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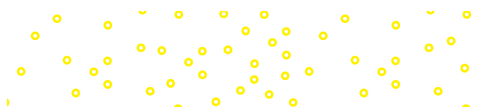
INTRODUCTION TO DATA ANALYTICS FOR ACCOUNTING



Second Edition

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Vernon J. Richardson | Katie L. Terrell | Ryan A. Teeter



Introduction to Data Analytics for Accounting

SECOND EDITION

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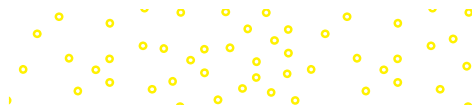
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INTRODUCTION TO DATA ANALYTICS FOR ACCOUNTING

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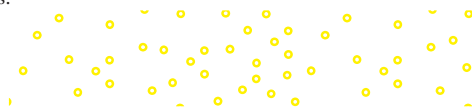
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Dedications

To my most amazing daughter, Rebecca, for sharing joy and laughter with me. From the first time you sat on our laps in Russia and became our child . . . until now! Love you!

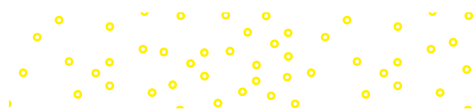
—Vern Richardson

To my many students over the past years and in the upcoming years—you inspire me to do better and I learn as much from you as I hope you learn from me.

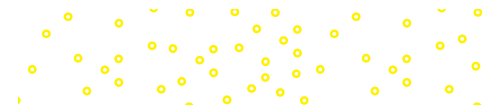
—Katie Terrell

To my mom and dad and the many memories they create.

—Ryan Teeter



About the Authors



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Vernon J. Richardson is a Distinguished Professor of Accounting and the G. William Glezen Chair in the Sam M. Walton College of Business at the University of Arkansas and a Research Fellow at Baruch College. He received his BS, Master's of Accountancy, and MBA from Brigham Young University and a PhD in Accounting from the University of Illinois at Urbana–Champaign. He has taught students at the University of Arkansas, University of Illinois, Brigham Young University, and University of Kansas and internationally at Chinese University of Hong Kong Shenzhen, Aarhus University, the China Europe International Business School (Shanghai), Xi'an Jiaotong Liverpool University, and the University of Technology Sydney.

Dr. Richardson is a member of the American Accounting Association. He has served as president of the American Accounting Association Information Systems section. He previously served as an editor of *The Accounting Review* and is currently an editor at *Accounting Horizons*. He has published articles in *The Accounting Review*, *Journal of Information Systems*, *Journal of Accounting and Economics*, *Contemporary Accounting Research*, *MIS Quarterly*, *International Journal of Accounting Information Systems*, *Journal of Management Information Systems*, *Journal of Operations Management*, and *Journal of Marketing*. Dr. Richardson is also the author of McGraw Hill's *Accounting Information Systems*, *Data Analytics for Accounting* and *Introduction to Business Analytics* textbooks.



Katie L. Terrell

Katie L. Terrell is an instructor in the Sam M. Walton College of Business at the University of Arkansas. She received her BA degrees in English literature and in the Spanish language from the University of Central Arkansas and her MBA from the University of Arkansas. She expects a doctoral degree by 2023. She has taught students at the University of Arkansas; Soochow University (Suzhou, China); the University College Dublin (Ireland); and Duoc UC, a branch of the Catholic University of Chile (Vina del Mar, Chile).

She is a member of the American Accounting Association and has published a *Statement on Management Accounting* for the Institute of Management Accountants on managing organizational change in operational change initiatives. Terrell was named the 2019 Business Professional of the Year (Education) by the national Beta Alpha Psi organization. She has recently been recognized for her innovative teaching methods, receiving the Mark Chain/FSA Teaching Award for innovative graduate-level accounting teaching practices in 2016. She has worked with Tyson Foods, where she held various information system roles, focusing on business analysis, project management for ERP implementations and upgrades, and organizational change management. She is also the author of McGraw Hill's *Data Analytics for Accounting* and *Introduction to Business Analytics* textbooks.



Ryan A. Teeter

Ryan A. Teeter is a Clinical Associate Professor of Accounting in the Katz Graduate School of Business at the University of Pittsburgh. He teaches accounting information systems, auditing, and accounting data analytics. Prior to receiving his PhD in accounting information systems from Rutgers University, he worked at Google in Mountain View, California. He has since worked with internal audit organizations at Siemens, Procter & Gamble, Alcoa/Arconic, and FedEx, helping to develop robotic process automation programs and data analytic solutions.

Dr. Teeter is a member of the American Accounting Association and has published articles in the *Journal of Strategic Technologies in Accounting* and *Issues in Accounting Education*. He has received grant funding for data analytics research from PwC. Dr. Teeter is also the author of McGraw Hill's *Data Analytics for Accounting* textbook.

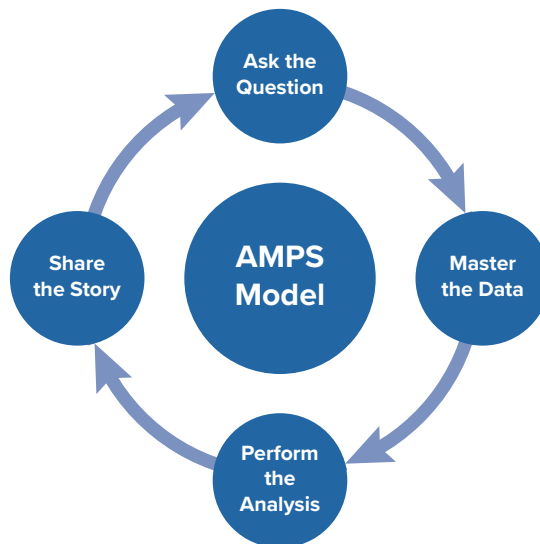
Preface

Accountants are increasingly applying an analytics mindset by analyzing data to address accounting questions. Indeed, the CPA Evolution initiative encourages such by recognizing the rapidly changing data analytics skills and competencies that the practice of accounting requires not only today, but in the future.

