

Session 1: Introduction

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Prof. Adam Elmachtoub

About Me

- Assistant Professor in IEOR and Data Science Institute
- Spent one year at IBM T.J. Watson Research Center
- Ph.D. from MIT in 2014, B.S. from Cornell in 2009, both in OR
- Research is focused on applications of operations research and analytics to retail, logistics, and travel
- Worked with several companies including Novartis, Tampa Bay Rays, Dassault Falcon, and IBM
- Selected for Forbes 30 under 30 in 2016 in science category

TA: Steven Yin

- Ph.D. student in Operations Research
- B.S. in Electrical Engineering, UCLA
- Interested in analytics and optimization
- Primary contact for 2:40 class

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TA: Min-hwan Oh

- Ph.D. student in Operations Research
- M.S. in Operations Research, Columbia University
- B.A. in Mathematics and Statistics, Columbia University
- Interested in machine learning / network science, and their application to sports analytics / neuroscience
- Primary contact for 4:10 class

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Class Objectives

What can you expect to learn in business analytics?

- High-level insights and critical thinking about analytics
- Concrete approaches and practical number-crunching experience

We will extensively use cases,

- Real stories about real companies
- Understanding the business need for analytics

and implement the techniques using R.

- Power statistical analysis tool
- Open Source and widely used
- Continually expanding library of statistical, data analysis and machine learning libraries

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Outline

- Introduction to Business Analytics
- Course overview and requirements
- Nomis A discussion

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What is Business Analytics?

The use of data, modeling and computation
to identify and capture value

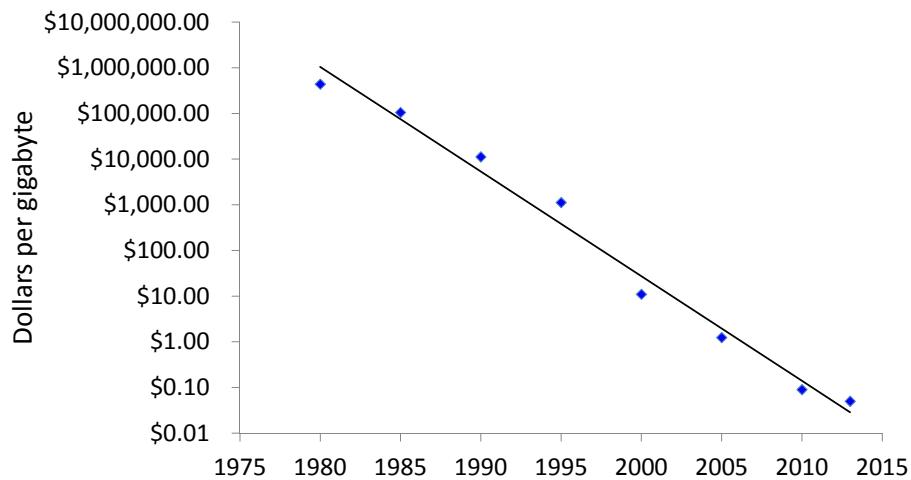
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Why Now? Available Data is Exploding ...



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... And Computing Cost is Plummeting



- Complete works of Shakespeare: 5 megabytes
- One DVD: 17 gigabytes (1000 megabytes in a gigabyte)
- US Library of Congress (print): 10 terabytes (1000 gigabytes in a terabyte)
- A terabyte hard drive now costs about \$50

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Economic Potential of Business Analytics

