

DECISION-ANALYSIS NEWSLETTER

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Berry's World

Next Deadline

July 30, 1983. A new feature of the News-letter will be a column from the Chairperson. (How's that for getting committed in print, Pete?) He did agree. Please send your new technical reports and working papers to:

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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.

Announcements

Woodward-Clyde Consultants has moved to: One Walnut Creek Center; 100 Pringle Avenue; Walnut Creek, CA 94596; (415)945-3000.

Decision Science Consortium, Inc. has opened a New England office at 19 Spring Street, Newport, RI 02840; (401)846-9808.

Congratulations to Tom Keelin, who has been promoted to Partner in Strategic Decisions Group. He is principal author of the report on electric-utility generating capacity abstracted below.

Sam Bodily is Visiting Associate Professor in the Department of



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New Council Members

As the result of the mail ballot for Council members to succeed Jim Matheson and Bob Winkler, the SIG membership elected Peter Fishburn and Jim Dyer to three-year terms expiring in the Spring of 1986. Special thanks are due to Jim Matheson and Bob Winkler for their many valuable contributions as founding members of the Council. A current and complete listing of the SIG 'masthead' is as follows: Chairperson - Peter Morris; Vice Chairperson/Chairperson Elect - David Bell; Secretary-Treasurer - Lee Merkhofer (all through Spring 1984); Council: Ward Edwards,

Peter Farquhar, and Irving LaValle (through Spring 1984); Robin Hogarth and John Lathrop (Through Spring 1985); and Jim Dyer and Peter Fishburn (through Spring 1986).

Future Meetings

The Chicago meeting bulletin has already appeared and bears witness to the outstanding job done by Rex Brown in coordinating the SIG sessions. Similar excellent slates of sessions are scheduled for the Orlando meeting this Fall, coordinated by Jim Dyer, and the San Francisco meeting next Spring, coordinated by Lee Merkhofer.

→ Finance, Business Economics, and QM at the University of Washington Graduate School of Business -- Seattle, WA 98195 -- until August.

Recently Available Reports

From L. Robin Keller, Graduate School of Management, University of California, Irvine, CA 92717:

The Effects of Decision-Problem Representation on Utility Conformance. This paper reports an empirical investigation of the effects of problem representation on conformity with von Neumann-Morgenstern utility theory. Two properties of choice behavior which are required by utility theory, but often empirically violated, were identified: the Sure-Thing Property, and the Substitution Property. In an examination of conformity with the utility properties, three forms of problem representation were considered: minimally-structured written statements, balls in tubes, and proportional decision matrices. A set of experiments was conducted evaluating subjects' adherence to the properties when presented with problems in each of the three forms of representation. In addition, one set of subjects was trained to structure written problems into proportional decision matrices, then instructed to make choices while looking at the matrix representations. There were significant effects on conformance with utility properties when the form of the problem representation was varied. Proportional matrices were found more useful in leading to conformance with both properties than minimally-structured written statements. Training people to restructure written statements into proportional matrices led to the greatest conformity with the utility properties. This study has provided a framework for the continued development of means for inducing conformity with utility properties by considering alternate forms of problem representation and problem-structuring training.

From Normal Dalkey, School of Engineering and Applied Science, University of California, Los Angeles, CA 90024:

The Positive Value of Information and Decisions with Partial Knowledge. The well-known positive value of information (PVI) principle is not applicable to the case of partial knowledge where some relevant probability distribution is unknown. The PVI Principle, however, can be extended to the case of partial knowledge as a postulate with a suitable interpretation of the terms "additional knowledge" and "value". It is shown that the postulate leads to the max-min (solution to the game against nature) decision rule for decisions with partial knowledge.

From Yves Balcer and Haim Reisman, School of Business, Tulane University, New Orleans, LA 70118:

Note on Risk Aversion and Betting. An additional explanation of why risk averse individuals will accept fair bets lies in supposing that the capital market is imperfect in the sense that the rate of return on investment is increasing with the size of the investment. Such an imperfection is easily shown, in a two-period context, to lead to a nonconcave indirect utility function for present income.

From Richard Englebrecht-Wiggans, Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign, Urbana, IL 61801:

Risk and Prices in Separable Utility Functions. Many decision problems involve more than one attribute. Separable multiattribute utility functions are commonly used to model preferences in such situations. We consider the case in which one attribute can be identified as money. The price at which nonmonetary attributes may be substituted by money, the relation of this price to a decision-maker's wealth, and the implications on attitudes towards risk are examined for additively and multiplicatively separable multiattribute utility functions. In particular, it is shown that additive separability, price independent of wealth, and monetary risk aversion are mutually inconsistent.