Building upon the fundamentals of accounting learned in prior courses, *Introduction to Data Analytics for Accounting* works to develop the analytics mindset by applying analytics to accounting questions. We also emphasize the analytics tools accounting students will encounter in the workplace such as Excel[®], Tableau[®], and Power BI[®].

Introduction to Data Analytics for Accounting provides a framework to help develop a data analytics mindset, which we refer to as the **AMPS Model**:

1. **A**sk the Question (Chapter 1).
2. **M**aster the Data (Chapters 2–4).
3. **P**erform the Analysis (Chapters 5–9).
4. **S**hare the Story (Chapter 10).



The AMPS model is used throughout the text in conjunction with the various types of analysis accountants need to perform. The labs also follow the AMPS model to reinforce the data analytics process. Chapter 11 acts as a capstone, providing two projects that help apply the complete AMPS model to address accounting questions. The first project guides students through analyzing Lending Club loans, while the second offers the framework for students to address their own accounting questions. Finally, in eBook only Chapters 12 and 13, financial statement analysis and managerial accounting topics and questions receive the AMPS treatment where it is particularly appropriate.

Key Features

Focus on Building Skills with Excel[®], Tableau[®], and Power BI[®]

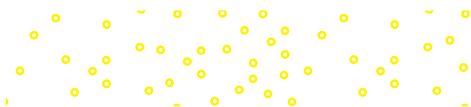
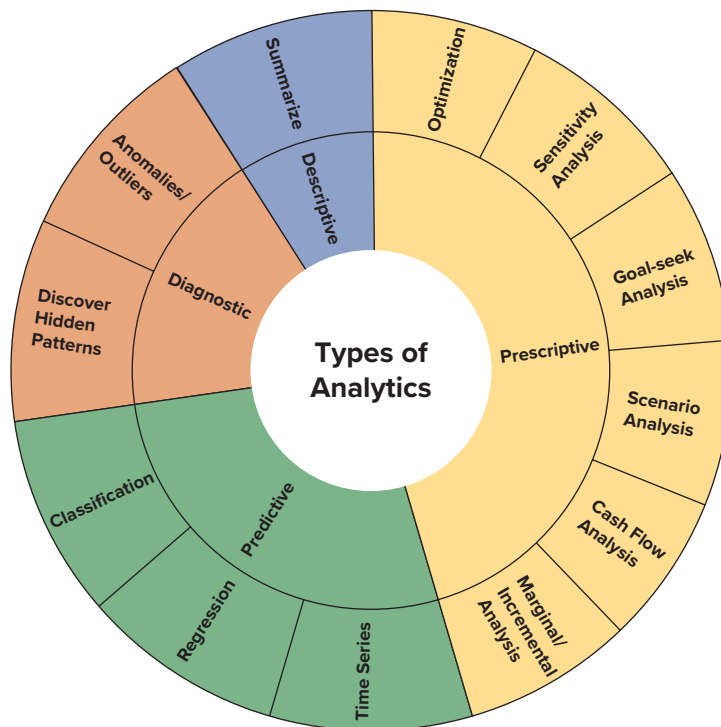
Students will learn how to conduct analysis using Excel, Tableau, and Power BI, exposing them to software tools they will use throughout their business careers.

Emphasis on Building Critical Thinking Skills & Performing Analysis

From learning to ask the right questions to interpreting and presenting results, *Introduction to Data Analytics for Accounting, 2e* fosters critical thinking while exploring data analytics skills.

The text focuses on the four analytics types used to address different accounting questions.

1. *Descriptive analytics*: What happened?
2. *Diagnostic analytics*: Why did it happen? What are the root causes of past results?
3. *Predictive analytics*: What is the probability something will happen? Is it forecastable?
4. *Prescriptive analytics*: What should we do based on what we expect will happen? How do we optimize our performance based on potential constraints or changing conditions?



Hands-on Labs

To illustrate data analytics techniques and skills, *Introduction to Data Analytics for Accounting, 2e* offers over 115 hands-on labs, using Excel, Tableau, or Power BI. Each lab has two datasets: the first relates to the step-by-step instructions (with screenshots) presented in the text, and the second, “alternate” dataset gives students the opportunity to apply what was learned using the first dataset. Lab assessment is done in Connect using autogradable multiple choice questions and analysis questions. (Assessment questions are also provided to instructors not using Connect via instructor resource materials.) Video tutorials of labs are also available in Connect for additional support.

LABS ASSOCIATED WITH CHAPTER 2

LAB 2-1 EXCEL	Accounts Receivable Summary by Customer
LAB 2-1 TABLEAU	Accounts Receivable Summary by Customer
LAB 2-1 POWER BI	Accounts Receivable Summary by Customer
LAB 2-2 EXCEL	Inventory Management by Customer Profitability
LAB 2-2 TABLEAU	Inventory Management by Customer Profitability
LAB 2-2 POWER BI	Inventory Management by Customer Profitability
LAB 2-3 EXCEL	Inventory Management by SKU Profitability
LAB 2-3 TABLEAU	Inventory Management by SKU Profitability
LAB 2-3 POWER BI	Inventory Management by SKU Profitability

The multiple choice assessment questions for each lab are assignable via Connect. Materials are also available for courses not utilizing Connect via the Solutions Manual.

Lab 2-1 Excel: Accounts Receivable Summary by Customer

Keywords

PivotTable, accounts receivable aging

Lab Insight

A key part of managing a company is to be able to compute how much each customer owes, summarizing the total accounts receivable by customer. To do so, crosstabulations are performed using PivotTables in Excel.

Required:

1. Summarize the unpaid invoices (accounts receivable) by customer. Show the PivotTable for the first 20 lines.
2. Get the detailed receivables for the customer “eBay.”

Ask the Question

How can we use PivotTables on the total detailed accounts receivables balance to get specific detail on invoices due by customer?

Master the Data

Open Excel File Lab 2-1 Data.xlsx.