There has been uneven progress in capturing value from data and analytics

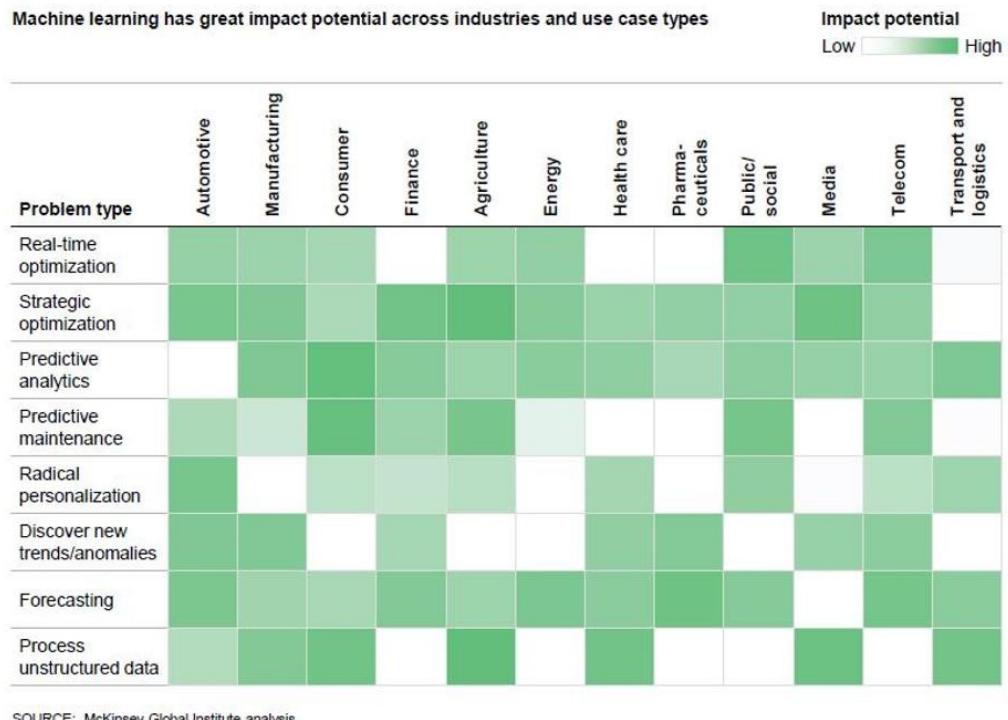
	Potential impact: 2011 research	Value captured		Major barriers
		%	Value	
Location-based data	<ul style="list-style-type: none">▪ \$100 billion+ revenues for service providers▪ Up to \$700 billion value to end users		\$50-60 billion	<ul style="list-style-type: none">▪ Penetration of GPS-enabled smartphones globally
US retail ¹	<ul style="list-style-type: none">▪ 60%+ increase in net margin▪ 0.5–1.0% annual productivity growth		\$30-40 billion	<ul style="list-style-type: none">▪ Lack of analytical talent▪ Siloed data within companies
Manufacturing ²	<ul style="list-style-type: none">▪ Up to 50% lower product development cost▪ Up to 25% lower operating cost▪ Up to 30% gross margin increase		\$20-30 billion	<ul style="list-style-type: none">▪ Siloed data in legacy IT systems▪ Leadership skeptical of impact
EU public sector ³	<ul style="list-style-type: none">▪ ~€250 billion value per year▪ ~0.5% annual productivity growth		\$10-20 billion	<ul style="list-style-type: none">▪ Lack of analytical talent▪ Siloed data within different agencies
US health care	<ul style="list-style-type: none">▪ \$300 billion value per year▪ ~0.7% annual productivity growth		\$10-20 billion	<ul style="list-style-type: none">▪ Need to demonstrate clinical utility to gain acceptance▪ Interoperability and data sharing

1 Similar observations hold true for the EU retail sector.

2 Manufacturing levers divided by functional application.

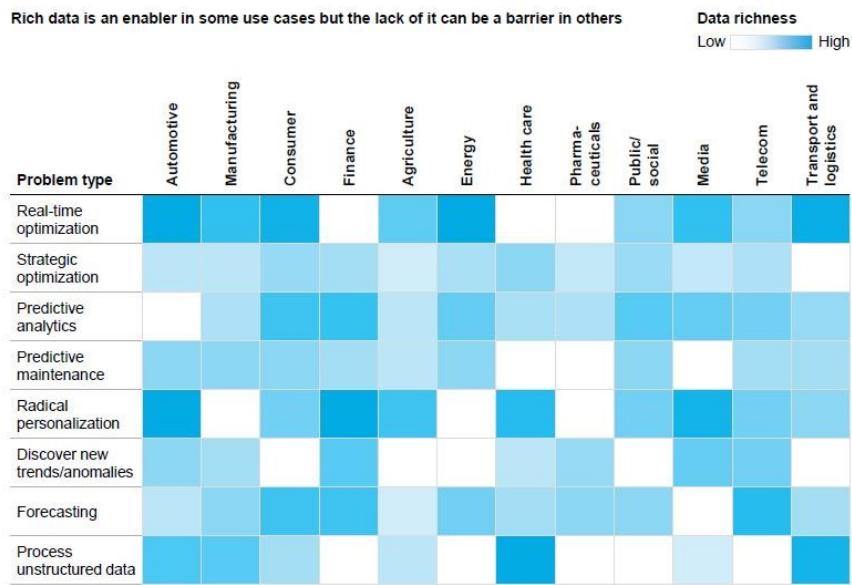
3 Similar observations hold true for other high-income country governments.

Economic Potential of Business Analytics



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Economic Potential of Business Analytics



SOURCE: McKinsey Global Institute analysis

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Economic Impact of Business Analytics



MIT/Wharton Study (2011 Brynjolfsson et al.)

- Study of 179 large publicly traded firms
- Firms that emphasize data driven decision making (DDD) and business analytics perform significantly better
- Output and productivity 5-6% higher after adjusting for other factors

New York Times, April 23, 2011

www.nytimes.com/2011/04/24/business/24unboxed.html

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Notable Recent Examples

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Target Targeting Mothers-to-Be



Andrew Pole, Target analytics: asked to identify pregnant women (2002)

What did he do?



