DECISION ANALYSIS NEWSLETTER

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Editor's Note

Just a reminder that we are eager to publish abstracts of all papers in the area of Decision Analysis, broadly conceived. The only requirements for our publishing an abstract of your work are:

1) That the paper itself be available for distribution upon request; and 2) that the abstract not exceed 200 words by much.

If there is a charge, please so indicate when you send your complete paper 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.

Please Note: Inform the ORSA business office of address changes; we get mailing labels from them! Thanks!

Inside

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J/DM

This issue of the Newsletter is also being sent to the members of the Society for Judgment and Decision Making, and we will be receiving copies of their newsletter, Judgment/Decision Making. Having learned more about the Society from reading back issues of their newsletter, I intend to join it by returning the form in J/DM.

Our colleagues in the Society might be interested in knowing that

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From the Chairperson

by Samuel E. Bodily; (804)924-4813; Box 6550, Charlottesville, VA 22906

Thank you, Detlof von Winterfeldt, cluster chair, for a nice set of Decision Analysis sessions at the Denver meeting, including a pair of sessions featuring Ramsey Medal winners organized by Ralph Keeney and videotaped for posterity. Robin Keller has organized the sessions for Vancouver. The cluster chairs of future meetings are:

Osaka International TIMS, July 23-26, 1989, Ron Howard, Stanford;
New York, Oct. 30-Nov. 1, 1989, Don Kleinmuntz, MIT
Las Vegas, May 7-9, 1990 Don Keefer, Arizona State.

Bob Clemen has agreed to chair the student paper competition in New York.

(cont'd. page 2)

Chairperson, cont'd.

Several items of interest were discussed at the DA SIG council meeting in Denver. One was the idea of having a periodic award for the best decision analysis publication. Bob Bordley will develop the idea further before the Vancouver meeting. It was decided to forgo awarding the Ramsey Medal this year. Nominees will be considered again at the New York meeting.

Interfaces welcomes ideas for special ideas from the SIGS. If you have an idea that would involve the SIG membership, you may discuss it with me and/or directly with the editor of Interfaces.

Richard D. Rennie Wins 1988 ORSA Decision Analysis Special Interest Group Student Paper Competition

Richard D. Rennie has won the third annual Operations Research Society of America Decision Analysis Special Interest Group's Student Paper Competition. Richard is a doctoral student in business at the University of Alberta who expects to complete his dissertation in the summer of 1989. His winning paper, titled "Auditors' Judgments of Probable Causes: Effects of Availability, Experience, Focusing and Omission," was coauthored with Professor Richard Johnson, also of the University of Alberta.

Professor Don N. Kleinmuntz was the Chair of the 1988 Student Paper Competition. The winner was announced and the winning paper was presented at the ORSA/TIMS Joint National Meeting in Denver, October 24-26, 1988.

Professor Robert T. Clemen will serve as the chair of the 1989 Student Paper Competition. The winner will (cont'd.)

Student Competition (cont'd.)

present his or her paper at the ORSA/TIMS meeting in New York, October 16-18, 1989. Inquiries regarding the upcoming competition should be addressed to Professor Clemen at the College of Business Administration, University of Oregon, Eugene, OR 97448.

J/DM cont'd.

membership in the Decision Analysis Special Interest Group is $3/year for members of ORSA and $5/year for nonmembers; checks should be made payable to Operations Research Society of America and sent (with cover note of intent!) to the attention of Mrs. Mary T. Magrogan, ORSA Business Office, Mount Royal and Guilford Avenues, Baltimore, Maryland 21202.

We look forward to a less episodic relationship between our groups!

Irving LaValle

Nominations Wanted for New Council Members

Two positions on the Decision Analysis SIG Council will be open this spring. A ballot will be enclosed with the March newsletter to elect members to these positions. We currently have one nomination, require three more, and are seeking nominations from any of you who wish to serve. Please forward your nominations to Dennis M. Buede, Chairman of the Nominations Committee, at:
Decision Logistics
2139 Golf Course Drive
Reston, VA 22091
(703) 860-3678
by 10 January 1989.

Abstracts of Papers Received

From **Paul Anand**, Centre for Experimental Economics, University of York, Heslington, York YO1 5DD, United Kingdom:

Dominance and Rationality

In an extensive survey of recent developments in the uni-dimensional modelling of agent's preferences to risks, Weber and Camerer (WC) (1987) make explicit a claim which seems to be widely held (see, for instance, Raiffa 1968), namely that there is something desirable about the fact (subjective) expected utility theory constrains preferences to be 'linear in the probabilities.' To be precise, the constraint is desirable because it is necessitated by our intuitions of what it is to make a rational choice, and in particular what it is to satisfy dominance in a stochastic context. Like similar claims made for other axioms of EU and SEU theory, I believe the claim to be less compelling than most researchers seem forced to admit.