To begin, we have a list of 200 receivables on specific invoices that are all past their due date as of today’s date of 12/31/2025. This is shown in the Excel file Lab 2-1 Data.xlsx. Here’s the data dictionary.

Data Dictionary

Customer: Customer Name
Invoice Amount: Invoice Amount
Due Date: Date that payment is due

Progress Checks

Periodic progress check questions are posed throughout the chapter and encourage students to stop and consider the concepts presented.



PROGRESS CHECK

7. What is the difference between data dictionaries and ER diagrams?
8. When would you prefer to read the data dictionary instead of viewing the ER diagram?
9. When would you prefer to view the ER diagram instead of reading the data dictionary?

End-of-Chapter Materials

End-of-chapter assignments have real-world application questions, with a special emphasis on skills and tools. Each chapter offers discussion questions, brief exercises, and problems to reinforce learning.

Discussion Questions

1. (LO 6-3) Why is the accounts receivable aging analysis done in terms of 30-day buckets? Why is that helpful to the decision maker trying to assess the appropriate level of the Allowance for Doubtful Accounts?
2. (LO 6-1, LO6-3, LO 6-5) The text discussed additional analysis that could be used to understand why customers are late paying their receivables, such learning more about the customers and their buying preferences. Why might this additional analysis be considered diagnostic analytics, as opposed to descriptive analytics? Or would you argue that it is just descriptive analytics?



Brief Exercises

1. (LO 6-2, LO 6-3, LO 6-4) Match the descriptive analytics terms (descriptive statistics, horizontal analysis, vertical analysis, DuPont analysis, DuPont analysis, histogram) to its definition.

Descriptive Analytics Term	Definition
DuPont analysis	Provides comparative changes about various line items of each financial statement over time.
Histogram	Expresses financial information in relation to some relevant figure, or base.
Vertical analysis	Summarizes and disaggregates company performance into three ratios: profit margin, asset turnover, and financial leverage.
Horizontal analysis	Display of rectangles with area proportional to the underlying frequency of the data.
Descriptive statistics	Brief summaries (or factoids) of a data set that provide a representation of the data set as a whole.

2. (LO 6-2, LO 6-3) Match descriptive analytics tools and techniques to their definitions.

Problems

1. (LO 6-4) Compute the DuPont ratios (profit margin, asset turnover, and financial leverage ratios) for Walmart and Target given these numbers for 2012–2020. Check your numbers to make sure that Profit margin × Asset turnover × Financial leverage = Return on equity. The data file, DuPont Analysis Walmart Target Data.xlsx is available in Connect or via the Additional Student Resources page. (Note the data is in \$ millions.)

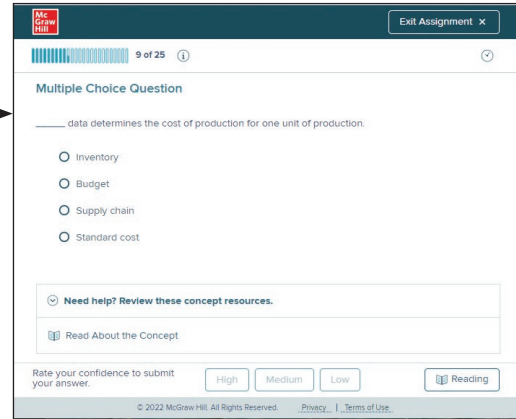
WMT (\$ millions)

Year	Sales Revenue	Net Income	Assets	Stockholders' Equity
2020	\$559,151	\$13,510	\$252,496	\$87,531
2019	\$523,964	\$14,881	\$236,495	\$81,552
2018	\$514,443	\$6,670	\$194,295	\$79,634

Available in Connect

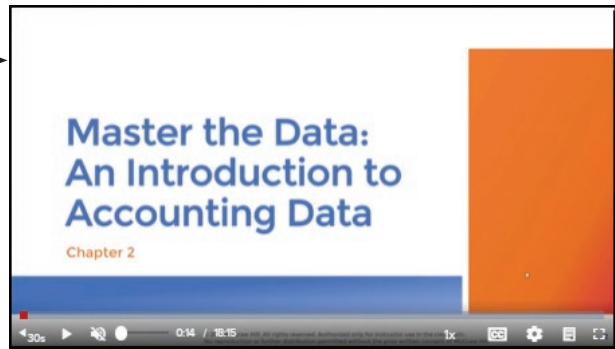
SmartBook 2.0[®]

SmartBook is the market-leading adaptive study resource that is proven to strengthen memory recall, increase retention, and boost grades. SmartBook 2.0 identifies and closes knowledge gaps through a continually adapting reading and questioning experience that helps students master the key concepts in the chapter.



Lecture Videos

Video-based tutorials are available for each chapter to reinforce select concepts.



Brief Exercises/Problems

Select Brief exercises and problems from the text are available for assignment in Connect to ensure students are building an analytical skill set.

1 **BE 6-1 (LO 6-2, 6-3, 6-4) Match the descriptive analytics terms (descriptive statistics, horizontal analysis, vertical analysis, DuPont analysis, histogram) to its definition.**

10 points

Required: Match the descriptive analytics terms (descriptive statistics, horizontal analysis, vertical analysis, DuPont analysis, histogram) to its definition.

Definition	Descriptive Analytics Term
Provides comparative changes about various line items of each financial statement over time.	
Expresses financial information in relation to some relevant figure, or base.	
Summarizes and disaggregates company performance into three ratios: profit margin, asset turnover, and financial leverage.	
Display of rectangles with area proportional to the underlying frequency of the data.	
Brief summaries (or factoids) of a data set that provide a representation of the data set as a whole.	

2 **PR 6-6 (LO 6-2) Download the "Accounts Receivable Balances" dataset in Excel from Connect.**

10 points

Download the "Accounts Receivable Balances" dataset in Excel from Connect.