From Richard Englebrecht-Wiggans (Cont'd)

Equilibrium Bidding Under Budget Constraints. Consider bidders who maximize their expected gross receipts subject to a limit on expected expenditures. The budget is assumed to be set so as to maximize profits. This contrasts with the typical assumption that bidders maximize expected profits directly. It is shown that both models result in the same bidding equilibria.

On Market Prices in Generalized Transportation Games. Consider a transportation linear program generalized so that the amount of supply needed to satisfy a unit of demand depends on which supply is used. What prices might reasonably be paid by retailers and to suppliers in the corresponding market? Attention is restricted to prices which are in the core of the market game and generate enough revenue to offset allocation costs. It is shown that such prices exist, are typically unique, and may be obtained from any minimum-cost solution to the generalized transportation linear program.

Estimating Future Coal Prices from Hypothesized Demands and Costs. A method is presented for estimating coal prices for any hypothesized future demand, mining, processing and transportation costs. Assuming two natural market conditions typically results in uniquely defined prices. The prices may be readily calculated from any optimal solution of a generalized transportation linear program. The linear program itself may be simplified. First, bounds on the prices are established and used to eliminate many variables. Second, appropriately transformed, the generalized transportation linear program may be very nearly approximated by a transportation linear program. Sample results are presented.

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

Research Directions in Multiattribute Utility Analysis. There have been many contributions in multiattribute utility research over the past two decades. This paper examines the progress of research on multiattribute utility theory and methods. The main purpose of this overview is to identify possible directions for further research. A division of research into theory and methods simplifies the exposition, even though these categories obviously overlap. In Section 2, we describe theoretical contributions to multiattribute utility research in such areas as (1) decomposition models, (2) multivalent preference structures, (3) indifference spanning analysis, (4) risk measurement, and (5) other topics. Ideas for further research are presented throughout the section. In Section 3, we explore methodological research on (1) decision structuring, (2) assessment methods, and (3) decision aiding and support. Because Keeney and Raiffa (1976) [Decisions with Multiple Objectives: Preferences and Value Tradeoffs(sic)], Keeney (1982) ["Decision Analysis: an Overview", Operations Research, Vol. 30], and others provide thorough reviews of the many applications of multiattribute utility analysis, we refer readers to these papers for further information. The paper concludes with a short summary in Section 4 and a detailed set of references to the literature on multiattribute utility analysis.

From Charles M. Harvey, Dickinson College, Carlisle, PA 17013:

Decision Analysis Models for Social Attitudes Toward Inequity. 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 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.

From Thomas W. Keelin, Strategic Decisions Group, 3000 Sand Hill Road, Menlo Park, CA 94025:

Generating Capacity in U.S. Electric Utilities: How is it Used? How much is Needed Over the Decade? (With Eugene N. Oatman [Electric Power Research Institute] and Michehl R. Gent [North American Electric Reliability Council]). This study was commissioned to address a misconception by national policy makers that current generating capacity, because it is about one-third greater than current demand, provides for many years of economic growth without building new generating capacity. The study shows that, in fact, over the past four years, 92 percent of the nation's generating capacity was needed to provide reliable service to current electricity users. The remaining eight percent provides an opportunity for operating the most fuel-efficient plants and only a small margin for future growth. The amount of new generating capacity needed depends upon the level of economic activity. Because the share of electricity is increasing relative to other forms of energy, economic growth is accompanied by an even greater growth in electricity demand. The report shows that current utility plans over the decade are just adequate to replace aging capacity and to support projected annual growth in peak demand of 2.9 percent. These electricity growth projections reflect a continuation of sluggish conditions experienced in recent years. If the Administration's economic goals were achieved, electricity demand might be substantially greater than the utilities' ability to respond.

From Martin O. Weber, Graduate School of Management, University of California, Los Angeles, CA 90024 and Institut für Wirtschaftswissenschaften RWTH Aachen, F.R.G.:

An Empirical Investigation on Multi-attribute Decision Making. An empirical investigation is presented to compare several methods for multiattribute decision making. The direct-midpoint technique, the HOPIE method, and a method based on the ideal-point concept are studied. Assuming certain decision situations - like determining the test alternative - we compared the results derived from the methods with one another as well as with the decision-maker's direct preferences.

Multiattribute Decision-making with Incomplete Information. A precise determination of a multiattribute utility function of a decision maker or a group of decision makers requires considerable information that may not be available in many decision situations. In this paper a conceptual framework is proposed for identifying preferred decisions when the information required for the determination of the utility function is incomplete. This framework is applicable in developing a method which determines the set of utility functions consistent with the amount of received information. The method is based on holistic judgments on hypothetical alternatives defined by a certain factorial design. It requires that the evaluation of the alternatives is given on an interval scale. The method can also accommodate other types of additional information as, for example, pairwise comparisons. It is shown that the so-defined set of utility functions gives strong support for decisions and in finding compromises.