"How Companies Learn Your Secrets," New York Times, February 16, 2012
www.nytimes.com/2012/02/19/magazine/shopping-habits.html

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Negative Reactions



How does Target know I'm pregnant?

5

Tweet 5

Like 74

View comments

By [Jenna Karvunidis](#), April 12, 2013 at 6:44 pm

This post was written a week after my positive pregnancy test. I'm now nine weeks along (with twins!) and since Target knows, why shouldn't you? Get caught up [here](#) and [here](#).

Three parties know my period is late: me, my husband, and Target. Yesterday, I purchased a winter maternity coat at an end-of-season clearance sale online (I plan ahead!) so technically the drones handling orders for the Destination

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The Colbert Report on Retail Analytics

[http://www.cc.com/video-clips/dv9iqc/
the-colbert-report-the-word---surrender-to-a-buyer-power](http://www.cc.com/video-clips/dv9iqc/the-colbert-report-the-word---surrender-to-a-buyer-power)

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A Matter of Framing?

"With the pregnancy products, though, we learned that some women react badly," the executive said. "Then we started mixing in all these ads for things we knew pregnant women would never buy, so the baby ads looked random. We'd put an ad for a lawn mower next to diapers. We'd put a coupon for wineglasses next to infant clothes. That way, it looked like all the products were chosen by chance ... As long as we don't spook her, it works."

"We are very conservative about compliance with all privacy laws. But even if you're following the law, you can do things where people get queasy."

Target Executive to the New York Times

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Business Impact

to our shareholders

2012 was an exciting year for Target, as we devoted meaningful resources to driving performance in support of our publicly stated sales and financial goals, while transforming Target to seize the tremendous opportunities we see in the most dynamic and disruptive retail landscape in generations.

Total sales and diluted earnings per share reached new highs of \$72.0 billion and \$4.52, respectively. We invested \$3.3 billion of capital in our U.S. and Canadian businesses, and we returned over \$2.7 billion to our shareholders through share repurchase and dividend payments. And our full-year results were right on track with our Long-Range Plan to reach at least \$100 billion in sales and \$8 in earnings per share in 2017.

In addition to our financial successes, we achieved significant strategic and operational milestones in 2012, including the launch of our first CityTarget stores in Chicago, Seattle, San Francisco and Los Angeles; extending our fresh-food remodel program to another 238 general merchandise stores; achieving record-setting sales penetration through our 5% REDcard loyalty program; and signing an agreement to sell our U.S. credit card receivables to TD Bank Group, a strong partner aligned with our goals for portfolio growth and profitability. We also surpassed \$4 million per week in charitable giving to support communities we serve.

In 2013, we'll continue to pursue a strategy that is being shaped by our guests' expectations for more shopping flexibility and price transparency, and the rapid pace of change in technology. To ensure that we continue to strengthen our guests' love for our stores, we will continue to surprise and delight them as we come to expect; we'll leverage our greatest asset, our stores. In combination with increased investment in our digital platforms, to create a seamless, relevant and personalized experience.

Differentiation with exceptional value, which represents the foundation of our "Expect More. Pay Less." brand promise, will continue to set Target apart in the marketplace. We remain committed to offering a truly unique assortment—through our design partnerships, our broad portfolio of private brands and limited editions of beloved national brands. And we are equally unwavering in our commitment to provide a compelling value proposition, as we showed by expanding our Price Match Guarantee to include select online competitors. We're also collaborating closely with our vendors on channel-management strategies that sharpen prices and improve selection for our guests.

Meanwhile, in 2013, we will also undertake the largest, single-year store expansion in Target's history. After two years of exceptional dedication and hard work by our team, we've begun

opening Target stores in Canada and are on track to open 124 stores across all 10 provinces by year end. In addition, we'll extend our new CityTarget urban format to additional locations in Los Angeles and San Francisco, and, for the first time, to Portland, Oregon.

We are excited by the physical and digital growth ahead of us. By staying focused on creating a superior shopping experience for our guests—whether they are in urban or suburban markets, in the U.S. or Canada, in our stores or digital channels—we believe Target will continue to thrive. And, this strategic clarity, in combination with our powerful brand, gives us confidence in our future: confidence in the values that have guided our company for 50 years, confidence in the talent and passion of our 361,000 team members and confidence in our continued ability to deliver profitable growth for many years to come.


Gregg Steinhafel | Chairman, President and CEO, Target

Board of Directors Changes: In March 2013, we welcomed Douglas M. Baker, Jr., Chairman and CEO of Ecobilt Inc., and Henrique De Castro, Chief Operating Officer of Yahoo! Inc., to our board of directors. Also in March, Stephen W. Sanger, former Chairman and CEO of General Mills, Inc., retired from our board of directors. We thank Steve for his contributions during his 17 years of service.



