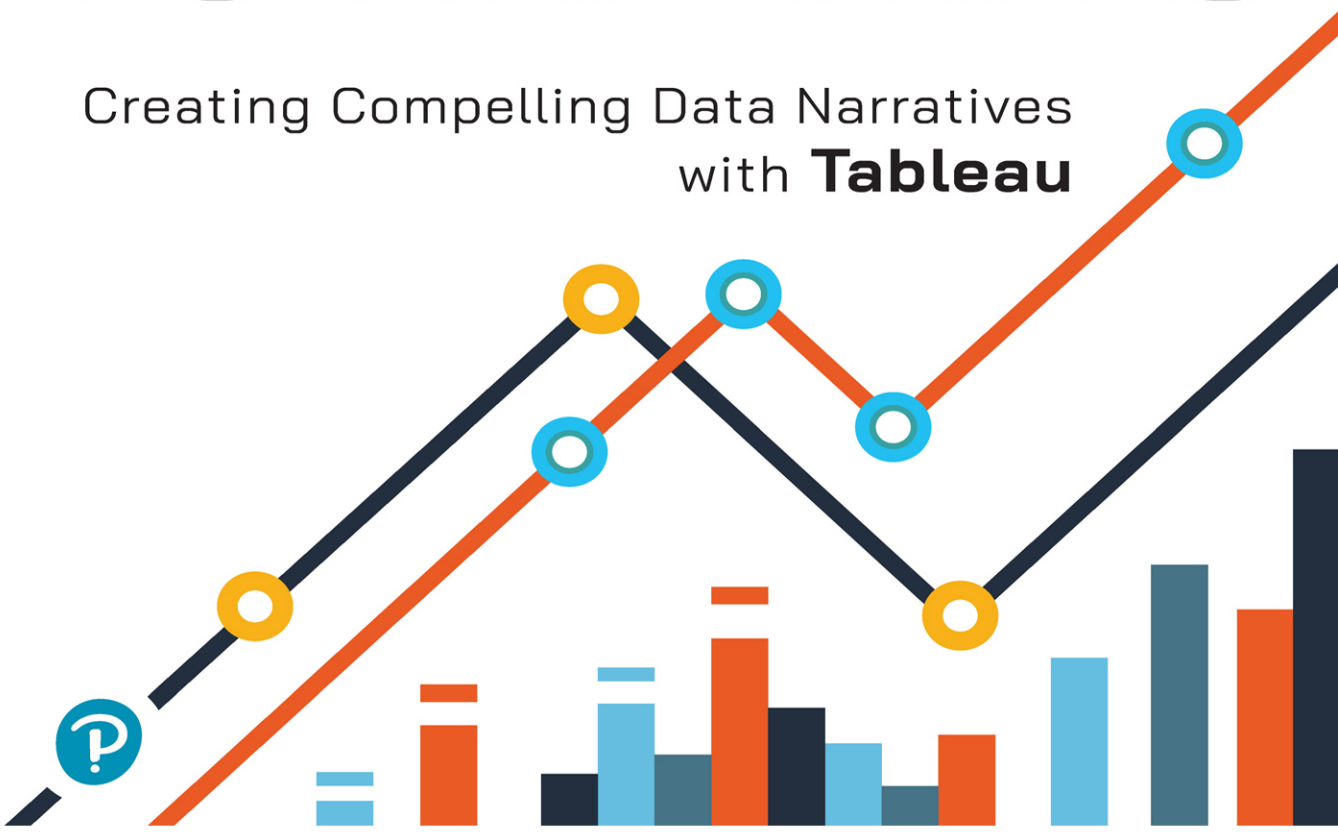
LINDY RYAN

VISUAL ANALYTICS FUNDAMENTALS

Creating Compelling Data Narratives with **Tableau**



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Visual Analytics Fundamentals

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Visual Analytics Fundamentals

Creating Compelling Data Narratives with Tableau

Lindy Ryan

Addison-Wesley

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PREFACE

For as long as I can remember, I have always been fascinated by the power of a good story.