Required:

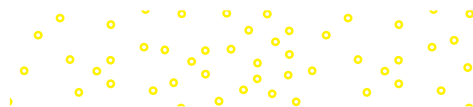
- Using the Quartile function in Excel, calculate the minimum and maximum values and the value of the first quartile (25th percentile), second quartile (50th percentile), and third quartile (75th percentile).
- Using the Percentile function in Excel, calculate the value of the 1st, 17th, 47th, 64th, and 99th percentile.
- Is there a difference in values between the 50th percentile, the second quartile, and the median?

Complete this question by entering your answers in the tabs below.

Required 1 Required 2 Required 3

Using the Quartile function in Excel, calculate the minimum and maximum values and the value of the first quartile (25th percentile), second quartile (50th percentile), and third quartile (75th percentile). Note: Round your answers to 2 decimal places.

Using the Quartile function in Excel	Answer
Minimum value	
Maximum value	
Value of the first quartile (25 th percentile)	
Value of the second quartile (50 th percentile)	
Value of the third quartile (75 th percentile)	



Labs with Lab Assessments

Connect allows to students to upload their results and answer both auto-graded assessment and manual-graded analysis questions designed to reinforce the lessons from the chapter. Alternate also labs allow for additional assignment options.

Submit: Lab 3-1

2

Part 2 of 2

5 points

Required information
(The following information applies to the questions displayed below.)

NOTE: Throughout this lab, every time a screenshot is requested, use your computer's screenshot tool, and paste each screenshot to the appropriate Word document. Label each screenshot in accordance to what is noted in the lab. This document with all of the screenshots included should be uploaded through Connect as a Word or PDF document when you have reached the final step of the lab.

In this lab, you will:

Required:

1. Calculate the grand totals of Customer Count, Sum of InvoiceAmount, and Count of Due Date.
2. Sort the accounts receivable by date in a pivot table.

Ask the Question: How do data types affect the way I can analyze data in Excel?

Master the Data: To begin, we have a list of 300 receivables that are all past their due date as of today's date of 12/31/2021. This is shown in the Excel file Lab 3-1 Data.xlsx.

Software needed:

- Excel
- Screen capture tool (Windows: Snipping Tool; Mac: Cmd+Shift+4)

Date: [Excel File Lab 3-1 Data.xlsx](#)

Perform the Analysis: Refer to Lab 3-1 in the text for instructions and steps for each of the lab parts.

Share the Story: You have analyzed the data types in this report, viewed summary statistics in Excel's status bar, and created summary statistics using Excel's pivot tables.

Required

1. What is the Data Type of the Due Date column in this dataset?

Interval

Ratio

Ordinal

Nominal

2. Select the summary measure(s) that is/are provided for the Customer column in Excel's status bar.

2 of 2

Lab Tutorial Videos

Tutorial videos are offered for all labs, providing a step-by-step tutorial walking students through featured Excel, Tableau, and Power BI functions. These videos are now also embedded within regular lab assignments.

Lab 1-3.mp4 - VLC media player

Media Playback Audio Video Subtitle Tools View Help

Book1 - Excel

Monthly payment number	Principal	Payment	Interest	Towards Principal	Ending Principal
1	200000	(\$1,199.10)	1000	(\$199.10)	\$199,800.90
2	\$199,800.90	(\$1,199.10)	\$999.00	(\$200.10)	\$199,600.80
3	\$199,600.80	(\$1,199.10)	\$998.00	(\$201.10)	\$199,399.71
4	\$199,399.71	(\$1,199.10)	\$997.00	(\$202.10)	\$199,197.60
5	\$199,197.60	(\$1,199.10)	\$995.99	(\$203.11)	\$198,994.49
6	\$198,994.49	(\$1,199.10)	\$994.97	(\$204.13)	\$198,790.36
7	\$198,790.36	(\$1,199.10)	\$993.95	(\$205.15)	\$198,585.21
8	\$198,585.21	(\$1,199.10)	\$992.93	(\$206.17)	\$198,379.04
9	\$198,379.04	(\$1,199.10)	\$991.90	(\$207.21)	\$198,171.83
10	\$198,171.83	(\$1,199.10)	\$990.86	(\$208.24)	\$197,963.59
11	\$197,963.59	(\$1,199.10)	\$989.82	(\$209.28)	\$197,754.31
12	\$197,754.31	(\$1,199.10)	\$988.77	(\$210.33)	\$197,543.98
13	\$197,543.98	(\$1,199.10)	\$987.72	(\$211.38)	\$197,332.60
14	\$197,332.60	(\$1,199.10)	\$986.66	(\$212.44)	\$197,120.16
15	\$197,120.16	(\$1,199.10)	\$985.60	(\$213.50)	\$196,906.66
16	\$196,906.66	(\$1,199.10)	\$984.53	(\$214.57)	\$196,692.09
17	\$196,692.09	(\$1,199.10)	\$983.46	(\$215.64)	\$196,476.45

New to the Second Edition

Overall Updates

- **New!** eBook only Chapter 12 Financial Statement Analysis and Chapter 13 Managerial Accounting Analytics help students apply the AMPS model to a single accounting topic. The chapters feature 15 new labs (7 labs in Ch. 12 and 8 labs in Ch. 13) using Excel, Tableau, and Power BI.
- Added Power BI labs throughout text and Power BI tutorial Appendix C.
- Added two analysis questions (with open-ended response) to each lab to reinforce critical thinking skills.
- Revised assessments for all primary and alternative labs. Alternative labs now have algorithmic questions.
- **New!** Lab videos embedded in assignments for all regular labs that walk students through lab processes for Excel, Tableau, and Power BI.
- **New!** Test bank lab questions added for select labs to enable testing of lab concepts.
- **New!** Discussion questions now available in Connect as manual-graded assignments.

Chapter by Chapter Updates

Chapter 1

- Added a learning objective on common visualization types, moving the initial discussion of visualizations earlier in the text.
- Reworked the discussion of analysis and visualization tools used at each component of the AMPS model, emphasizing Excel, Tableau, and Power BI and their capabilities.
- Added two additional problems with datasets to the end-of-chapter assessment.
- Changed chapter title to be consistent with the AMPS model.

