

# **Preface**

In the past 30 years, data envelopment analysis (DEA) has grown into a powerful quantitative, analytical tool for measuring and evaluating relative efficiency of decision-making units (DMUs). DEA has been successfully applied to many different types of entities engaged in a wide variety of activities in many contexts worldwide. Although DEA offers more advantages than many other statistical approaches, some limitations have to be considered. One important problem is its sensitivity to data. Therefore, a key to the success of the DEA approach is the accurate measure of all factors, including that of inputs and outputs. However, in many situations, such as in a manufacturing system, in a production process, or in a service system, inputs and outputs are so volatile and complex that they are difficult to measure in an accurate way. Thus, various uncertain DEA methods have been proposed to handle the data variation in DEA. This book is intended to present the milestones in the progression of uncertain DEA.

## **Uncertain Theories**

Based on different uncertain theories, uncertain DEA methods deal with the problems involving uncertain inputs and uncertain outputs. Chapter 1 will present the basic introduction to uncertain theories which are crucial for the following chapters, including probability theory, credibility theory, uncertainty theory, and chance theory.

## **Introduction to DEA**

Chapter 2 is intended to represent a milestone in the progression of DEA, including a comprehensive review and discussion of basic DEA models and extensions to the basic DEA methods.

## **Stochastic DEA**

Incorporation of random variations into DEA analysis has received considerable attention in recent years. Chapter 3 will present some stochastic DEA model extensions of the usual deterministic DEA formulations. This kind of models makes it possible to replace “efficient” and “not efficient” with “probability efficient” and “probability not efficient,” respectively.

## **Fuzzy DEA**

Fuzziness is a basic type of subjective uncertainty, which has been applied in DEA recently. Chapter 4 will provide some fuzzy DEA methods based on credibility measure, including fuzzy DEA models, fuzzy sensitivity analysis, fuzzy fully ranking methods, and fuzzy congestion.

## **Uncertain DEA**

Uncertainty theory is a branch of axiomatic mathematics for modeling human uncertainty. Chapter 5 will apply uncertainty theory to DEA so as to produce a new method of dealing with the empirical data. Besides uncertain DEA models, uncertain sensitivity analysis, uncertain fully ranking methods, and uncertain congestion will also be taken into account.

## **Hybrid DEA**

In order to evaluate the DMUs in which uncertainty and randomness appear simultaneously, Chap.6 will introduce a hybrid DEA method based on chance measure. Hybrid DEA models, hybrid fully ranking methods, and hybrid congestion will be included in Chap. 6.

## **Purpose**

The purpose of this book is to provide some methods in dealing with uncertainty in DEA. The book presents four uncertain DEA methods based on different measures including probability measure, credibility measure, uncertainty measure, and chance measure. The book is suitable for researchers, engineers, and students in the fields of management science, economics, operations research, industrial engineering, information science, and so on.

## **Acknowledgment**

This work was supported by the National Natural Science Foundation of China (No.71201005).

Beijing, China  
October 1, 2013

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<http://www.springer.com/978-3-662-43801-5>

Uncertain Data Envelopment Analysis

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2015, XI, 149 p. 4 illus., Hardcover

ISBN: 978-3-662-43801-5