Like taste buds, our taste for stories evolves over time, both in terms of format and content. Our appetite changes alongside age, experiences, and interests, yet still the desire for a good story persists. We crave stories; it's part of our design. Humans are intrinsically hungry for a good story. They entertain us, educate us, and provide mechanisms to transmit knowledge, information, and experiences. We're rather indiscriminate about how we receive stories, too. In fact, according to scientific evidence, we might even *prefer* stories that move us and touch our senses.

So it is with data stories. As we learn to communicate the results of our analysis—the hidden secrets carefully plucked from within the rows and columns of our data and curated into insight—we mature from being okay with being told something to wanting to see it for ourselves and, eventually, to wanting to interact with it. We need more information, more context, more action, more substance. This is where visual analytics and visual data storytelling can help.

Today, visual analytics and data storytelling are reshaping how we see, interpret, and communicate data insights. Students from grade school to graduate school are working hands-on with data and changing the way they learn about and communicate about information. Business analysts, managers, and executives are moving away from static, statistic-laden reports and toward interactive, visual data dashboards. Journalists and news editors are using data storyboards and engaging, often interactive, infographics to share information with society-at-large.

Visual analytics helps us visually explore and uncover insights in our data. Data visualization provides a way to showcase our findings by harnessing our brains' visual processing horsepower. Data storytelling gives us a very human way to communicate. This approach pushes beyond the boundaries of simply analyzing information to providing the capacity to communicate it in ways that leave a meaningful, lasting impact.

Together, these converge into what I've termed the "visual imperative," a paradigm shift that has radically reshaped how we work with and seek to understand our data, big and small. This visual imperative is reforming our expectations of information,

changing the question from "what can we do with our data" to "what can our data do for us." It's making its mark on every aspect of a progressively data-driven culture, too. From traditional business intelligence and data discovery to the personal analytics on our smart devices to how creators use data to cook up our new favorite television shows, we are becoming more data-dependent and data-driven—and we're doing it *visually*.

While visual analytics and data storytelling leverages some of our innate human communication and knowledge-sharing capabilities, it isn't always an intuitive and obvious process. It takes work, it takes understanding, and it takes a lot of practice. This book is a steppingstone in your journey to becoming a visual analyst, providing the fundamental knowledge and hands-on training needed to help you take your first steps as a visual data storyteller.

Three Core Takeaways

This book focuses on giving you the foundational knowledge, contextualized learning, and hands-on skills you need to be successful in leveraging the power of visual analytics in data visualization and data stories. The goal is not to inundate you with academic lessons in the science of data visualization or story composition, nor to provide a full-scale training experience on any software or technical application, but to provide guidance as you build the necessary skills to visually analyze and represent your data's insights. Therefore, this book concentrates on helping you learn how to organize your data and structure analysis with stories in mind; to embrace exploration and the visual discovery process; and to articulate your findings with rich data, purposefully curated visualizations, and skillfully crafted narrative frameworks. Ultimately, these presentations can help you to deliver your business message while satisfying the needs of your audience. By the time you've reached the end of the text, the expectation is that you will have earned the three core takeaways represented in Figure P.1.

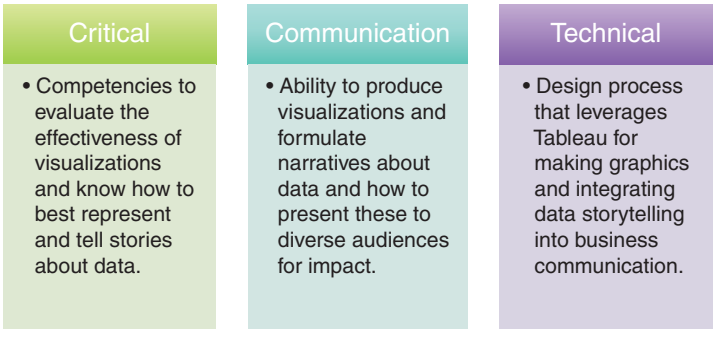

Figure P.1 The core takeaways.