Chapter 2

- Added a learning objective defining data ethics and a description of how to gather, protect, and use personally identifiable information in an ethical manner.
- Added three Power BI labs to illustrate ways to analyze and visualize data.
- Updated examples of XBRL data, conference calls, and social media data.
- Added three additional problems with datasets to the end-of-chapter assessment.

Chapter 3

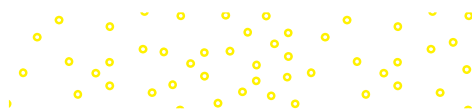
- Rewrote all labs and added two Power BI labs.
- Changed chapter title to be consistent with the AMPS model.

Chapter 4

- Expanded and reworked the section on connecting to external databases. The example now features connecting to Reuters and a new section discussing Calcbench.
- Rewrote all labs and added one Power BI lab.

Chapter 5

- Added four additional problems with datasets to the end-of-chapter assessment.
- Added one Tableau and one Power BI lab.



Chapter 6

- Enhanced discussion of descriptive statistics of large datasets, including definitions, examples, and assessment of deciles and percentiles.
- Added four additional problems with datasets to the end-of-chapter assessment.
- Added one Power BI lab.

Chapter 7

- Added explanation of chi-square test as a statistical test for Benford's Law.
- Added four additional problems with datasets to the end-of-chapter assessment.
- Added one Tableau and two Power BI labs.

Chapter 8

- Added four additional problems with datasets to the end-of-chapter assessment.
- Enhanced discussion/image of the tradeoff between investment risk taken and expected investment returns.
- Added one Power BI lab.

Chapter 9

- Restructured the discussion of prescriptive analytics to better explain its capabilities.
- Revised cash flow analysis section to enhance clarity.
- Enhanced discussion of sensitivity analysis and added illustration.
- Added a learning objective regarding optimization as a prescriptive analytics technique.
- Revised multiple choice questions and enhanced discussion questions.
- Added three additional problems with datasets to the end-of-chapter assessment.

Chapter 10

- Added a learning objective regarding executive summaries.
- Added one Power BI lab.

Chapter 11

- Revised introduction to Project 1.
- Enhanced list of data sources available for Project 2, addressing students' own analytics questions.

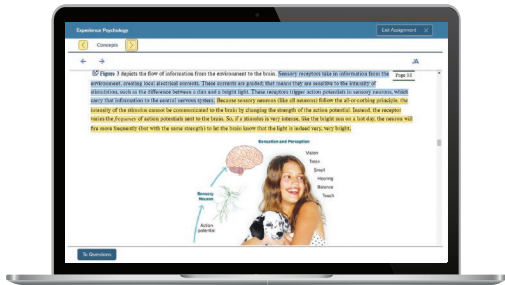
This second edition of *Introduction to Data Analytics for Accounting* has been revised using Microsoft Excel[®] 365 (2022), Tableau Desktop version (2022.2), and Microsoft Power BI version (Aug 2022). Please note that the software used is dynamic, where updates are a regular feature. While changes are often more cosmetic than functional, updates may also change textbook screen exhibits from the time of publication. This may help students be flexible and further develop the analytics mindset when determining differences between the software and text instructions and exhibits. Major known updates will be noted on the Text Updates section of the Connect Library.

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Students

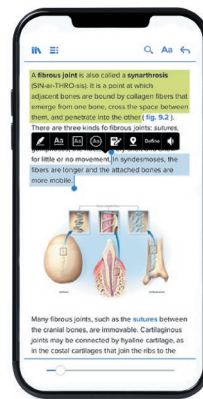
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"I really liked this app—it made it easy to study when you don't have your textbook in front of you."

- Jordan Cunningham,
Eastern Washington University

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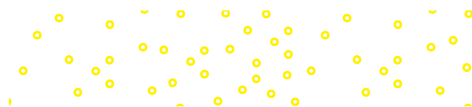
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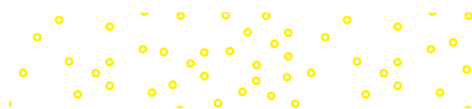
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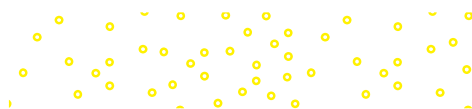
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*Appendix B Tableau Tutorial

*Appendix C Power BI Desktop

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Introduction to Data Analytics for Accounting

SECOND EDITION

Chapter 1

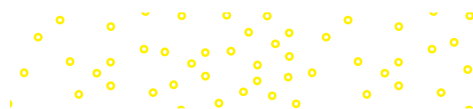
Ask the Question: Using Data Analytics to Address Accounting Questions

A Look at This Chapter:

- The skills needed to be successful in the accounting profession are changing due to computerization and the growing availability of data.
- Accountants must develop higher-order critical thinking skills, including the development of an analytics mindset and ability to perform data analytics.
- The AMPS analytics model is a useful framework for understanding and performing Data Analytics.
- The first step of the AMPS model is to Ask the Question. We highlight the four general types of accounting questions, and their corresponding data analytics types (including descriptive, diagnostic, predictive and prescriptive analytics).

A Look Ahead:

- To address accounting questions, we must know what data is available.
- Chapter 2 introduces the second step of the AMPS model: Master the Data.
- Both internal and external data sources may be used to provide the data needed to address accounting questions.





Mateusz_Szymanski/Shutterstock

Developing an Analytics Mindset

EY argues that its professionals and its new hires need an analytics mindset.

So, what is an analytics mindset?

An analytics mindset is the ability to:

- Ask the right questions.
- Extract, transform, and load relevant data.
- Apply appropriate data analytic techniques.
- Interpret and share the results with stakeholders.

To reinforce the importance of an analytics mindset in the accounting profession, EY recently announced a free Masters

of Data Analytics program for all of its professionals to help them have the necessary skills to be ready for their careers.

In this text, we will focus on (1) developing an analytics mindset and (2) learning appropriate data analytic techniques that can be used to analyze data. This analytics mindset serves as a way to see how the Data Analytics process can help you think through the types of questions that can be asked and addressed with data.

