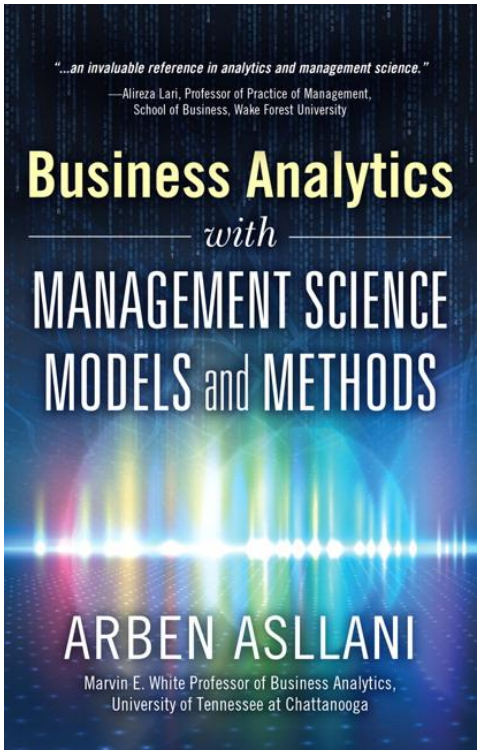
Business Analytics
Prescriptive Models



Based on

Business Analytics
With
Management Science
Models and Methods
by
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Chapter 1

Business Analytics with Management Science

Business Analytics with Management Science Models and Methods

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Chapter Outline

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- Three Vs of Big Data
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Chapter Objectives

- Emphasize the importance of business analytics in today's organizations;
- Discuss the scope of business analytics and the set of skills required for business analyst practitioners;
- Explain Big Data and it impact on Management Science
- Offer a Methodology for implementing Big Data initiatives
- Discuss challenges faced by organizations when implementing business analytics;
- Examine new challenges faced by management scientists in the era of Big Data.

Prescriptive Analytics in Action: Success Stories

- 67% of companies use data analytics to gain a competitive advantage compared to only 37% in 2010
- First Tennessee: increases ROI by 600%
- Target's Revenue: *$23 billion* since the implementation of the new analytics approach
- LinkedIn
  - People you may know- ads achieved a 30% higher click-through rate
  - Millions of new members-today over 260 million

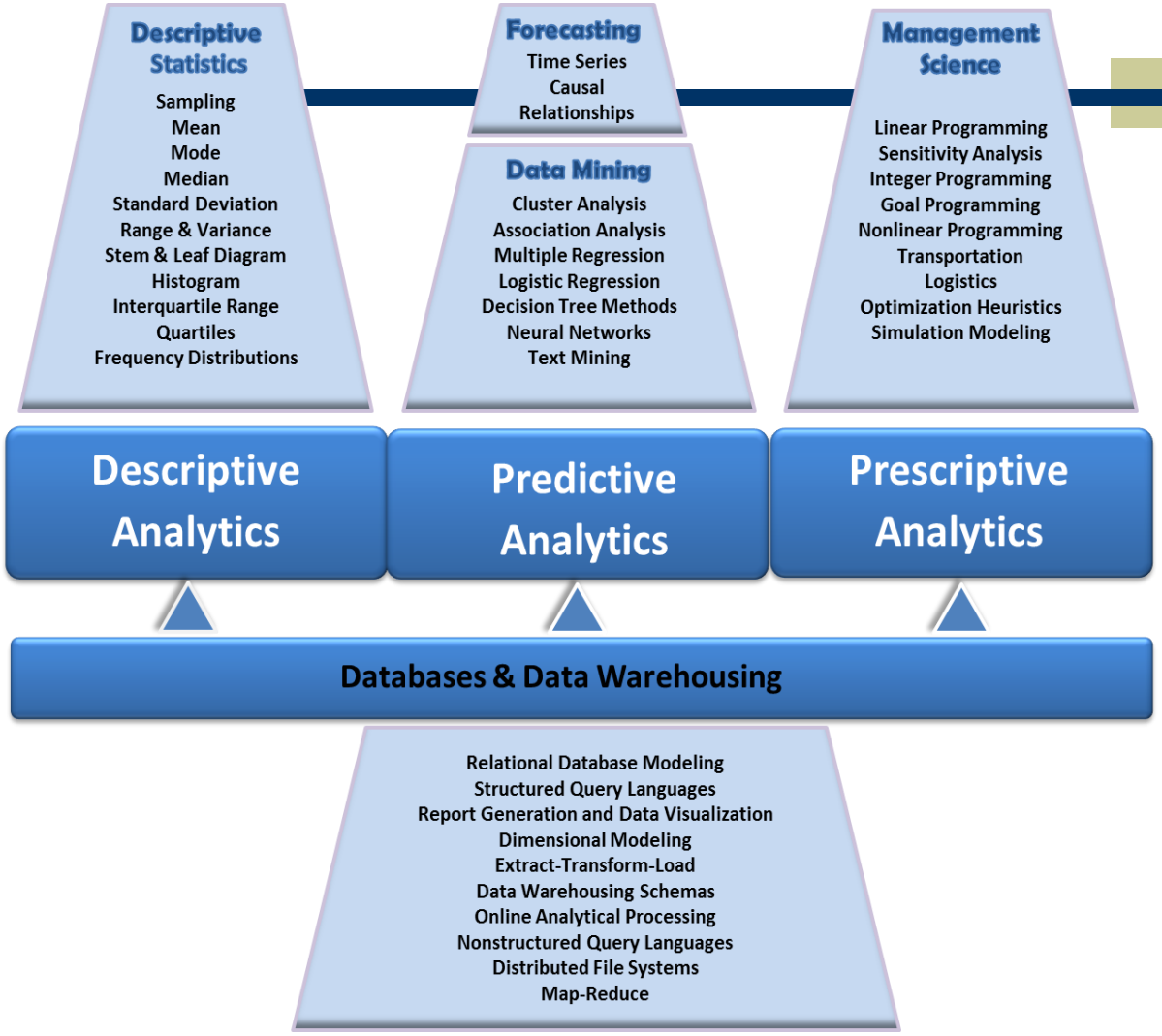
Introduction

- Big data
  - Automatic capture of massive date
- Business Analytics
  - Definition of business analytics
    - Wayne Winston: ”using data for better decision making.”
- Four major fields:
  1. Information management
  2. Descriptive analytics
  3. Predictive analytics
  4. Prescriptive analytics

