



PHIL 474/673 -Natural Rationality – week 4, January 25

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THE FORMALIZATION OF RATIONALITY

1.1 The denaturalization of rationality

(Schabas, 2005): Mills and the denaturalization of economics

"While naturalists were bringing man into nature, treating him as just another biological species and reducing his intellectual and moral capacities to animal instincts, political economists such as Mill were taking him out [of nature]" (p. 133). The result is a social science in which customs, and law-like relationships surrounding the consumption, production and distribution of wealth are all mental and the structures of the economy are "artificially" created (p. 136)

1.2 Naturalist vs formalist project

Two Newton:

- *Principia Mathematica* (Newton, 1687): **Rational mechanics** (abstract and formal). Ex: Mill, Jevons Marshall. *"rational mechanics will be the science of motions resulting from any forces whatsoever, and of the forces required to produce any motions, accurately proposed and demonstrated."* (Preface)
- *Optics* (Newton, 1704): **Experimental science**. Ex: Physiocrats (Quesnay, Mirabeau). *This analysis consists in making experiments and observations, and in drawing general conclusions from them by induction and admitting of no objections against the conclusions, but such as are taken from experiments, or other certain truths.* (Book 3, Part 1, Question 24)

Hobbes vs Hume:

- Hobbes: precepts, general rules of action that can be found by reason
- Hume: reason is the "slave of the passions"

Intellectualism vs. voluntarism

Kantian rigorism vs utilitarianism

1.3 “logistic turn”

- see (Roncaglia, 2005; Ross, 1999) and (Bruni & Sugden, 2007) for historical accounts
- Bentham: utility as happiness (Bentham, 1789/2007)
- Mills: higher (happiness) and lower pleasures (Mill, 1848/1909; Mill, 1871)
- Jevons: feelings (Jevons, 1871)
- Edgeworth: self-interest (Edgeworth, 1881/1961)
- Pareto: “ophelimity”: utility without psychology (Pareto, 1906/1971).
 - Utility as a universal truth (Bentham) to a logical construct.
 - Indifference curves
 - Newtonism: “Economic science thus acquires the rigour of rational mechanics” (p.113)

It is an empirical fact that the natural sciences have progressed only when they have taken secondary principles as their point of departure, instead of trying to discover the essence of things. . . . Pure political economy has therefore a great interest in relying as little as possible on the domain of psychology. (quoted in Bruni & Sugden, 2007)

- See (Mirowski, 1989) for historical analogies between physics and economics
- Revealed preferences (Samuelson, 1947): choices reveal preferences
- Axiomatization of Decision Theory (Savage, 1954):
 - An agent as reflexive, transitive and complete preferences (see notes week 2)
 - Sure-thing principle: if two alternatives have a common outcome under a particular state of nature, then the ordering of the alternatives should be independent of that outcome. A is preferable to B, if and only if (A or C) is preferable to (B or C)
 - As-If: If an agent’s preferences satisfy all axioms, her behavior may be construed as utility-maximization

Logic of actions instead of an abstract psychology: formal relations instead of causal ones

“before the Paretian turn, neoclassical economics was based on what was then state-of-the-art research on the psychology of sensation.” (Bruni & Sugden, 2007, p. 147)

1.4 Stages of formalization (Birnbaum *et al.*, 2001):

1) **Expected Value** (mathematical expectation): objective probability (p) * objective value (x)

$$EV = \sum_{i=1}^n p_i x_i$$

eq. 1

2) **Expected Utility** (Bernouilli): objective probability (p) * subjective utility (u) of objective value (x)

$$EU = \sum_{i=1}^n p_i u(x_i)$$

eq. 2

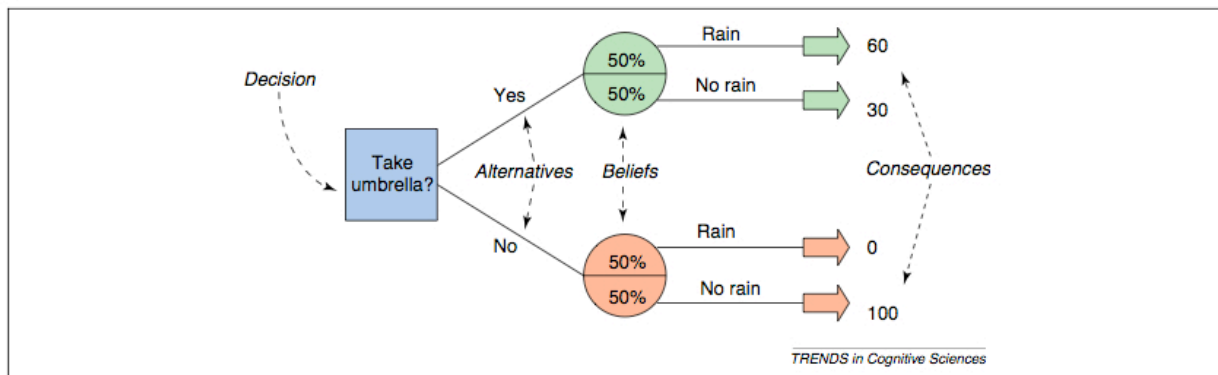
3) **Subjective Expected Utility** (Modern Decision Theory): subjective probability (S) of the an event (E) * subjective utility (u) of objective value (x)

$$SEU = \sum_{i=1}^n S(E_i)u(x_i)$$

eq. 3

See (Birnbbaum *et al.*, 2001; Hollis & Sugden, 1993)

