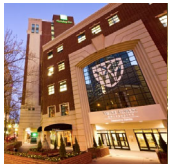
The Analytics Academic Landscape

Jeffrey Camm
Associate Dean of Business Analytics
Wake Forest University School of Business
cammjd@wfu.edu

Analytics is the scientific process of transforming data into insight for making better decisions

Source: INFORMS

What does it mean to be scientific?

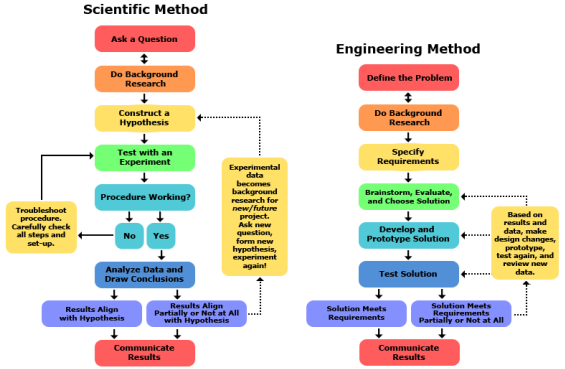
The Scientific Method

- Ask a Question
- Do Background Research
- Construct a Hypothesis
- Test Your Hypothesis by Doing an Experiment
- Analyze Your Data and Draw a Conclusion
- Communicate Your Results

The Engineering Design Process

- Define the Problem
- Do Background Research
- Specify Requirements
- Brainstorm Solutions
- Choose the Best Solution
- Do Development Work
- Build a Prototype
- Test and Redesign

Source: SCIENCE BUDDIES



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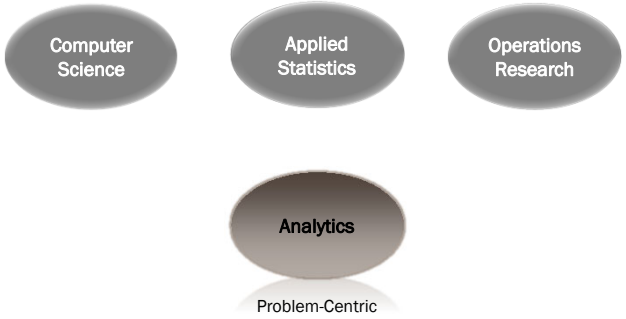


4

Data as Capital

The world's most valuable resource is no longer oil, but data

The Economist

The data economy demands a new approach to antitrust rules

5

The Use of Analytics is Pervasive

6

Analytics

- **Descriptive** Analytics - the use of data to figure out what happened in the past.
- **Predictive** Analytics – the use of data to find out what could happen in the future or to find how variables are related
- **Prescriptive** Analytics – the use of data to prescribe a course of action

7

Example: Descriptive Analytics

8

Example: Predictive Analytics

Predicting the Number of Members in a Zip Code

- **M = 0.0213*(Zip Code Population) – 26.941**
  - For every increase of 100 people in a zip code, we expect about 2 more donors
  - Adjusted R^2 = 0.3847
- **M = 0.0196*(Zip Code Population) + 0.0026*(Avg Home Price in Zip Code) – 372.15**
  - For every $1000 increase in average home price in a zip code, we expect about 2.6 more donors
  - Adjusted R^2 = 0.4857

9

Example: Prescriptive Analytics

Blending OR/MS, Judgment, and GIS: Restructuring P&G's Supply Chain

JEFFREY D. CAMM — Department of Quantitative Analysis and Operations Management, University of Cincinnati, Cincinnati, Ohio 45221-0130
THOMAS E. CHORMAN — The Procter & Gamble Company, Cincinnati, Ohio 45224
FRANZ A. DILL — The Procter & Gamble Company, Cincinnati, Ohio 45224
JAMES R. EVANS — Department of Quantitative Analysis and Operations Management, University of Cincinnati
DENNIS J. SWEENEY — Department of Quantitative Analysis and Operations Management, University of Cincinnati
GLENN W. WEGRYN — The Procter & Gamble Company, 2 Procter & Gamble Plaza, PNC-12, Cincinnati, Ohio 45201-5530

In 1993, P… …ntitled …line work strengthe…

North American Product Supply Study

- $1B + NPV
- $250M savings per year

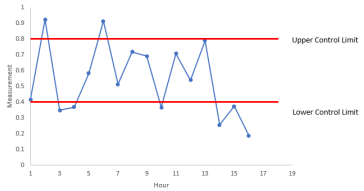
10

Prescriptive Analytics

- Rule-based Systems
- Heuristics
- Optimization
- Optimization – Simulation
- Decision Analysis

The Deployment of a Descriptive Model

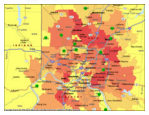
Control Chart on a Data Dashboard



Rule: If we see three consecutive measurements outside the control limits, stop the machine and investigate.

