

# Preface

Fuzziness is a basic type of subjective uncertainty. The study on fuzziness was started in 1965 after the publication of Zadeh's seminal work *Fuzzy Sets*. In order to measure the chance of a fuzzy event occurs, Zadeh proposed the concepts of possibility measure and necessity measure, which are proved to be normal, non-negative, monotone, but not self-dual. Since the duality is intuitive and important in both theory and practice, Liu and Liu (2002) defined a credibility measure as the average value of possibility measure and necessity measure, which was redefined by Li and Liu (2006) as a set function satisfying the normality, monotonicity, duality, and maximality axioms. After that, credibility measure was widely used in the fields of fuzzy decision, fuzzy process, fuzzy calculus, fuzzy differential equation, fuzzy logic, fuzzy inference, and so on. Nowadays, credibility theory has become a branch of mathematics for studying the behavior of fuzzy phenomena. Chapter 1 will be devoted to the credibility theory.

The decision analysis with fuzzy objective or fuzzy constraints is natural in some real-world applications, and sometimes seems to be inevitable. Credibilistic programming is a type of mathematical programming used to handle the fuzzy decision problems. In past years, researchers have proposed many efficient modeling approaches, which have been widely applied to many real-life problems. For example, Liu and Liu (2002) formulated an expected value model to minimize the average value of the objective under certain expected constraints. Liu and Iwamura (1998) proposed a maximax chance-constrained programming model, and Liu (1998) proposed a maximin chance-constrained programming model, which respectively maximizes the optimistic value and the pessimistic value of the objective with assumption that the fuzzy constraints will hold with certain confidence levels. Based on the concepts of fuzzy entropy, Li et al. (2011) proposed an entropy optimization model to minimize the uncertainty on possible values of the fuzzy objective, and Qin et al. (2009) formulated a cross-entropy minimization model to minimize the divergence of the fuzzy objective from a priori fuzzy quantity. Recently, Li et al. (2012) provided a regret minimization model to minimize the distance between the fuzzy objective values and the best values. Chapter 2 will provide a general introduction on the credibilistic programming as well as the genetic algorithm. Then the

following chapters will respectively introduce the expected value model, chance-constrained programming model, entropy optimization model, cross-entropy minimization model, and regret minimization model.

The purpose of this book is to provide a powerful mathematical tool to handle the fuzzy decision problems. The book provides a self-contained and comprehensive presentation of credibilistic programming models and applications. The book is suitable for researchers, engineers, and students in the fields of management science, operations research, financial analysis, industrial engineering, information science, computer science, artificial intelligence, and so on. The readers will learn numerous new and efficient modeling ideas, and find this work a stimulating and useful reference.

## **Acknowledgment**

This work was supported by the National Natural Science Foundation of China (No. 71101007), and the Specialized Research Fund for the Doctoral Program of Higher Education of China (No. 20110009120036).

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November 14, 2012

Credibilistic Programming

An Introduction to Models and Applications

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2013, IX, 144 p., Hardcover

ISBN: 978-3-642-36375-7