Indeed, the skills required to succeed in the accounting professionals have changed, and data analytics is a key component of those skills.

Source: *The Analytics Mindset*, Ernst & Young Foundation: EY Academic Resource Center (EYARC), 2017, <http://aaahq.org/Education/Webinars/6-7-17-EY-Academic-Resource-Center-An-Overview-of-Analytics-Mindset-Competencies-and-Case-Offerings> (accessed November 15, 2021) and Press Release: EY announcement of new Masters of Business Analytics https://www.ey.com/en_gl/news/2021/10/ey-and-hult-international-business-school-announce-new-masters-in-business-analytics-free-for-all-ey-people (accessed November 15, 2021).

OBJECTIVES

After reading this chapter, you should be able to:

- LO 1-1** Explain how increasing data availability and computerization are shaping the accounting profession.
- LO 1-2** Describe the critical thinking skills accountants must develop to address accounting questions with data.
- LO 1-3** Describe how the AMPS model outlines the Data Analytics process.
 - LAB 1-1 EXCEL** Journal Entries to Trial Balance
 - LAB 1-2 EXCEL** Calculating Depreciation Using Excel Functions
 - LAB 1-3 EXCEL** Creating a Mortgage Amortization Schedule
- LO 1-4** Describe the use of common visualization types to analyze data and communicate results.
- LO 1-5** Evaluate the available software tools and assess their ability to acquire and prepare, analyze, and visualize data.

LO 1-1

Explain how increasing data availability and computerization are shaping the accounting profession.

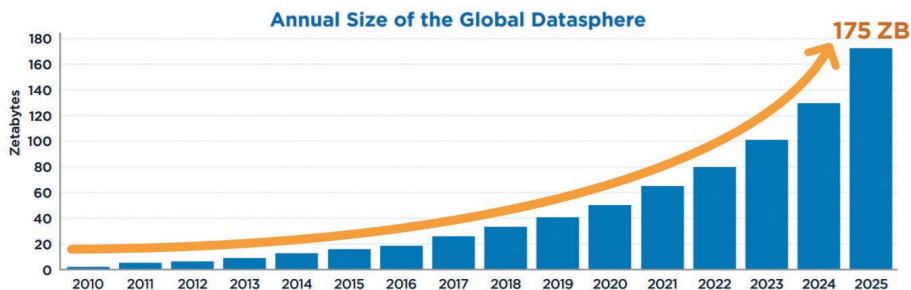
THE EXPLOSION OF DATA AND THE IMPACT ON THE ACCOUNTING PROFESSION

“Data are widely available; what is scarce is the ability to extract wisdom from them.”
Hal Varian (UC Berkeley and Chief Economist, Google)

The amount of data available continues to explode. There are 2.5 quintillion bytes of data created each day, which continues to accelerate. Over the last two years alone, 90 percent of the data in the world was generated.¹ Exhibit 1.1 shows this surge of data does not show any signs of slowing down. The increasing amount of data available to the accountant can both help and hinder the accountant and his/her work. The abundance of data can be helpful in addressing company questions, problems, and challenges to the extent the accountant can harness and analyze the available data. However, the increasing amount of data may hinder the work of the accountant through **information overload**, where too much information may not be properly synthesized or interpreted.

EXHIBIT 1.1 Data Growth Since 2010

IDC Global DataSphere, Nov. 2018, page 6.



With so much data available and computers doing much of the basic accounting work, including collecting transactional data, recording journal entries, posting to the general ledger, and reporting (such as publishing financial statements), the job of the accountant is continuing to change from that of data collection and summarization to a role of data, or accounting, analyst.

The opening vignette states that EY expects its accountants to develop an analytics mindset, able to ask relevant questions, find and extract pertinent data that might address the question, analyze the data, and then communicate the findings to decision makers. Accountants are uniquely positioned to do this type of analytics and serve a critical role in the decision-making process. Indeed, “Analytics is at the heart of every business decision.”² In this text, we will work to develop your analytics mindset and prepare you for the new and evolving skills needed in the accounting profession.

¹Bernard Marr, “How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read,” *Forbes*, May 21, 2018, <https://www.forbes.com/sites/bernardmarr/2018/05/21/how-much-data-do-we-create-every-day-the-mind-blowing-stats-everyone-should-read/#6ddf004d60ba> (accessed February 8, 2019).

²*The Analytics Mindset*, Ernst & Young Foundation: EY Academic Resource Center (EYARC), 2017, <http://aaahq.org/Education/Webinars/6-7-17-EY-Academic-Resource-Center-An-Overview-of-Analytics-Mindset-Competencies-and-Case-Offerings> (accessed November 17, 2018).

PROGRESS CHECK

1. How does increasing the amount of data available to address accounting questions both help and hinder the accountant’s role?

ACCOUNTANTS NEED TO DEVELOP CRITICAL THINKING SKILLS

To address accounting questions, we argue that accountants need an increasingly higher level of critical thinking and reasoning skills than was previously required for accounting professionals. We define critical thinking as a “manner of thinking that employs curiosity, creativity, skepticism, analytics, and logic.”³

To illustrate, we turn to **Bloom’s Taxonomy**, which provides a hierarchical view of critical thinking skills. As shown in Exhibit 1.2, the hierarchical set of critical thinking skills go from the lowest levels in (1) remembering, (2) understanding, and (3) applying, to higher levels of thinking in (4) analyzing, (5) evaluating, and (6) creating.

LO 1-2

Describe the critical thinking skills accountants must develop to address accounting questions with data.