What You'll Learn in This Book

In visual analytics and data visualization-related courses, students learn how to present data in visual form. This involves working with data, learning how to apply visual design principles, and, often, learning new software. This book will tackle all three. You will learn the following:

- Why we use visual analytics to tell stories about data
- The difference between data visualization for analysis versus presentation
- The fundamentals of visual analytics—from data prep to presentation
- How to design visual analytic outputs that communicate insights and make an impact
- How to create important data visualizations in Tableau and know which to use
- How to utilize concepts of design in data visualization and storytelling
- How to best storyboard your story for your message based on your audience
- How to direct your audience's attention to the most important parts of your data story
- How to design effective business presentations to showcase your data story with Tableau

Who This Book Is For

This book is for anyone who has data and wants to use it to visually communicate its insights to someone else in engaging and memorable ways. This includes, but is not limited to

- Analysts sharing the results of their data discovery or visual analysis
- Students communicating data for reports or presentations
- Teachers helping learners (of any age) to cultivate visual data literacy
- Executives and business managers reporting data-driven results or metrics
- Journalists giving data the starring role in their editorials

Essentially, if you have some data and want to tell a story about it using visualization, then this book is for you. So, from the savviest of data users to students just beginning to learn about the power of data visualization in business communication, if you are interested in becoming a better visual data analyst, curator, and storyteller, then you're in the right place!

There are no prerequisites for this book. In fact, it might be preferable if you're coming into this text with fresh eyes and a fresh perspective. We start with the basics and build incrementally on concepts and to move through the data storytelling process from beginning to end.

Don't let the topic overwhelm you: Whether you have been practicing data visualization and visual analysis for some time or are just taking your first steps in visual analytics, you don't have to be a statistician or a computer scientist, a graphic designer, or even a well-trained writer to learn how to navigate the art and science that is data visualization or to become a master data storyteller. Likewise, you do not need to be a data visualization expert or come armed with deep technical expertise in visualization software packages. Although this book utilizes Tableau as the primary mechanism for data visualization, you need not be a power user or expert prior to getting started—you don't even have to have a purchased license on your machine! You can simply download a free trial of Tableau Desktop to get started. Finally, you don't even need to bring your own data to play just yet (although you certainly can). The sample datasets used in this text, as well as information on where you can find other free datasets, are available to you through the resources listed at the end of this book. Tableau also provides a large selection of sample datasets that you can use for practice, too.

I realize that the idea of visual analysis or data storytelling might sound intimidating to many and that learning new software is always a challenge. Therefore, this book is designed in a way that a professor or a tutor might teach visual data storytelling (and in fact is the approach I take in my classrooms for graduate-level students) using what I call the 1-2-3 Method (see Figure P.2). This breaks down like this: (1) grounding easy-to-understand principles, (2) reinforcing these through real-world examples, and (3) guided hands-on work to incrementally develop skills. By the time you have worked your way through each of the chapters and exercises in this book, you will walk away with something tangible: competency as a visual data storyteller using your own data in your own dashboards and presentations. And you'll have some great visuals on your Tableau Public profile that you can add to your resume!

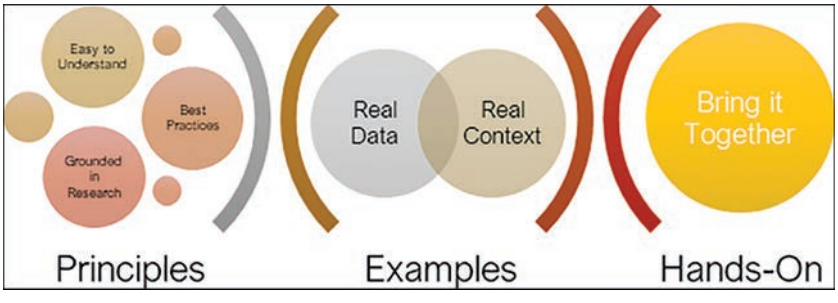

Figure P.2 The 1-2-3 Method

Assumptions

To write a comprehensive text on any of the topics covered in this book would take several volumes and the combined mind power of multiple subject matter experts and scholars across industry and academia. Thus, this book makes some assumptions about the skillset, expectations, and needs of its audience to limit the scope to the most valuable content. My goal is to distill complex topics to the most effective level of detail necessary to help you learn how to leverage visual analytics fundamentals to communicate business-relevant implications using fundamental data visualization and storytelling capabilities of Tableau.