Schematic representation (Sanfey *et al.*, 2006):



1.5 Game theory: strategic rationality

Rationality will not save us
- Robert S. McNamara, in *The Fog of War* (2003)

“it would be desirable to have a complete study made of games, treated mathematically”
- Leibniz, letter of July 29, 1715 to de Montmort

Game: an interactive, strategic, decision-making situation (Dutta, 1999; Holt & Roth, 2004; Ross, 2005; Von Neumann & Morgenstern, 1953[1944])

- Agents: Savage-rational agents
- Actions available to agents
- Strategies: set of actions that pre-specifies optimal actions
- Rules of the game
- Structure of the game: strategy space
- Pay-off structure: the utility of actions/strategies

- Common knowledge: everybody knows P, everybody knows that everybody know that P, etc. *ad infinitum*. 1) Common knowledge of rationality 2) Common knowledge of the game

Types of game

- Zero/nonzero sum
- Sequential/simultaneous
- One-shot/repeated
- Finite/indefinite
- Complete/incomplete, perfect/imperfect information
- Cooperative / non-cooperative
- Pure strategies/Mixed strategies

Equilibriums (Nash, 1950b, 1953)

- Solution of a game
- Nash theorem: every finite game has an equilibrium point.
- Guarantees the existence of a set of mixed strategies for finite, noncooperative games of two or more players in which no player can improve his payoff by unilaterally changing strategy. (Weisstein 2003)
- 3 uses (Holt & Roth, 2004): prescription, prediction or self-enforcing agreement,

Ex: Stag Hunt

	Stag	Hare
Stag	4, 4	0, 3
Hare	3, 0	3, 3

Prisoner' dilemma (Poundstone, 1992; Tucker, 1950)

Utility function:

- Go free = 4,
- 2 years = 3
- 5 years = 2
- 10 years = 0

		Player II	
		Confess	Refuse
Player I	Confess	2,2	4,0
	Refuse	0,4	3,3

(from Ross, 2005)

- Nash equilibrium: C,C
- Rational agents will select dominant strategy

1.6 Mass-action vs rational agents

- Standard interpretation: one-shot game, solutions play a major role. Players make rational decisions based on rational predictions. Players know “the full structure of the game in order to be able to deduce the prediction for themselves” (Nash, 1950a, p. 23)
- Mass-action interpretation: repeated game, solutions play no major role

“We shall now take up the ‘mass-action’ interpretation of equilibrium point. It is unnecessary to assume that the participants have full knowledge of the total structure of the game, or the ability and inclination to go through any complex reasoning processes. But the participants are supposed to accumulate empirical information on the relative advantages of the various pure strategies at their disposal. To be more detailed, we assume that there is a population (in the sense of statistics) of participants for each position of the game. [...] mixed strategies representing the average behavior in each of the populations form an equilibrium point. [...] we can only expect some sort of approximate equilibrium, since the information, its utilization, and the stability of the average frequencies will be imperfect” (Nash, 1950a, pp. 21-23)

Evolutionary Game Theory (Gintis, 2000; Hammerstein, 1998; Maynard Smith, 1982)

- evolutionary stable strategy (ESS): a strategy such that, if all the members of a population adopt it, no mutant strategy can invade

Studies in experimental economics and computational game theory

- People cooperate almost half the time (Ledyard, 1995; Sally, 1995)
- “tit for tat” (Axelrod & Hamilton, 1981)
- good only if no mutant is allowed
- beaten by “win-stay, lose-shift”, that allow exploitation (Nowak & Sigmund, 1993)
- but: there is no evolutionary stable strategy in the P.D.(Lorberbaum, 1994)

Links

- Weisstein, Eric W. "Nash's Theorem." MathWorld <http://mathworld.wolfram.com/NashesTheorem.html>
- <http://www.princeton.edu/mudd/news/faq/topics/nash.shtml> FAQ About Nash and the movie *A Beautiful Mind*
- http://nobelprize.org/nobel_prizes/economics/laureates/1994/press.html Press releases, Nobel Prizes 1994 (Nash, Selten, Harsanyi)
- <http://www.pbs.org/wgbh/amex/nash/> PBS documentary about Nash
- In P. P. Wiener (Ed.), 1974, *The dictionary of the history of ideas*. New York: Charles Scribner's Sons.:
- Morgenstern, O. Game theory. <http://etext.virginia.edu/cgi-local/DHI/dhi.cgi?id=dv2-32>
- Knight, F.H. Economic History <http://etext.virginia.edu/cgi-local/DHI/dhi.cgi?id=dv2-06>
- Hausman, Daniel M., "Philosophy of Economics", *The Stanford Encyclopedia of Philosophy* (Summer 2006 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/sum2006/entries/economics>

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