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EXPECTED UTILITY THEORY

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Expected Utility Theory (EUT) states that the decision maker (DM) chooses between risky or uncertain prospects by comparing their expected utility values, i.e., the weighted sums obtained by adding the utility values of outcomes multiplied by their respective probabilities. This elementary and seemingly commonsensical decision rule raises at once the most important questions in contemporary decision theory. First, what do the utility numbers in the formula refer to, and in particular do they belong to the same value scale as do the utility numbers that represent the DM's choices under certainty? Second, is the weighted sum procedure of combining probability and utility values the only one to be considered, and if there are indeed alternative, intuitively attractive modellings, how will the theorist arbitrate this conflict? Third, should it be taken for granted that the DM relies on probability values, or are there again alternative constructions that call for theoretical comparison? The last question is normally addressed only in the context of uncertainty, as opposed to risk, that is, in a context in which probabilities are not explicitly part of the agent's decision problem. Corresponding to this standard distinction, there are two well-received versions of the theory, i.e., Subjective Expected Utility Theory (SEUT) in the case of uncertainty, and von Neumann-Morgenstern Theory (VNMT) in the case of risk.

We shall examine each question in turn, after restating the sources and basic axiomatic structure of EUT. It has been used as both a positive and normative or prescriptive theory, which suggests a rich potential of philosophical discussion. Methodological discussions are primarily concerned with the theory in its first role, and the second question, which in effect relates to the relaxation of the " VNM independence axiom ".

The history of EUT is often construed in terms of the following smooth generalization process: the principle of maximizing expected monetary values antidates EUT, which is now in the process of being generalized in two directions, by either non-additive or non-probabilistic decision theories. The highlights in this sequence are Bernoulli's (1738) resolution of the St. Petersburg paradox, and Allais's (1953) invention of a thought-provoking problem widely referrred to as the Allais paradox. In the St. Petersburg game people were asked how much they would pay for the following prospect: if tails comes out of the first toss of a fair coin, to receive nothing and stop the game, and in the complementary case, to receive two guilders and stay in the game; if tails comes out of the second toss of the coin, to receive nothing and stop the game, and in the complementary case, to receive four guilders and stay in the game; and so on ad infinitum. The expected monetary value of this prospect is $\sum_n(2^n \times 1/2^n)$ = infinite. Since the people always set a definite, possibly quite small upper value on the St. Petersburg prospect, it follows that they do not price it in terms of its expected monetary value. Bernoulli argued in effect that they estimate it in terms of the utility of money outcomes, and defended the Log function as a plausible idealisation, given its property of quickly decreasing marginal utilities. Because the resulting series, $\sum_n(\text{Log } 2^n \times 1/2^n)$, is convergent, Bernoulli's hypothesis is supposed to deliver a solution to the paradox; more on the debate surrounding the latter can be found in Todhunter (1865). At least, Bernoulli's hypothesis counts as the first systematic occurrence of EUT theory. Two centuries later, Allais questioned the naturalness of EU-based choices by devising the following questionnaire. Question 1: which prospect would you choose of x_1= to receive 100 millions FF with probability 1,

and y_1= to receive 500 millions FF with probabibility 0.10, 100 millions FF with probability 0.89, and nothing with probability 0.01.

Question 2: which prospect would you choose of x_2= to receive 100 millions FF with probability 0.11, and nothing with probability 0.89,

and y_2=to receive 500 millions FF with probability 0.10, and nothing with probability 0.90.

Allais found that the majority answers were x_1 to question 1 and y_2 to question 2, and argued that this pair of prospects could indeed be chosen for good reasons. But it violates EUT, since there is no function U that would both satisfy:

$U(100) > 10/100\, U(500) + 89/100\, U(100) + 1/100\, U(0)$, and

$11/100\, U(100) + 89/100\, U(0) < 10/100\, U(500) + 90/100\, U(0)$. Although the word " paradox " is frequently used in the history of EUT, it should be clear from these two famous examples that it does not refer to deeply ingrained conceptual difficulties, such as Russell's paradox in set theory, or the EPR paradox in physics, but rather just to problems or anomalies for the theory that is currently taken for granted -- expected monetary value theory and EUT, respectively.