First, this book is focused primarily on fundamentals and is limited in scope to surface-level exploration of various core concepts important to visual data analysis and outputs of visualization and storytelling. While analysis is an intrinsic part of this, in this book you work from a perspective of communicating insights rather than statistical analysis. Thus, the way you curate visualizations for storytelling purposes may be slightly different than how you would approach these tasks if you were designing analytically accurate data representation not intended for presentation. Additionally, while I will touch on subjects like data preparation and wrangling tasks associated with getting data ready for analysis, the full scope of what is involved in all the steps necessary to transform raw data into a workable format is beyond what is covered in this book.

Last, but not least, this book assumes that the reader has access to Tableau Desktop 2022, which is currently available to install on either Windows or Mac operating systems. Free trials are available for business users or general audiences, while students and educators can take advantage of the Tableau for Teaching program, which offers free licenses to the full desktop version.

> A Caveat Versions of Tableau prior to version 2022 support much of the same functionality that you will see in this book. However, the interface is notably different and may affect navigability of instructions in this text.

Why Tableau?

If you browse the shelves of your local bookstore, you'll find a bevy of wonderful books available that teach data visualization and data storytelling in a tool-agnostic manner. There is a good reason for this. To borrow the words of Cole Nussbaumer

Knaflic, author of *Storytelling with Data*, "No matter how good the tool, it will never know your data or its story like you do." With any software, there will always be weak points to balance out the strong ones. However, my goal in this book is to not only give you the information you need but the application to use it. For that, we need a tool.

Many software packages are available on the market that would serve as capable platforms to support this book, including Excel, which is still the most ubiquitous, if unexciting, analysis tool, with the capability to create functional if problematic basic charts and graphs. However, although many of the more advanced available technologies meet the rigors of building beautiful data visualizations, few provide the end-to-end capabilities that Tableau does. What we're looking for is a best-of-breed tool that delivers an approachable, intuitive environment for self-service users of all levels to prepare, analyze, and visualize data, as well as delivery platforms like dashboards and story preparation—and one at the top of employer's wishlist for incoming visual analysts (we'll look at this data in a future chapter). All of these are native to Tableau.

Today, Tableau is the world's leading data visualization analytics software company with over 80,000 customer accounts ranging from small to large organizations across all industries and with users logging on all over the world. Tableau provides a suite of licensed and free software products and excels at displaying data visually, using a drag-and-drop canvas on top of embedded analytics to help users explore their data. As you'll soon see, although Tableau can mimic Excel by providing the capability to analyze rows and columns of numbers, its focus is on interactive, visual data exploration through complex analytical capabilities as well as dashboarding and storytelling features not found in other tools. For more advanced users, Tableau supports a complete formula language and robust data connections: Tableau's live query engine enables users to connect to more than forty different data sources; its in-memory data engine leverages the complete memory hierarchy from disk to L1 cache and shifts the curve between big data and fast analysis. And according to Tableau's aggressive product roadmap, the fine-tuning of some of these capabilities as well as several worthwhile new features are on their way. We'll take a closer look at some of the details in a later chapter.

One aspect of Tableau that I find impressive and worthwhile to a larger visual data analytics movement is its focus on building a community of data users and a culture of visual analysis. I encourage you to join the Tableau Community and connect with the resources and peers you will find there.

Installing Tableau Desktop

Tableau Desktop is a fantastic out-of-the-box tool for your visual data analytics needs. While there are many other wonderful visual data analytics tools, software, and languages available, I encourage you to experiment with Tableau as the core technology utilized in this book. There are free trials available for new users, and a wealth of ongoing resources, communities, and other groups to help support your visual analytics journey using Tableau.