Watch CEO Gregg Steinhafel review 2012.
Scan the code

- Strong revenue growth from \$44B in 2002 to \$67B in 2010
- CEO Steinhafel: results due to "heightened focus on items and categories that appeal to specific guest segments such as mom and baby."

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Obama's 2008 and 2012 Campaigns



Dan Wagner: headed up quant campaign staff (40 people for 2012)

What did he do?



"Data You Can Believe In: The Obama Campaign's Digital Masterminds Cash In,"
NY Times, June 20, 2013

www.nytimes.com/2013/06/23/magazine/the-obama-campaigns-digital-masterminds-cash-in.html?smid=pl-share

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Political Impact

"It was unlike any politics I'd ever seen. And it won the 2012 campaign. Those 'Martians' were reinventing how national campaigns are done. They didn't just write a new political chapter with their Internet outreach, vote-tracking data-mining and voter engagement, especially in the battleground states. **They wrote a whole new book. And it was a masterpiece.**"

Peggy Noonan to the Wall Street Journal, 12/28/2012

"Though the old guard may have viewed such techniques as a disruptive force in campaigns, **they enabled a presidential candidate to view the electorate the way local candidates do:** as a collection of people who make up a more perfect union, each of them approachable on his or her terms, their changing levels of support and enthusiasm open to measurement and, thus, to respect."

MIT Technology Review

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Where Does Analytic Value Come From?

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It's Fundamentally About Information

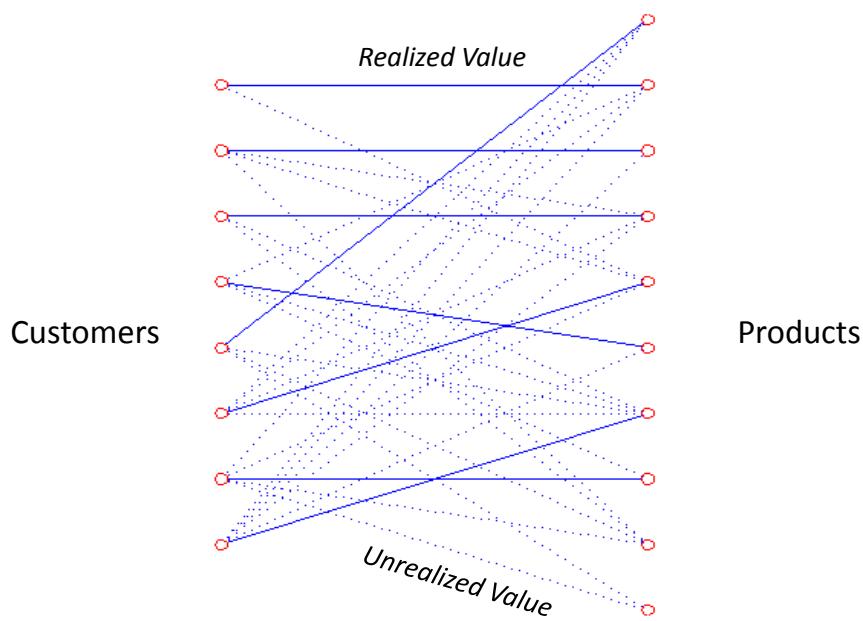
Analytics is about leveraging information to find untapped sources of value for

- Consumers
- Producers

How?

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Helping customers find better (more valued) or undiscovered alternatives ...



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... through better targeting and recommendations

