

FM feedback loops and phase-locked loops, respectively. The linear models are presented with design graphs and the effects of nonlinearities and noise are discussed.

Chapter 6 is devoted to the design of phase-locked loops for FM demodulation and includes the necessary design curves. The chapter is well illustrated by a number of numerical design problems. Chapter 7 covers the design of frequency-feedback loops for FM demodulation and again gives a step-by-step design procedure with a number of illustrative examples.

Chapter 8 explains the need for designing and methods for the design of compound and multiple loops for low-threshold demodulation. The ninth chapter contains a very short review of digital FM and considers very briefly a number of other phase-locked loop applications (including a passing reference to frequency synthesis, which has become a major topic in its own right since the book was published). The final chapter contains a review of system test procedures—a useful but unusual item in a textbook.

There are a number of useful analytical appendices, including one on varactor VCO distortion. The bibliography is extensive and is laid out both chronologically and according to topic.

Workers in the communications field will find this work a valuable reference book. A major criticism is that the work on phase-locked loops is confined to the analog variety; digital phase-locked loops, nowadays extensively used in frequency synthesis, are neglected.

Decisions with Multiple Objectives: Preferences and Value Trade-Offs—R. L. Keeney and H. Raiffa (New York: Wiley, 1976, 569 pp.). Reviewed by David W. Rajala, Department of Engineering Science and Systems, University of Virginia, Charlottesville, VA 22903.

This book is a welcome and unquestionably significant contribution to the practice of decision analysis as well as to the research and teaching of its theory and application. Its primary contributions are a development of a prescriptive framework, based on some behavioral assumptions, for quantifying decisionmaker preferences under uncertainty through the unification of extensive theoretical results previously appearing predominantly in the journal literature and a concurrent lucid exposition of the operational aspects of that framework. This book is important to those practicing systems engineering, as well as to economists, managers, policy advisors, and others because of the ubiquitous nature of decision problems and the book's treatment of a variety of real applications. The authors have stressed the need for the decisionmaker to think hard and systematically about his/her decision problem and, for the preference assessment process, have emphasized a decomposition approach by which to examine value trade-offs and risk attitudes.

The material in this book may be organized into four categories. The subject of the first category is the defining and structuring of problems for a multiattribute decision analysis. In the second category the theory of quantifying preferences over multiple objectives is presented. Applications of the theory are presented in the third category. The last category introduces two important special topics: preferences over time and the aggregation of individual preferences. The reader should have little difficulty comprehending the theory's basic concepts because of the book's organization and clarity of presentation. For example, standard concepts such as independence, risk attitude, and value and utility functions, which have come out of economics, the management sciences, mathematics, operations research, and psychology, are unambiguously defined, and the use of notation is consistent throughout. Although the first chapter introduces the subject of decision analysis, it might be helpful if the reader were familiar with its fundamentals as presented in [1], [3], [4], for example. A more extensive treatment of the encoding of uncertainty in decision analysis problems, not the subject of this text, may be found in [1]–[5].

The material related to problem definition and structuring is composed of two chapters that respectively introduce the decision analysis paradigm and the preference structuring process. The development of decision analysis is motivated by sketches of a variety of complex real decision

problems from business, medicine, and the public sector, and later by methodological problems. The sections pertaining to the authors' comments on the decision analysis paradigm and on complex value problems offer valuable insight into decision analysis use. The authors' concern with the preference structuring process has ranged from suggesting useful guidelines for obtaining quality inputs to suggesting criteria for judging the quality of its output. Topics discussed include the generation of objectives and identification of attributes (objectives measures), the hierarchical manner in which objectives are often structured, and attribute selection criteria.

The theory of quantifying preferences over multiple objectives is covered in four chapters. In Chapter 3 systematic procedures for ranking a set of consequences whose value is described in terms of multiple attributes are considered in order to compare alternatives under conditions of certainty. It includes presentations on choice procedures not requiring a formalized preference structure, trade-offs, preferential independence and its implications, and willingness to pay. In Chapter 4 a generalization to the uncertain case occurs for the special situation of a single attribute. It lucidly presents the utility concept and develops procedures for analyzing and assessing a decisionmaker's preferences under uncertainty. The structure and assessment of multiattribute utility functions are examined in Chapters 5 and 6. The former addresses the two-attribute case, and the latter is concerned with the more complicated situation of more than two attributes. Utility and additive independence concepts and their implications are presented together with an operational procedure for assessing a multiattribute utility function. Throughout the chapters in this category, the authors provide valuable insight, based on their experience, to facilitate implementation of the theory.

There are two chapters presenting noncontrived cases to demonstrate the theory's application. Chapter 7 is exclusively devoted to examining assessments of preferences for a variety of interesting topics, including an air pollution problem, a resource allocation problem for an educational program, the problem of structuring corporate preferences, nuclear power plant siting and licensing, and many others. A complete case is carefully presented in Chapter 8 for the siting of a Mexico City airport. It includes a definition of the problem, a specification of the client's value system through the definition and structuring of objectives and their measures, development of a decision model and the requisite probability and multiattribute preference assessments, an analysis of alternatives, and a follow-up appraisal of the study's impact.

The special topics material is contained in two chapters. Chapter 9, contributed to by Richard F. Meyer, presents a multiattribute framework for examining preferences over time. Its emphasis is on the discrete-time problem, and it introduces many of the usual concepts such as discounting and an uncertain horizon. Chapter 10 contains an introduction to the complex problem of aggregating individual preferences. It considers Arrow's impossibility theorem and interprets many of the results of Chapter 3 in the context of the group problem.

Short appendices, totaling four in number, appear at the end of certain chapters and present material supplementary to the main development. There is also a valuable and extensive bibliography that should be of considerable use to a diverse audience. The lack of any home problems should not hinder the reasonably capable reader from understanding or applying this material.

In summary, this well-written book is an outstanding addition to the decision analysis literature. Most of the theoretical results, having previously appeared in professional journals, are new in textbook form. Additionally, the synthesis of the theoretical results with some original contributions to the operational aspects of the theory makes this book currently quite unique.

REFERENCES

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