Rational Choice and the Continuity Axiom.

In Anand (1987), I reviewed a number of arguments against the claims that three axioms of expected utility theory, completeness, transitivity and independence are rational imperatives. As LaValle (forthcoming) has pointed out, the work failed to address the assumption that utility is, or should be, continuous in the probabilities (CP). Quite apart from the modelling questions and the issues of empirical validity, it is worth asking, are choices which violate continuity thereby irrational? I shall argue that they are not. There are an increasing number of arguments being made against the normative interpretation of the axioms of expected utility theory, but what makes the continuity axiom particularly interesting is its immediate applicability to a whole range of major social problems. In considering the rationality of adhering to continuity, I shall also make some methodological remarks on the nature and aims of theories of rational choice.

From **David J. Butler**, Centre for Experimental Economics, University of York, Heslington, York YO1 5DD, United Kingdom:

An Experimental Inquiry into the Effects of Uncertainty on Rational Behaviour in Two-Person Games.

This paper reports an experimental investigation into the effects of payoff alterations in two-person games. We wished to see if the games retained their strategic distinctiveness in a real decision environment. All decisions were made without feedback as we were interested only in the impact on behaviour of the decision parameters.

Our experiment involved sixty people, each of whom stood to earn up to 15, dependent on their decisions and the (unkown) decisions of their opponent. Our results showed that few game frontiers had an impact on behaviour by themselves. We proposed an alternative model of rational behaviour which incorporated the uncertainty of the decision situation, which received strong support. It was found that recognition of the impact of uncertainty in these games had profound implications for the interpretation of observed choice behaviour. A normative defence of the above theory was also presented.

From **Robert F. Bordley**, Operating Sciences Dept., General Motors Research Laboratories, Warren, Michigan 48090:

Calibration Uncertainty May Explain the Allais Paradox.

Harrison noted that calibration uncertainty implies that one will never perceive unrelated events as correlated. This paper shows that calibration uncertainty can be used to provide an explanation of the Allais Paradox.

From **Jane M. Fraser**, Dept. of Industrial and Systems Engineering, Ohio State University, 210 Baker Systems, 1971 Neil Avenue, Columus, Ohio 43210:

Utility Functions Based on Net Present Worth.

In order to help a decision maker, an analyst often seeks to represent the decision maker's preferences in a value function, if the decision is under certainty, or in a utility function, if the decision is under uncertianty. When the alternatives involve outcomes that are different streams of future cash flows, net present worth can be justified as an appropriate value function, but it may not be an appropriate utility function since net present worth requires the decision maker to be univariate and multivariate risk neutral. This paper describes which risk attitudes can be described by net present worth and by general functions of net present worth. Furthermore, it is shown that the preferences implied by comparing lotteries on the basis of discounted certainty equivalent can be expressed as a utility function only if that utility function is equivalent to net present worth.

From **Gordon B. Hazen**, Dept. of Industrial and Operations Engineering, College of Engineering, The University of Michigan, 1205 Beal Avenue, Ann Arbor, Michigan 48109:

Ambiguity Aversion in the Small and in the Large.

Ambiguity aversion results from the desire for additional information concerning the likelihoods of uncertain events, and is not predicted or explained by conventional expected utility models. One model which does allow ambiguity averson is the Subjectively Weighted Linear Utility (SWLU) model, in which subjective probabilities are distinguished from objective probabilities, and ambiguity averters can be regarded as those who prefer to replace the former probabilities by the latter. We define ambiguity premium as the increase in utility when objective probabilities replace subjective ones. We introduce a local ambiguity aversion function a(u), which is proportional to ambiguity premium for small uncertainties, and show that one's global degree of ambiguity aversion may be characterized by examining a(u). One may also speak of constant, increasing or decreasing ambiguity attitude, and we also characterize such behavior in terms of a(u).

From **Richard L. Daniels**, Fuqua School of Business, Duke University, Durham, NC 27706 and **L. Robin Keller**, Graduate School of Management, University of California, Irvine, CA 92717:

An Experimental Evaluation of the Descriptive Validity of Lottery Dependent Utility Theory

Becker and Sarin (1987a) have recently proposed a generalization of von Neumann-Morgenstern expected utility theory that allows the utility of an outcome to vary with the lottery in which it is contained. This lottery dependent expected utility model is functionally capable of predicting commonly held preference patterns that are incompatible with the expected utility model. However, empirical evidence is required to demonstrate that this generalization more accurately reflects subjects' choices under risk.

