

Preface

Multi-attribute decision making (MADM) (or called multi-objective decision making with finite alternatives) is an important component of modern decision science. The theory and methods of MADM have been extensively applied to the fields of engineering project, economy, management and military affairs, such as investment decision making, venture capital project evaluation, facility location, bidding, maintenance services, military system efficiency evaluation, development ranking of industrial sectors, comprehensive evaluation of economic performance, etc. Essentially, MADM is to select the most desirable alternative(s) from a given finite set of alternatives according to a collection of attributes by using a proper means. It mainly consists of two stages: (1) Collect decision information. The decision information generally includes the attribute weights and the attribute values (expressed as real numbers, interval numbers or linguistic labels), especially, how to determine the attribute weights is an important research topic in MADM; (2) Aggregate the decision information through some proper approaches. Currently, four of the most common aggregation techniques are the weighted averaging operator, the weighted geometric operator, the ordered weighted averaging operator, and the ordered weighted geometric operator.

With the increasing complexity and uncertainty of objective things and the fuzziness of human thought, more and more attention has been paid to the investigation on MADM under uncertain environments, and fruitful research results have been achieved over the last decades. This book offers a systematic introduction to the methods for uncertain MADM and their applications to various practical problems. We organize the book as the following four parts, which contain twelve chapters:

Part 1 consists of three chapters (Chaps. 1–3) which introduce the methods for real-valued MADM and their applications. Concretely speaking, Chap. 1 introduces the methods for solving the decision making problems in which the information about attribute weights is completely unknown and the attribute values take the form of real numbers, and applies them to investment decision making in enterprises and information systems, respectively, military spaceflight equipment evaluation, financial assessment in the institutions of higher education, training plane type selection, purchases of fighter planes and artillery weapons, developing new products, and cadre selection. Chapter 2 introduces the methods for MADM in

which the information about attribute weights is given in the form of preferences and the attribute values are real numbers, and gives their applications to the efficiency evaluation of equipment maintenance support systems, and the performance evaluation of military administration units. Chapter 3 introduces the methods for decision making with partial attribute weight information and exact attribute values, and applies them to the fire deployment of a defensive battle in Xiaoshan region, the evaluation and ranking of the industrial economic benefits of 16 provinces and municipalities in China, the assessment for the expansion of a coal mine, sorting the order of the enemy's targets to attack, the improvement of old products, and the alternative selection for buying a house.

Part 2 consists of three chapters (Chaps. 4–6) which introduce the methods for interval MADM and their applications. Concretely speaking, Chap. 4 introduces the methods for the decision making problems in which the attribute weights are real numbers and the attribute values are expressed as interval numbers, and gives their applications to the evaluation of schools of a university, the exploitations of leather industry of a region and a new model of cars of an investment company, and the selection of the robots of an advanced manufacturing company. Chapter 5 introduces the methods for the decision making problems in which the information about attribute weights is unknown completely and the attribute values are interval numbers. Also, these methods are applied to the purchase of artillery weapons, cadre selection of a unit, and investment decision making in natural resources. Chapter 6 introduces the methods for interval MADM with the partial attribute weight information, and applies them to determine what kind of air-conditioning system should be installed in the library, evaluate anti-ship missile weapon systems, help select a suitable refrigerator for a family, assess the investment of high technology project of venture capital firms, and purchase college textbooks, respectively.

Part 3 consists of three chapters (Chaps. 7–9) which introduce the methods for linguistic MADM and their applications. Concretely speaking, Chap. 7 introduces the methods for the decision making problems in which the information about attribute weights is unknown completely and the attribute values take the form of linguistic labels, and applies them to investment decision making in enterprises, the fire deployment in a battle, and knowledge management performance evaluation of enterprises. Chapter 8 introduces the methods for the decision making problems in which the attribute weights are real numbers and the attribute values are linguistic labels, and then gives their applications to assess the management information systems of enterprises and evaluate the outstanding dissertation(s). Chapter 9 introduces the MADM methods for the problems where both the attribute weights and the attribute values are expressed in linguistic labels, and applies them to the partner selection of a virtual enterprise, and the quality evaluation of teachers in a middle school.

Part 4 consists of three chapters (Chaps. 10–12) which introduce the methods for uncertain linguistic MADM and their applications. In Chap. 10, we introduce the methods for the decision making problems in which the information about attribute weights is unknown completely and the attribute values are uncertain linguistic variables, and show their applications in the strategic partner selection of

an enterprise in the field of supply chain management. Chapter 11 introduces the methods for the decision making problems in which the attribute weights are real numbers and the attribute values are uncertain linguistic variables, and then applies them to appraise and choose investment regions in China, and the maintenance services of manufacturing enterprises. In Chap. 12, we introduce the MADM methods for the problems in which the attribute weights are interval numbers and the attribute values are uncertain linguistic variables, and verify their practicality via the evaluation of the socio-economic systems of cities.

This book can be used as a reference for researchers and practitioners working in the fields of fuzzy mathematics, operations research, information science, management science and engineering, etc. It can also be used as a textbook for postgraduate and senior undergraduate students. This book is a substantial extension of the book “Uncertain Multiple Attribute Decision Making: Methods and Applications” (published by Tsinghua University Press, Beijing, 2004, in Chinese).

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