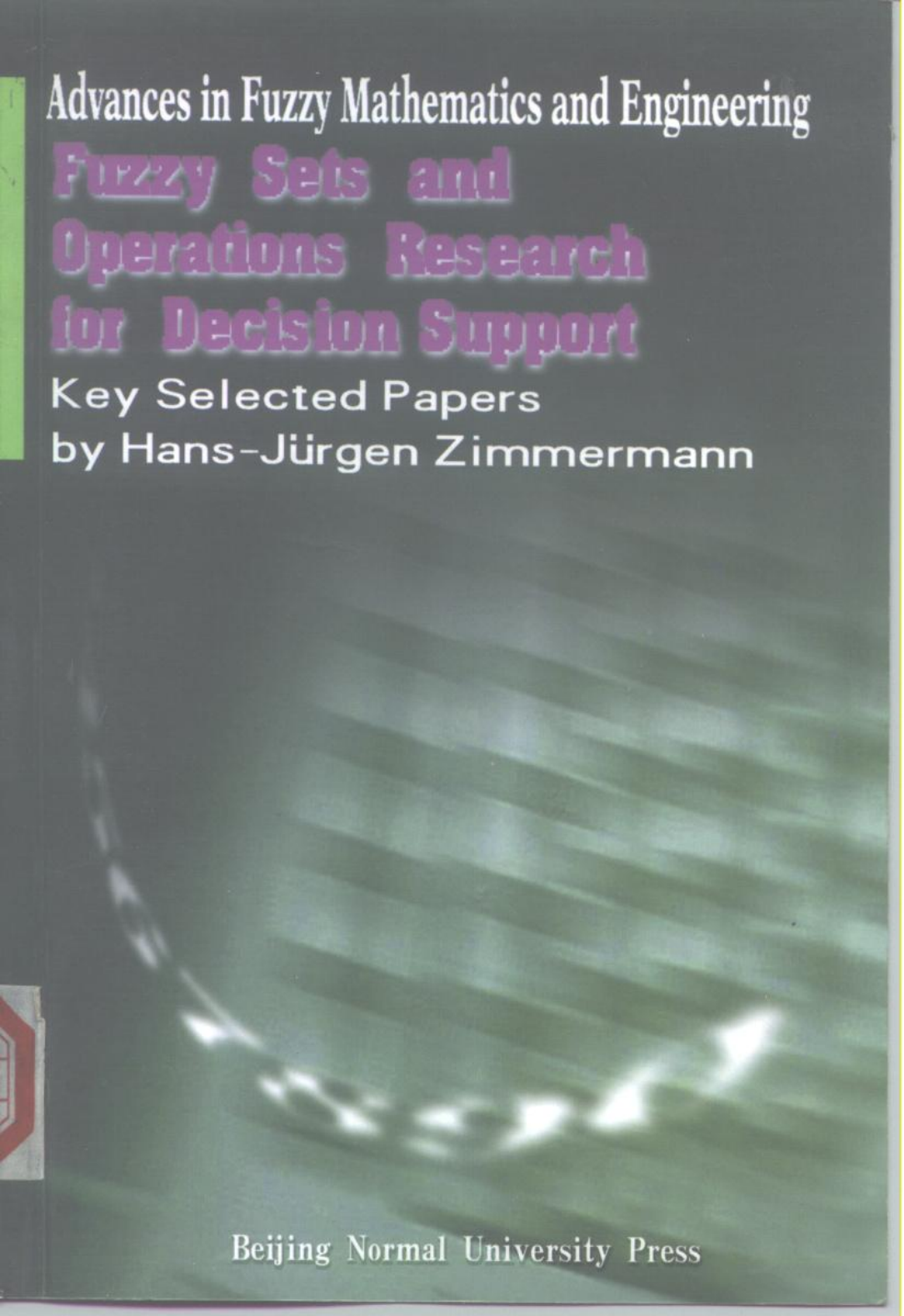
Advances in Fuzzy Mathematics and Engineering

Fuzzy Sets and Operations Research for Decision Support

Key Selected Papers
by Hans-Jürgen Zimmermann



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Fuzzy Sets and Operations Research for Decision Support