This paper compares the performance of the expected utility and lottery dependent expected utility models, based on the assessed models' relative ability to predict the choices of experimental subjects on hold-out samples of risky choice problems. Each model was assessed in two ways, using a direct probability equivalence approach and an indirect curve-fitting approach with certainty equivalence judgments. One hold-out sample of experimental scenarios consisted of a series of dependent options designed to illustrate several paradoxical violations of expected utility theory. A second set of independent scenarios measured relative performance in a non-paradoxical context.

The results indicate that subjects do follow the paradoxical choice patterns reported in the literature. However, while the lottery dependent model tends to indicate a greater utility difference between options, it does not outperform expected utility in predicting subjects' responses. Further, the relative performance of the models is not dependent on the type of choice scenario, the domain in which scenarios are presented, or calibration by probability or certainty equivalents. A specific functional form is suggested for the parametric function that defines the lottery dependent model; alternative assessment approaches which exploit the structure of this function are also discussed.

From **Richard Engelbrecht-Wiggans**, College of Commerce and Business Administration, The University of Illinois, 1206 South 6th Street, Champaign, IL 61820:

An Example of Auction Design: A Theoretical Basis for 19th Century Modifications to the Port of New York Imported Goods Market

Over 150 years ago, with the express purpose of assuring the future prosperity of the Port, a New York auctioneer persuaded the State to lower the tax rate on goods imported through dockside auctions, and simultaneously, to extend the tax to goods offered for sale but not actually sold. He suggested that this would encourage the absolute sale of all goods offered in auctions, that the absolute sale of offered goods--possibly at bargain prices--would attract more buyers, and that, ultimately, the State would benefit. Neither the historical record nor the current theory of auctions provides much insight into these suggestions. Still, after the change, the Port prospered as never before.

This paper defines a model of auctions in which potential bidders join the auction so long as it is in their own best interest to do so, and the potential bidders presume that the seller will act in his own best interests--independent of any promises--in the auction itself. In an analytic example, taxing--at an appropriately lower rate--all goods offered for sale reduces the sellers' benefits from retaining the goods, lowers the anticipated reservation price, attracts more bidders, drives up the expected price, and ultimately benefits both the sellers and the tax collector. An examination of the example's underlying structure reveals the, rather general, factors driving

this sequence of results. Finally, a more general argument suggests similar results for a wider class of models.

From **Allan H. Murphy** and **Yin-Sheng Chen**, Dept. of Atmospheric Sciences, Oregon State University, Corvallis, OR 97331; and **Robert T. Clemen**, College of Business Administration, University of Oregon, Eugene, OR 97403:

Statistical Analysis of Interrelationships Between Objective and Subjective Temperature Forecasts.

In this paper we investigate the interrelationships between objective and subjective temperature forecasts. An information-content approach is adopted within the overall context of a general framework for forecast verification. This approach can be used to address questions such as whether the subjective forecasts contain information, regarding the corresponding observed temperatures, that is not included in the objective forecasts. Two methods of analysis are employed: (1) ordinary least-square regression analysis and (2) a Bayesian information-content analysis.

Maximum and minimum temperature forecasts formulated operationally for six National Weather Service offices during the period 1980-86 are analyzed. Results produced by the two methods are quite consistent and can be summarized as follows: (1) the subjective forecasts contain information not included in the objective forecasts for all cases (i.e., stratifications) considered and (2) the objective forecasts contain information not included in the subjective forecasts in a substantial majority of these cases. Generally, the incremental information content in the subjective forecasts considerably exceeds the incremental information content in the objective forecasts. The implications of these results for operational short-range temperature forecasting are briefly discussed.

From **Robert T. Clemen**, College of Business Administration, University of Oregon, Eugene, OR 97403.

Combining Forecasts: a Review and Annotated Bibliography

Considerable literature has accumulated over the years regarding the combination of forecasts. This paper provides a review and annotated bibliography of that literature, including contributions from the forecasting, psychology, statistics, and management science literatures. The aims are (1) to provide a roadmap to the literature for students and researchers, and (2) to help researchers locate contributions in specific arenas, both theoretical and applied. Suggestions for future research directions are given.

From **Robert T. Clemen**, (see above) and **John Guerard**, O'Connor and Associates, 141 W. Jackson Blvd., Suite 291A, Chicago, IL 60604.

