DECISION-ANALYSIS NEWSLETTER

Published by the ORSA Special Interest Group on Decision Analysis

VOL. 2, NO. 1

October 1, 1982

Editorial

Despite fears of some to the contrary, the newsletter is alive and about to be coming out much more regularly. Quarterly, if not bimonthly, publication is planned - and will be facilitated by my putting it on the word-processing facilities of my IBM PC.

But to make the newsletter interesting and substantial reading on a frequent basis is going to require your submitting a lot more news, commentary, and abstracts than has been the case over the past year.

New technical reports and working papers; new activities and positions (and personal news as well!) of our members; publication opportunities such as special issues of journals; and SIG activities are the primary grist for our mill.

Whatever you send will be 'word-processed' immediately and included in the next issue to come out. So, for the January 1983 issue, I shall need material by Christmas. Please send your present to:

Irving H. LaValle
School of Business
Tulane University
New Orleans, LA 70118
(O) (504) 865-5401
(H) (504) 899-8110

Rule of the game: To list a new technical report or working paper in the Newsletter, send a copy of it, together with an abstract not (grossly) exceeding 200 words to the editor, at the above address. Also indicate whether there is a per-copy charge.

Contents

New Officers

At the Detroit meeting, the guard of the SIG changed, with Pete Morris becoming Chairperson through Spring, 1984; David Bell, Vice Chairperson/Chairperson-Elect; and Lee Merkhofer, Secretary/Treasurer. Irv LaValle moves to the Council as emeritus chairperson, joining newly elected Council members Robin Hogarth and John Lathrop. Congratulations to all!

A special vote of thanks is due our outgoing Secretary/Treasurer, Craig Kirkwood and the outgoing Council members Rex Brown, Ralph Keeney, and Dick Smallwood, for their valuable and unstinting services in getting us going.

About Reprint Listings

Some of you have submitted reprints of already published articles, for lisiting in the Newsletter. Please do so only if you believe that the publication in which the article appeared is one that many of our members do not regularly encounter. And please do not feel hurt if your submitted reprint is not listed here; its omission reflects a (fallible) editorial judgment that is subject to reconsideration. Rule of thumb: when in doubt, submit it!

Hand-made bumper sticker observed recently in the environs of the Tulane Business School: "HAVE YOU MAXIMIZED UTILITY TODAY?"

Future Meetings (1): San Diego

A large number of Decision Analysis sessions is scheduled for the San Diego meeting later this month. Most of our sessions will be conducted in the Sunset room - as will our Business meeting, scheduled for 7:00 to 8:00 PM Monday, October 25th:

Probability and Judgments
--Robert L. Winkler
Decision and Utility Research
--Peter H. Farquhar
Energy Applications of Decision Analysis
--Ralph L. Keeney
Panel Discussion on Individual Decision Making and Organizational Design(1)
--Peter H. Farquhar
Decision Analysis in Health(2)
--Ronald A. Howard
Utility and Attitudes Toward Risk
--Charles M. Harvey
Panel: Decision Analysis and Analysts In Industry
--Donald L. Keefer
Modeling in Decision Analysis
--Richard D. Smallwood
Measurable Value and Preferences
--Rakesh K. Sarin
Decision Analysis - I
--Carson E. Agnew
Decision Analysis - II
--Norman C. Dalkey
Decision Analysis - III
--Kathy S. Smith
Decision Analysis - IV
--Ileana Costea

(1) Co-sponsored with the TIMS College on Organization; in the Congress Room.

(2) Sponsored by the Technical Section on Health Applications; in the Esquire Room.

Although 7:00 PM is indeed a late hour to hold meetings in a city as attractive as San Diego, do stary in the Sunset Room for the business meeting!

Henry II: Tell me: do you ever think?
Courtier: Never, Sire! A Gentleman has better things to do.

"Becket" movie

Future Meetings (2): Chicago

For next Spring (April 25-27) in Chicago, Rex Brown has arranged for nine invited-paper sessions in Decision Analysis:

Decision Analysis Applications
--Ralph Keeney
Decision Analysis in Regulation
--Rex Brown
Expert Judgment in Decision Analysis
--David A. Seaver
Modeling Value
--David Bell
Modeling Uncertainty
--Robert Winkler
Psychological and Organizational Decision Theory
--Gregory W. Fischer
Panel - Where is the Use of DA Headed?
--Detlof von Winterfeldt
Decision Analysis in Business
--Jacob W. Ulvila
Decision Analysis in Negotiations
--James K. Sebenius

Thwew will undoubtedly be other Decision Analysis sessions devoted to contributed papers. Many thanks to Rex and the Session Chairmen for what promises to be an outstanding slate of sessions.

