PREFACE

In 1978, **Data** *Envelopment* **Analysis** (DEA) was developed by Charnes, Cooper and Rhodes[1]. Until 2000 or so, DEA remained as an academic tool for measuring and managing the relative performance of peer organizations. This was mainly due to the fact that DEA is based upon a technique called "linear programming". The user must have expertise on linear programming in order to execute the DEA models and interpret the DEA outcomes. Shortly after 2000, DEA algorithms were adapted for Microsoft Excel software, making it accessible to users with little or no knowledge of linear programming.

In the meantime, researchers and practitioners in many fields have recognized DEA's power as a method for evaluating the performance of operational processes. DEA has been successfully applied in many organizations world-wide, including hospitals, HMO's, military units, universities, cities, courts, investment portfolio managers, retailers, financial

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[1] Charnes, A., W.W. Cooper and E. Rhodes, "Measuring the efficiency of decision making units," European Journal of Operational Research, 2 (1978), 429-444.

institutions, and logistics and manufacturing firms. DEA helps identify best performers in these organizations and suggests ways for the others to improve. In 2006, DEA co-founder A. Charnes and W.W. Cooper were awarded the INFORMS Impact Prize[2] for their seminal work on DEA.

In 2013, the *MIT Sloan Management Review* article by Sherman and Zhu[3] characterized DEA as a "*balanced benchmarking*". This study pointed out that by measuring performance metrics across a number of stores or offices, DEA can identify best practices that are often hidden and managers can apply findings to dramatically improve efficiency across different business units.

DEA is a data-oriented operations analytics that analyzes multiple performance metrics, integrates multi-dimensional data into a composite index, and recommends directions for improvement. A number of DEA books have been written for conventional and new DEA models. Yet, many of these books still require fundamental and necessary knowledge on linear mathematical optimization. This book is uniquely designed to present the DEA methodology in an applied setting where a reader is not required to have the knowledge on linear programming and linear algebra.

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[2] The Impact Prize, awarded once every two years, is intended to recognize contributions that have had a broad impact on the field. This award is from the Institute for Operations Research and the Management Sciences (INFORMS).

[3] Sherman, H.D., and J. Zhu, "Analyzing performance in service organizations," Sloan Management Review, Vol. 54, No. 4 (Summer 2013), 37-42.

About the Book

This book provides readers with the fundamental concepts and models needed to understand and use DEA. The focus of the book is on how to use DEA as an operations analytics tool for performance evaluation and benchmarking.

Topics include balanced benchmarking, best-practices, concept of relative efficiency, and performance improvement. Examples in both manufacturing and service industries are provided. Specifically, the data analysis technique discussed can help organizations to test about their assumptions about productivity and provide guidelines for continuous improvement.

By studying this book, readers are expected to

1) Learn data analysis tool for balanced benchmarking when multiple (sometime conflicting) key performance metrics are present.
2) Develop balanced benchmarking models for specific applications.
3) Identify best practices where traditional data analysis tools are not able to succeed.
4) Integrate different measures without the need to convert them to dollar value.
5) Handle information which are in different scales and units of measurement, and non-economic factors.
6) Perform productivity and market analysis along with operational performance evaluation.

This book is presented in six chapters.

Chapter 1 introduces DEA as a benchmarking tool for operations analytics. A laptop purchasing example is provided to demonstrate how DEA integrates multiple laptop features. DEA lets the data speak for themselves.

Chapter 2 illustrates DEA as a balanced benchmarking technique. It is shown that DEA can be flexibly adjusted to the need of a particular evaluation goal. DEA is an objective approach in the sense that DEA requires little or no user input. On the other hand, DEA allows the user to refine the results by incorporating the value judgment. Such value judgment reflects the user's preference over multiple performance metrics.

Chapter 3 presents the DEA terminology and shows how to classify performance metrics into measures that can be used by DEA.

Chapter 4 shows how to improve the performance of under-performing units using DEA.

Chapter 5 provides several case studies.

Chapter 6 introduces a basic DEA model where the user is able to identify the benchmarks and benchmarking shares. The DEA best-practice frontier shapes are discussed.

This book also provides an Appendix which introduces an Excel Add-In software – *DEAFrontier*. While a number of software packages are available for performing DEA analysis, this book uses Microsoft Excel and Excel Solver. *DEAFrontier* uses Excel Solver as the engine for solving the DEA models.

We believe that Microsoft Excel with the Excel Solver add-in provides a better platform for applying DEA models. The mathematical DEA models are established and solved using Microsoft Excel and Excel Solver. Some very basic Visual Basic for Application (VBA) coding is required.

To the Readers

The following items are available from **www.deafrontier.net**:

1. Data and Excel DEA Models – excel files used in the book.

2. A free version of *DEAFrontier*. A tutorial is available on how to use the *DEAFrontier* software.

3. Videos – demonstrating the key concepts and Excel modeling of DEA models.

Learning the DEA technique is more than reading this book. To get most of this book, you need to practice the examples in the Excel by yourself. We strongly recommend that you work through the examples in this book on your computer to replicate the results provided in this book and the excel files. The videos are resources for your reference. Only in this fashion will you learn how to use DEA effectively and correctly, gain a better understanding of the underlying DEA concepts, and apply DEA to your own settings.

The following two readings are recommended for interested readers who want to deepen their knowledge on DEA.

1. Cook, W.D., and Zhu, J., Data Envelopment Analysis: Balanced Benchmarking, amazon.com, 2013.

2. Zhu, J., Quantitative Models for Performance Evaluation and Benchmarking: Data Envelopment Analysis with Spreadsheets. 3rd edition. Springer Science, New York. 2014.

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