Preface

The Advanced Business Analytics synthesizes analytic principles with business and provides an interface between the main disciplines of engineering/economics and the organizational, administrative, and planning abilities of management. It is also complementary to other disciplines such as finance, marketing, decision, and risk analysis. In this book, each chapter discusses different topics in Advanced Business Analytics.

This book is intended for engineers, economists, and researchers who wish to know more about the new discipline of Business Analytics or who apply Business Analytics tools in their profession. The authors who contributed the various 12 chapters of this edited volume describe their original work in these areas or provide material for case studies, which have been successfully implemented in real-life cases.

The first chapter presents Decision Making (DM) with a set of criteria for choosing among several alternatives. The diagram of a DM is performed by logical decision trees (LDTs). This is achieved by having a graphical representation of those cases that need to be improved. Applying Binary Decision Diagrams (BDDs) reduces the computational cost of quantitative analysis. LDT graphically describes the sources of certain problems and their interrelations. The size of the BDDs depends on the number of variables, thus affecting the computational cost of the analysis. A real case study is discussed here, which turns out to be an NP-hard nonlinear programming problem. The necessary conditions of optimality are defined by Karush–Khun–Tucker conditions and we find the optimal allocation when resources are limited.

Chapter 2 focuses on the design of an efficient algorithm to reduce inventory costs and its eventual integration as an add-on in SAP Business One platform. The problem arises in those firms with storage capacity that replenish orders for several items along a finite planning horizon. After 2 years, the algorithm is finally implemented in Microsoft C# and .NET. A comprehensive computational experiment is carried out considering a wide range of random cases. The experimental results revealed that heuristic solutions are on average 5 % better than CPLEX optimizers.

The rising wind energy industry and the increasing number of failures of the large wind turbines necessitate the reduction of costs in this industry and increase competition in this sector. For this reason, the wind energy industry is focused on

the reduction of operation and maintenance (O&M) costs, which is discussed in Chap. 3. Condition Monitoring Systems (CMS) are probably the most effective approach to minimize O&M costs and substantially improve the availability, reliability, and safety of wind turbines by early detection of the problems. CMS requires knowledge and expertise to analyze the large volume of data collected from the sensors located in the wind turbines. The main objective of Chap. 3 is the development of a life cycle cost (LCC) model of the CMS for a wind turbine and the analysis of its economic feasibility. The LCC model has been applied to a real case study in Germany.

Multiple-Attribute Decision Making (MADM) refers to making decisions when there are multiple alternatives and multiple criteria. MADM considers a problem where management needs to prioritize or rank order alternative choices: identify key nodes in a business network, pick a contractor/sub-contractor, choose airports, rank recruiting efforts, rank banking facilities, or rank schools/colleges. How does one proceed to accomplish this analytically? In Chap. 4, four methodologies are presented to rank order alternatives based upon multiple criteria. These four methodologies include Data Envelopment Analysis (DEA), Simple Average Weighting (SAW), Analytical Hierarchy Process (AHP), and Technique of Order Preference by Similarity to Ideal Solution (TOPSIS). We describe all four methods and their uses, discuss the strengths and limitations of each method, present suggestions for sensitivity analysis, and present illustrative examples.

Business Analytics and Intelligence tools (BAI) are spreading across all industries. As the amount of business data grows exponentially, it is critical to have appropriate tools that make it possible to comprehend and utilize this digital era. Even though BAI tools have positively evolved in this direction, meaningful and productive use of data still remains a major challenge for many organizations. It has been demonstrated that BAI technologies should evolve toward a more holistic approach in which business users can focus on business concepts and questions, reducing time for data manipulation. Chapter 5 proposes a Business Analytics Architecture (BAA) as the infrastructure supporting "smart" enterprise BAI operations. It enables users to define the business concepts they want to focus on, as well as connecting them with data at storage-level. Analytical and data-mining algorithms are intensively exploited, all guided by the "semantic layer" previously depicted by business users. BAA integrates up-to-date data-mining and artificial intelligence techniques as well as some well-known business practices such as Balanced Scorecard and Strategy Maps.

Considering the reliability of an area traffic control road network, most travel delays are directly dependent on correct operation of signal settings. The purpose of Chap. 6 is to devise an efficient scheme to evaluate the reliability of a signal-controlled road network. A min–max complementarity problem is proposed to characterize user equilibrium flow in the presence of a worst-case disruption of a given link capacity loss. A computationally tractable solution scheme is proposed to identify important links whose disruption could cause a substantial increase in travel delays to all road users. Numerical computations are conducted in a medium-sized road network to demonstrate the feasibility of the proposed solution

scheme. The results indicate that the most critical signal-controlled traffic streams can be conveniently identified and, when failed to perform their normal functions, would give rise to maximum travel delays to all road users.