Implementing Business Analytics

- 8-step cycle (LinkedIn's Big Data initiative)
  1. Understand the company's products in depth
  2. Establish tracking mechanisms to retrieve the data about the products
  3. Deploy good quality data throughout the enterprise
  4. Apply real time analysis to the data
  5. Use business intelligence to standardize reporting
  6. Use more advanced analytics functions to discover important patterns
  7. Obtain insights to extract relevant knowledge from the patterns
  8. Make decisions to derive value using the knowledge discovered

Business Analytics Domain



Database and Data Warehouse

- Serve as the foundation of business analytics
- Principles of database design and implementation:
  - Conceptual, logical and physical modeling
- Relational Databases
- ETL process (Extraction, Transformation and Loading)
- SQL (Structured Query Language)
- NoSQL (Non-Structured Query Language)

Descriptive Analytics

- Function:
  - describe the main features of organizational data
- Common tools:
  - sampling, mean, mode, median, standard deviation, range, variance, stem and leaf diagram, histogram, interquartile range, quartiles, and frequency distributions
- Displaying results:
  - graphics/charts, tables, and summary statistics such as single numbers

Predictive Analytics

- Function:
  - draw conclusions and predict future behavior
- Common tools:
  - cluster analysis, association analysis, multiple regression, logistic regression, decision tree methods, neural networks, text mining and forecasting tools (such as time series and causal relationships)
- Example of Fandango

Prescriptive Analytics

- Function:
  - make decisions based on data
- Common models:
  - linear programming
  - sensitivity analysis
  - integer programming
  - goal programming
  - nonlinear programming
  - simulation modeling

Challenges with Business Analytics

- Lack of Management Science Experts
  - Spreadsheet modeling
    - Simple formulation
    - Seek practical solutions
    - But limited in the amount of data they can store
- Analytics Bring Change in the Decision-Making Process
  - Information based decision can upset traditional power relationship
  - The case of Oberweis Dairy (Illinois)
    - Data analytics changed the focus: from marketing to strategic

Challenges with Business Analytics

- Big Data Leads to Incorrect Information
  - Difficult for data analyst to find the right information
  - GIGO – garbage in, garbage out
  - The case of AboutTheData.com
- Big Data Demands Big Thinking
  - Big data demands new techniques
  - Big data requires a new way of thinking

What is Big Data?

- Structured in-house operational databases
- External databases
- Automatically captured
- Often non-structured data from social networks, web server logs, banking transactions, content of web pages, and emails
- Combined into non-normalized data warehouse schema

Three Vs of Big Data

- Volume: the quantity of data
  - Larger than the volume processed by conventional relational database
  - Benefits all descriptive, predictive, and prescriptive
  - Benefits stochastic models as well
- Velocity: the rate at which data flows
  - Prescriptive models run in the background and take data from input to make an optimal or near optimal decision
- Variety: different data sources in different formats
  - The implementation of management science models requires an additional layer to make the input data uniform

Exploring Big Data with Prescriptive Analytics

- Volume:
  - generally improves the quality and accuracy of optimization models
- Velocity:
  - Prescriptive modeling techniques can take advantage of velocity
  - They can be modeled to run in the background and can be connected with live operational databases or data warehouses
- Variety:
  - a hindrance to the implementation but negative impact can be mitigated with right technological framework

Big data dimension	Challenges to LP	Technology-based Solutions	Methodology-based Solutions
Volume	Managing large and rapidly increasing data sources	• Advanced software programs able to process large number of constraints and decision variables	• Standardize the ETL processes to automatically capture and process input parameters • Encourage system-driven versus user-driven optimization programs
Variety	Dealing with heterogeneity of data sources Dealing with incomplete data sets	• Relational database systems and declarative query language to retrieve data input for optimization models • ETL toward specialized optimization driven Data Marts	• Add data structuring prior to analysis • Implement data cleaning and imputation techniques
Velocity	Managing large and rapidly changing data sets Reaching on-time optimal solutions for operational business intelligence	• Advanced optimization software with the capability to reach optimal solutions within a feasible amount of time • Use optimization packages that directly connect to operational data bases	• Consider a trade-off between less than optimal but time feasible and practical solution and optimal but complex and often delayed solutions

Wrap Up

- In the era of Big Data, management scientists have “rediscovered their roots” and are modifying traditional techniques:
  - better process large volumes of data
  - offer simpler and practical models
  - utilize spreadsheet modeling techniques
  - offer practical solutions, which can be implemented in real time.
- Several optimization software programs exist
- Solver is an excellent program
  - solve mathematical programming models
  - perform what-if analysis and optimizations

Wrap Up

- Two-step approach:
  - setting up a template
  - running Solver and analyzing the results
- ETL processes can be used to automatically capture and process input parameters
- Design optimization models that are process driven
  - continuously adjust input parameters and periodically produce optimal solutions