Abstracts for Newsletter

Next deadline: end of March, 1987. Please send copies of your complete but as-yet unpublished papers, together with abstracts not exceeding approximately 200 words, to the editor:

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Please phone or write in any changes in your activities or employment that could be of interest to our membership.

New Orleans Meeting

In addition to the two sessions chaired by Ron Howard, in which finalists for the Applications Award will present their projects, the New Orleans, meeting [May 4-6, 1987] will include eleven other sessions sponsored by the SIG. Four of these sessions, "Choice Under Uncertainty I-IV", constitute a symposium on foundations and reflect the high level of theoretical activity over the past few years. Almost everyone who has published on generalized foundations is on the schedule.

Two other sessions present recent behavioral findings on multiattribute utility and decision aids, two others concern various aspects of modeling in Decision Analysis, and three concern various methodological issues.

Last, but far from least, two other

The Distinctive Contributions of Decision Analysis

By Rex Brown [Reprinted with Author's blessing from Omega 12 (1984)]

Although I make a living from purveying the types of analysis which Stuart Dreyfus assails in his paper on risk-benefit analysis [Dreyfus, SE (1984) "The risks! and benefits? of risk-benefit analysis," Omega 12 (4), 335-340.], and decision analysis more generally, I can take little exception to what he says. In particular, I agree that an expert in any given decision-making domain usually produces decisions which cannot much be improved upon by substituting a decision-analytic model which decomposes his judgment into probabilities, utilities and such. Much of the current work in artifical intelligence is, indeed, directed at replicating (rather than enhancing) the expert - with what success remains to be seen. (I might argue that with infinite and impeccable pains, a decision analysis could be constructed which would improve on the expert, but as a practical matter I take Dreyfus' point.)

However, I am not ready to take down my decision analyst's shingle. Decision analysis, at the current state-of-the-art, can earn its keep in ways other than competing with the expert. Let me suggest some examples.

HAPPY HOLIDAYS TO

ONE AND ALL!

Meeting cont'd.

sessions deserve special mention: the plenary speaker will be Professor Martin Shubik of Yale University (TB time slot); and Dr. Peter Fishburn of AT&T Bell Laboratories will present a tutorial (TD time slot) entitled "New Models for Decision Making Under Risk and Uncertainty". Both individuals are incomparable. The SIG has nothing scheduled to conflict with either.

This promises to be a meeting not to be missed!

Distinctive Contributions (Cont'd:2)

Firstly, we can help a decision maker who is not an expert, at least not with the decision in question and who has plenty of room for improvement. This might come about because the situation is novel to him (e.g. a government administrator moving into a new department); or because no one has relevant experience (e.g. making, in peacetime, defense decisions whose merit will only be proven in a war).

Secondly, decision analysis, through its logical, transparent structure, may be used to validate to third parties decisions arrived at by the direct application of expertise (for example to justify a controversial bit of regulatory legislation to Congress, the public, or the courts). Decision analysts, like myself, have in fact been called upon as 'expert witnesses' to testify as to the logical defensibility of positions argued (by substantive experts) in judicial proceeding.

Thirdly, we may help the decision maker integrate the expertise of others about particular parts of his problem, which can be captured in probabilistic or utility terms. For example, it may help the regulator to have the technical consequences of a standard assessed (as probabilities) by scientists and have those consequences evaluated (cont'd.)

Distinctive Contributions (Cont'd: 3)

(as utilities) by representatives of the public or the political process. Decision analysis would provide a convenient mechanism for inferring their action implications.

Fourthly, a decision maker may use decision analysis to supplement (rather than supplant) the direct application of expertise. One may simply display to the expert decision maker the implications of a decision analysis and let him combine them with his direct judgment as he sees fit. The most promising decision aids currently being developed do no more than prompt possible actions or alert to significant dangers or opportunities. They typically permit judgmental override on either inputs or outputs of the underlying analysis.

Fifthly, a prescriptive model may reduce the demands on time and stress on the decision maker, in situations where these are at a high premium. For example, decision aids are being developed for submarine commanders to help them manage multiple decision processes in the heat of battle, involving several weapons, threats and targets at the same time. (I would not want to suggest, however, that it is easy to develop decision aids that actually reduce decision maker burden, but we are getting there.)

Lastly, decision analysis may be used by a higher-order authority to constrain the freedom of choice of a junior on-the-spot decision maker, for example, by obliging him to use the boss' utilities rather than his own. This might be used, for example, in a Pueblo-type situation to assure that a local commander does not give higher precedence to his own safety than the avoiding of an international incident, in deciding (cont'd.)

Distinctive Contributions (cont'd: 4)

how to respond to a dangerous crisis.

The main practical implication I draw from Dreyfus' thesis is that we decision analysts should guard against arrogance in trying to sell our approach to an expert. (Of course, unless he feels unsure of his expertise, he is unlikely to come to us for help anyway.) We may not have (cont'd) much to offer a decision maker in making up his mind if all relevant information is already in his head; and if he has a great deal of successful experience in making similar decisions. I have suggested some cases where these conditions are not met and where decision analysis may, after all, be able to help.

