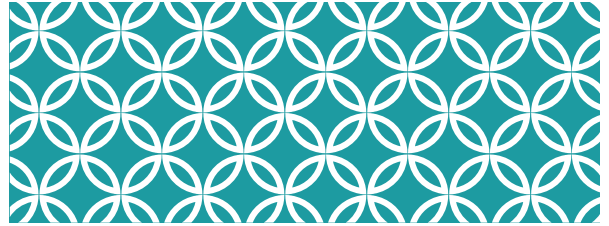INTRODUCTION TO
DATA ANALYTICS | Lesson 1.1

INTRODUCTION | Lesson 1.1.1

INTRODUCTION

- Three developments spurred recent explosive growth in the use of analytical methods in business applications:
- First development:
  - Technological advances, Internet social networks, and data generated from personal electronic devices, produce incredible amounts of data for businesses.
  - Businesses want to use these data to improve the efficiency and profitability of their operations, better understand their customers, price their products more effectively, and gain a competitive advantage.

INTRODUCTION

- Second development:
  - Ongoing research has resulted in numerous methodological developments, including:
    - Advances in computational approaches to effectively handle and explore massive amounts of data
    - Faster algorithms for optimization and simulation, and
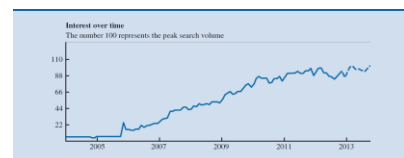   - More effective approaches for visualizing data.

INTRODUCTION

- Third development:
  - The methodological developments were paired with an explosion in computing power and storage capability.
  - Better computing hardware, parallel computing, and cloud computing have enabled businesses to solve big problems faster and more accurately than ever before.

## FIGURE 1.1 - GOOGLE TRENDS GRAPH OF SEARCHES ON THE TERM *ANALYTICS*

BUSINESS ANALYTICS DEFINED

- **Business analytics:**
  - Scientific process of transforming data into insight for making better decisions.
  - Used for data-driven or fact-based decision making, which is often seen as more objective than other alternatives for decision making.

BUSINESS ANALYTICS DEFINED

- Tools of business analytics can aid decision making by:
  - Creating insights from data
  - Improving our ability to more accurately forecast for planning
  - Helping us quantify risk
  - Yielding better alternatives through analysis and optimization
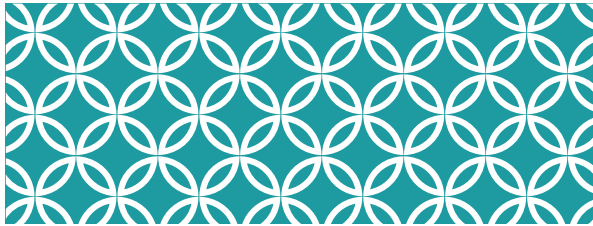
A CATEGORIZATION OF ANALYTICAL METHODS AND MODELS
Lesson 1.1.4

DESCRIPTIVE ANALYTICS

- **Descriptive analytics:** It encompasses the set of techniques that describes what has happened in the past.

  Examples - data queries, reports, descriptive statistics, data visualization (data dashboards), data-mining techniques, and basic what-if spreadsheet models.

  Data query - It is a request for information with certain characteristics from a database.

DESCRIPTIVE ANALYTICS

- Data dashboards - Collections of tables, charts, maps, and summary statistics that are updated as new data become available.
  - Uses of dashboards
    - To help management monitor specific aspects of the company's performance related to their decision-making responsibilities.
    - For corporate-level managers, daily data dashboards might summarize sales by region, current inventory levels, and other company-wide metrics.
    - Front-line managers may view dashboards that contain metrics related to staffing levels, local inventory levels, and short-term sales forecasts.

PREDICTIVE ANALYTICS

- **Predictive analytics:** It consists of techniques that use models constructed from past data to predict the future or ascertain the impact of one variable on another.
  - Survey data and past purchase behavior may be used to help predict the market share of a new product.

PREDICTIVE ANALYTICS

- Techniques used in Predictive Analytics: *contd*.

Data mining
- Used to find patterns or relationships among elements of the data in a large database; often used in predictive analytics.

Simulation
- It involves the use of probability and statistics to construct a computer model to study the impact of uncertainty on a decision.

PRESCRIPTIVE ANALYTICS

- **Prescriptive Analytics**: It indicates a best course of action to take
  - Models used in prescriptive analytics:

Optimization models
- Models that give the best decision subject to constraints of the situation.

Simulation optimization
- Combines the use of probability and statistics to model uncertainty with optimization techniques to find good decisions in highly complex and highly uncertain settings.

Decision analysis
- Used to develop an optimal strategy when a decision maker is faced with several decision alternatives and an uncertain set of future events.
- It also employs utility theory, which assigns values to outcomes based on the decision maker's attitude toward risk, loss, and other factors.