Announcements: Editorial Boards

It is, by now, well known that Ralph Keeney and Bob Winkler are the Decision-Analysis-Area Editors of Operations Research and Management Science respectively. What is not so well known is the identities of their hard-working Associate Editors. For Operations Research, they are: David Bell, Rex Brown, Peter Farquhar, and Detlof von Winterfeldt. For Managament Science, they are: David Bell, Robin Hogarth, Craig Kirkwood, Irving LaValle, Peter Morris, D. Warner North, Rakesh Sarin, and Wayne Winston. It is in all of our interests to try to oblige when asked by one of these people to review a submission for publication. Thanks in advance!

The reward for being a good problem-solver is to be heaped with more and more difficult problems to solve!

Buckminster Fuller

Recently Available Reports

An Application of Measurable Multiattribute Value Functions to the Evaluation of Program Planning Contractors, by J. S. Dyer [Department of Management, the University of Texas, Austin, TX 78712] and H. W. Lorber [Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545]. This paper describes how the theory of measurable multiattribute value functions was used to evaluate the proposals of three competing subcontractors for a program planning project undertaken by Los Alamos National Laboratory. While we emphasize details associated with this specific application, we expect the program structure and methodology to be amenable to other contractor- and proposal-evaluation efforts after only minor modifications.

Cost-Benefit Analysis of Oil Pollution Contingency Plans, by Gunnar F. W. Fredrikson, [Central Institute of Industrial Research, P.O. Box 350, Blindern, Oslo 3, Norway]. Also, Cost-Benefit Analysis of Oil Pollution Control Stategies [Gunnar F. W. Fredrikson and Morten Østby - same address as first listed paper.] These papers concern a four-year research program started in 1978 and arising from concern about the possibility and adverse consequences of oil spills along the Norwegian coastline.

From Gordon B. Hazen, Department of Industrial Engineering and Management Science, Northwestern University, Evanston, Illinois:

Optimality Conditions in Nonconical Multiple Objective programming (With T. L. Morin). (To appear in Journal of Optimization Theory and Applications). Previous theoretical work in multiple-objective optimization has focused entirely o-vector orders representable by positive cones. Here we treat mutliple objective problems in which solutions are sought which are maximal (efficient, nondominated) under an order which may be nonconical. Compactness conditions under which solutions exist and bound the remaining alternatives are given. First-order necessary conditions and first-order sufficient consitions for maximality in general normed linear spaces are derived, and a scalarization result is given. A small computational example is also presented.

Preference Convex Unanimity in Multiple Criteria Decision Making (to appear in Mathematics of Operations Research). The approach which results in the definition of stochastic dominance orders for risky decision making can also be applied to the non-risky case, that is, one may postulate that alternative x dominates alternative y if x is preferred to y by every possible decision maker with specified preference characteristics. One such "unanimity" order is the standard componentwise vector order of multiple objective optimization. In this paper, a unanimity order is constructed based upon the characteristics of preference convexity in conjunction with finitely many elicited preference responses. Since the new order properly includes the vector order, the corresponding efficient frontier may be smaller.

Reliability and Risk Aversion in Power System Planning (with Thomas L. Morin, School of Industrial Engineering, Purdue Univ-rsity, West Lafayette, IN 47907 and A. H. El-Abiad, School of Electrical Engineering, Purdue University, West Lafayette, IN 47907). The use of constraints involving loss-of-load probability in optimization models for electrical power system planning is examined, and is shown to be in conflict with risk averse nehavior for preferences involving reliability. A new alternate characterization of risk aversion is developed which is appropriate to the generating system reliability setting.

Steepest Ascent Algorithms for Nonconical Multiple Objective Programming (with Thomas L. Morin, School of Industrial Engineering, Purdue University). A steepest ascent family of algorithms suitable for the direct solution of continuous variable unconstrained nonconical multiple objective programming problems is introduced. We are motivated by the fact that nonconical multiple objective

problems, unlike standard (conical) vector optimization problems, cannot be easily solved by examining related single objective problems. We generalize the concept of a direction of steepest ascent to the multiple objective context, and treat the question of algorithmic convergence. A computational example involving a non-conical unanimity order is given.

Independence Assumptions Regarding Strength of Preference in Risky Decision Making. Strength of preference among lotteries is considered. The concepts of difference independence and weak difference independence are extended in the natural way, and implications on relative risk attitude, multivariate risk attitude, the form of the relative utility function, and decomposition of multiattribute utility are investigated. A framework for operationally defining strength of preference is introduced, and the impact of an expected utility assumption in that framework is explored. One consequence is that utility is either a linear or exponential function of measurable value.

