

Preface

Multi-level decision-making (MLDM) handles problems that require compromise between the objectives of two or more interacting entities which are arranged within a hierarchical structure with independent and perhaps conflicting objectives. Bi-level decision-making is a special and particularly popular case of MLDM, in which only two levels of decision entities are involved, each of which tries to optimize their individual objectives under certain constraints, and to act and react in a sequential manner. The MLDM problem appears naturally in critical resource management, production and transportation planning, and organizational policy making. There are two fundamental issues to address in dealing with an MLDM problem. One is how to model a multi-level decision problem, and the other is how to find an optimal solution to the problem.

This monograph presents the new developments in multi-level (in particular bi-level and tri-level) decision-making theory, technique and methodology in both modelling and solution issues. It especially presents how a decision support system (software) can support managers in reaching a solution to a multi-level decision problem in practice.

This monograph offers the following advantages:

- It focuses on one of the most complex and challenging decision-making structures, in which several levels of decision entities are involved in a hierarchical decision-making process in which each level may have more than one decision entity, and each entity may have more than one objective function and fuzzy parameters in the functions.
- It combines decision theories, methods, algorithms and applications effectively. We discuss in detail the models and solution algorithms of each issue of bi-level and tri-level decision-making, such as multi-leaders, multi-followers, multi-objectives, rule-based, and fuzzy parameters presented in this monograph, as well as the related case studies and/or software systems.
- It is designed as a unified whole in which the content in each chapter is related to the material that precedes it, and also to what will follow. A number of case-based examples, such as logistics, are discussed in various chapters for different

multi-level decision situations, as well as the use of decision support systems to obtain the desired solutions.

- It reflects the latest academic research progress and state-of-the-art development through the results of our own and other authors' recent publications in this field. It does not attempt to provide exhaustive coverage of every fact or research result that exists.

This monograph is principally based on our research developments over the past ten years, during which time we have produced more than 50 journal and conference publications in this field.

The monograph has 14 chapters, organized into five parts. The first part, from Chaps. 1 to 3, covers concepts of decision-making, decision support systems and bi-level decision-making in general. The second part of the monograph, from Chaps. 4 to 6, presents bi-level multi-follower and tri-level multi-follower decision-making, including related models, solution methods, algorithms and case studies. The third part, from Chaps. 7 to 9, focuses on uncertainty issues in multi-level decision-making and discusses fuzzy bi-level and fuzzy multi-objective bi-level decision models and solution algorithms. In Part IV, Chap. 10 deals with a non-programming multi-level decision issue and proposes the framework and methods of rule-set-based bi-level decision-making. The last part, from Chaps. 11 to 14, shows the development of bi-level and tri-level decision support systems and related applications by using the methods presented in the previous chapters. These applications include the power market, supply chain management and railway organization.

Our potential readers include organizational managers and practicing professionals, who can use the methods and software provided to solve their real decision problems; researchers in the areas of bi-level and multi-level decision-making and decision support systems; students at an advanced undergraduate or master's level in information systems, business administration, or the application of computer science programs.

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