12

The Deployment of a Predictive Model



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13

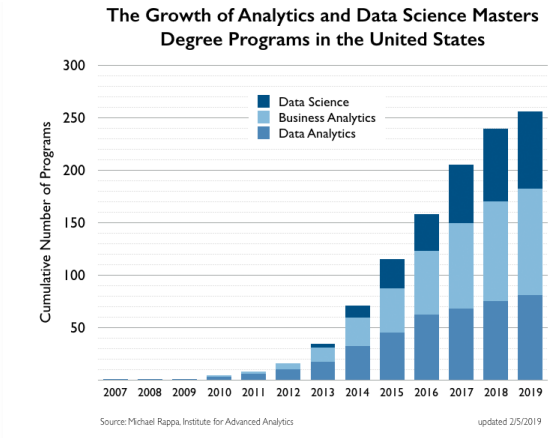
Crowd Solving

The Traveling Salesperson Problem

14

Academic Programs

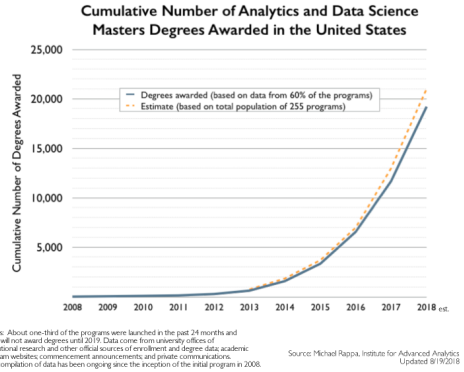
15



24 are in Engineering

14/24 are data science

16



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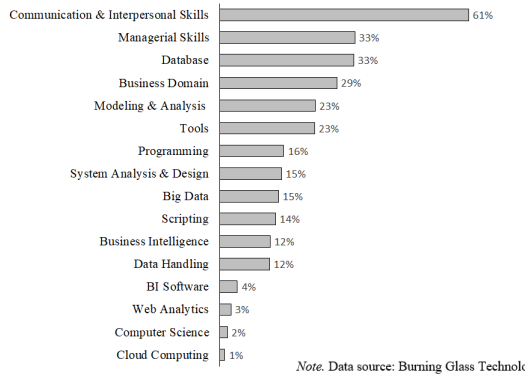
Industry Needs

18

Industry Needs



Note. Data source: Burning Glass Technologies. (2018).

Source: Bowers, Camm and Chakraborty, The Evolution of Analytics and Implications for Industry and Academic Programs, *Interfaces*, Vol. 48, No. 6, Nov-Dec, 2018, pp. 487-499.

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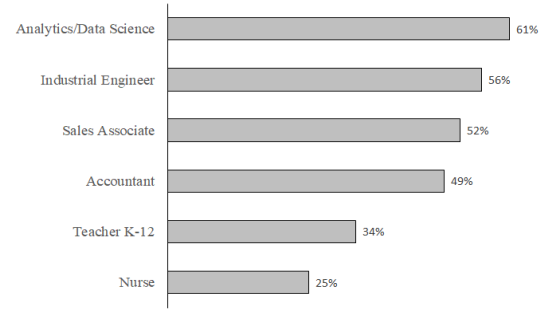

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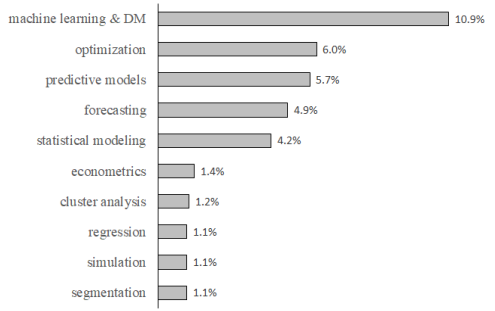
20

Industry Needs - - Tools



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21

Closing the Gaps

22

Wake Forest MSBA Curriculum

Analytical Skills

Data Analysis & Business Modeling
Data Management
Data Visualization
Forecasting
Intro to Programming with R
Intro to SAS
Predictive Analytics & Data Mining
Prescriptive Analytics
Probability and Statistical Modeling

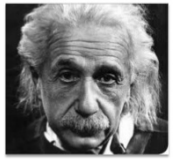
Business Acumen

Business Metrics
Financial and Risk Analytics
HR Analytics
Marketing Analytics
Digital Marketing Analytics
Process Analytics
Supply Chain Analytics

Impactful Professionalism

Analytics in the Board Room
Analytics in Society
BAP I: Mess to Model
BAP II: Model to Insight
BAP III: Insight to Impact
Career Management

Problem Framing



"If I had only one hour to save the world, I would spend fifty-five minutes defining the problem, and only five minutes finding the solution."

- Albert Einstein

Ask the right questions.
Understand the real problem.