If you're new to the software, the following are the current technical specifications needed to install Tableau Desktop:

- **Windows**
  - Microsoft Windows 8/8.1, Windows 10 (x64)
  - 2 GB memory
  - 1.5 GB minimum free disk space
  - CPUs must support SSE4.2 and POPCNT instruction sets
- **Mac**
  - macOS Mojave 10.14, macOS Catalina 10.15, and Big Sur 11.4+
  - Intel processors
  - M1 processors under Rosetta 2 emulation mode
  - 1.5 GB minimum free disk space
  - CPUs must support SSE4.2 and POPCNT instruction sets

How to Use This Text

Like traditional classroom instruction, this book's chapters are organized as individual modules that will be your guide as you learn how to communicate business-relevant implications of visual data analysis using the analytic, visualization, and storytelling capabilities of Tableau. Some chapters provide fundamental learning of core concepts, while others are organized as granular exploration of a single concept.

Although you are not limited to working through this book cover to cover, it is recommended that you do so for incremental development of learning and reinforcement of skills. Each module builds on concepts and skills discussed in the preceding one and may include advancements on working through an end-to-end data project that are necessary before taking the next steps forward.

> **note**
>
> With a very few exceptions, all visualizations and screenshots in this book are created using Tableau 2022 for Mac. Differences in operating system versions are negligible.

Supporting Materials

Beyond the modules of this text, there are several companion materials to support ongoing skills development and learning in fundamental visual analytics. These are intended to go beyond the confines of these chapters and to attempt to keep pace with innovations in Tableau functionality as well as review some of its more nuanced advanced features that are out of scope for this book. These resources are suitable for the workplace, although special attention has been given to classroom use:

- **Website** (www.lindyryanwrites.com/academic): This website acts as an information hub to share all companion materials, including lecture decks, datasets, and more.
- **Pearson Educator Portal:** All non-Tableau-provided sample data, presentation materials, curriculum, and other educator resources are maintained by Pearson Education.
- **Datasets:** All publicly available datasets used in this text are available either from their original source or through www.lindyryanwrites.com. Additionally, Tableau catalogs a wide array of datasets that can be used to practice, teach, or otherwise engage with data visualization.
- **Curricula:** Designed for entry to mid-level analysts, as well as undergraduate and graduate students, selected lecture materials and assignments to support this text are also available. These are hosted and available via Pearson Education for educators. They are incrementally updated and include recommended readings and videos. Guest lecturing services are available to university faculty, as well as corporate training workshops for industry professionals. Tableau also offers educator support with its Tableau for Teaching program, which includes classroom software licensing and curricula kits.
- **Connect with me:** Reach out to me directly on any social media. I love to engage with you and see what stories you are telling with data!
  - **Twitter:** @lindyryanwrites
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  - **LinkedIn:** www.linkedin.com/in/lindyryan/

Contents of This Book

Each chapter in this book pairs fundamental learning with hands-on application of core concepts, and the lessons learned in each chapter are intended to compound as you make your way through the text. Because some aspects require more in-depth discussion while others favor practical application, you may feel some chapters lean one way or another, while others are more equally balanced. You will leave each chapter ready to apply the lesson given, and with an additional layer of knowledge laid over the previous.

The chapters in this book are organized in a pedagogical manner to best support incremental learning. Each is intended to

- Provide a foundation of knowledge that is grounded in best practices and empirical evidence to form the basis for education on the concepts we'll cover.
- Give you the opportunity to get hands on in Tableau and develop working skills to practice core concepts. These chapters provide step-by-step instruction, visual aids, and tips and techniques to expand your software skills.

The following provides a brief overview of what you can expect in each chapter.

Chapter 1: Welcome to Visual Analytics

This chapter introduces the practice of visual analytics with an overview of the state of the data visualization industry. As a foundation for more in-depth explorations throughout this book, we'll explore how data visualization and visual data storytelling have become in-demand analytic job skills today, how the two practices are similar and different, and how both are propelled by new technologies and bigger, more diverse, and more dynamic data. Lastly, we'll examine the role of communication skills within visual analytics and briefly look at how academia is supporting the demand for visual analysts today.

