DECISION-ANALYSIS NEWSLETTER

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Editor's Note

First: Please mark your ballot for officer and Council members and return to me by June 15. Retiring Council members Jim Dyer and Peter Fishburn join me in thanking you!

Second: Please send papers with abstracts not exceeding (fuzzy) 200 words for listing in the next issue. 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 paper to:

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A. B. Freeman School of Business
Tulane University
New Orleans, LA 70118.
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Please phone or write any changes in your activities or employment that could be of interest to our membership!

Brief News Announcements

(1) Your Editor delivered a series of five lectures on Decision Analysis and on recent advances in the theory of choice under uncertianty at Catholic University, Valparaiso, Chile, in December and is participating in a three-week professional tour of China as a part of a delegation of systems engineers organized by Chelsea White under the auspices of the People-to-People Citizen Ambassador Program.

(2) Chairperson – Elect Ralph L. Keeney is indeed back from Passau and preparing for the annual summer workshops (introductory and advanced) on Decision Analysis that he and Alvin Drake conduct at M.I.T. Anyone interested in participating in one of these should contact Ralph promptly at: 101 Lombard Street, Suite 704W, San Francisco, CA 94111; (415) 433-8338.

Ronald A. Howard Awarded Frank P. Ramsey Medal

At the Los Angeles meeting, Professor Ronald A. Howard of Stanford University was awarded the Frank P. Ramsey Medal for distinguished contributions to the field of Decision Analysis. The award by SIG Chairperson David Bell, and acceptance by Ron Howard, will appear in the next issue.

SEE PAGE SEVEN FOR BALLOT

The SSB Song*

The Nonlinear tastes of deciders
are much stranger than anyone thinks
But with SSB they're not back-sliders
though hard to predict as the sphynx.

While it seems that their preferences waffle
and cycle around in a ring
Yet to Fishburn this isn't so awful
since a randomized act is the thing.

Now, preferences lie in comparing
one context against all the rest
And some of us may find it wearing
that the rest does determine the best!

But if preferences can never cycle
as assumed by MacCrimmon and Chew
Then nothing occurs that is frightful
if holistic approaching you do.

Yet Axiom I has a glo-ow
when you do confront big tree
As LaValle and Ken Wapmann did sho-ow
it lets you roll back op-tim-ly

Now, where will this awesome discovery
contribute to a better day?
To Peter, for all it's recovery,
but Irv says for groups it makes hay.

(Key of C)

G, E G G, E G G, E C

C A G# C8 B A G

G A A A C8 B A G E

G G A G F E D C

* For clarification of obscure terminology, see the Fishburn-LaValle and LaValle-Fishburn abstracts which follow.

From Peter C. Fishburn, AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974 and Irving H. LaValle, A. B. Freeman School of Business, Tulane University, New Orleans, LA 70118 (address requests to Dr. Fishburn):

A Nonlinear, Nontransitive and Additive-Probability Model for Decisions Under Uncertainty

Let $\succ$ denote a preference relation on a set F of lottery acts. Each f in F maps a state space S into a set P of lotteries on decision outcomes. The paper discusses axioms for $\succ$ on F which imply the existence of an SSB (skew-symmetric bilinear) functional ϕ on $p \times p$ and a finitely additive probability measure π on 2^S such that, for all f and g in F,

$$f \succ g \iff \int_S \phi(f(s),g(s))d\pi(s) > 0.$$

This S^3B (states SSB) model generalizes the traditional Ramsey-Savage model in which ϕ decomposes as $\phi(p,q) = u(p) - u(q)$, where u is a linear functional on P. The S^3B model preserves the probability structure of the Ramsey-Savage model while weakening their assumptions of transitivity and independence.

Context-Dependent Choice with Nonlinear and Nontransitive Utilities

This paper develops a theory of choice by maximal-preference-under-randomization for a nontransitive preference relation $\succ$ on an abstract convex set F under the assumption that $\succ$ on F is represented by an SSB (skew-symmetric bilinear) functional ϕ on $F \times F$ as $p \succ q \iff \phi(p,q) > 0$. Let $\bar{F}$ denote the set of convex hulls of nonempty, finite subsets of F, considered as potential contexts for choice. A main purpose of the paper is to explore choice among potential contexts P,Q,... in $\bar{F}$ on the basis of ϕ on $F \times F$ extended to Φ on $\bar{F} \times \bar{F}$ by the minimax definition

$$\Phi(P,Q) = \max_{p \in P} \min_{q \in Q} \phi(p,q).$$

It is shown that Φ has many of the properties of ϕ and that the properties of ϕ are sufficient to imply that, for any finite set of contexts, there is a mixture P of those contexts for which $\Phi(P,Q) \geq 0$ for all other mixtures Q of the same contexts. This provides a rationale for two-step procedures that first select a context and then choose a maximally-preferred alternative in the selected context. Several procedures for overall choice in the multiple-context setting are shown to yield very different results when preferences are intransitive. However, the procedures become essentially equivalent when preferences are fully transitive.

From Irving H. LaValle, A. B. Freeman School of Business, Tulane University, New Orleans, LA 70118 and Peter C. Fishburn, AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974 (address requests to Dr. LaValle):

Equivalent Decision Trees and Their Associated Strategy Sets

The purpose of this paper is to examine the structure of individual decisions under uncertainty in extensive (i.e., decision-tree) form at a sufficient level of generality to encompass many traditional as well as novel criteria of general choice under uncertainty. Considerations both of structure and of strategic effect arise. In §2 we define weak and strong forms of strategic equivalence of decision trees and describe partial-normalization procedures by which all economically defined complete pure strategies may be identified for the decider and for "chance". In §3 we examine characteristics of locally randomized, "behavior" strategies for the decider as the degree of normalization is varied, and we deduce useful properties of the function which specifies an out-come lottery for each behavior strategy of the decider in conjunction with a deterministic or stochastic selection by Chance. In §4 we list a wide variety of choice criteria which may be invoked within the framework developed here.