Higher value alternatives

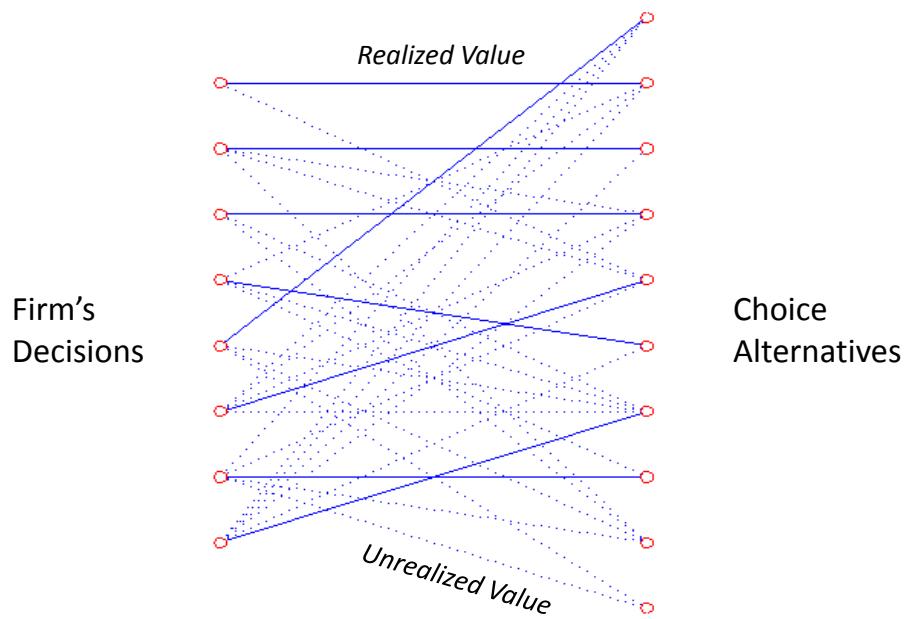


Buying decision support



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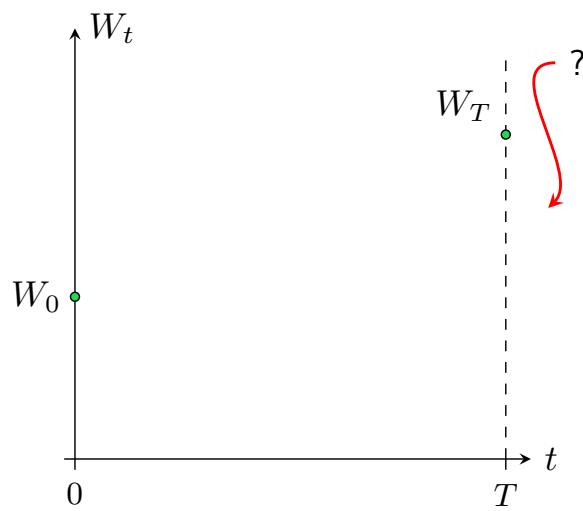
Helping firms find more value-added activities and make better choices ...



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... through better evaluation and selection of alternatives

