

## PREFACE

Multiple criteria decision making (MCDM) is a modeling and methodological tool for dealing with complex engineering problems. Decision makers face many problems with incomplete and vague information in MCDM problems since the characteristics of these problems often require this kind of information. Fuzzy set approaches are suitable to use when the modeling of human knowledge is necessary and when human evaluations are needed. Fuzzy set theory is recognized as an important problem modeling and solution technique. Fuzzy set theory has been studied extensively over the past 40 years. Most of the early interest in fuzzy set theory pertained to representing uncertainty in human cognitive processes. Fuzzy set theory is now applied to problems in engineering, business, medical and related health sciences, and the natural sciences. Over the years there have been successful applications and implementations of fuzzy set theory in MCDM. MCDM is one of the branches in which fuzzy set theory found a wide application area. Many curriculums of undergraduate and graduate programs include many courses teaching how to use fuzzy sets when you face incomplete and vague information. One of these courses is fuzzy MCDM and its applications.

This book presents examples of applications of fuzzy sets in MCDM. It contains 22 original research and application chapters from different perspectives; and covers different areas of fuzzy MCDM. The book contains chapters on the two major areas of MCDM to which fuzzy set theory contributes. These areas are fuzzy multiple-attribute decision making (MADM) and fuzzy multiple-objective decision making (MODM). MADM approaches can be viewed as alternative methods for combining the information in a problem's decision matrix together with additional information from the decision maker to determine a final ranking, screening, or selection from among the alternatives. MODM is a powerful tool to assist in the process of searching for decisions that best satisfy a multitude of conflicting objectives.

The classification, review and analysis of fuzzy multi-criteria decision-making methods are summarized in the first two chapters. While the first chapter classifies the multi-criteria methods in a general sense, the second chapter focuses on intelligent fuzzy multi-criteria decision making.

The rest of the book is divided into two main parts. The first part includes chapters on frequently used MADM techniques under fuzziness, e.g., fuzzy Analytic Hierarchy Process (AHP), fuzzy TOPSIS, fuzzy outranking methods, fuzzy weighting methods, and a few application chapters of these techniques. The third chapter includes the most frequently used fuzzy AHP methods and their numerical and didactic examples. The fourth chapter shows how a fuzzy AHP method can be jointly used with another technique. The fifth chapter summarizes fuzzy outranking methods, which dichotomize preferred alternatives and nonpreferred ones by establishing outranking relationships. The sixth chapter presents another commonly used multi-attribute method, fuzzy TOPSIS and its application to selection among industrial robotic systems. The seventh chapter includes many fuzzy scoring methods and their applications. The rest of this part includes the other most frequently used fuzzy MADM techniques in the literature: fuzzy information axiom approach, intelligent fuzzy MADM approaches, gray-related analysis, and neuro-fuzzy approximation.

The second part of the book includes chapters on MODM techniques under fuzziness, e.g., fuzzy multi-objective linear programming, quasi-concave and non-concave fuzzy multi-objective programming, interactive fuzzy stochastic linear programming, fuzzy multi-objective integer goal programming, gray fuzzy multi-objective optimization, fuzzy multi-objective geometric programming and some applications of these techniques. These methods are the most frequently used MODM techniques in the fuzzy literature.

The presented methods in this book have been prepared by the authors who are the developers of these techniques. I hope that this book will provide a useful resource of ideas, techniques, and methods for additional research on the applications of fuzzy sets in MCDM. I am grateful to the referees whose valuable and highly appreciated works contributed to select the high quality of chapters published in this book. I am also grateful to my research assistant, Dr. Ihsan Kaya, for his invaluable effort to edit this book.

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