There are few explicit EU calculations in economics before von Neumann and Morgenstern (1944), who chose to determine the utility value of a randomized strategy in this mathematically convenient way. Their theoretical choice has proved to be of long-lasting influence. Not only is current game theory (including its branch specialized in incomplete information games, which dates back to Harsanyi's work in the late sixties) still heavily dependent on EU calculations, but the same can be said, although to a lesser degree, of today's microeconomics of imperfect information, as textbooks will confirm. Like Bernoulli, VNM are concerned with the case in which the probabilities are part of the decision problem. Their work did not yet amount to an axiomatization in the sense decision theorists and economists have become accustomed to. It is only in the hands of Marschak and of Herstein and Milnor, in the early fifties, that the EU formula was derived as the numerical counterpart of a qualitatively defined preference structure subjected to various axiomatic constraints. In homage to the founders of game theory, this derivation is called the VNM theorem. Their historical precedence should not lead methodologists to overlook a curious historical fact: the axiom which was to arouse innumerable discussions after Allais, i.e., the independence axiom, also called VNM independence axiom, is not explicit VNM's own account! Fishburn (1989) and Fishburn and Wakker (1995) discuss this fact while surveying the work of the formative years.

All available axiomatizations assume that there is a binary relation ≤ on the set X of all risky prospects, also called lotteries, and subject this relation to the preordering (i.e., transitivity and completeness), continuity, and independence properties (the so-called VNM independence). Little will be said here about the first axiom, not because it lacks empirical content, but because it is not specific to the theory of risky or uncertain choices. (However, the transitivity condition has come to be discussed widely in the EUT context, in particular because of the " preference reversal " phenomenon, for which the reader is referred to Hausman, 1992.) The second axiom typically says that if x is strictly preferred to z, which is strictly preferred to y, then a suitable mixture of x and y will be strictly preferred to z, and z will be strictly preferred to another suitable mixture of x and y. In the presence of the first, this axiom makes it possible to " represent " the qualitative datum ≤ by some, yet unspecific, numerical function u(x). It has some empirical content but plays mostly a technical role. The third, crucial axiom can be stated in the following easy form:

for all x, y, and z in X, and any number α such that $0< \alpha<1$, $x \leq y$ if and only if $\alpha x+(1-\alpha)z \leq \alpha y+(1-\alpha)z$.

In words, preference inequalities are preserved when the initial two lotteries are mixed in a given proportion with a third lottery. This axiom is responsible for the specific, expectional form of the function u(x) provided by the VNM theorem. A few constructions also involve a compound lottery axiom, which says in effect that any lottery having further lotteries as its outcomes can be reduced to a one-stage lottery. This axiom has a definite empirical content and is now regarded as being responsible for some cases of violation of EUT; it is automatically satisfied by the standard formalization of lotteries in terms of probabilities.

Historically, SEUT can be said to result from two distinct traditions, for one the Bernoulli-VNM tradition of decision theory, for another the mathematical and philosophical tradition of subjective probability, which can be traced back to the British empiricists and Bayes, and was revived in the 30's by Ramsey and de Finetti. (The contrast between " objective " and " subjective " schools of probability is surveyed in Fine (1973); see also Fishburn's 1986 introduction to subjective probability.) De Finetti was particularly emphatic in claiming that probability does not exist in any substantial sense. As he conceived of it, probability does not even necessarily exist in the subject's mind; it might just be the numerical expression, as perceived by an outside observer, of the property that the subject behaves coherently when choosing between uncertain prospects. This interpretation elaborates on the " Dutch book theorem ": a Dutch book is a list of bets on all possible events which leads to a net loss of money whichever state of the world is realized; the theorem shows that to avoid Dutch books is equivalent to choose among prospects according to the expectation of their monetary values, where the expectation is taken with respect to some well-defined probability. Leaving aside the strong anti-realist stand taken by de Finetti, as well as (though to a lesser degree) Ramsey, these authors were the first to bridge the analysis of probability and a (rudimentary) decision theory. Savage (1954) consolidated and enlarged the bridge by showing that to satisfy certain behavioral requirements in the style of, but more abstract and general than, the no-Dutch-book assumption is equivalent to choosing among prospects according to the expectation of their utility values, where the expectation is taken with respect to some well-defined pair of probability and utility function. The deeply non-trivial step in Savage's contribution is to reveal these two items simultaneously from the axiomatically constrained preference behavior. To do so, he had to make use of VNM theory. While two of his axioms (P3 and P4) are reminiscent of the Dutch book scheme, his postulate P2, or " sure-thing principle " , is the counterpart of VNM independence in the subjective probability framework. Unsurprisingly, VNM independence and the " sure-thing principle " have been criticized in broadly similar ways, and have led to parallel generalizations. Savage's axiomatization has also induced a specific " paradox ", Ellsberg's (1954), which is usually understood as contradicting the existence of subjective probabilities and constitutes the starting point of another generalization trend.