Better evaluation of payoffs



Optimizing over many alternatives

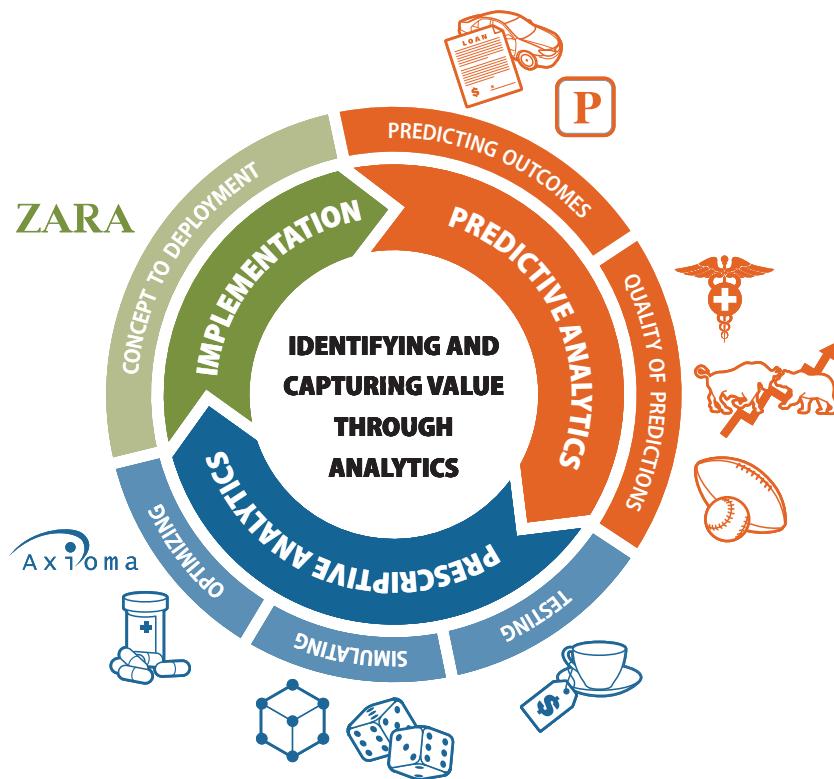


Fresh Direct optimizes deliveries

<http://tinyurl.com/mskwcg2>

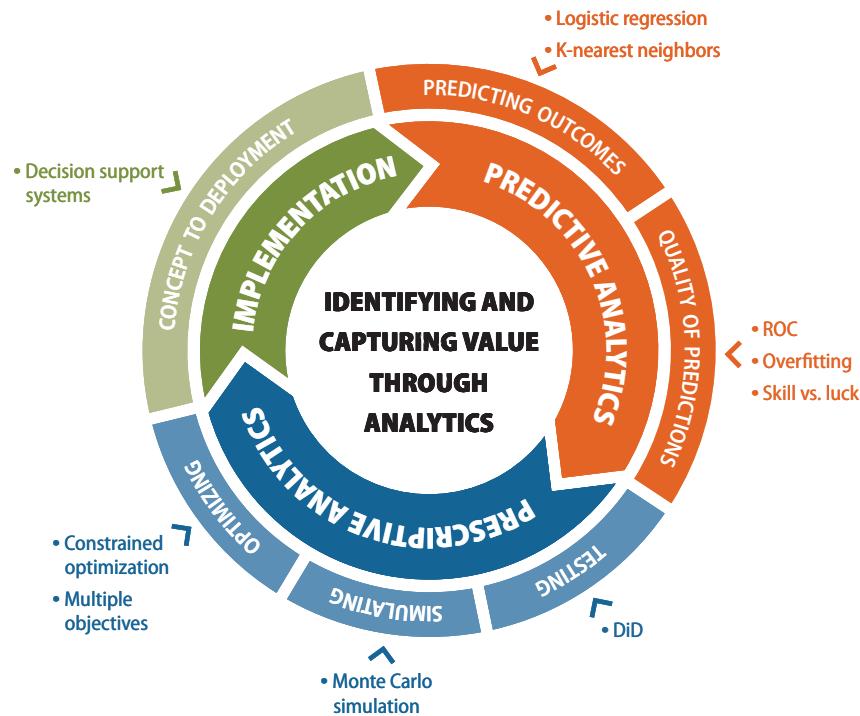
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Course Roadmap - Case Studies



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Course Roadmap - Concepts



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Class Requirements

- Read cases and be ready to discuss them in class
- Follow analytics news and blog about it
- Individual problem sets
 - Typically requires implementing methods in R and interpreting the results
- Group project
 - Work in a team to find data to answer the question, apply analytics tools and uncover insights
 - Present your work at the end of class
- Midterm (in-class) and final (exam week)
- Participation
 - Mandatory attendance
 - No laptops or cell phones

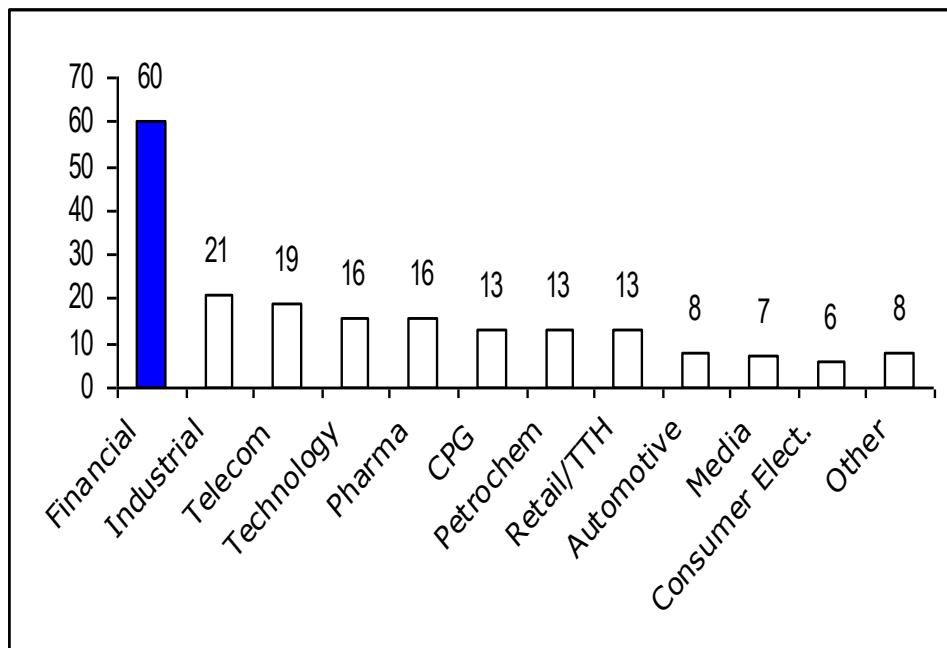
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Nomis A

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Exhibit 1

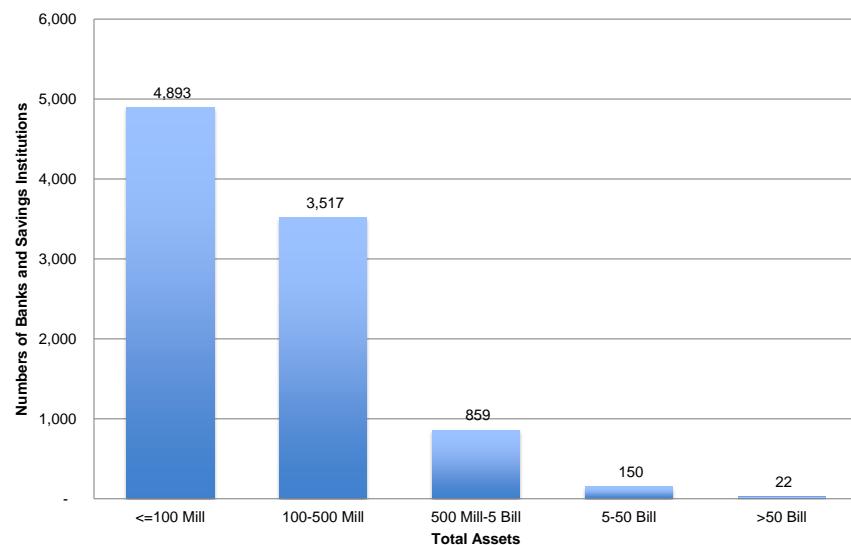
The Largest 200 Global Companies (by Market Cap) by Industry