Decision Analysis under States-Linear SSB Preferences

We survey Fishburn's SSB theory of risky choice under nonlinear and potentially nontransitive preferences and apply the states-linear special case in the Decision-Analysis context, showing that tractable characterizations of optimal choices are obtainable via linear programming and that much of the accepted wisdom in this field continues to obtain when preference is transitive but not necessarily linear. The distinctive marginal contribution of linear and transitive (i.e., von Neumann-Morgenstern) preferences over nonlinear transitive (i.e., Chew-MacCrimmon) preferences appears to be in justifying the recursive analysis of decisions in extensive form.

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

A Preference Model for Averse-Prone Risk Attitudes

This paper proposes an explanation and a model for the tendency of many decision makers to be risk averse in their preferences among actions leading to net gains or the status quo but to be risk prone in their preferences among actions leading to net losses or the status quo. It is suggested that for a person having such an averse-prone risk attitude, the consequences can be more realistically described by including additional attributes for the psychological effects of financial outcomes, e.g., effects on the decision maker's self-esteem and reputation. A preference model is described that relates an attitude of risk aversion for gains and losses in a context in which these psychological effects are omitted to an averse-prone risk attitude in a context in which these psychological effects are present.

From David E. Bell, Morgan 307, Harvard Graduate School of Business Administration, Soldiers Field, Boston, MA 02163:

Conditional Ordinal Additivity

An ordinal utility function u over two attributes X_1, X_2 is additive if there exists a strictly monotonic function ϕ such that $\phi(u) = v_1(x_1) + v_2(x_2)$ for some functions v_1, v_2. Here we consider the class of ordinal utility functions over n attributes for which each pair of attributes is additive for any fixed levels of the remaining attributes. We show that while this class is more general than those that are ordinally additive, the assessment task is of the same order of difficulty.

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

An Operational Theory of Fuzzy Subjective Probabilities

A generalization of the theory of interval (lower and upper) probabilities is presented, in which confidence weights may be attached to different intervals for the probability of an event. This representation of uncertainty is shown to arise naturally from a set of axioms for limited rational betting. Confidence is given an operational definition with reference to an assumed limit on betting stakes. A Dutch book argument shows that confidence-weighted interval probabilities are described by functions that are interpretable as membership functions of fuzzy sets, although a modification of the "extension principle" of fuzzy set theory is required. An alternative graphical representation in the form of "confidence functions" is presented, and it is shown that confidence tends to dissipate (i.e., fuzziness accumulates) in chains of probabilistic inference.

Reconciling Incoherence and Combining Judgments with Fuzzy Probabilities

The "Operational Theory of Fuzzy Subjective Probabilities" is herein applied to the problems of combining judgments and of reconciling incoherent judgmental assessments.

From Ross D. Shachter, Department of Engineering-Economic Systems, Stanford University, Stanford, CA 94305:

Evaluating Influence Diagrams

An influence diagram is a graphical structure for modeling uncertain variables and decisions, explicitly revealing probabilistic dependence and the flow of information. It is an intuitive framework in which to formulate problems as perceived by decision makers and to incorporate the knowledge of experts. At the same time, it is a precise description of that information which can be stored and manipulated by a computer.

An algorithm is developed which can evaluate any well-formed influence diagram and determine the optimal policy for its decisions. Since the diagram can be analyzed directly, there is no need to construct other representations, such as a decision tree. As a

result, the analysis can be performed using the decision maker's perspective on the problem. Questions of sensitivity and the value of information are natural and easily posed. Modifications to the model suggested such analyses can be made directly to the problem formulation, and then evaluated directly.

Probabilistic Inference and Influence Diagrams

An influence diagram is a network which represents random variables and decisions and their probabilistic dependence. Influence diagrams are more compact and less cluttered than decision trees because they are hierarchical. They are powerful communication tools for structuring models and can serve as a representation for evaluation as well.

An algorithm is developed that performs inference on a probabilistic model represented as an influence diagram. When possible, the algorithm avoids manipulating the full joint distribution. In fact, it can determine precisely which information is needed to solve a given problem just from the structure of the associated influence diagram graph. These results are extended to problems of decision analysis and stochastic control.

BALLOT

ORSA Special Interest Group on Decision Analysis

Mark one choice for Vice Chairperson/Chairperson Elect and two choices for Council members. Return by June 15 to Irving H. LaValle, Secretary/Treasurer, A. B. Freeman School of Business, Tulane University, New Orleans, LA 70118.

For Vice Chairperson/Chairperson-Elect (vote for one)

☐ Samuel E. Bodily (Colgate-Darden School, University of Virginia)

☐ D. Warner North (Decision Focus, Inc.)

For Council Members (Vote for two)

☐ Robert Clemen (University of Oregon)

☐ L. Robin Keller (University of California-Irvine)

☐ William Samuelson (Boston University)

☐ Martin Weber (Technical University-Aachen)

Please send news items of interest to the profession as well to the Editor, Irving H. LaValle, A. B. Freeman School of Business, Tulane University, New Orleans, Louisiana 70118!

Your name: _____. News: _____

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