Econometric GNP Forecasts: Incremental Information Relative to Naive Extrapolation

Recent studies of macroeconomic forecasts have focused primarily on the relative performance of individual forecasts and combinations thereof. We suggest that these forecasts be evaluated in terms of the incremental information that they provide relative to a simple extrapolation forecast. Using a Bayesian approach, we measure the incremental information contained in

econometric forecasts of US GNP relative to a random-walk-with-drift time series forecast. The results indicate that 1) substantial incremental gains can be obtained from econometric GNP forecasts for the current quarter, but that these gains decrease rapidly as the forecast horizon increases, and 2) after one econometric forecast has been consulted, subsequent such forecasts add little information.

From **John Guerard** (see above) and **Robert T. Clemen** (see above):

Collinearity and the Use of Latent Root Regression for Combining GNP Forecasts

In combining economic forecasts, a problem often faced is that the individual forecasts display some degree of dependence. We discuss latent root regression for combining collinear GNP forecasts. Our results indicate that latent root regression produces more efficient combining weight estimates (regression parameter estimates) that ordinary least squares estimation (OLS), although out-of-sample forecasting performance is comparable to OLS.

From **Robert T. Clemen** (see above), and **Alla9n H. Murphy** (see above).

The Expected Value of Frequency Calibration

It is possible to calibrate subjective probabilities using relative frequency information pertaining to a probability assessor's past performance. This procedure is known as frequency calibration and can be used to improve the quality of assessed probabilities. We develop a conceptual model of the probability assessment process and, on the basis of this model, show how to calculate the expected value of frequency calibration (EVFC) using standard Bayesian preposterior analysis. U.S. National Weather Service precipitation probability forecasts are used to illustrate the calculation of EVFC in the contexts of scoring rules and the familiar umbrella problem.

From **Steven J. Brams**, Dept. of Politics, New York University, New York, NY 10003; **Morton D. Davis**, Dept. of Mathematics, City College of New York, New York, NY 10031; and **D. Marc Kilgour**, Dept. of Mathematics, Wilfrid Laurier University, Waterloo, Ontario N2L 3C5, Canada:

Optimal Cheating and Inspection Strategies Under INF.

The Intermediate-Range Nuclear Forces (INF) Treaty allows both superpowers a limited number of short-notice inspections, whereby they can inspect agreed-upon sites suspected of cheating. In modeling this problem, it is postulated that the inspector must decide what sites to inspect as a function of the level of cheating he suspects and the number of inspections he has remaining. The inspectee, who is assumed to have a fixed amount of "cheating resources" that he can allocate across the sites, must decide what level of cheating is optimal at each site. These choices are modeled by a two-person, zero-sum sequental game, in which the payoffs to the inspector and inspectee are based on the amounts of cheating that are discovered from inspections. Maximin/minimax strategies and values are calculated recursively; both analytic results and numerical patterns in computer-generated data are analyzed. The relevance of the findings to the verification of arms-control agreements, and the INF treaty in particular, is assessed.

From **Bruce R. Judd, Leland W. Younker, Williard J. Hannon, Jr., R. Scott Straight, Paul C. Meagher,** and **Alan Sicherman** [address requests to Bruce R. Judd, 335 golden Oak Drive, Portola Valley, CA 94025]:

Decision Framework for Evaluation Compliance with the Threshold Test Ban Treaty

We have developed a decision framework for evaluating Soviet compliance with the 150-kt limit on the yield of nuclear tests, as specified by the Threshold Test Ban Treaty. The framework is designed to help interpret available evidence of possible violations and respond appropriately to that evidence. The "evidence" consists of estimates of the yield of Soviet tests.

Interpreting and responding to evidence of possible violations requires a series of technical determinations and policy judgments. The decision maker may wish to consider: the degree of uncertainty in the monitoring data; potential Soviet violation scenarios and their significance; the probability of Soviet violations; the relative values of correct or incorrect responses; the role of U.S. responses to evidence in deterring future violations. The decision framework provides methods for incorporating explicitly each of these factors when interpreting and responding to evidence.

The framework is best viewed as an aid to decision making. The intent, of course, is not to replace the policy maker with an analytic process. Rather, the framework provides a systematic method for organizing and incorporating diverse inputs, exploring the implications of alternative technical and value judgments, and understanding complex trade-offs. By exercising the framework, technical analysts and policy makers can build new insights, which ultimately can lead to better compliance evaluation decisions.

From **Donald L. Keefer,** Dept. of Decision and Information systems, Arizona State University, Tempe, AZ 8527; **F. Beckley Smith, Jr.,** 3937 Wilshire Circle, Sarasota, FL 34238; and **Harry B. Back,** Alcoa Laboratories, Alcoa Center, PA 15069:

A Modeling System Used to Help a Major Oil Company Allocate Bidding Capital: Overview and Statistical Models.

