restrictions depend on the identification of objective with subjective choices
- ▶ Identification of subjective with objective choice sets not a conceptual necessity.
- ▶ Research goal: to take account of DM's interpretation of available choices.
- ▶ In fitting with psychometric research back to Weber
- ▶ Progress is being made but only at the start of this road