From **H. Tamura**, Faculty of Engineering, Osaka University, 2- Yamada-Oka, Suita, Osaka 565, Japan:

Multiobjective Decision Making-Utility Theoretic Approach.

One of the difficult problems in decision analysis relates to the situation, when the decision must be undertaken by a committee. There exist several formalizations of decision making process based on the utility function approach. This approach is however very difficult to apply in the group decision case, since the number of coefficients characterizing the utility function is very high and it is practically impossible to directly identify such utility fuctions. Therefore, reduction of dimensionality of the parameter space is necessary.

In this paper a concept of convex dependence between two conflicting decision makers is presented. This concept was effectively used by the author to develop a decomposition principle of the group utility function as well as to formulate the conditions necessary to perform such a decomposition. The concept was successfully applied for a practical example.

From **H. Tamura**, **Y. Mori**, and **Y. Nakamura**, Faculty of Engineering, and Osaka University, 2-1 Yamada-Oka, Suita, Osaka 565, Japan:

On a Measurable Value Function Under Risk.

This paper deals with a descriptive model to account for various paradoxes (e.g. Allais paradox) which violate the von Neumann-Morgenstern expected utility theory. Extending the prospect theory of Kahnemann-Tversky we propose a "measurable value function under risk" which is a two-variable function of outcome and probability. The descriptive model proposed in this paper could properly account for Allais paradox (certainty effect), reference effect, and the phenomena of insurance and gambling. If we eliminated the risky situations from our model, we could obtain the conventional model of measurable value function under certainty as a special case.

From Gordon B. Hazen, Department of Industrial Engineering and Management Sciences, Northwestern University, Evanston, IL 60201:

Subjectively Weighted Linear Utility.

An axiomatized theory of nonlinear utility and subjective probability is presented in which assessed probabilities are allowed to depend on the consequences associated with events. The representation includes the expected utility model as a special case, but can accommodate the Ellsberg paradox and other types of ambiguity sensitive behavior, while retaining familiar properties of subjective proability, such as additivity for disjoint events and multiplication of conditional probabilities. It is an extension, to the states model of decision making under uncertainty, of Chew's weighted linear utility representation for decision making under risk.

Does Rolling Back Decision Trees Really Require the Independence Axiom?

In a recent article, LaValle and Wapman argue that the recursion analysis of decision trees in extensive form requires the Herstein-Milnor independence axiom. I claim that most extensive form analyses are perfectly proper in the absence of independence, but that the transformation from extensive to normal form is impermissible.

From Robert F. Nau, Fuquha School of business, Duke University, Durham, NC 27706:

A New Theory of Indeterminate Probabilities and Utilities.

A generalization of the theory of interval (lower and upper) probabilities is presented, in which nested sets of intervals with differing "confidence weights" may be assessed for the probability of an event or the expected value of a lottery, leading to a description of uncertainty by a concave function over a set of probability measures. This representation is shown to follow from axioms for rational betting on finite sets of events with limited stakes, using a Dutch book argument. An extension of the model is presented that treats joint indeterminacy between probabilities and utilities over finite sets of elementary rewards.

From Joao L. Becker, Universidade Federal Do Rio Grande Do Sul, 9000-Porto Alegre-RS, Brazil, and Rakesh K. Sarin, Graduate School of Management, University of California, Los Angeles, CA 90024 (Address requests to Professor Sarin):

Lottery Dependent Utility

In this paper we propose a model for decision making under risk that is capable of predicting empirically observed preference patterns that have been found to be incompatible with the expected utility model. This model departs from the classical expected utility model by allowing utilities to depend on the lottery. It however retains the properties of transitivity, stochastic dominance, and continuity. The model is simple to calibrate and permits types of analyses, such as exploitation of basic attitudes toward risk through risk aversion properties, that have been found useful in decision theory.

A specific version of our model is the exponential form which has been widely used in decision analysis. Except, we allow the exponential's coefficient to vary with the lottery. This simple property allows us a great deal of flexibility in predicting preference patterns that can not be predicted with any fixed utility function. The simplest version of our model can be calibrated with only two preference judgments and it too can explain violation of the substitution principle.

The primary use of our model is in descriptive or predictive research and applications. For some decision makers who wish to retian the preference patterns that are incompatible with the substitution principle, even after the implications of their choices are made transparent, our model could be of prescriptive use as well.

From **L. Robin Keller**, Graduate School of Management, University of California, Irvine, CA 92717, and **Rakesh K. Sarin**, Graduate School of Management, University of California, Los Angeles, CA 90024 (Address requests to Professor Keller):

Equity in Social Risk: Some Empirical Observations.

In societal risk analysis the equity of the distribution of risk is often an important consideration due to the indivisibility, nontransferability, and irreversibility of health risks. We empirically validate some assumptions about equity that have been discussed in the decision analytic literature. Our results show that the way fatalities are distributed throughout a society is considered along with the number of fatalities in evaluating alternative decisions involving mortality risks. The concepts of ex ante equity and ex post equity are both shown to be important in judgments of fairness. We next present a decision model based on multi-attribute preference theory incorporating the number of fatalities, as well as ex ante equity and ex post equity. Finally, we explore how perceived *deservedness* influences judgments about equity. We conclude with a discussion of the implications of research on alternative notions of equity for policy makers dealing with social risks.