Bidding at U.S. offshore oil and gas lease sales is characterized by high stakes, enormous uncertainties, interrelated decisions, performance measurement difficulties, and changing bidding rules. The Lease Bidding Strategy System provided analytically-based information and insights to management responsible for bidding in a major oil company. It was used prior to every major Federal lease sale from September 1980 until the company was acquired in 1984, influencing company bids in excess of $1.5 billion. This paper describes the evolution and use of this system. Specifically, the paper: (i) documents a successful long-term application of analytical methodology in the bidding area, emphasizing its impact and mode of use; (ii) provides an overview of the methodology, which integrated techniques from decision analysis, statistics, and nonlinear optimization; (iii) illustrates the importance of adapting methodology to problem changes over time; and (iv) describes efforts that gained acceptance for this system in an area of operations that was initially "off-limits."

From **Peter C. Fishburn**, Rm 2C-354, AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974:

Binary Probabilities Induced by Rankings.

A system $[p_{ij}: i, j \in \{1,2,...,n\}, i = j, p_{ij} + p_{ji} = 1]$ of binary probabilities is said to be induced by rankings if there is a probability distribution P on the set of n! linear orders of {1,2,...,n} such that, for all distinct i and j, p_{ij} is the sum of the P values over all linear orders in which i precedes j. It has been known for some time that the triangle inequality $p_{ij} + p_{jk} \geq p_{ik}$ is necessary for $\{p_{ij}\}$ to be induced by rankings and that it is also sufficient if $n \leq 5$. The insufficiency of the triangle inequality when $n \geq 6$ has been known since about 1970, and other necessary conditions for $n \geq 6$ have been known since 1978.

The present paper generates new necessary conditions that pertain to $n \geq 6$ and shows that they are independent of previous necessary conditions. It then observes that the set of conditions on the p_{ij} that are sufficient for $\{p_{ij}\}$ to be induced by rankings regardless of n must be infinite. As far as I am aware, identification of finite sets of necessary and sufficient conditions for each particular $n \geq 6$ remains open.

From **Peter C. Fishburn** (see above) and **Philip D. Straffin**, Dept. of Mathematics and Computer Science, Beloit College, Beloit, WI 53511:

Equity Considerations in Public Risks Evaluation

Recent contributions by Sarin, and Keeney and Winkler, approach the problem of public risks evaluation from a multiattribute perspective in which fatalities, ex ante equity, and ex post equity play leading roles. The present paper considers the same problem from the perspective of holistic comparisons between potential fatality distributions. We consider a number of axioms for such comparisons, identify maximally compatible sets of axioms, and relate our approach to the multiattribute approach. We also identify a form of dispersive equity that is not discussed in recent work but deserves further consideration.

Appeared Elsewhere

"Why America Can't Think Straight," by **Jonathan Baron** and **Rex V. Brown**, The Washington Post, August 7, 1988. (Teaching Decision Analysis in the Schools. Reprints are obtainable from Rex Brown, Decision Science Consortium, Inc., 1895 Preston White Drive, Reston, VA 22091.)

The following are summarized from abstracts submitted by Professor William B. Roush, College of Agriculture, Penn State University, University Park, PA 16802:

"Economics of Brucella Ovis Control in Sheep: Epidemiologic Situlation Model," and "Economics of Brucella Ovis Control in Sheep: Computerized Decision Tree Analysis," by **T. E. Carpenter, S. L. Berry, and J. S. Glenn**, Journal of the American Veterinary Medical Association 190 (4/15/87), pp 977-982, 983-987. (The epidemiologic model was designed to simulate the transmission and persistence of B ovis in a ram flock during mating and nonmating seasons; it predicted that B ovis could be eradicated within a year by using intensive screening. A decision-tree program then determined the

economically best of several available alternatives.)

"Economic Impact of the Use of Prostiglandin to Induce Estrus in Dairy Cows," by **J. Fetrow** and **T. Blanchard**, Journal of the American Veterinary Medical Association 190, pp. 163-169. (1/15/87), (Profitability of using prostiglandin to regularize and aid in detecting estrus, and of waiting for detected estrus rather than using timed artificial insemination, are examined.)

"Decision-Tree Analysis Using a Microcomputer," by **T. E. Carpenter**, American Journal of Epidemiology 124 (1986), pp. 843-850. (Description of a program in PASCAL for structuring a hypothetical decision-analysis problem and performing simulations and risk anlayses thereon.)