-Decision Support under Uncertainty-

Key Selected Papers
by Hans-Jürgen Zimmermann

Edited by Da Ruan
Chongfu Huang

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内 容 提 要

本书分两篇。第一篇包括经济合同、技术合同、税收、涉外以及合同的订立、形式、变更、解除、无效与担保等纠纷案例评析。第二篇包括对违反工商登记、市场、商标、合同、个体、广告管理等有关规定给予行政处罚的案例评析。

本书是工商企业家们经营活动的指南，是工商管理人员依法施政的范例，是大专院校师生教学科研的参考资料。

经济合同纠纷
工商行政处罚 案例评析

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Preface

Advances in Fuzzy Mathematics and Engineering is a new international series dedicated to the support and development of the theory of fuzzy mathematics and related areas and their industrial applications in general and in engineering in particular. The series is supported and published by Beijing Normal University Press, Beijing, China.

Fuzzy Sets and Operations Research for Decision Support is a congratulatory volume of *Key Selected Papers* by Hans-Jürgen Zimmermann on the occasion of Professor Zimmermann's retirement. This edited-volume is designed as a natural continuation of the previous two dedicated volumes *Operations Research* (edited by B. Werners and R. Gabriel, Springer, 1994 to Hans-Jürgen Zimmermann for his 60th birthday) and *Fuzzy Logic Foundations and Industrial Applications* (edited by D. Ruan, Kluwer Academic, 1996 to Hans-Jürgen Zimmermann for 25 years of contribution to fuzzy logic theory and applications). The previous two volumes, captured the essence of Professor Zimmermann's enormous contributions to each of these areas, have proved to be great utility to anyone interested in Operations Research, Fuzzy Sets, and related applications.

Considering the largest number of the readers related to Fuzzy Mathematics and Engineering in China, we felt that a collected version of key selected papers by Hans-Jürgen *Fuzzy Sets and Operations Research for Decision Support* would fit well into the book series on **Advances in Fuzzy Mathematics and Engineering** by Beijing Normal University Press. The balanced approach of this book, with 15 selected papers by Professor Zimmermann in three parts of Basic and Historical Considerations, Fuzzy Sets for Uncertainty Modeling and Fuzzy Sets for Uncertainty Modeling, are important and a reflection of Professor Zimmermann's truly own research activities.

In addition, the purpose of this book can be twofold. Firstly, it is intended as a quick reference for those working in *Fuzzy Mathematics and Engineering* in China as well as in the world. Secondly, it is expected to play a major role in Research and Development of *Fuzzy Mathematics and Engineering*, as a useful source of supplementary readings in this new book series. We hope this volume will benefit many readers around the world.

Da Ruan, Chongfu Huang
Editors

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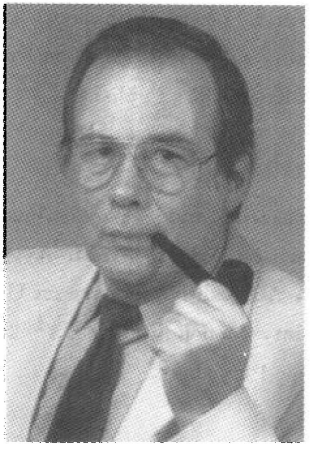
Hans-Jürgen Zimmermann's biography



Hans-Jürgen Zimmermann is Chairman of the Department for Operations Research at the Aachen Institute of Technology and Scientific Director of ELITE (European Laboratory for Intelligent Techniques Engineering).

He received his Bachelor in Engineering from Darmstadt Institute of Technology, his Masters in Engineering and his Ph. D. in Mathematical Economics and Business Administration from the Technical University of Berlin. After having held various positions in industry, he was Professor at the University of Illinois and has been teaching at various universities in India, Europe and the USA. He received his Honorary Doctorate from the Free University of Brussels. In 1985 he received the EURO Gold Medal, the highest distinction in Operations Research in Europe, the K. S. Fu Certificate of Appreciation, the highest distinction of the "North American Fuzzy Information Processing Society" and in 1993 the Moisil Prize and Gold Medal. In 1997 he received the Kaufmann Prize: Gold Medal for Excellence in Uncertainty Research in Management.