PRESCRIPTIVE ANALYTICS

- Optimization models

Model	Field	Purpose
Portfolio models	Finance	Use historical investment return data to determine the mix of investments that yield the highest expected return while controlling or limiting exposure to risk.
Supply network design models	Operations	Provide the cost-minimizing plant and distribution center locations subject to meeting the customer service requirements.
Price markdown models	Retailing	Uses historical data to yield revenue-maximizing discount levels and the timing of discount offers when goods have not sold as planned.
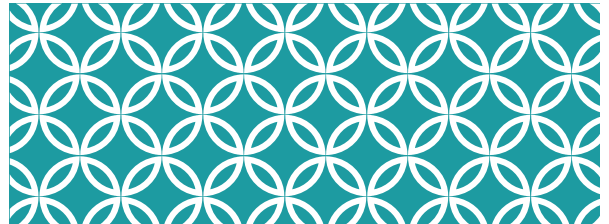
BIG DATA Lesson 1.1.5

BIG DATA

- **Big data**: A set of data that cannot be managed, processed, or analyzed with commonly available software in a reasonable amount of time.
  - Big data represents opportunities.
  - It also presents analytical challenges from a processing point of view and consequently has itself led to an increase in the use of analytics.
  - More companies are hiring data scientists who know how to process and analyze massive amounts of data.
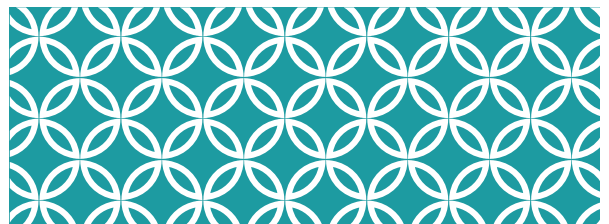
BUSINESS ANALYTICS IN PRACTICE Lesson 1.1.6

FIGURE 1.2 - THE SPECTRUM OF BUSINESS ANALYTICS

Source: Adapted from SAS.
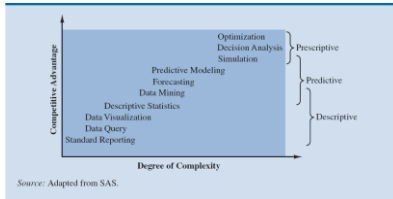
BUSINESS ANALYTICS IN PRACTICE

Retail Markdown Decisions
- Most department stores clear seasonal inventory by reducing prices.
- The question is:
  - When to reduce the price and by how much?
- Descriptive analytics: examine historical data for similar products (prices, units sold, advertising, …)
- Predictive analytics: predict sales based on price
- Prescriptive analytics: find the best sets of pricing and advertising to maximize sales revenue

BUSINESS ANALYTICS IN PRACTICE

Harrah's Entertainment
- Harrah's owns numerous hotels and casinos
- Uses analytics to:
  - forecast demand for rooms
  - segment customers by gaming activities
- Uses prescriptive models to:
  - set room rates
  - allocate rooms
  - offer perks and rewards to customers

BUSINESS ANALYTICS IN PRACTICE

- Types of applications of analytics by application area
- Financial analytics
  - Use of predictive models
    - To forecast future financial performance
    - To assess the risk of investment portfolios and projects
    - To construct financial instruments such as derivatives

BUSINESS ANALYTICS IN PRACTICE

- Financial analytics (contd.)
  - Use of prescriptive models
    - To construct optimal portfolios of investments
    - To allocate assets, and
    - To create optimal capital budgeting plans.
  - Simulation is also often used to assess risk in the financial sector

BUSINESS ANALYTICS IN PRACTICE

- Human resource (HR) analytics
  - New area of application for analytics
  - The HR function is charged with ensuring that the organization
    - Has the mix of skill sets necessary to meet its needs
    - Is hiring the highest-quality talent and providing an environment that retains it, and
    - Achieves its organizational diversity goals.

BUSINESS ANALYTICS IN PRACTICE

- Marketing analytics
  - Marketing is one of the fastest growing areas for the application of analytics.
  - A better understanding of consumer behavior through the use of scanner data and data generated from social media has led to an increased interest in marketing analytics.
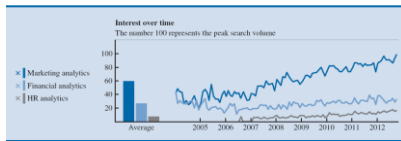
BUSINESS ANALYTICS IN PRACTICE

- Marketing analytics (contd.)
  - A better understanding of consumer behavior through marketing analytics leads to:
    - The better use of advertising budgets
    - More effective pricing strategies
    - Improved forecasting of demand
    - Improved product line management, and
    - Increased customer satisfaction and loyalty

FIGURE 1.3 - GOOGLE TRENDS FOR MARKETING, FINANCIAL, AND HUMAN RESOURCE ANALYTICS, 2004—2012

BUSINESS ANALYTICS IN PRACTICE

- Health care analytics
  - Descriptive, predictive, and prescriptive analytics are used:
    - To improve patient, staff, and facility scheduling
    - Patient flow
    - Purchasing
    - Inventory control
  - Use of prescriptive analytics for diagnosis and treatment

BUSINESS ANALYTICS IN PRACTICE

- Supply chain analytics
  - The core service of companies such as UPS and FedEx is the efficient delivery of goods, and analytics has long been used to achieve efficiency.
  - The optimal sorting of goods, vehicle and staff scheduling, and vehicle routing are all key to profitability for logistics companies such as UPS, FedEx, and others like them.
  - Companies can benefit from better inventory and processing control and more efficient supply chains.

BUSINESS ANALYTICS IN PRACTICE

- Analytics for government and nonprofits
  - To drive out inefficiencies
  - To increase the effectiveness and accountability of programs
  - Analytics for nonprofit agencies
    - To ensure their effectiveness and accountability to their donors and clients.

BUSINESS ANALYTICS IN PRACTICE

- Sports analytics
  - Used for player evaluation and on-field strategy in professional sports.
    - To assess players for the amateur drafts and to decide how much to offer players in contract negotiations.
    - Professional motorcycle racing teams that use sophisticated optimization for gearbox design to gain competitive advantage.

BUSINESS ANALYTICS IN PRACTICE

- Sports analytics (contd.)
  - The use of analytics for off-the-field business decisions is also increasing rapidly.
    - Using prescriptive analytics, franchises across several major sports dynamically adjust ticket prices throughout the season to reflect the relative attractiveness and potential demand for each game.