From Robert L. Winkler, School of Business, Indiana University, Bloomington, IN 47405:

Research Directions in Decision Making Under Uncertainty. This paper considers the modeling of decision-making problems under uncertainty, indicating current gaps in knowledge and promising research directions. Technical details are omitted, and no attempt is made to review past work, since excellent reviews are available. The discussion of research topics is divided into four categories: model formulation, modeling uncertainty, modeling preferences, and modeling competitive and group decisions. The primary focus is normative, although descriptive work that can be valuable from a normative perspective is included. The suggested research directions cover the entire spectrum from theory to application.

From Max Henrion, Department of Engineering and Public Policy, Carnegie-Mellon University, Schenley Park, Pittsburgh, PA 15213:

Expert Judgments for Policy Analysis (with M. Granger Morgan and Samuel C. Morris). This report summarizes the deliberations of a small invitational three-day workshop which explored the current state of the art and identified research needs in eliciting and using subjective probabilistic expert judgments for policy analysis involving energy and environmental systems. Part 1 of this report discusses the growing importance of these techniques and outlines the structure and objectives of the workshop. Part 2 summarizes many of the workshop's most important deliberations. Part 3 contains a preliminary description of some of the essential elements of a program of national research which should be mounted in this area in order to provide the theoretical and applied understanding necessary to support a wide--spread adoption of techniques that use subjective expert judgments, stated in probabilistic terms, by regulatory agencies that are concerned with energy and environmental systems.

From Peter H. Farquhar, Graduate School of Administration, University of California, Davis, CA 95616:

Indifference Spanning Analysis (with Peter C. Fishburn, Bell Telephone Laboratories, Inc., 600 Mountain Avenue, Murray Hill, NJ 07974). The indifference spanning approach to assessing multiattribute utility functions is based on conditional indifference relations. Such relations are used to derive multiadditive representations that involve finite sume of products of single-attribute conditional utility functions. This paper reviews the multiadditive representation theorems of Fishburn and Farquhar [Finite-degree Utility Independence, Math. of Opers. Res. Vol. 7] and then provides a procedure for constructing a set of basis elements to implement the indifference spanning approach. Several examples and directions for further research are given also.

Utility Assessment Methods. This paper integrates existing and new methods for assessing unidimensional expected utility functions in a comprehensive study of

utility assessment. We describe briefly the utility assessment process in decision analysis and then review problem formulations, sources of bias in preference judgments, and the analysis of risk attitudes. We critically examine about two dozen utility assessment mthods of which half appear for the first time. These methods are grouped under preference comparison methods, probability equivalence methods, value equivalence methods, certainty equivalence methods, hybrid methods, paired-gamble methods, and other approaches. We emphasize the nature of judgmental biases in comparing different assessment procedures. Since mosr multiattribute utility functions are decomposed into single-attribute functions, this study should facilitate such applications. We conclude with several directions for further developmental, empirical, and applied research.

From Woodward-Clyde Consultants, Three Embarcadero Center, Suite 700, San Francisco, CA. 94111:

Bounding Probabilities for Scenarios with Multiple Attributes (by Craig W. Kirkwood [Woodward Clyde] and Stephen M. Pollock [Dept. of Industrial and Operations Engineering, The University of Michigan, Ann Arbor, MI 48109]). A method is presented for developing descriptions of future scenarios and using expert judgment to assess bounds on the probabilities of these scenarios. Multiple attributes are used to describe the important features of the scenarios, and the scenarios are defined as collections of different possible levels of the attributes. Experts assess either numerical values or bounds on various unconditional and conditional probabilities for different attribute levels. These are used to establish constraints for a series of linear programs which are solved to determine the highest and lowest possible probabilities for each scenario. An application if presented to the assessment of potential threats against nuclear material safeguards systems.

An Index of Trauma Severity based on Multiattribute Utility: an Illustration of Complex Utility Modeling (by Dennis G. Fryback [Depts. of Industrial Engineering and Preventive Medicine, University of Wisconsin, Madison, WI 53706] and Ralph L. Keeney [Woodward-Clyde]). An application of multivariate utility assessment to scale the trauma severity of injuries to individuals is presented. Special attention is given to problems not usually present or reported in applications of the assessment techniques. These include nonmonotonic utility functions, strong dependencies among attributes, and state dependence of trauma severity on age and existing diseases of the individual. The manner in which these complexities were addressed is indicated.