To make precise the first of the questions raised above, a formal statement of the VNM theorem is needed. Denoting by the $c_1,\ldots, c_k$ the outcomes of lottery x, and by $p_1, \ldots, p_k$ the attached probabilities, the theorem says that if the three axioms of preordering, continuity and independence hold, there is a representation of the preference relation in terms of the expectation of some utility function U on the outcomes, i.e., $\sum_i p_i U(c_i)$, and that this U function is " unique up to a positive linear transformation ". Now, the question is, does U refer to the same quantities as does the utility function of non-stochastic theories, such as consumer theory in microeconomics? The " measurability controversy " -- in which Baumol, Friedman and Savage, Ellsberg, Luce and Raiffa took part in the 50's -- was mostly concerned with this question. The participants agreed that for a given individual, the ordinal properties of U(c) should be the same as those of any alternative index V(c) provided by the non-stochastic theory of preferences among outcomes. However, there were severe disagreements on what added properties the VNM theorem delivered. A view shared by some prominent economists, including perhaps VNM themselves, was that the U(c) index succeeded where earlier indexes from non-stochastic theory had failed, i.e., it had cardinal properties in the sense of measuring the individual's preference differences or intensities over the outcome set. This conclusion was supported by the following argument: take three outcomes c, c′ and c′′ such that: $U(c)>U(c')>U(c'')$, and suppose that:

$1/2U(c)+1/2U(c'') > U(c')$ holds, then:

$U(c)-U(c') > U(c')-U(c'')$ trivially follows; because the last inequality does not depend on the particular representation U (see the uniqueness part of the VNM theorem), it would seem natural to interpret it as implying that the individual's intensity of preference of c over c′ is stronger than the intensity of his preference of c′ over c′′. Hence the conclusion that VNM had gone beyond the purely ordinalist stand at which the Paretian school had stopped. By and large, the " measurability controversy " resulted in the rejection of this optimistic interpretation. It was shown to rely on a superficial understanding of the uniqueness part of the VNM theorem.

To make sense of a cardinal index in the desired sense, one should first of all impose a special axiom on the preference relation, to the effect that preference differences or intensities are meaningful. In the presence of the preordering and continuity axioms, this added axiom will (essentially) have the effect of determining another utility function W on outcomes, which is itself " unique up to a linear transformation ". But unless this is explicitly required by adding still another axiom, there is no reason for expecting that W is a linear transformation of the VNM index U. In words, the uniqueness part of the theorem does provide a formal method for comparing utility differences but the numbers derived in this way might be unrelated to the measurement of preference differences, which is the only thing that the decision theorist is interested in measuring. The refutation sketched here is in accord with Fishburn's (1989) and further clarified by Bouyssou and Vansnick (1990).

Although the negative point just made might now count as standard doctrine, it is not universally recognized. Harsanyi is prominent among those who interpret the VNM index as measuring the individual's true preference differences. He actually needs this interpretation in order to tighten up and clarify the important work he pursued in the 50's to connect EU theory with utililitarianism. Because of Harsanyi's influence on current welfare economics, the " measurability controversy " is not yet closed; for further details, see Mongin and d'Aspremont (forthcoming). Allais's notion of cardinality is also at variance with the standard doctrine, although for reasons of his own.

