Preface

To improve performance, organizations need to constantly evaluate operations or processes related to products, services, marketing, and others. Performance evaluation and benchmarking are a widely used method to identify and adopt best practices as a means to improve performance and increase productivity, and are particularly valuable when no objective or engineered standard is available to define efficient and effective performance. For this reason, benchmarking is often used in managing service operations, because service standards (benchmarks) are more difficult to define than manufacturing standards.

Benchmarks can be established but are somewhat limited as they work with single measurements one at a time. It is difficult to evaluate an organization's performance when there are multiple performance metrics related to a system or operation. The difficulties are further enhanced when the relationships among the performance metrics are complex and involve unknown tradeoffs. It is critical to show benchmarks where multiple performance metrics exist. The current book introduces the methodology of data envelopment analysis (DEA) and its uses in performance evaluation and benchmarking under the context of multiple performance measures.

DEA uses mathematical programming techniques and models to evaluate the performance of peer units (e.g., bank branches, hospitals, and schools) in terms of multiple performance metrics/measures/features. These peer units are called Decision Making Units (DMUs). The performance of DMUs is measured based upon a set of selected performance measures/metrics. These performance metrics are classified as "inputs" and "outputs" in DEA. However, "inputs" and "outputs" in DEA do not necessarily represent inputs and outputs of production processes. For example, if one benchmarks the performance of computers, it is natural to consider different features (screen size and resolution, memory size, process speed, hard disk size, and others). One would then have to classify these features into "inputs" and "outputs" in order to apply a proper DEA analysis. However, these features may not actually represent inputs and outputs at all, in the standard notion of production. Therefore, the notion of DEA "inputs" and "outputs" is generic. DEA "inputs" and "outputs" can be inputs and outputs of production processes, but can also be general performance measures. In the former case, DEA yields an efficiency score, and the latter case a composite measure.

Because of the flexibility of DEA, researchers in a number of fields have quickly recognized that DEA is an excellent methodology for modeling operational processes. DEA's empirical orientation and absence of *a priori* assumptions have resulted in its use in a number of studies involving best-practice identification in the nonprofit sector, in the regulated sector, and in the private sector. DEA applications involve a wide range of contexts, such as education, health care, banking, armed forces, auditing, market research, retail outlets, organization effectiveness, transportation, public housing, and manufacturing.

The motivation for this book is three-fold. First, as DEA is being applied to a variety of efficiency evaluation problems, managers may want to conduct performance evaluation and analyze decision alternatives without the help of sophisticated modeling programs. For this purpose, spreadsheet modeling is a suitable vehicle. In fact, spreadsheet modeling has been recognized as one of the most effective ways to evaluate decision alternatives. It is easy for users to apply various DEA models in spreadsheets. The book introduces spreadsheet modeling into DEA, and shows how various conventional and new DEA approaches can be implemented using Microsoft® Excel and Solver. With the assistant of the developed DEA spreadsheets, the user can easily develop new DEA models to deal with specific evaluation scenarios.

Second, new models for performance evaluation and benchmarking are needed to evaluate business operations and processes under a variety of contexts. After briefly presenting the basic DEA techniques, the current book introduces new DEA models and approaches. For example, a context-dependent DEA measures the relative attractiveness of competitive alternatives. Sensitivity analysis techniques can be easily applied, and used to identify critical performance measures. Two-stage DEA models deal with multi-stage efficiency evaluation problems. DEA benchmarking models incorporate benchmarks and standards into DEA evaluation. Cross efficiency provides peer evaluation scores.

All these new models can be useful in benchmarking and analyzing complex operational efficiency in manufacturing organizations as well as evaluating processes in banking, retail, franchising, health care, e-business, public services, and many other industries.

Third, although the spreadsheet modeling approach is an excellent way to build new DEA models, an integrated easy-to-use DEA software can be helpful to managers, researchers, and practitioners. Therefore the current version includes a *DEAFrontier* software which is a DEA Add-In for Microsoft Excel and offers the user the ability to perform a variety of DEA models and approaches—it provides a custom Excel menu which calculates various different DEA models and can solve up to 50 DMUs, subject to the capacity of Excel Solver.

This third edition improves a number of DEA spreadsheet models. Several new DEA models and approaches are added. For example, cross efficiency approaches, and interval data treatment are new addition to the book. Bootstrapping in DEA is added into the *DEAFrontier* software. The third edition is reorganized to better present the traditional and new DEA models and approaches.

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DEA methodology and applications, and I would like to acknowledge my research collaborators, in particular, Professor Wade Cook, whose efforts made this edition possible. I would like to dedicate this edition to the memory of Late Dr. William W. Cooper who constantly supported my DEA research.

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