

PREFACE

The purpose of this book is to provide a comprehensive view on multiple criteria and multiple constraint-level (MC^2) linear programming that has become a major part of the field of Multiple Criteria Decision Making (MCDM). Most of the contents in the book are directly from the research and application activities that my colleagues and I have conducted over the last fifteen years. The book also contains materials developed for the university honor course on MCDM that I taught in 1993 at the University of Nebraska at Omaha. Starting from 1990, I have received a number of letters and e-mails from scholars and professionals in several countries who generously encouraged me to publish a summary of what has been done in MC^2 linear programming. This has been the major motivation for me to write this book. I started writing the book in 1997 and it has taken almost four years to complete. There are two main reasons why it has been delayed. The first one is that because MC^2 linear programming is a growing field, I have always hesitated including immature results or ongoing projects in the book. Instead, I prefer first publishing or applying the findings and then integrating them into the book. Almost one-fifth materials in the book are related to our publications after 1997. The second reason for delay has been the completing demands of my constant research projects and overwhelming academic and service activities. Nevertheless, I now feel more relaxed to see this book finally is printed.

This book introduces the concepts, techniques and applications of MC^2 linear programming, which is an extension of linear programming (LP) and multiple criteria (MC) linear programming. It can serve as a seminar or course text for both undergraduates and graduates who have a linear algebra or equivalent background. For practitioners, it will help in handling LP type problems.

The book is organized into six parts, and each part contains several chapters. In addition to the content description, each chapter includes some remarks and necessary exercises. To practice their understanding of the chapter, readers are encouraged to do the exercises. In the back of the book, a package of five MC^2 computer programs is provided for the interested readers. Two sets of software, called `firstMC2` and `secondMC2`, are about how to solve the standard MC^2 problems discussed in Chapter 4. Then, the two sets of software called `binaryMC2` and `branch-boundMC2`, are for solving the integer

MC² problems in Chapter 5. Finally, the software, tpMC2 can be used to solve the MC² transportation problems in Chapter 6. The details of each chapter of the book are given as follows:

Part one addresses basic concepts and techniques. It contains Chapters 1, 2, 3 and 4. Chapter 1 reviews the history of LP, MC and MC² problems and uses an illustrative example to explain the meaning of the three kinds of problems. While Chapters 2 and 3 go over the fundamentals of LP and MC problems, Chapter 4 covers the bases of MC² problems, mainly from Chapter 8 of Yu (1985).

Part two deals with special MC² problems. Chapter 5 discusses first MC² zero-one (or binary) problems, and then general MC² integer problems. Chapter 6 elaborates on MC² Transportation problems. One model is a steady problem and another one is dynamic problem.

Part three presents fuzzy MC² problems. The “fuzzy” MC² solution is a sort of compromise solution classified by a membership function. Chapter 7 describes the primal fuzzy MC² problems and Chapter 8 provides approaches to dual fuzzy MC² problems.

Part four discusses optimal linear designs. This part includes Chapters 9, 10, 11, and 12. Much discussion in these chapters is detailed, but meaningful in the sense of linear structure. Chapter 9 provides a general framework of designing optimal systems, which goes beyond finding an optimal point for a given linear system, and then discusses the primal contingency plans. Chapter 10 extends the system designs into a generalized good system. It further derives the primal contingency plans for generalized good systems. Chapters 11 and 12 elaborate on the dual contingency plans for system designs and generalized good systems, respectively. A computer-aided system that integrates all of the different linear designs is also shown in Chapter 12.

Part five provides several related approaches. Chapter 13, heavily depending on Chapter 4 of Yu (1985), has a significant inner connection with both MC and MC² problems, and serves as a simplified version for various application problems that have an MC² feature. Chapter 14 is another approach, known as De novo programming, to linear system designs, in which the resource availability is unknown. Chapter 15 shows an effective algorithm that can save computational time to search other dominated opportunities (variables) in solving the MC² problems.

Part six gives a variety of MC² related applications. Some of them (Chapters 16, 17, 18, and 21) are applications driven by academic interests. Others (Chapters 19, 20 and 22) come directly from the real-world applications. Chapter 16 deals with transfer pricing. Chapter 17

is about capital budgeting. Chapter 18 handles data allocation in information management. Chapter 19 concerns a rural telecommunication system. Chapter 20 manages credit card portfolios. Chapter 21 schedules production planning. Chapter 22 provides an agricultural policy. All of them can be explicitly and implicitly understood from the MC² framework. For the convenience of the reader, each chapter of this part is self-contained and self-explained.

If this book is used for an upper-level undergraduate course, Chapters 1, 2, 3, 4, 5, 6, 13, and some of Part six may be chosen. If this book is used for a graduate course, Chapters 1, 2, 3, 4, 5, 6, 7, 8, 9, and some of Part six can be covered. Chapters 1, 2, 3, 4 and Part four are also recommended for a special graduate seminar on Optimal System Designs. Furthermore, Chapters 1, 2, 3, 4, and Part six can be attractive contents for many practitioners.

I am indebted to many people around the world for their encouragement and kind support of my research on MC² linear programming. The first person is my Ph.D. Advisor and personal friend, P. L. Yu (University of Kansas and National Chiao Tung University of Taiwan). His guiding me to this new, challenging, and complex field of research is greatly appreciated. His insignificant advice in my academic and social life has been always remembered.

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Yong Shi

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