The second of the above questions is concerned with the VNM independence axiom and has led to a host of competing answers. Among the many available generalizations of this axiom two will be singled out here. Machina's proposed theory is non-axiomatic in character; it amounts to directly generalizing the EU representation without investigating the corresponding properties of the preference relation. The first step is to replace the linearity-in-the-probababilities property of the EU representation by the weaker property of differentiability with respect to the probabilities. It can be seen that EUT then holds as a local approximation of the new theory: there are as many EU representations as there are lotteries (formally: probability distributions), and these many representations can be used to approximate relevant properties of the global, differentiable representation in the neighbourhood of the lottery x they are associated with. Each of them gives rise to a function on outcomes which will be denoted by $U_x(c)$. (Note emphatically the difference with VNM theory, which deduced a function U(c) independent of the particular lottery x.) Clearly, the U_x may exhibit widely differing curvature properties. The second step in Machina's theory precisely consists in determining how the curvature of U_x varies with x: following the " fanning out " hypothesis, it should satisfy a condition of increasing risk aversion (as measured in terms of concavity) when x varies in the direction of increasing stochastic dominance (roughly speaking: in the direction of lotteries that move probabilistic weight towards the better outcomes). The whole of this technical construction can be illustrated elegantly in terms of indifference curves: step 1 then means that the agent's indifference curves are of any smooth shape, instead of being parallel straight lines, as in VNM's particular case; and step 2 simply means that they become steeper when one looks in the direction defined by the best outcome. As Machina (1983) explains, it becomes possible to account for the common, systematic pattern underlying a number of well-established anomalies of EUT: not only the “ common consequence effect ” (which is Allais’s paradox in more abstract form), but also the “ common ratio effect ” (a related anomaly, which was investigated by Kahneman and Tversky), the “ utility evaluation effect ” (an anomaly which emerged from the attempts at numerically estimating the U(c) function), and a lesser known “ effect ”, called “ oversensitivity to changes in small probability-outlying events ”.

Another generalization of EUT which has perhaps become more popular than any other among decision theorists is the so-called rank-dependent or anticipated utility theory (AUT). It is now endowed with an axiomatic version which clarifies the sense in which VNM independence is weakened, but is easier to discuss in terms of functional representations. Assuming that the outcomes $c_1,\ldots, c_k$ of lottery x are ranked in increasing preference order, AUT evaluates x as follows:

$$f(p_1)\ U(c_1)+\ \{f(p_1+p_2)-f(p_1)\}\ \ U(c_2)+\ldots+\ \ \{f(p_1+p_2+\ldots+p_k)-f(p_1+p_2+\ldots+p_{k-1})\}\ \ U(c_k),$$

where f: [0,1]→[0,1] and f(0)=0, f(1)=1 and f is weakly increasing.

This added function is intended to capture the agent’s distortion of probability values. When f is the identity function, the formula collapses into EUT. If f satisfies $f(p)\geq p$ for all p, and in particular if it is concave throughout, it expresses a psychological attitude akin to risk aversion: think of a lottery with two distant monetary outcomes and compare it with the lottery giving its expected monetary value for sure. Conversely, $f(p)\leq p$ for all p expresses a kind of risk-seeking attitude. The case of a S-shaped f has also been explored; it involves a strong tendency to overweight small probability values. Various shapes can be invoked to account for the Allais paradox and the other “ effects ” mentioned by Machina.

Conceptually, there are two important connections between AUT and earlier work. For one, the idea of enriching EUT with a probability-distortion element is very natural, and indeed emerged at an early stage in the empirical psychologists’ work. For instance, Kahneman and Tversky’s “ prospect theory ” involved generalizing EUT in terms of the following formula:

$$g(p_1)\ U(c_1)+\ g(p_2)\ U(c_2)+\ldots+g(p_k)\ U(c_k),$$

Natural though it seems, this formula leads to an unwelcome consequence. Decision theorists were willing to give up the linearity-in-the probability property of EUT, but not that further, much weaker implication of VNM independence: if lottery x stochastically dominates lottery y, the agent prefers x to y. The stochastic dominance property can be violated in Kahneman and Tverky’s generalization of EUT. Importantly, it is always satisfied by the AUT formula, in which cumulative distribution values, rather than probability values irrespective of the order of prospects, are assumed to be distorted. Following Quiggin’s (1993) interpretation this is indeed the decisive contribution of AUT: it salvaged the psychologists’ intuition in the only way compatible with a hard core postulate of decision theory. For another, AUT connects with the “ measurability controversy ”. As explained above, one of the results of this controversy was that the VNM cardinalization should not be confused with the cardinalization relevant to the measurement of preference differences in the certainty case. A closely related conclusion is that the property of risk aversion, as measured by the concavity of the VNM index, should not be confused with the property of diminishing marginal utility of money, which belongs to the certainty context. A richer theory than EUT is needed to express this conceptual distinction formally. According to Allais and his followers, AUT is the needed theory: the added function f has the role of expressing risk attitudes, so that U can be reserved for another use, i.e., to convey certainty-related properties, such as diminishing marginal utility.