Chapter 2: The Power of Visual Analytics

Memory, retention, and emotion form the understanding for experience, all of which work in tandem with our brains' visual processing horsepower. This chapter leverages real-life examples to showcase the power of visual analytics and visual data stories to communicate discoveries and insights hidden in data. We will review the role of human cognition in visual analytics, how the brain reacts to inputs of data, stories, and data stories as unique entities, and how we can leverage this power to tell impactful data narratives and influence action.

Chapter 3: Getting Started with Tableau

Application requires an environment for practice as a first step toward efficacy. This chapter shifts focus from theory to implementation as we briefly explore the different products contained within the Tableau application suite, focusing on the Tableau Desktop 2022 user interface. We cover how to get started with Tableau Desktop, review the tool's user interface and basic functionality, and discuss how to connect to data and ensure it is properly prepared for analysis. From here, you will be able to move on to the visual analytics process to curate visuals and build data dashboards and stories while building skills and competencies in the market-leading data visualization tool most in demand by today's employers.

Chapter 4: Keeping Visual Analytics in Context

This chapter describes the importance of understanding data's context and its role in helping visual analysts ask the right questions to build a data narrative framework. You'll learn about exploratory and explanatory analysis and strategies for successful data storytelling, including narrative flow, considerations for spoken versus written narratives that support visuals, and structures that can support your stories for maximum impact. We will also explore helpful techniques in Tableau that guide you to crafting effective data narrative structure, and keeping data firmly connected to its context.

Chapter 5: Fundamental Data Visualizations

This chapter introduces the fundamental charts and graphs used to visually communicate data that are offered on the Tableau Show Me Card. We discuss appropriate use cases for each and get hands-on to create examples in Tableau. You will learn techniques to help you assess when to use each visualization type according to the data, how to generate these according to best practices, and helpful considerations for when to avoid certain types of charts. We'll also explore some of the special features available in Tableau to help you get the most from your visual.

Chapter 6: Fundamental Maps

As a continuation of the previous chapter, this chapter introduces two fundamental types of maps available on the Tableau Show Me Card. Again, we'll discuss appropriate use cases for each and get hands-on to create examples in Tableau, as well as how to generate these according to best practices, and helpful considerations specifically for mapping data. We'll also explore some of the special features available in Tableau to help you get the most from your maps.

Chapter 7: Design Tips for Curating Visual Analytics

This chapter dives into human cognition and visual perception to frame how pre-attentive attributes like size, color, shape, and position affect the usability and efficacy of visual analytics. We will explore best practices for how the design elements can be employed to direct an audience's attention and create a visual hierarchy of components to communicate effectively.

Chapter 8: Structuring Analytics for Storytelling: Prep, Dashboards, and Stories

This chapter moves beyond the basics of visual analytics to take our first steps in architecting outputs of analysis in visual data dashboards and stories. We'll begin by taking a closer look at how to prepare data in Tableau, utilizing some messy survey data—a common experience for data storytellers—before building data dashboards and stories that incorporate features like filters, annotations, and highlights to present compelling, meaningful, and actionable outcomes of visual analytics.

Chapter 9: Beyond Fundamentals: Advanced Visualizations

This penultimate chapter explores advanced strategies that go beyond fundamental data visualizations to explore a curated set of advanced data visualizations beyond the Tableau Show Me Card. We'll cover how to create advanced charts that require additional formatting and calculations, including timelines, Likert scale charts, lollipop charts, and more.

Chapter 10: Closing Thoughts

This final chapter recaps the main lessons covered throughout the text. It also serves as a resource kit for life beyond the book by providing checklists of best practices and practical suggestions for continuing to master outputs of visual analytics and discusses additional resources available to support you on this journey.