From Woodward-Clyde Consultants, Inc., One Walnut Creek Center, 100 Pringle Avenue, Walnut Creek, CA 94596:

Ranking with Partial Information about Attribute Weights, Including an Application to Nuclear Waste Containment Materials Selection, by Carig W. Kirkwood and Rakesh K. Sarin. A method is presented for ranking multiattributed alter atives using a weighted-additive evaluation function with only partial information about weighting (scaling) constants. Conditions are derived which can be tested to determine whether or not pairs of alternatives can be ranked given only the partial information about weighting constants. An algorithm is presented which rank-orders the complete set of alternatives based on the pairwise ranking information. The ranking method is computationally straightforward to implement in either a manual or computerized analysis. An application is presented to the evaluation of materials for use in

mined geologic nuclear waste repositories.

von Neumann-Morgenstern Utility and Equity of Public Risks, by Ralph L. Keeney and Robert L. Winkler. Many important decisions include the loss of life among their possible consequences. Alternative actions have different implications for the number of possible fatalities, the equity of those resulting fatalities, and the equity of the process resulting in those fatalities. This paper defines the concept of ex ante risk equity to address the equity of the process and distinguishes it from the ex post risk equity of the resulting fatalities. Both types of equity, as well as the loss of life per se, are included in a von Neumann-Morgenstern utility model developed to evaluate public risks. This provides a method to investigate the implications of different value judgments in examining alternatives and serves to expel a myth about the inappropriateness of von Neumann-Morgenstern utility for problems involving social consequences such as public risks.

From Peter C. Fishburn, Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974:

Nontransitive Measurable Utility [Economics Discussion Paper #209]. A new theory of preferences under risk is presented that does not use the transitivity and independence axioms of the von Neumann-Morgenstern linear utility theory. Utilities in the new theory are unique up to a similarity transformation (ratio scale measurement). The key to this generalization of the traditional linear theory lies in its representation of binary preferences by a bivariate rather than univariate real-valued function. Linearity theory obtains a linear function u on a set P of probability measures for which $u(p) > u(q)$ if and only if p is preferred to q . The new theory obtains a skew-symmetric bilinear ("SSB") function ϕ on $P \times P$ for which $\phi(p,q) > 0$ if and only if p is preferred to q . Continuity, dominance, and symmetry axioms are shown to be necessary and sufficient for the new representation.

Transitive Measurable Utility [Economics Discussion Paper #224]. This paper continues a study of theories of preferences under risk that do not use the independence axiom of the von Neumann-Morgenstern theory. Unlike its predecessor (immediately preceding abstract), it assumes that preferences are transitive. The effects of transitivity are noted in two representations of preferences. The first, which also uses continuity and dominance axioms, involves a function u on a set P of probability measures for which $u(p) > u(q)$ if and only if p is preferred to q . Although u might be nonlinear, it has other features of a von Neumann-Morgenstern linear utility function. The second representation has linear functions u and w on P , with w strictly positive except perhaps at preference-extreme measures -- where it might vanish, such that $u(p)w(q) > u(q)w(p)$ if and only if p is preferred to q . A symmetry axiom along with the axioms for the first representation are necessary and sufficient for the second representation.

Dominance in SSB Utility Theory. SSB utility theory is a generalization of the linear utility theory of von Neumann and Morgenstern that relaxes their transitivity and independence assumptions. It represents preferences between probability measures p, q, \dots on outcomes x, y, \dots in an outcome space X by a skew-symmetric bilinear functional ϕ that has $\phi(p,q) > 0$ precisely when p is preferred to q . Three facets of the SSB theory are examined in this paper. First, dominance axioms are used to extend ϕ to the integral form $\phi(p,q) = \int_X \int_X \phi(x,y) dp(x) dq(y)$ for nonfinite X . Second, the maximizing behavior of ϕ on subspaces of measures is discussed. For example, if X is finite and all measures on X are feasible, then there is a measure p^* on X that is preferred or indifferent to every other measure on X . This is true even when there are preference cycles among the measures. Finally, the concept of stochastic dominance is explored in the setting of SSB utilities.