Perhaps the most important methodological question raised by EUT is whether the process of successful generalization sketched above can be interpreted as evidence of scientific progress. Mongin (1988) gives some perspective on this issue by investigating EUT in the context of Duhem's problem, i.e., the problem of choosing which part of a compound hypothesis should be sacrificed when that hypothesis is faced with unfavourable evidence. This paper emphasizes the Duhem problem raised by the axiomatic structure of VNM theory, and using standard philosophy of science arguments, claims that this problem was solved satisfactorily, when -- after many hesitations -- decision theorists agreed to follow Allais's suggestion of sacrificing VNM independence while retaining the other axioms and the weaker property of stochastic dominance. Another, perhaps equally important Duhem problem of EUT has to do with the structure of evidence. Even leaving aside thought experiments, introspection, and stylized facts, which play a role in decision-theoretic discussions as they do elsewhere in economics, truly experimental evidence can be interpreted as telling only on the background of delicate auxiliary hypotheses. The crucial ones relate to the subject's cognitive abilities (typically, his understanding of probability and expectation), his financial motivations (rewards should be neither too small nor too large, and losses are difficult to investigate), as well as to the subject's consistency from one set of answers to another (e.g., when data on different gambles are matched against each other, or gambling data are matched against market data). The only existing discussions of auxiliary hypotheses are by experimenters themselves, who have invented further experiments to assess their hidden role: see the ongoing work around the widely used " Becker-De Groot-Marschak procedure ", as reported in, e.g., Camerer's (1995) survey. At this juncture, the methodological consequences of the experimenters' assessments of their own methods remain unclear. However, there is some reason for believing that the Duhem problem, in the second of the two senses distinguished here, was at least occasionally resolved satisfactorily: it would seem as if the four " effects " listed by Machina were correctly interpreted as telling evidence against EUT, because they follow a highly systematic pattern of mutually supporting evidence.

To solve the Duhem problem in the theory of risky choice would be an important negative step but it would not yet provide a positive warrant of scientific progress. Mongin noted that Machina's generalized expected utility theory (GEUT) satisfies neither Popper's nor Lakatos's criteria of progressivity; the same could probably be said of AUT. Leaving aside the refutationist context in which this conclusion is phrased, the underlying philosophical problem seems to be that both GEUT and AUT are generalizations of EUT in the sense of being logically weaker than EUT. As a result, they account for violations of EUT in a loose way: they are compatible with these violations whereas EUT was not, but they do not imply them, hence, under a standard construal, do not explain them. Similarly, neither GEUT nor AUT really explain the occasional empirical succcess of EUT. When philosophers of physics of whichever school say that relativity theory is more general than Newtonian mechanics, they do not want to suggest that the former is a logical weakening of the latter. Rather the contrary: they mean to say that for some values of relevant parameters, the former implies the latter. The theory of risky choices is far from this stage, even if both Machina's discussion of " fanning out " and the investigation of the f function in AUT might be construed as coarse attempts to identify the parameters whose special values would turn the more general theories into the particular case of EUT. It is at least a reassuring feature of recent experimental work that the logical structure of the test problem is fully taken account, and that methods are being devised to compare not only EUT with alternatives but also these alternatives between themselves (e.g., Hey and Orme, 1994).

The previous assessment was concerned with EUT viewed as a positive theory of individual behaviour, but much of the current discussion of VNM independence is normative in character. Friedman and Savage (1952) had claimed that this axiom followed from a basic, universally compelling dominance principle; the flaw in their argument is blatant, since when the latter is formalized as the stochastic dominance principle, it turns out to be much weaker than VNM independence. A more important line of reasoning originates with Rubin's hinted defense of independence in terms of temporal consistency; it has gained acquiescence among many decision theorists.To explain why Allais's pair of choices might be irrational, these authors reformulate his first choice problem in the context of decision trees (where as usual, means a chance node and a decision mode): given the tree

which of the two, T'or B', would you commit yourself to choose in case nature chooses B? The second choice problem is reformulated by asking the same question after the monetary outcome of T has been changed from 100 millions FF to 0 FF. It would seem as if the value of this outcome were irrelevant to the agent's answers, so they should be identical in the two choice problems. Now, granting the pointwise analogy between Allais's questions and the new ones, to give invariant answers in the latter case amounts to satisfying VNM independence in the former case; hence, Allais notwithstanding, agents should satisfy VNM independence. Hammond's axiomatized theory (" consequentialism ") clarifies the logical structure of this argument and extends it to a defense of Savage's sure-thing-principle; see McClennen's (1990) account and critical discussion of this and related work.