From **F. Hutton Barron** and **Charles P. Schmidt**, Department of Management Science and Statistics, University of Alabama, Tuskaloosa, AL 35487-9725:

Entropy Based Selection with Multiple Objectives.

In this paper we present an approach to determine the initially unspecified weights in an additive measurable multiattribute value function. We formulate and solve a series of nonlinear programming problems which (1) incorporate whatever partial information concerning the attribute weights or overall relative value of alternatives the decision maker chooses to provide yet (2) yield a specific set of weights as a result. Although each formulation is rather easily solved using GINO, solutions in closed form dependent on a single parameter are also provided for a number of these problems.

From R. von Nitzsch and Martin Weber. Lehrgebiet Allgemeine Betriebswirtschaftslehre, RWTH Aachen, Templergraben 64, D 5100 Aachen, F.R. Germany; Working paper #86/02, Institut für Wirtschaftswissenschaften:

Utility Function Assessment on a Micro-Computer: A Reliable, Interactive Procedure.

A procedure is described which allows a decision maker to interactively assess his/her von Neumann/Morgenstern single atrribute utility function. In the first part of the procedure three different assessment methods are used to derive possible ranges for the utility function. Using different methods enables us to point out a possible bias in the elicitation process. In the second part a consistent class of utility functions is derived. Depending on the answers given in the first part the decision maker has to reconsider selected answers given before.

From Martin Weber and Franz Eisenführ, Rheinisch-Westfälische Technische Hochschule Aachen, Lehr-und Forschungsgebiet Allgemeine Betriebswirtschaftslehre, Templergraben 64, 5100 Aachen, F.R. Germany, and Detlof von Winterfeldt, Systems Science Department, Institute of Safety and Systems Management, University of Southern California, Los Angelies, CA 90028:

The Effects of Splitting Attributes on Weights in Multiattribute Utility Measurement.

This study examined how weights in multiattribute utility measurement change when objectives are split into more detailed levels. Subjects were asked to weight attributes in value trees containing three objectives which were specified by either three, four, five, or six attributes. The robust finding was that the more detailed parts of the value tree were weighted significantly higher than the less detailed ones. This overweighting bias was found for several weighting techniques, but the techniques that used holistic judgments to derive weights were affected somewhat less than techniques that used decomposed attribute weights. This bias is interpreted in terms of the increased salience and availability of attributes that are spelled out in more detail.

From William V. Gehrlein, Department of Business Administration, University of Delaware, Newark, Del. 19716

The Probability of Intransitivity in Pairwise Comparisons.

Many researchers have defined rational behavior for individuals and groups of individuals by the requirement that pairwise comparisons on all pairs of elements in a set result in a complete and transitive set of responses. Some arguments have been made that the transitivity requirement is too strict to define rationality for group behavior, but transitivity is still normally assumed as a valid assumption for individual behavior. This study develops a model for the method by which an individual determines preference in pairwise comparisons on the basis of multiple attributes of comparison. The model is based on earlier work that attempted to explain empirical results on pairwise comparisons. This model is used to obtain estimates of the probability that an individual's complete set of pairwise responses is transitive. Results indicate that intransitivity should be expected to occur regularly in an individual's pairwise comparisons and that intransitivity should not be used to characterize individual irrationality.

From <u>Richard Engelbrecht-Wiggins</u>, Dept. of Business Administration, 350 Commerce Bldg., University of Illinois, 1206 South 6th St., Champaign, IL 61620:

<u>On the Value of Private Information in an Auction: Ignorance May Be Bliss.</u>

Two examples illustrate that if your competitors in an auction vary their behavior with the amount of information that you have, then your obtaining additional information may reduce your expected profit. Therefore, unlike in traditional decision theoretic settings, the value of information in a competitive setting may be strictly negative.

<u>Appeared Elsewhere:</u>

"What Can We Learn from Experiments in Multiobjective Analysis?", by Benjamin F. Hobbs, Dept. of Systems Engineering, Case Wastern Reserve University. <u>IEEE Transactions on Systems, Man and Cybernetics</u>, SMC-16, No. 3, 384-394.

From Robert F. Bordley, Societal Analysis Dept., General Motors Research Labs, Warren, Michigan 48090-9055:

"Linear Forecasts with an Intercept: a Bayesian Approach"
<u>J. Forecasting</u> (1986).

"One Person/One Vote is not Efficient Given Information on Factions."
<u>Theory and Decision XXI</u>, #3 (1986).

"Higher Derivatives of Velocity and Quantum Mechanics."
<u>Physics Letters</u> (1986).

"Wagner and Lehrer's Rationality and Concensus in Science and Society: A Book Review." <u>Nous</u> (1986).

"Bayesian Group Decision Theory", in <u>Information Pooling and Group Decision Making</u>, B. Grofman and G. Owen (Eds); Decision Research Services, Jai Publishers, London (1986).