Selected Topics in a Decision Theoretic [DT] Introduction to Imprecise Probabilities [IP] Day 2 of the SIPTA Summer School 2022 Teddy Seidenfeld (teddy@stat.cmu.edu)

In frequent discussion with



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Session 1: IP as a DT generalization of precise subjective probability

- B. de Finetti's *Coherence* and personal probability.
- The Fundamental Theorem and "weak-IP"

Session 2: On the Value of Information and IP theory

- Precise conditional probability, the value of information, and optimal sequential decisions
- Act/state dependence and the disvalue of information.
- IP sequential decision making, dilation, and the disvalue of information

Session 3: IP theory and multi-agent DT

- Pareto, consensus, and non-binary theories of choice
- Axiomatizing IP decision making

Session 4: Three opportunities for IP DT.

- Forward induction in sequential games
- IP forecasting and de Finetti's two senses of coherence
- Dominance principles: non-Archimedean theories,

WILEY SERIES IN PROBABILITY AND STATISTICS

Introduction to Imprecise Probabilities

Edited by Thomas Augustin Frank P. A. Coolen Gert de Cooman Matthias C. M. Troffaes



Some suggested books that related to the selected topics of today's SIPTA SS session.

Here are a few *must read* books! But it will take a lifetime to learn their wisdom!!

Classics

The Theory of Games and Economic Behavior (1944) John von Neumann and Oskar Morgenstern, Princeton U. Press. Also, consider their 60th Anniversary Edition. As happens when reading a seminal work that changes the direction of a discipline, this one is valuable to the contemporary reader to show how the authors map out the space of problems, especially the ones for which they have not found satisfactory solutions!

The Foundations of Statistics (1954) Leonard J.Savage, John Wiley. Dover, 1972. This is the classic statement of the Subjective Expected Utility program, with an eye on justifying traditional statistical tests, e.g., Minimax procedures. To the author's surprise, the SEU perspective serves, instead, as a basis for criticizing those procedures!

The Dover edition contains a superb annotated bibliography, circa 1970.

Theory of Games and Statistical Decisions (1954) David Blackwell and M.A.Girshick, Wiley. The Dover paperback edition appeared in 1979.

A companion piece to Savage's classic, with many important insights about the applications of Game Theory to Statistics.

Games and Decisions (1957) R. Duncan Luce and Howard Raiffa, John Wiley. Also, consider the Dover paperback edition.

Sixty years after its first publication, this remains important for the range and depth of the problems its authors discuss, with sensitivity and amazing insight regarding the tensions between game-theoretic and decision-theoretic approaches.

Studies in Subjective Probability (1964) H.E.Kyburg, Jr. and Howard Smokler (eds) Wiley.
Also a revised 2nd edition (1980) by Krieger Press.
Includes de Finetti's 1937 essay about coherence, along with other foundational essays.

Optimal Statistical Decisions (1970) M.H. DeGroot. Wiley. Also as a Wiley Classic, 2004. Just what the title advertises!

Theory of Probability (1974, vol 1; 1975, vol 2) Bruno de Finetti. Wiley De Finetti's most expansive presentation of his theory of personal probability, with some applications to Statistics.

Some more recent works relating to today's selected topics

The Enterprise of Knowledge (1980) Isaac Levi, MIT Press,

A monograph defending an important Philosophic program, in the Pragmatist tradition, that uses sets of probabilities and utilities to address questions of belief change, consensus of opinions, and some problems in the foundations of statistical inference.

Fun and Games (1992) Ken Binmore. D.C.Heath Publishing.

A highly provocative and equally informative, and sometimes entertaining textbook about recent Game Theory.

- Statistical Reasoning with Imprecise Probabilities (1991) Peter Walley. Chapman Hall A virtual encyclopedia of material relating to the theory of lower and upper probabilities.
- www.sipta.org Website of the Society for Imprecise Probability Theories and Applications. This website contains links to many relevant papers that explore theory and use of sets of probabilities for representing uncertainty. See, especially, the on-line proceedings for the biennial ISIPTA conferences, which began in 1999.
- *Rethinking the Foundations of Statistics* (1999) J.B.Kadane, M.J.Schervish, and T.Seidenfeld. Cambridge U. Press. This volume contains a selection of our papers about some of the topics I presented during this Summer School.

You are most welcome to contact me by email: teddy@stat.cmu.edu, to discuss these and other topics.