Selecting Sites for Coal-fired Power Plants (by Magnus B. Bennedsen and Craig W. Kirkwood [both of Woodward-Clyde]). Methods that have been used to select sites for coal-fired power plants are briefly reviewed. A specific site selection procedure is presented that has been successfully applied in a number of different cases. This procedure addresses the challenging features of site selection, including multiple evaluation concerns, significant uncertainties, multiple interest groups, data limitations and regulatory requirements. With this procedure, screening criteris and expert judgment are utilized to determine candidate sites within a large study area. These candidate sites are then evaluated using multiobjective decision analysis methods to select preferred and alternate sites for the power plant. With this approach, evaluation measures are determined and a multiattribute utility function assessed over these which reflects tradeoffs among the evaluation measures and attitude toward risktaking. Levels are assessed for each evaluation measure for the candidate sites, including the use of probabilities to indicate uncertainties. An illustrative application is presented to show how the site selection procedure is carried out.

From Rex V. Brown, Decision Science Consortium, Inc., 700 Leesburg Pike, Falls Church, VA 22043:

The Fred Fiske Show with Rex Brown. Excerpted transcipt of a broadcast on National Public Radio at American University, Weashington, BC, on January 8, 1980. Subject: The Science of Making Up your Mind. Includes call-ins.

From Robert C. Bromage, Decision Science Consortium, Inc., 700 Leesburg Pike, Falls Church, VA 22043:

Partial Information in Linear Multiattribute Utility Theory. Linear multiattribute utility analysis is an increasingly popular tool for the decision analyst. Such an analysis requires the input of difficult psychological assessments of weights and scores. Sensitivity analyses are usually performed reflecting both analyst and decision maker concern about the precise values assigned. [It often happens too that inconsistent or "incoherent" weights are elicited.] This paper suggests ways in which two types of "partial information" about weights can be used to provide insights into an analysis, in a manner that is easily understood. The first type of information considered is an ordinal preference relation over weights. The second is that, in addition to this relation, certain inequality assessments can be made. Finally, the procedure is illustrated with a numerical example.

From Donald L. Keefer, Gulf Management Sciences Group, Gulf Oil Corporation, Pittsburgh, PA 15230:

Three-Point Approximations for Judgmental Probability Distributions. This paper examines and compares a number of approximations used to represent or to estimate parameters for continuous judgmental probability distributions, with particular emphasis on approximations requiring just three points from the underlying judgmental distribution. Numerical results from estimating the means and variances for a set of beta distributions indicate surprisingly large differences in accuracy among approximations in current use, with some popular ones such as the PERT and triangular-density-function approximations faring poorly. A simple new three-point discrete-distribution approximation, which is a straightforward extension of earlier work done by Pearson and Tukey, outperforms the others significantly and seems appropriate for a wide variety of applications. The results presented here are germane to those using decision or probability trees, to those conducting probabilistic engineering economic analyses, to those utilizing PERT-type network analysis techniques, and to those performing risk-analysis simulations -- including such simulations done via financial planning software packages.

From Charles M. Harvey, Department of Mathematical Sciences, Dickinson College, Carlisle, PA 17013:

Pricing Out Method with Pricing Out Amounts Dependent Upon Financial Position. In the pricing out method of determining a multiattribute value function, the assessed pricing out amounts are assumed not to depend upon the decision maker's current financial position. This paper presents a method of determining a value function when the pricing out amounts do depend on financial position. Several conditions on such a dependence are introduced, and it is shown that if one of these conditions is satisfied, then a value function can be determined by a variant of the pricing out method.

Assessment of Multiattribute Utility by Conditions on Value Tradeoffs. A method of assessing a multiattribute utility function is presented in which the decision maker uses a condition on value tradeoffs, e.g., fixed value tradeoffs, instead of a condition on multiattribute utility, e.g., additive utility independence. It is shown that if one of several such value tradeoff conditions is satisfied, then the multiattribute utility function has an associated special form in terms of

conditional utility functions, scaling constants, and at most one parameter.

Conditions on Attitudes Toward Equity for Social Cost-Benefit Studies. A method is presented by which considerations of equity and of interpersonal comparisons of value can be included in a social cost-benefit study. This approach is similar to the use of conditions on risk attitude such as constant risk aversion to facilitate the determination of a utility function. In this paper, conditions on attitude toward equity are introduced that when appropriate can reduce the determination of a group value function (social welfare function) to the determin--ation of a number of parameters.

Conditions on Social Preferences for Cost-Benefit Studies. Utilitarian social welfare functions are discussed as a means of including in a cost-benefit study important preference considerations that are not adequately described by the sum of the individuals' net present values. A number of conditions are introduced on tradeoffs between the individuals in a group and on tradeoffs between the costs and benefits for a single individual. It is shown that these conditions can help in determining social welfare functions that model such preference attitudes as aversion toward inequity and dependence between an individual's willingness to pay for benefits and his monetary position.