24

Master of Science in Analytics

The core of the MS in Analytics program consists of six foundational courses, and four elective courses, totaling 30 units. The foundational courses cover the basic topics of data science and management, statistical methods, optimization, simulation and other operations research tools. The elective courses allow students to deepen their technical skills and expose them to the applied domains where analytics is much needed; some of these domains include electricity markets, supply chains and logistics, health care systems, and transportation.

Required Courses (15 units)

- INF 559 Introduction to Data Management Units: 3
- ISE 529 Engineering Data Analytics Units: 3
- ISE 530 Optimization Methods for Analytics Units: 3
- ISE 533 Integrative Analytics Units: 3
- ISE 562 Value and Decision Theory Units: 3

Group A (3 units are required)

Select one course

- ISE 538 Markov Models for Performance Analysis Units: 3
- ISE 580 Performance Modeling with Simulation Units: 3

Electives (12 units)

- ISE Elective Units: 3
- INF or CSCI Elective Units: 3
- Additional electives subject to adviser's approval Units: 6

Total units required for the degree: 30

Return to: Industrial and Systems Engineering – Daniel J. Epstein Department of Industrial and Systems Engineering

Source: USC website

25

FALL QUARTER (FIRST)

INDUSTRY PRACTICUM (MSIA 489)
Under the guidance of business and technical advisers, students work in small teams to integrate coursework into an industry-supplied project.

EVERYTHING STARTS WITH DATA (MSIA 400)
A gateway course covering basic analytics concepts through projects and success stories.

INTRODUCTION TO DATABASES & INFORMATION RETRIEVAL (MSIA 413)
Data models and database design: SQL, distributed databases, and information retrieval.

PREDICTIVE ANALYTICS I (MSIA 401)
Multiple regression, logistic regression, discriminant analysis, generalized linear models, and survival analysis.

INTRODUCTION TO JAVA & PYTHON PROGRAMMING (MSIA 422)
Object oriented programming, data structures, and algorithms.

SPRING QUARTER

INDUSTRY PRACTICUM (MSIA 489)
Under the guidance of business and technical advisers, students work in small teams to integrate coursework into an industry supplied projects.

ANALYTICS VALUE CHAIN (MSIA 423)
A/B testing, design of experiments, and production-ready data science solutions.

ANALYTICS FOR BIG DATA (MSIA 431)
With emphasis on Hadoop, unstructured data concepts (key-value), MapReduce technology, and analytics for big data.

INTRODUCTION TO DATA MANAGEMENT FOR BUSINESS INTELLIGENCE (MSIA 430)
Online Analytical Processing (OLAP), dimensional modeling, and data streaming.

DEEP LEARNING (MSIA 432)
Deep learning models (generative and discriminative), CNN, RNN, and back propagation.

WINTER QUARTER

INDUSTRY PRACTICUM (MSIA 489)
Under the guidance of business and technical advisers, students work in small teams to integrate coursework into an industry supplied projects.

ANALYTICAL CONSULTING PROJECT LEADERSHIP (MSIA 410)
Presenting, proposal writing, business etiquette, and consulting practices.

DATA VISUALIZATION (MSIA 411)
Visualization principles, scorecards, dashboards, interacting with graphics, story telling, and D3.

DATA MINING (MSIA 421)
Clustering (k-means, partitioning), association rules, factor analysis, scale development, survival analysis, principal components analysis, and dimension reduction.

PREDICTIVE ANALYTICS II (MSIA 420)
Non-parametric regression and classification, time series, and statistical process control.

FALL QUARTER (SECOND)

CAPSTONE DESIGN PROJECT (MSIA 499)
In this culminating project, students draw on the breadth and depth of the curriculum to address an industry supplied problem.

BUSINESS VALUE FROM ANALYTICS IN THE DIGITAL AGE (MSIA 412)
Identifying appropriate analytics projects, ROI, and building an analytics organization.

TEXT ANALYTICS (MSIA 414)
Text analytics preprocessing, document clustering, retrieval, sentiment analysis, POST, and name entity recognition (NER).

ELECTIVE
Choose from (examples): **Healthcare Analytics**, **Predictive Models for Credit Risk Management**, **Optimization & Heuristics**, or **Social Networks Analysis**.

Source: Northwestern McCormick website

26

Innovation through Analytics in Manufacturing and Services

27

Mass Customization: Coke Freestyle

Prescriptive Analytics as a Product/Service

JOHN DEERE

Source: 3g.co.uk

Prescriptive Analytics as a Product/Service

GE Aviation

Source: 3g.co.uk

Summary

- In my opinion, analytics today is problem-centric like OR was in its original form
- As OR became an academic discipline, it became more tool/algorithmic centric
- Analytics in its current form is not yet thought of as an academic discipline and so it is almost a reset back to the origins of OR
- While many have written about the need for "soft skills" in OR, few OR programs devoted credit hours to these skills
- Analytics/Business Analytics programs are now paying more attention to soft skills and ethics.
- Data availability offers the opportunity for innovation and requires more attention to ethics in modeling and data handling