Multiattribute Nonlinear Utility Theory [Economics Discussion Paper #249]. Linear utility theory, developed by von Neumann and Morgenstern, represents preferences

between probability distributions on an outcome space by a linear $[u(\lambda p + (1-\lambda)q) = \lambda u(p) + (1-\lambda)u(q)]$ functional u on the distributions, with p preferred to q if and only if $u(p) > u(q)$. Let $u(x) = u(p)$ when x is an outcome and $p(x) = 1$. When the outcomes are composed of several attributes, say $x = (x_1, x_2)$ in the two-attribute case, independence axioms on the attributes lead to simplifying decompositions of u on x , such as $u(x_1, x_2) = u_1(x_1) + u_2(x_2)$ and $u(x_1, x_2) = u_1(x_1)u_2(x_2)$. This paper investigates the effects of similar attribute-independence axioms on utilities in theories of preferences between probability distributions that are designed to be more flexible than the traditional linear theory. One of these new theories has p preferred to q when $u(p)/w(p) > u(q)/w(q)$, where u and w are linear functionals and w is strictly positive. When $x = (x_1, x_2)$, independence axioms lead to forms such as $\{u(x_1, x_2) = u_1(x_1) + u_2(x_2), w(x_1, x_2) = w_1(x_1) + w_2(x_2)\}$ and $\{u(x_1, x_2) = v_1(x_1), w(x_1, x_2) = v_2(x_2)\}$. Another new theory has p preferred to q when $\phi(p, q) > 0$, where ϕ is a skew-symmetric [$\phi(p, q) = -\phi(q, p)$] functional that is linear in each argument. In this case a basic independence axiom between attributes leads to the decomposition $\phi((x_1, x_2), (y_1, y_2)) = \phi_1(x_1, y_1) + \phi_2(x_2, y_2) + v(x_1, y_2) - v(y_1, x_2)$, where skew symmetry and bilinearity apply in natural ways to the functions in the decompositions. Further specializations of this form arise under even stronger independence axioms.

Foundations of Risk Measurement, I: Risk as Probable Loss. This paper explores the foundations of risk measurement using an axiomatic approach based on a binary risk relation applied to a set of probability measures on nonfavorable outcomes. It seeks to get behind specific contextual referents in order to consider characteristics of risk that may apply to many particular situations. The paper is guided by previous theoretical and empirical research on perceived risk, and focuses on the joint effects of loss probability and the distribution of losses.

Foundations of Risk Measurement, II: Effects of Gains on Risk. This paper presents the second part of a two-part study on axiomatizations of perceived risk. The first part focussed on risk as probable loss. The second part considers measures of risk that include effects of gains on perceived risk. It adopts the position that increased gains can reduce the risk of fixed probable losses without completely negating this risk. Moreover, every prospect that has no chance of yielding a loss is presumed to have no risk. Several numerical measures of risk are axiomatized. The more specialized are separable in gains and losses. Further specializations isolate the effects of loss and gain probabilities.

Recently or Just About to be Published

Identification of a Group Utility Function for Siting a Nuclear Power Plant, by Hiroyuki Tamura and Shiro Hikita, Dept. of Precision Engineering, Osaka University, 2-1 Yamada-oka, Suita, Osaka 565, Japan. To appear in 1982 IEEE International Large Scale Systems Symposium, Virginia Beach, VA.

Group Utility Function for Siting a Major Airport, by Hiroyuki Tamura and Keisuke Yukimura, Dept. of Precision Engineering, Osaka Univ.; in Environmental Systems Analysis and Management, S. Rinaldi (Ed), North-Holland, 1982.

Identification of Group Utility Functions for Group Decision Making Based on Convex Dependence, by Hiroyuki Tamura and Keisuke Yukimura, Dept. of Precision Engineering, Osaka Univ.; to appear in 3rd IFAC/IFORS Symposium on Large-Scale Systems: Theory and Applications, Warsaw, Poland, 1983.

Deriving Hamilton's Principle and the Schrödinger Equation from Consistency Conditions by Robert F. Bordley, Societal Analysis Department, General Motors Research Laboratories, Warren Michigan 48090; to appear in International Journal of Theoretical Physics, March 1983.

A Central Principle of Science: Maximizing Expected Utility, by Robert F. Bordley, G.M. Research Labs; Behavioral Science, January 1983.

A Pragmatic Approach toward Evaluating Election Schemes through Simulation, by Robert F. Bordley, G.M. Research Labs.; American Political Science Review, March 1983.

A Derivation of Warr's Empirical Power Odds Function, by Robert F. Bordley, G.M. Research Labs.; Social Forces, December, 1982.

Decision Analysis Comes of Age, by Jacob W. Ulvila and Rex V. Brown, Harvard Business Review, Sept-Oct, 1982.

Proposed SIG response to the gentleman in Berry's cartoon: In the immortal words of J. R. Ewing,

ZATTAFACK?

FROM: DR. IRVING H. LAVALLE
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*Handy news form to send in to the editor:
(tear at line)*

TO: Irving H. LaValle, School of Business, Tulane University, New Orleans, LA 70118

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