Appendix

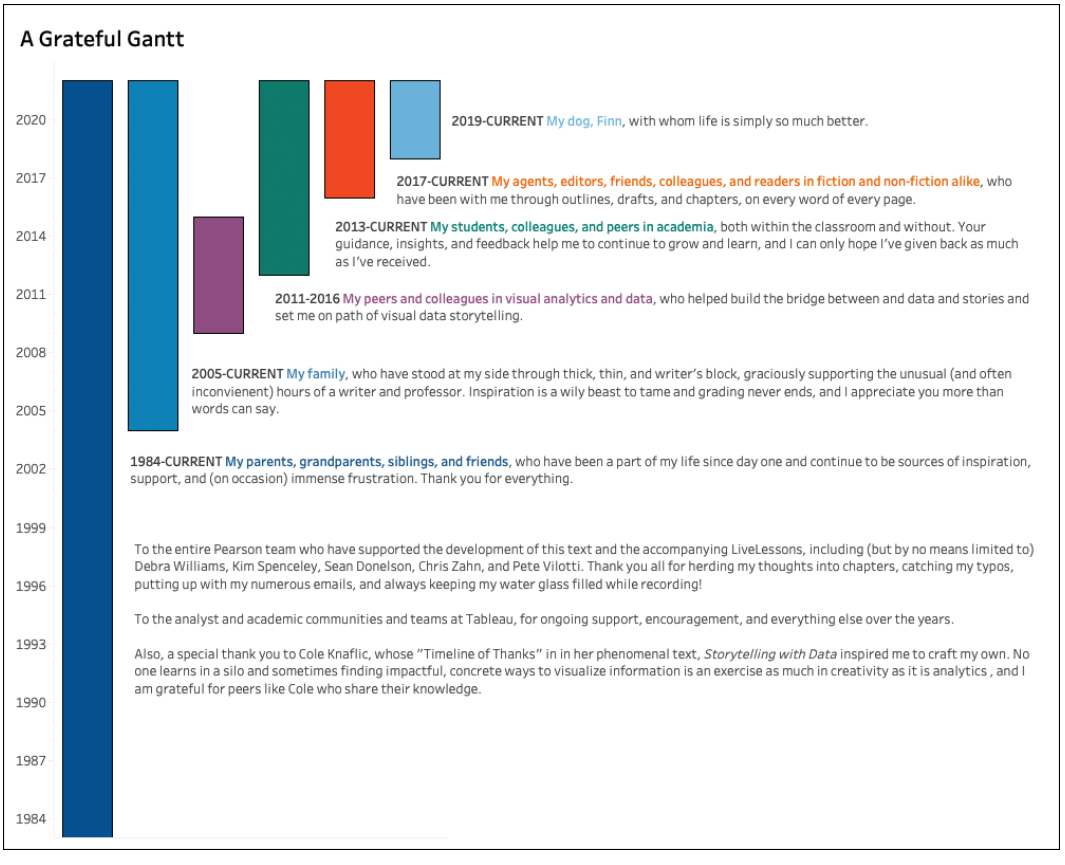
Appendix A, "Tableau Services," provides a list of additional Tableau educational resources.

Let's get started!

Register your copy of *Visual Analytics Fundamentals* on the InformIT site for convenient access to updates and/or corrections as they become available. To start the registration process, go to informit.com/register and log in or create an account. Enter the product ISBN (9780137956821) and click Submit. Look on the Registered Products tab for an Access Bonus Content link next to this product, and follow that link to access any available bonus materials. If you would like to be notified of exclusive offers on new editions and updates, please check the box to receive email from us.

Certain figures in the print edition may not be as distinct as they are in the digital version. To ensure an optimal reading experience, color PDFs of figures are available at https://www.informit.com/store/visual-analytics-fundamentals-creating-compelling-data-9780137956821.

ACKNOWLEDGMENTS



To the entire Pearson team who have supported the development of this text and the accompanying LiveLessons, including (but by no means limited to) Debra Williams, Kim Spenceley, Sean Donelson, Chris Zahn, and Pete Vilotti. Thank you all for herding my thoughts into chapters, catching my typos, putting up with my numerous emails, and always keeping my water glass filled while recording!

To the analyst and academic communities and teams at Tableau, for ongoing support, encouragement, and everything else over the years.