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Exhibit 2

Number of US Banks and Saving Institutions by Total Assets, 2003

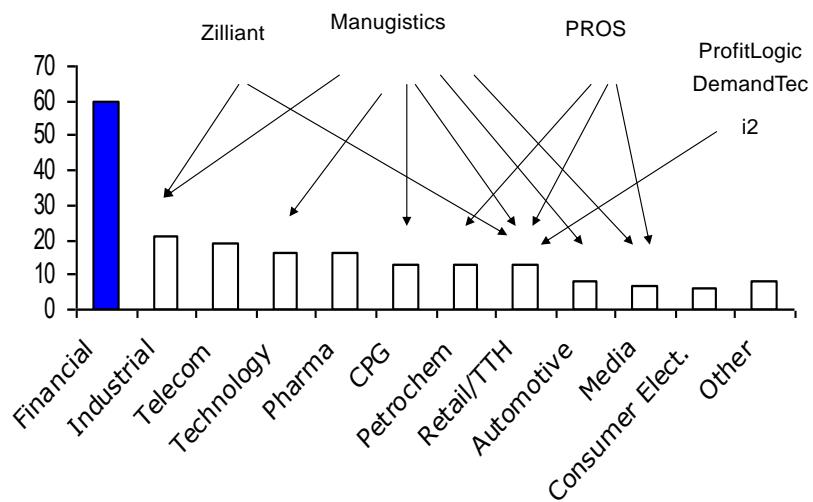


Source: Andrea M. Maechler and Kathleen McDill, *Dynamic Depositor Discipline in U.S. Banks*, IMF Working Paper 03/226, (Washington, DC: International Monetary Fund, November 2003).

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Exhibit 3

Existing Price Optimization Companies and their Industries of Focus (2002)

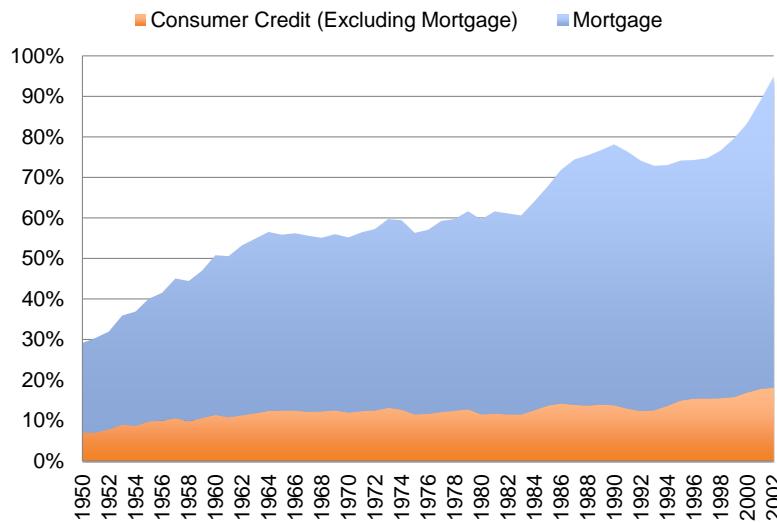


Source: Nomis Solutions.

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Exhibit 4

Consumer Credit as Percentage of GDP in the United States (1950 to 2002)

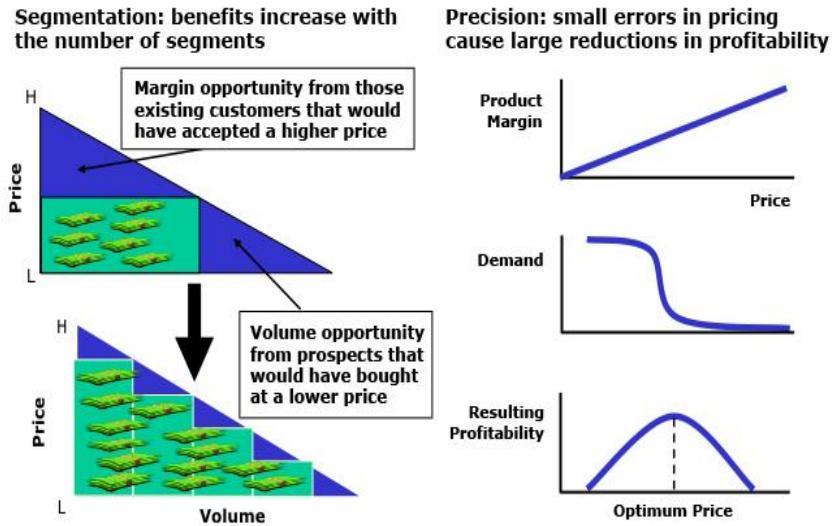


Source: Federal Reserve System data (accessible at www.federalreserve.gov).