Business development requires technologically reliable products developed through excellence in project management. This excellence is obtained with advanced project control that should include Earned Value Management (EVM) methodology and project objectives accomplishment orientation. Chapter 7 presents an analytical model to implement the project objectives control with the EVM. The objectives are periodically measured along the project life with their weights and impact at the end of the project affecting the earned value. This provides early indications for the project progress and results and highlights the possible need for corrective actions. The analytical model also considers the forecasting of the objectives and their limits at project completion. The model is applied to a case study of engineering product development focusing on obtaining technical objectives. The generality of the model permits to apply it to any type of project, small or large, in any industry and with any kind of objectives either technical, commercial, economic, etc.

Chapter 8 describes a new point of view for the concept of a maturity model, introducing new evaluation elements beyond the concept of process. Maturity models can be defined as approaches to improving the business process management of any organization, or, from a global system-wide perspective, the organizational processes. The rationale behind the concept of maturity is that the organizations with experience carry out tasks systematically, where immature organizations achieve their outcomes as a result of considerable efforts of individuals using approaches that they create more or less spontaneously. Nowadays, maturity models are indissolubly linked with the process maturity models, as conceptual models compare the maturity of an organization's current practices against an industry standard. These models support any organization in setting priorities for improving the product/service operations in order to find the optimum levels of efficiency and effectiveness. On the other hand, excellence models provide a holistic view of the organization and can be used to determine how these different methods fit together and complement each other. Any excellence model can therefore be used in conjunction with any number of these tools, including Business Process Management, based on the needs and function of the organization, as an overarching framework for developing sustainable excellence. In fact, one of the eight fundamental concepts of the European Foundation for Quality Management (EFQM) excellence model is "managing with agility," a principle based on how excellent organizations are managed through structured and strategically aligned processes using fact-based decision making to create balanced and sustained results. The structure of excellence models, in the case of the EFQM excellence model, includes the following criteria: fundamental concepts of excellence, model criteria, and RADAR Logic. They allow introducing a more complex concept about maturity in the management, and not only in processes.

Chapter 9 gives an overview of the Analytic Hierarchy Process (AHP) and Intuitionistic Fuzzy TOPSIS (IFT) methods. It deals with an evaluation

methodology based on the AHP-IFT where the uncertainties are handled with linguistic values. First, the supplier selection problem is formulated using AHP and, then, it is used to determine the weights of the criteria. Later, IFT is used to obtain full ranking among the alternatives based on the opinion of the Decision Makers. The present model provides an accurate and easy classification in supplier attributes by chains prioritized in the hybrid model. A numerical example is given to clarify the main result that is developed in this chapter.

Chapter 10 intends to be a small guide to investing in hedge funds or a guide to consider when trying to understand the complexities of investing in hedge funds. It presents a general overview of the field of alternative investments and introduces its complexities, since investing in hedge funds is not a simple task. Alternative investment vehicles have taken an important role, not only in the diversification of portfolios but also as standalone investments. Capturing the entire risk dimensions implied in hedge fund investment strategies is paramount in understanding alternative investments.

The chapter also analyzes the problem of the lack of benchmarks. Should the performance of a hedge fund follow a benchmark? As absolute return vehicles, alternative investment organizations should not be benchmarked. However, investors need to compare returns with other assets in order to properly assess the opportunity cost implied in hedge fund investing. This chapter considers benchmarking among peers as a new and latest strategy.

Chapter 11 introduces functional data analysis, a relatively new technique for data analysis in business analytics. The distinct feature of this technique is that it deals with smooth functions or processes, which generate a discretized data sample that can be observed. The functional approach allows the user to flexibly model system dynamics, to analyze observations with measurement errors, and to fit data with sparse observations. This chapter illustrates the application of functional data analysis in the capital structure of California hospitals. It also points out the functional data analysis application in business research and future research directions.

Finally, Chap. 12 presents a software application developed to optimize the annual planning of visits of a brewing company sales/marketing staff to their customers. Each of these customers must be annually visited a provided number of times. Therefore, each salesperson is assigned to a set of customers that must be visited each week. The application assigns all visits of a salesperson to each customer so that all weeks should have roughly the same number of visits. By virtue of this approach, the brewing company diminished their marketing operating costs, as well as improved their customer relationships.

Ciudad Real, Spain — Fausto Pedro García Márquez
Philadelphia, Pennsylvania — Benjamin Lev

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García Márquez, F.P.; Lev, B. (Eds.)
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