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Book Reviews

Non-EU and insurance

NON-EXPECTED UTILITY AND RISK MANAGEMENT, C. Gollier and M. Machina, (eds), Dordrecht: Kluwer, 1995, 156pp., ISBN 0-7923-9642-1.

Review by Peter Wakker, University of Leiden

This book reproduces the special issue of the *Geneva Papers on Risk and Insurance Theory*, Vol. 20, No. 1, where a number of economists working on nonexpected utility models was invited to discuss applications to insurance. The first contribution is by Mark Machina, building on Machina (1982). The latter generalizes risk aversion results from expected utility to almost all nonexpected utility theories. For example, if one person reveals more risk aversion than a second person in simple lotteries, then his (local) utility function will be more concave, and from this it can be predicted that the person will invest less in, possibly complex, risky options. First, these results are important in themselves. Second, Machina (1982) showed what the general program for nonexpected utility theory should be. Not only should one falsify erroneous predictions of expected utility, but also one should keep the valuable predictions. One should be able to derive theories and positive empirical predictions; such an aspect was dearly missing in the work of Allais (1953) because Allais' models contain too many free parameters. Machina's paper in this book gives a didactical introduction into nonexpected utility and applies his 1982 techniques to insurance topics. Thus, risk aversion monotonically enhances the buying of insurance, the levels of deductibles, coinsurance above a deductible, low incremental shares in a group risk sharing rule, and higher levels of self-insurance. Comments are provided by Karni.

Before discussing the next papers, let me comment on terminology. First, 'risk aversion' is commonly used in the sense of lower preference for a lottery than for its expected value; some authors in this book, however, use it in a noncustomary stronger sense, i.e. as aversion to mean-preserving spreads. Second, the term EURDP (expected utility with rank-dependent probabilities), used by some authors in this book, is too intractable and has been generally abandoned. Alternatives are anticipated utility (Quiggin's original term, now rarely used), RDEU (rank-dependent expected utility, currently the most common term) and the term used in this review, i.e. rank-dependent utility (RDU). I prefer the latter because of its efficiency.

In Schlee's paper, results on insurance equilibria are added to the individual optimization problems that were studied in the first two papers. His results are not robust, but differentiate between different nonexpected utility models while assuming, as do most authors in this book, universal risk aversion. In particular, he shows that the response of a deductible to a mean-preserving spread around the deductible, and to distribution-changes in an equilibrium, can differentiate between rank-dependent utility and weighted utility.

Cohen gives a comprehensive survey of several notions of risk aversion and the corresponding preference conditions, including monotone risk aversion introduced by Quiggin, for rank-dependent utility. She presents some new comparative statics results for monotone risk aversion.

Viscusi studies the influence of risk-misperception on insurance behavior. In general, information that increases the level of perceived risk, also increases risk compensation demanded for individuals, the statistical value of an injury, self-protection, and insurance coverage. Information to make perceived risk more precise can raise or lower perceived risk, hence can affect risk behavior in either direction. An interesting research question is to see to what degree risk communication *improves* insurance behavior for the insured, rather than increase or decrease the demand. The paper invokes Viscusi's prospective reference theory, which permits nonlinear transformation of probability. The last paragraph of his paper contains a message that is not only relevant to insurance markets, but to the entire field of decision theory. It is argued there that one should not only signal the existence of biases and deviations from rationality, but one should also estimate the magnitudes of these effects and seek to alleviate the resulting inadequacies. I think that this is an important topic in decision theory.

Carbone and Hey present an experiment to compare the performance of several nonexpected utility theories. While there have been several such investigations

(e.g. Harless and Camerer, 1994), the novelty of this paper is that a complete ranking of choice options is considered, besides pairwise choice. The finding of this paper is also remarkable. Expected utility is not at all a bad descriptive theory, in fact, in this research it is chosen as the best-performing theory. That is remarkable because current papers in decision theory often begin with the statement that expected utility is inadequate for descriptive purposes. The current literature has concentrated on a few exceptional paradoxical situations where expected utility does not perform well. In many situations, however, the contenders of expected utility perform worse due to their increased complexity. Another finding of this paper is that binary choice deviates considerably from complete ranking. That suggests that basic violations of rationality, due to framing, intransitivities, etc., comprise the major part of deviations from expected utility.