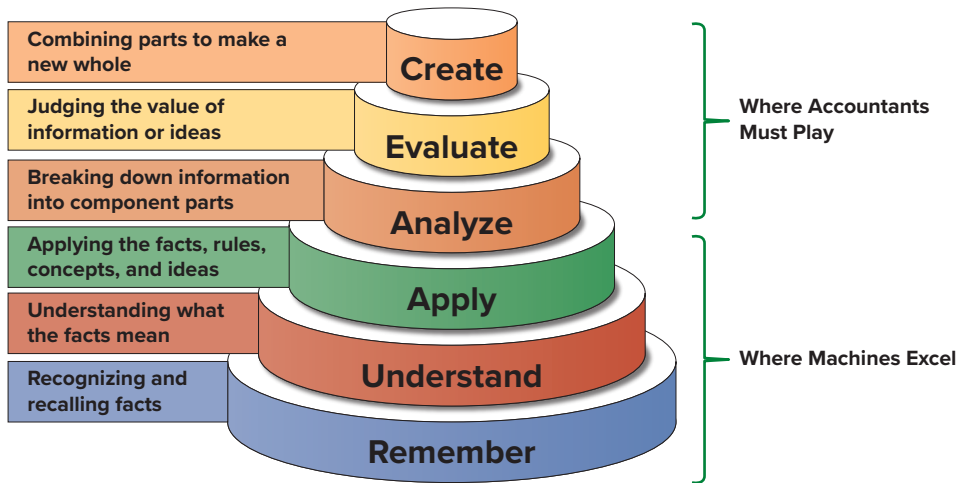


EXHIBIT 1.2
Bloom’s Taxonomy of Critical Thinking Skills: Where Machines Excel and Where Accountants Must Play

Based on: Jessica Shabatura, “Using Bloom’s Taxonomy to Write Effective Learning Objectives,” Teaching Innovation & Pedagogical Support, University of Arkansas website, <https://tips.uark.edu/using-blooms-taxonomy/> (accessed November 15, 2021).

The basic academic accounting classes like “Accounting Principles,” “Introduction to Financial Accounting,” or “Introduction to Managerial Accounting” primarily address the remember, understand, and apply skills as noted in Bloom’s Taxonomy. Yet these are the same skills that computers now perform more reliably than do accountants.

As the accounting profession moves to higher-order critical thinking skills—including analyzing, evaluating, and creating information most valuable to decision makers—it

³K. F. Reding and C. Newman, “Improving Critical Thinking through Data Analysis,” *Strategic Finance*, June 2, 2017, <https://sfmagazine.com/post-entry/june-2017-improving-critical-thinking-through-data-analysis/> (accessed November 20, 2018).



generates more value to the organization.⁴ Indeed, it is these higher-order critical thinking skills that we believe will be a place where accountants can take advantage of the explosion of available data for accountants to analyze and harness. In other words, Bloom's Taxonomy offers a framework to think about the higher order critical thinking skills, which both accounting firms and companies that employ accountants now expect accountants to have.⁵

To be clear, accountants need to master all levels of critical thinking skills shown in Bloom's Taxonomy from the lowest to the most advanced skills. Accountants simply cannot analyze, evaluate, and create if they have not mastered the basic accounting knowledge and understanding required by the lower-level skills of remembering, understanding, and applying levels of critical thinking. The challenge then is to move beyond the basics to develop higher-order critical thinking skills.

So, how do you develop these skills? A data analytics approach promotes hands-on learning, to ask specific accounting questions, to access applicable data, to analyze data using appropriate analytic techniques, and then to communicate the results to the decision maker. We argue that experiencing data analytics is perhaps the best way to both address accounting questions and build critical thinking skills at the same time.

PROGRESS CHECK

2. In your intro to financial accounting class, were the skills taught more of remembering, understanding, and applying skills, or were they more analyzing, evaluating, and creating skills?
3. How might data analytics address the analyzing, evaluating, and creating skills more than the lower-level skills of remembering, understanding, and applying?

LO 1-3

Describe how the AMPS model outlines the Data Analytics process.

DATA ANALYTICS AND THE AMPS MODEL

Recall the analytics mindset proposed by EY (from the chapter-opening vignette) that their accounting professionals will ultimately need. Exhibit 1.3 details the components of the analytics mindset:

EXHIBIT 1.3 The Analytics Mindset

Source: *The Analytics Mindset*, Ernst & Young Foundation: E&Y Academic Resource Center (EYARC), 2017, Available online on November 17, 2018, <http://aaahq.org/Education/Webinars/6-7-17-EY-Academic-Resource-Center-An-Overview-of-Analytics-Mindset-Competencies-and-Case-Offerings>

- Ask the right questions.
- Extract, transform, and load relevant data.
- Apply appropriate data analytic techniques.
- Interpret and share the results with stakeholders.

Closely related to the analytics mindset is the use of a model we propose that explains the steps involved in the Data Analytics process. We define **Data Analytics** as the process

⁴C. Harper and C. Dunn, "Building Better Accounting Curricula," *Strategic Finance* 100(2), 2018, pp. 46–53.

⁵V. J. Richardson and M. W. Watson, Act or Be Acted Upon: Revolutionizing Accounting Curriculums with Data Analytics. *Accounting Horizons*, 35(2) (2021), 129–144.

of evaluating data with the purpose of drawing conclusions to address all types of questions (including accounting questions).

We call this framework the **AMPS model**, which stands for the following (and the chapter(s) where each step is developed further):

1. **Ask the Question** (Chapter 1).
2. **Master the Data** (Chapters 2–4).
3. **Perform the Analysis** (Chapters 5–9).
4. **Share the Story** (Chapter 10).

Note how each component of the analytics mindset corresponds to a specific step of the AMPS model. In each lab of the textbook, we promote the AMPS model to go from asking the question to communicating the results by sharing the story. In Chapters 12 and 13, we use the AMPS model to address financial statement analysis and managerial analytics questions.

To give you an idea of how the AMPS model would work in addressing accounting questions, consider the following example:

ILLUSTRATION OF AMPS MODEL

As an example of how the AMPS model might be applied in a Data Analytics setting, imagine a shoe manufacturing company trying to establish the appropriate value of its inventory of shoes.

Ask the Question

Which shoes in inventory are obsolete or slow moving? Should their value be reduced?

Master the Data

Access data regarding the amount of inventory on hand and the cost of each specific shoe type and shoe size listed by its stock-keeping unit (SKU) in inventory. A SKU is a unique code consisting of letters and numbers that identify characteristics about each product, such as manufacturer, brand, style, color, and size.