By and large, the still lively discussion around dynamic rationality does not interact with experimental work. The specialists' wisdom is that these are completely separate areas, since one belongs to positive decision theory and the other to normative decision theory, which are (and should be) kept separate. Methodologists should be impressed by this peculiar version of Hume's thesis. There are several reasons for believing that the alleged cleavage between two groups of investigations is inadequate. First, any piece of axiomatic decision theory is prima facie open to both positive and normative interpretations, so that the cleavage cannot be a material one but at most a distinction between two vantage points on the same theories. For instance, Hammond's axioms should be discussed also at the experimental level, even it is not obvious how to test them. Second, one might submit that the positive vantage point is not entirely self-contained. One way of controlling for experimental data is simply to attempt to reproduce them in different circumstances; another, which was used in the context of the Allais paradox, is to check verbally whether subjects acquiesce in the principles of choice they spontaneously apply. Whether or not this definitely non-behaviouristic method has a role to play in experimental decision theory, and perhaps elsewhere in experimental economics, is an intriguing philosophical question. Even answering it in the negative, one might wonder what makes the experimentalist confident in the control value of data collected on the same subject under different circumstances. He appears to depend on assumptions of individual rationality and constancy through time that are difficult to state within the positive theory: they really belong to the common metaphysical core of the positive and normative theories. Third, some decision theorists are primarily interested in applying EUT and its variants to actual decision, typically in business and medicine. They are faced with, and in some sense made to supersede, the positive-normative distinction. For instance, the parameter values in the prescriptive model derive from data obtained from the subject, which data can be obtained only by assuming that the subject obeys some theory. Incoherences result if the observer's recommended theory is too distant from the theory implicit in the data; hence the search, typical of prescriptive decision theory, for a compromise between the two theories, the normative one and the positive one.

To (briefly) mention the last of the three questions mentioned at the outset, EUT has also been generalized in the direction of non-probabilistic models of uncertainty. Interpreters of subjective probability have long been aware of, and concerned with, the fact that equiprobability assumptions serve two purposes at the same time, one is to convey the subject's conviction that two complementary events are equally likely, the other is to render the subject's complete ignorance of how likely these two events are. At an early stage, Shackle suggested that the modelling of complete ignorance should rely on one's attributing zero " degree of belief " both to the given event and its complementary. Shackle's concept is then non-additive; it is an informal anticipation of the notions of " capacity ", " belief function ", " lower probability " that are currently investigated. A " capacity " usually refers to a set function which satisfies $\phi(\Delta)=0$, $\phi(\Omega)=1$, and is monotonic with respect to set-theoretic inclusion. The other concepts satisfy this basic requirement as well as further (" super-additivity ") conditions, such as: $\phi(A)+\phi(B)\geq\phi(A\cup B)+\phi(A\cap B)$. Another, strictly decision-theoretic source of current work is Ellsberg's paradox, which can be resolved by relaxing the additivity axiom of probability. Schmeidler (1989) and others have provided axiomatic derivations of non-additive probability, primarily of capacity; these new axiomatizations can be viewed as modifications of Savage's in which the probability-related axioms are suitably weakened. Similarly, weak forms of the Dutch book argument can be devised to account for the new concepts. It is remarkable that here again, the history of EUT conforms to a process of smooth generalization. However, the impetus for the new theories comes from different sources in VNMT and SEUT. Despite the fact that Ellsberg's paradox relies on an experiment, exactly as Allais's, the evidence adduced against SEUT is primarily based on stylized facts and plausibility arguments, exactly as in traditional economics.

Methodologists have hardly begun to explore the developments of EUT. The above shows that they constitute a rich vein of case studies. Actually, a stronger suggestion can be made. EUT assumptions are not only persistenly crucial to economic theorizing but in a sense have become increasingly so: they are now not anymore reserved for a special department, i.e., the economics of uncertainty, but in a sense channelled everywhere by game-theoretic assumptions. Hence, it might be submitted that every attempt at constructing a general economic methodology would have to be submitted to the test of whether or not it is applicable to EUT. A famous precedent here is Friedman, whose articles with Savage contain a defense of EUT in the spirit of some of his later methodological themes.

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