He has published approximately 200 papers in the areas of Operations Research, Decision Theory, and Fuzzy Set Theory and 25 books in English and German in similar areas. He is Editor-in-Chief of the International Journal for Fuzzy Sets and Systems, Editor of the European Journal for Operational Research, Editor of the book series International Series in Intelligent Technologies, and Editor or Co-Editor of another 12 International Journals.

He has been President of the German Operations Research Society, the European Associations of Operational Research Societies, IFSA (International Fuzzy Systems Association), the German Industrial Engineering Society, and EEMA (European Engineering and Management Associations). He has also been Vice President of IFORS (International Federation of Operational Research Societies) and some other professional associations. Dr. Zimmermann has been organizer or chairman of numerous national and international conferences.

He has been actively pursuing research in fuzzy set theory and its applications since 1972. His current research interests include fuzzy mathematical programming, fuzzy control, fuzzy expert systems, fuzzy data analysis, and their application to various areas, such as, strategic planning, managerial decision making, concurrent engineering, etc. He is supervising a number of industrial projects, in which these methods are applied to industrial problems. He is also responsible for two software houses engaged in operations research and intelligent software solutions.

Contents

Part I: Basic and Historical Consider -ations (Foundations and History)

原书空白

Cognitive Sciences, Decision Technology, and Fuzzy Sets

1. Introduction

Cognitive Science focuses on one of the oldest subject areas of scientific reflection, human thinking itself. What does it mean that somebody thinks, imagines, or perceives? How does a human brain perform these functions, and can this behavior be imitated by artificial constructions? For long time, the location of scientific reflection on thinking was philosophy. This branch of scientific endeavor included psychology. In the 19th century, sciences split up into more focused disciplines, psychology parted from philosophy and added an "empirical leg" to its so-far-existing "philosophical leg." In addition, new scientific areas developed in the 20th century, such as decision theory, operations research, management science, and artificial intelligence, which all to a higher or lower degree were concerned with either cognition, decision, thinking, or information processing. Nowadays the meaning of cognitive science may be quite different from its definition in the 19th century, and so may be its semantic interpretation and scope. In the following, we will try to trace connections

and differences between some of these similar but also different areas with "cognitive concern." It is hoped that this may avoid misinterpretations of results in one of these areas by researchers of another of these disciplines.

2. Cognitive sciences vs. decision technology

Let us first review the origin and the development of cognitive science in somewhat more detail: as mentioned above, the origin of psychology can be found in philosophy. Behaviorism certainly opened psychology for approaches that before were used in natural sciences. It opened the door to the use of experiments and computer simulation to explore mental processes. On the other hand, it reduced the perspective to only observing stimulus-reaction schemes, regarding the human brain as a black box. This prevented us from looking for and finding adequate models for human mental processes. In this sense, the new cognitive science did not start before the '60s of this century.

In cognitive psychology, the computer and the emergence of programs like the logic thinker(LT)had a profound effect, even though cognitive psychology does not share the enthusiasm of information-processing psychology for computer models:

> "The activities of the computer itself seemed in some ways akin to cognitive processes. Computers accept information, manipulate symbols, store items in 'memory' and retrieve them again, classify inputs, recognize patterns, and so on. Whether they do these things just like

people was less important than that they do them at all. The coming of the computer provided a much-needed reassurance that cognitive processes were real... Some theorists even maintained that all psychological theories should be explicitly written in the form of computer programs."[4]

These theorists were Newell, Simon, and J. C. Shaw. Their position that computer programs can be psychological theories is the point at which cognitive psychology and information-processing psychology part company. For most cognitive psychologists, information processing is a metaphor for human thought, a means of focusing attention on new and interesting questions about the mind. Very few cognitive psychologists have implemented information-processing models—programs—of their theories.

At the present time, two major paradigms in cognitive sciences can be recognized, both of which claim to supply adequate models for cognitive phenomena:

1. The more orthodox cognitive science has the basic paradigm which is characterized by the "computational theory of mind." Intelligent systems are regarded as "physical symbol systems" and a necessary condition for their intelligent behavior is the rule-inducted manipulation of internal symbolical structures. This is an approach which is still very common in operations research, in cognitive decision theory, and in "classical" expert system technology.

2. A newer paradigm, on which the connectionism is based, is the idea that cognitive systems consist of a very large number