Perform the Analysis

Calculate the inventory turnover rate:

$$\frac{\text{Cost of goods sold for each SKU}}{\text{Average inventory of each SKU}}$$

The lower the inventory turnover, the higher possibility of the sales of this item (or shoe in this case) is slow or nonexistent, which might lead to obsolescence.

Share the Story

Report the level of inventory turnover for each SKU in a graph or table to management and decide which inventory SKUs are slow moving (those with low inventory turnover ratios).

Management might decide to lower the inventory valuation for those items on its balance sheet and/or discontinue manufacturing that particular shoe altogether.

We first provide background information on each of the four components of the AMPS model.

The AMPS Model: Ask the Question

The best way to start developing critical thinking skills is to ask questions, which is also the first component of the analytics mindset.⁶ Given that analyzing data helps strengthen critical thinking skills (and vice versa),⁷ one should ask carefully constructed questions that can potentially be solved using data and Data Analytics. Decision makers may ask questions such as:

1. Which product is more profitable at stores in Arizona?
2. Is it more profitable to produce an item in the United States or in the Philippines?
3. How much overhead should we apply to each one of our five Android apps that we've built?
4. What is the probability that the company we're considering for an investment will go bankrupt or commit financial statement fraud?
5. To the extent our product's fixed and variable costs change, how will that affect our breakeven point in sales?
6. What is a reasonable estimate for the allowance for doubtful accounts, based on past experience?

Generally, the more succinct the question, the better. For example, it is hard to consider a question like "How will Target grow its net income?" but easier to potentially address "How do we sell more snack foods at Target in Fayetteville, Arkansas, store 359?" Narrowing the scope of the question better sets us up to find the necessary data, perform the analytics, and potentially be able to address the question at hand.

In data analytics, the axiom "Your data won't speak unless you ask it the right data analytics questions"⁸ really refers to the expertise the accountant can offer by asking questions that are answerable by the data. Given accountants' knowledge of business processes, such as how information flows from customer purchase to order fulfilment and how those transactions affect the income statement or the balance sheet, accountants can help management create specific questions addressing the problem, opportunity, or challenge at hand. Because accountants often have a good sense of what data (whether from an internal or external source) is available to address the question, accountants are in a perfect position to perform Data Analytics.

The type of analytics performed commonly depends on these four common types of questions:

1. What happened? What is happening?
2. Why did it happen? What are the root causes of past results?
3. Will it happen in the future? What is the probability something will happen? Is it forecastable?
4. What should we do based on what we expect will happen? How do we optimize our performance based on potential constraints or changing conditions?

We revisit each of these question types in Chapters 5–9 to match the available data and appropriate analytics method.

⁶J. Sullivan, "How Does Bloom's Taxonomy Relate to Critical Thinking Information?" *Classroom*, 2018, <https://classroom.synonym.com/blooms-relate-critical-thinking-information-6233382.html> (accessed January 21, 2019).

⁷K. F. Reding and C. Newman, "Improving Critical Thinking through Data Analysis," *Strategic Finance*, June 2, 2017, <https://sfmagazine.com/post-entry/june-2017-improving-critical-thinking-through-data-analysis/> (accessed January 21, 2019).

⁸M. Lebiad, "Your Data Won't Speak Unless You Ask It the Right Data Analysis Questions," *Datapine*, June 21, 2017, <https://www.datapine.com/blog/data-analysis-questions/> (accessed January 23, 2019).

Specific questions from each of these four types might include the following:

1. **Questions like “What happened? What is happening?” (forming the basis of descriptive analytics).** These types of questions include:
 - a. Did we make a profit last year?
 - b. Did return on assets improve or decline over the past year?
 - c. Did the airline company’s on-time departures improve this past month?
 - d. How much did we pay in state taxes last year?
 - e. How long have the existing accounts receivable been past due?
 - f. Which product is the most profitable one for the company?
2. **Questions like “Why did it happen? What are the root causes of past results?” (forming the basis of diagnostic analytics).** These types of questions include:
 - a. Why did sales, general, and administrative expenses increase relative to the industry?
 - b. Why did overall taxes paid decrease even though net income increased?
 - c. How did the journal entry and approval of various transactions violate the segregation of duties?
 - d. Can our variance analysis help explain why the labor expenses increased over the past year?
3. **Questions like “Will it happen in the future? What is the probability something will happen? Is it forecastable?” (forming the basis of predictive analytics).** These types of questions include:
 - a. What is the risk of bankruptcy for each company in our portfolio?
 - b. Can we predict whether customers will repay their loan based on customer background (credit score, employment record, existing debt)?
 - c. Can the IRS find those individuals or corporations evading taxes using predictive techniques?
 - d. Can we predict if or when the financial statements might be misstated?
4. **Questions like “What should we do based on what we expect will happen? How do we optimize our performance based on potential constraints?” (forming the basis of prescriptive analytics).** These types of questions include:
 - a. If we have all 12/31 year-end audit clients, how will we organize our audit work in the new year?
 - b. What is the level of sales that will allow us to break even?
 - c. Should the company rent or lease its headquarters office building?
 - d. Should the company make its products or outsource to other manufacturers?
 - e. How do we adjust product mix to maximize profits?
 - f. How do we price the product to maximize profits?

Once we know what specific question we are addressing, we can continue to the next step of acquiring the appropriate data to address the question as completely as possible.

The AMPS Model: Master the Data (Chapters 2–4)

Once the accountant specifies the question, he/she starts to consider the most appropriate data that could be used. Accountants need to understand the trade-offs between relevant data and reliable data (such as that data which might exhibit more representational faithfulness). Does the data exhibit high levels of **data integrity**, where data is accurate, valid, and consistent over time? Are the data considered to be factual or opinion-based?

Accountants also need to understand the trade-offs between data that are well organized (like a financial statement or a spreadsheet) or not well organized (like an Instagram post); data internal or external to the company; and even the potential *cost* of acquiring, preparing, and analyzing the data as compared to the potential *value* provided by use of the data.