The final paper is by Diewert. He considers betweenness-nonexpected utility models for a state space of N equally likely states, explaining their relation to other existing betweenness theories. First, results are given on the optimality of full insurance or partial insurance. Then measures are proposed for the economic output of insurance and gambling, through the total utility gain that these provide and the translation thereof into terms of economic output.

I end this review by discussing insurance, and the several papers in this book, from the perspective of cumulative prospect theory (CPT). CPT, which is my personal favorite among the present nonexpected utility theories, was introduced by Tversky and Kahneman (1992). Similar forms were proposed by Starmer and Sugden (1989, Appendix) and Luce and Fishburn (1991). CPT combines the empirical realism of the original prospect theory (Kahneman and Tversky, 1979) with a solid theoretical foundation which makes it better suited for the development of economic theories. Still, CPT is more driven by empirical findings than most of the economic risk theories and, because CPT does not predict universal risk aversion, it is less suited for deriving the existence of equilibria. These points may explain why CPT has not yet gained much popularity in economics and, indeed, is not mentioned in this book.

Tversky and Wakker's (1995) paper on CPT cites ample empirical evidence for a 'four-fold pattern', with risk aversion for lotteries with moderate- and high-probability gains and lotteries with small-probability losses. For small-probability gain lotteries and moderate- and high-probability loss lotteries, however, one finds risk seeking rather than risk aversion. The latter deviates from the universal risk aversion generally assumed in most economic papers, and also in the papers of this book. The four-fold pattern is modeled in CPT mainly through an inverse S-shape of the graph of the probability weighting function, called bounded subadditivity or simply S-shape in Tversky and Wakker (1995). That paper also introduces preference characterizations of bounded subadditivity, similar to the risk aversion preference conditions summarized in the paper by Cohen.

Now I turn to the implications of CPT for the papers in this book. The empirical estimations of probability weighting functions suggest a shape intermediate between the pessimistic power function ('RP rank-dependent utility') and the symmetric function ('RQ rank-dependent utility') in the paper of Carbone and Hey (Tversky and Kahneman, 1992; Camerer and Ho, 1994; Tversky and Fox, 1995; Wu and Gonzalez, 1996; Abdellaoui and Munier, in preparation; Gonzalez, in preparation). It would be interesting to see how their analysis of rank-dependent utility would have ended up with that weighting function. That question would also be interesting for many other tests of the various nonexpected utility theories, such as Harless and Camerer (1994) and other similar investigations.

Wakker, Thaler and Tversky, (1996) suggest that insurance is more driven by the nonlinear sensitivity towards probability than by curvature of utility, and thus overestimation of small probability is the primary cause for insurance, rather than concave utility as traditionally put forward in economics. The finding is in line with Viscusi's analysis, whose prospective reference theory also puts probability transformation central and in particular permits overestimation of small probabilities; see the beginning of his conclusion. His theory transforms probabilities for fixed single outcomes, as in the original prospect theory, and not the cumulative probabilities as in CPT.

One of the most pronounced phenomena in risk theory is, according to CPT, loss aversion. That is, in gambles with both gains and losses, losses are weighed more heavily than gains, thus enhancing risk aversion. It would have been interesting to study loss aversion for the gambles with both gains and losses in the experiment of Carbone and Hey.

I found a few, but not many, typos in the book. There are many endnotes (111) which sometimes made reading inconvenient. This book has made a useful step forward towards the 'desperately needed' application of nonexpected utility models to real-world data for the largest, most systematic, and most intensive set of field data on choice under uncertainty, i.e. insurance (Machina, p. 10).

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Advances in multicriteria analysis

ADVANCES IN MULTICRITERIA ANALYSIS, P. M. Pardalos, Y. Siskos and C. Zopounidis (eds), Dordrecht: Kluwer Academic Publishers, 1995, 247 pp, ISBN 0-7923-3671-2.