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Exhibit 5

Optimizing Prices for Consumer Credit

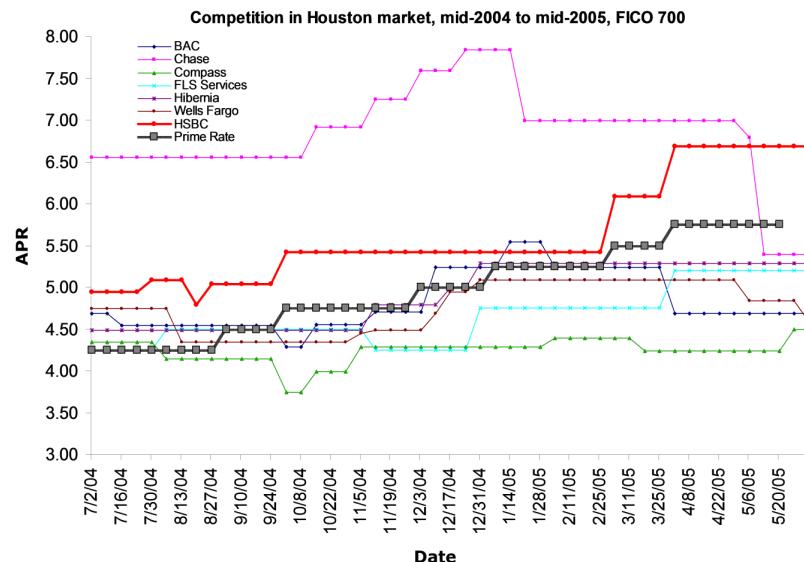


Source: Nomis Solutions

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Exhibit 6

Auto Loan Pricing in the Houston Market, mid-2004 to mid-2005, FICO 700

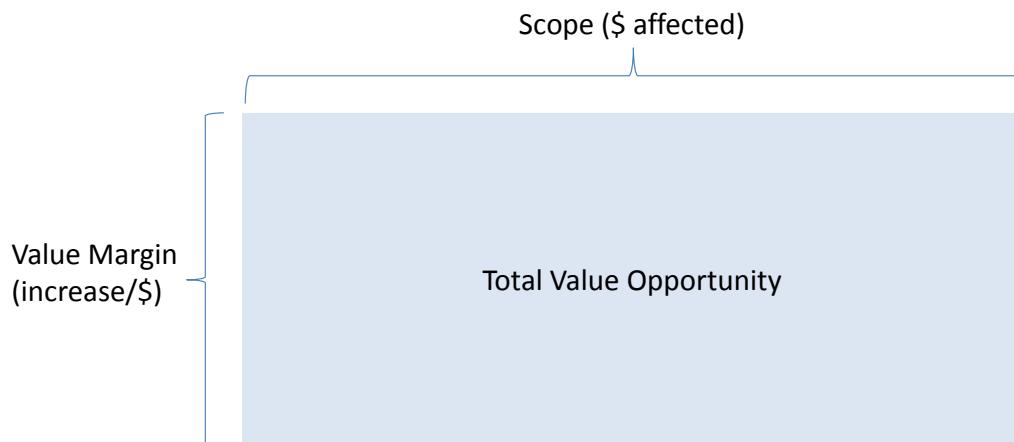


Source: Nomis Solutions. Analysis based on Informa Research Rate Sheet data.

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Assessing the Size of the Opportunity

- **Value margin:** how much can analytics improve each transaction or decision?
- **Scope:** How many transactions and decisions can we improve?

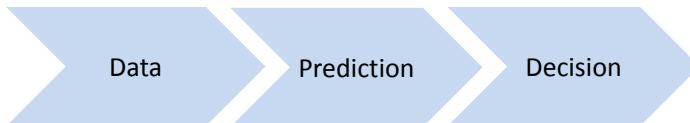


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Wrap Up

How to identify and capture value?

- Prediction: identify the value opportunity
- Prescription: determine the decision that captures the most value?



Next: Nomis (B)

- How can we quantify the magnitude of the pricing opportunity at e-Car?
- What should Robert and Simon do to make a business case to e-Car for pricing analytics?