

Preface

This handbook complements the second edition of the *Handbook on Data Envelopment Analysis* (Cooper et al. 2011, Springer). Data envelopment analysis (DEA) is a “data-oriented” approach for evaluating the performance of a set of entities called Decision Making Units (DMUs) whose performance is categorized by multiple metrics. These performance metrics are indicated as inputs and outputs under DEA. Although DEA has a strong link to production theory in economics, the tool is also used for benchmarking in operations management where a set of measures is selected to benchmark the performance of manufacturing and service operations. In the circumstance of benchmarking, the efficient DMUs, as defined by DEA, may not necessarily form a “production frontier,” but rather lead to a “best-practice frontier” (Cook et al. 2014).

Since the publication of the second edition of *Handbook on Data Envelopment Analysis*, there has been a significant amount of research on DEA methodology. As pointed out in a citation-based DEA survey by Liu et al. (2013), it is expected that the literature will grow to at least double its current size. With the recent publication of *Data Envelopment Analysis: A Handbook of Modeling Internal Structures and Networks* (Cook and Zhu 2014) written by experts on models and applications of DEA dealing with network and internal DMU structures, the current handbook is intended to represent another milestone in the progression of DEA. Written by experts, who are often major contributors to the DEA theory, it includes a collection of 16 chapters that represent the current state-of-the-art DEA research.

Chapter 1, by Färe, Grosskopf and Margaritis, provides an overview of the dual measurement of efficiency by means of distance functions and their value duals, the profit, revenue and cost functions.

Chapter 2, by Cook and Zhu, discusses cross-efficiency measures in DEA. While DEA has been proven an effective approach in identifying best practice frontiers, its flexibility in weighting multiple performance measures (inputs and outputs) and its nature of self-evaluation have been criticized. The cross efficiency method is developed as a DEA extension to rank DMUs and as a peer-evaluation approach. To complement Chap. 2, Lim and Zhu discuss how to use Variable Returns to Scale (VRS) models to develop cross efficiency in Chap. 3.

While the standard DEA assumes that data for inputs and outputs are continuous, there are situations where data are discrete and take form of integers. Chapter 4, by Kuosmanen, Keshvari and Kazemi Matin, examines the axiomatic foundations of integer DEA. The authors examine alternative efficiency metrics available for integer DEA, and consider estimation of the integer DEA technology under stochastic noise, modeling inefficiency and noise as Poisson distributed random variables.

There is a large literature on the use of weight restrictions in multiplier DEA models. In Chap. 5, Podinovski provides an alternative view of this subject from the perspective of dual envelopment DEA models in which weight restrictions can be interpreted as production trade-offs.

Chapter 6, by Olesen and Petersen, is concerned with development of indicators to determine whether or not the specification of the input and output space is supported by data in the sense that the variation in data is sufficient for estimation of a frontier of the same dimension as the input output space.

Kuosmanen, Johnson and Saastamoinen present a unified framework of productivity analysis, referred to as Stochastic Nonparametric Envelopment of Data (StoNED) in Chap. 7.

Chapter 8, by Pastor and Aparicio, presents an overview of the different approaches that have considered translation invariant DEA models. Translation invariance is a relevant property for dealing with non-positive input and/or non-positive output values in DEA.

Chapter 9, by Sahoo and Tone, provides a critical review of various possible estimation methods of scale economies in a non-parametric data envelopment analysis approach.

Chapter 10, by Zhu, describes several DEA models that can be used as a benchmarking tool where a set of DMUs is compared to existing standards. These existing standards can be in a form of DEA best-practice frontier or a set of pre-selected DMUs.

The conventional DEA assumes a set of homogeneous DMUs in the sense that each uses the same input and output measures (in varying amounts from one DMU to another). In some situations however, the assumption of homogeneity among DMUs may not apply. Chapter 11, by Cook, Harrison, Imanirad, Rouse and Zhu, presents DEA approaches for performance evaluation in the absence of homogeneity.

Chapter 12, by Kao, introduces a set of fuzzy DEA models in which data are missing and have to be estimated or predicted.

While it is generally assumed that all DEA outputs are impacted by all DEA inputs, there are many situations where this may not be the case. Chapter 13, by Cook and Zhu, extends the conventional DEA methodology to allow for the measurement of technical efficiency in situations where only partial input-to-output impacts exist. The new methodology involves viewing the DMU as a business unit, consisting of a set of mutually exclusive subunits, each of which can be treated in the conventional DEA sense.

In an effort to discriminate the performance of DMUs, the concept of super-efficiency is proposed in DEA. When applied to the variable returns to scale (VRS) situation, the resulting super-efficiency model may become infeasible for certain

DMUs. In Chap. 14, Chen and Du present a comprehensive overview of the infeasibility issues in the super efficiency DEA.

Chapter 15, by Zhou and Liu, discusses the treatment of undesirable measures in DEA. Chapter 16, by Asmild, reviews different ways of comparing the efficiency frontiers for subgroups within a data set, specifically program efficiency, the meta-technology (or technology gap) ratio and the global frontier difference index.

The current handbook focuses only on (new) models/approaches of DEA. Empirical studies using DEA will appear in *Data Envelopment Analysis: A Handbook of Empirical Studies and Applications*, which I am currently editing. Along with other DEA handbooks, I hope that this handbook can serve as a reference for researcher and practitioners using DEA and as a guide for further development of DEA. I am indebted to the many DEA researchers worldwide for their continued effort in pushing the DEA research frontier. Without their work, many of the DEA models and approaches would not exist and be applied. I would like to thank the support from the Priority Academic Program Development of Jiangsu Higher Education Institutions in China.

September 2014

Joe Zhu

References

- Cook WD, Tone K, Zhu J (2014) Data envelopment analysis: prior to choosing a model. *Omega* 44:1–4
- Cook WD, Zhu J (2014) Data envelopment analysis: a handbook of modeling internal structures and networks, Springer
- Cooper WW, Seiford LM, Zhu J (2011) Handbook on data envelopment analysis, 2nd Edn., Springer
- Liu JS, Lu LY, Lu WM, Lin BJ (2013) Data envelopment analysis 1978–2010: a citation based literature survey. *Omega* 41(1):3–15

Data Envelopment Analysis

A Handbook of Models and Methods

Zhu, J. (Ed.)

2015, XII, 465 p. 43 illus., 18 illus. in color., Hardcover

ISBN: 978-1-4899-7552-2