Review by Valerie Belton, University of Strathclyde

This book which is the fifth in a series entitled non-convex optimization and its applications, contains 15 papers on multicriteria analysis. The editors claim that it '... represents a small contribution to the state of the art of multicriteria analysis'. This is an entirely appropriate description, but not one which should reflect adversely on the book — multicriteria analysis is a broad field encompassing contributions from many disciplines and application areas and it would now be impossible to do justice to the whole subject area in any one book. However, the book does dip into a substantial range of subjects as indicated by its division into five subject areas: methodology, problem structuring, utility assessment, multi-objective optimization and applications. This makes it difficult to describe the book as a whole as there is no clearly identifiable unifying theme except the all-embracing one of multicriteria analysis. Thus, in order to give a good idea of the content I feel I must resort to a description of the component papers, something which the book's editorial does already.

The mathematically faint-hearted should not despair at the series title — this is not a book primarily focused on optimization methods. On the contrary, a significant number of papers are oriented towards the development and use of procedures which are practically feasible and acceptable to decision makers in organizations — a call made by many key researchers in the field and echoed in the editorial to this volume. However, the majority of contributions do demand a basic competence in reading mathematical notation, and in addition to the papers in the section entitled multi-objective optimization, all the papers in the sections on utility assessment and real-world applications utilize optimization as part of the adopted procedure.

The section entitled methodology raises two issues of general importance, namely the need for a basic theory of MCDA procedures which can guide the choice of method in particular circumstances, and the widely debated issue of the meaning of the concept of the relative importance of criteria. Each of these issues is illustrated by reference to the ELECTRE methods. A paper by Bouyssou discusses the problem of defining a choice procedure based on a fuzzy preference relation.

The Problem Structuring section does not really deal with what I consider to be problem structuring — namely helping the decision maker(s) to understand the nature of the problem and to identify options and criteria. This section contains two papers — the first, by Larichev and Moskovich, describes a particular class of problems dominated by qualitative issues, and goes on to describe a multicriteria decision aid (ZAPROS) based on qualitative judgements. The second paper, by Korotkich, is a very mathematical presentation which focuses on the role of structural complexity as a tool for criteria definition and the study of optimal problem solving.

The section on utility assessment describes extensions of the two approaches MACBETH and UTA. The focus of the former is on deriving a theoretically sound but practically acceptable questioning procedure

Expected utility provides simple, testable properties of the optimum behavior that should be displayed by risk-averse individuals in risky decisions. Simultaneously, given the existence of paradoxes u.Â A Special Issue of the Geneva Papers on Risk and Insurance Theory. Editors. Christian Gollier. Mark Machina. Book. 18 Citations. 407 Downloads. Buying options. eBook. EUR 117.69. Price includes VAT. The expected utility hypothesis is a popular concept in economics, game theory and decision theory that serves as a reference guide for judging decisions involving uncertainty. The theory recommends which option a rational individual should choose in a complex situation, based on his tolerance for risk and personal preferences. The expected utility of an agent's risky decision is the mathematical expectation of his utility from different outcomes given their probabilities. If an agent derives 0 utils Expected utility theory is used as a tool for analyzing situations where individuals must make a decision without knowing which outcomes may result from that decision, i.e., decision making under uncertainty. These individuals will choose the action that will result in the highest expected utility, which is the sum of the products of probability and utility over all possible outcomes. The decision made will also depend on the agentâ€™s risk aversion and the utility of other agents. This theory also notes that the utility of a money does not necessarily equate to the total value of money. This th Expected-utility theory thus supplied a basis for studying the supply and demand for risk-taking. But there was still the problem of integrating risk-bearing into the general equilibrium theory of economic markets. Modigliani and Miller (1958) first showed how arbitrage considerations based on the existence of securities markets can impose significant constraints on the prices of differently-levered firms.Â Table 1 Articles on Risk and Uncertainty in Leading Journals (American Economic Review, Journal of Political Economy, Quarterly Journal of Economics)*. 1962 Neither Risk Uncertainty Both Total. Theoretical 51 1 3 0 55. It is important to distinguish the utility function U(), defined on lotteries, and the utility functionn u() defined on sure amounts of money. For this reason we call U() the von-Neumann-Morgenstern expected utility function and u() the Bernoulli utility function. Properties of EU function. von Neumann-Morgenstern utilities are unique up to a linear affine transformation: for b > 0, w(x) = a + bÂ·u(x). w and u represent the same preferences. Convex combination of lotteries. â€¢ One may interpret convex combinations of lotteries as compound lotteries.