Risk Aversion in Stochastic Programming Models. There isa potential for stochastic programming models that include a formulation of the decision maker's aversion toward risk. This note reports an error in the method of analysis of a model previously introduced by the author and shows that the model can be analyzed by means of separable convex programming.

From David E. Bell, Graduate School of Business Administration, Harvard University, Soldiers Field, Boston, MA 02163:

Regret in Decision Making Under Uncertainty. Evidence is accumulating to show that people do not always make decisions involving uncertain monetary rewards as if they were maximizing expected utility of final assets. There are explanations for this which say that the cognitive demands of consistency to such a theory are too great. There are situations where more than mental shortcuts are involved and it is these anomalies that raise questions about the appropriateness of expected utility theory as a guide to behavior. This paper explores the possibility that expected utility theory appears to fail because the single outcome descriptor - money - is not sufficient. After making a decision under uncertainty, a person may discover, on learning the relevant outcomes, that another alternative would have been preferable and this knowledge may impart a sense of loss, or regret, to the decision maker. It is shown that a decision maker who is prepared to trade off financial return in order to avoid regret will exhibit some of the behavioral paradoxes of decision theory. By explicitly incorporating regret, expected utility theory not only becomes a better descriptive predictor but also may become a more convincing guide to prescriptive behavior.

Risk Premiums for Decision Regret. Some people find decision maing under uncertainty difficult because they fear making the "wrong" decision; wrong in the sense that the outcome of their chosen alternative proves to be worse than could have been achieved with another alternative. These people may be willing to pay a premium to avoid consequences that produce this decision regret. This paper continues an earlier investigation into the normative implications of decision regret and looks at situations where the joint probability distribution of consequences between alternatives is not specified at the time of the decision. It includes a discussion of cases where the outcomes produced by alternatives not chosen are never resolved. A consequence of this model of preferences for risky situations is that two components of risk aversion may be identified, decreasing marginal value and regret aversion.

The Manager's Dilemma: Good Decisions Need not Lead to Good Outcomes. The use of a utility function traditionally incorporates the assumption that an alternative may be evaluated individually, ithout reference to the potential outcomes of other alternatives. Yet the business manager may recognize that when his decision making abilities are assessed, comparison will be made between the results of his chosen alternative and others that he dismissed. This leads to behavior inconsistent with a simple one-attribute utility representation. This paper emphasizes that careful modellingmay be required to produce an effective decision support system for such a manager.

Disappointment in Decision Making Under Uncertainty. Decision analysis requires that two equally desirable consequences should have the same utility and vice versa. Most analyses of financial decision making presume that two consequences with the same dollar outcome will be equally preferred. However, winning the top prize of $10,000 in a lottery may leave one much happier than receiving $10,000 as the lowest prize in a lottery. There is a certain satisfaction to be had from winning but there is also the question of comparing the outcome to one's prior expectations. This paper explores the implications of disappointment and elation for decision making under uncertainty. Explicit recognition that decision makers may be paying a premium to avoid potential disappointments provides an explanation for some of the known behavioral paradoxes and provides another basis for one of the prospect theory formulations of Kahneman and Tversky. This paper is part of continuing research into the components of risk aversion.

From Michael M. Menke, Strategic Decisions Group, 3000 Sand Hill Road, Menlo Park, CA 94025:

The Dangerous Quest for Certainty in Market Forecasting (with R. Abt, M. Borja, and J. P. Pezier). Long Range Planning 12 (April 1979). Pp. 52-62.

An Inside View: Analyzing Investment Strategies (with Robert F. Egger). Planning Review (May 1981). Pp. 32-39.

Probabilistic and Decision Tree Approach Cuts 20% off Cost of New Plant Construction (with Jacques P. Pezier). Journal of Business Forecasting (Spring 1982). Pp. 11-18.

Quantifying and Forecasting Exploratory Research Success (with Roberto A. A. Boschi and Hans Ulrich Balthasar). Research Management XXII (September 1979). Pp. 14-21.

Calling the Shots in R&D (with Hans Ulrich Balthasar and Roberto A. A. Boschi). Harvard Business Review (May-June 1978). Pp.151-160.

Meeting the Challenge of an Age of Uncertainty (with Weldon B. Gibson). 1973 Presidential Issue of Handling and Shipping. Pp. 2-7.

Question: Why isn't your latest magnum opus abstracted here?
Answer: Because you didn't send it to the editor!

See you in San Diego!

IHL