Also, a special thank you to Cole Knaflic, whose "Timeline of Thanks" in in her phenomenal text, *Storytelling with Data* inspired me to craft my own. No one learns in a silo and sometimes finding impactful, concrete ways to visualize information is an exercise as much in creativity as it is analytics , and I am grateful for peers like Cole who share their knowledge.

ABOUT THE AUTHOR

Lindy Ryan is passionate about telling stories with data. She specializes in translating raw data into insightful stories through carefully curated visuals and engaging narrative frameworks.

Prior to joining academia, Lindy worked for The Data Warehousing Institute (TWDI) before becoming the Research Director for research and advisory firm Radiant Advisors from 2011 through 2016. In this role, Lindy led Radiant's analyst activities in the confluence of data discovery and enablement, visualization, and visual analytics. She also developed the Data Visualization Competency Center (DVCC) methodology, a framework for helping data-driven organizations effectively implement data visualization for enterprise-wide visual data analysis and communication. Her tool-agnostic approach has been successfully implemented at a variety of organizations across several industries and with multiple visualization technologies, including Tableau, Qlik, and GoodData, among others.

Lindy began her academic career as an associate faculty member at City University of Seattle's School of Applied Leadership where she taught graduate courses in business leadership from 2013 to 2016. In early 2016, she joined the ambitious team at the Rutgers Discovery Informatics Institute (RDI^2) and contributed to multidisciplinary research focused on designing solutions for the next generation of supercomputers tasked with enabling cutting-edge extreme-scale science. She also led RDI^2's research on understanding and preventing cyberbullying behaviors in emerging technology users through advanced computing approaches and has presented her research at conferences worldwide.

Today, Lindy teaches courses in visual analytics and data visualization in the Professional Science Master's program at Rutgers, the State University of New Jersey. She also formerly taught in the Montclair State University (MSU) Business Analytics program and was the recipient of the MSU Professing Excellence Award, which recognizes professors' teaching excellence, particularly those who inspire and motivate students. She has been a Tableau user since 2012. In addition to her work in analytics, Lindy also serves as guest faculty in Western Connecticut State University's MFA program, mentoring creative writing students working in their second genres.

Lindy is the author of *The Visual Imperative: Creating a Culture of Visual Discovery* (Elsevier Morgan Kaufmann, 2016) and *Visual Data Storytelling with Tableau* (Pearson Addison-Wesley, 2018), as well as numerous papers, book chapters, and conference presentations worldwide. A published novelist, screenwriter, and award-winning short-film director, Lindy's creative work has been adapted for film and has been the recipient of numerous literary awards.

Learn more at www.lindyryanwrites.com.

CHAPTER 3

GETTING STARTED WITH TABLEAU

Application requires an environment for practice as a first step toward efficacy. This chapter shifts the focus from theory to implementation as we briefly explore the different products contained within the Tableau application suite, focusing on the Tableau Desktop 2022 user interface. We cover how to get started with Tableau Desktop, review the tool's user interface and basic functionality, and discuss how to connect to data and ensure it is properly prepared for analysis. From here, you will be able to move on to the visual analytics process to curate visuals and create data dashboards and stories, while building skills and competencies in the market-leading data visualization tool most in demand by today's employers.

While this text should not be approached as a user manual for Tableau, if you are already an intermediate Tableau user and familiar with the 2022 interface and Tableau terminology, you might want to skip this chapter and move on to Chapter 4, "Keeping Visual Analytics in Context."

Using Tableau

Acquired in June 2019 by Salesforce at a price tag of USD $15.7 billion in enterprise value,[1] Tableau stands out against other data visualization tools on the market as the industry-leading, best-of-breed tool that delivers an approachable, intuitive environment for self-service users of all levels to prepare, analyze, and visualize their data. This software also provides delivery channels for the fruits of its users' visual analysis, including dashboards and native storytelling functionality, called "story points" in Tableau. While focused on building a data-driven culture in analytics, Tableau boasts a robust and diverse data community, customer-focused innovation, an intuitive user experience, and an ever-growing catalog of enablement resources to support each of its products. As of 2022, Tableau had enjoyed a decade ranked as a Leader in Gartner's Magic Quadrant™ for Analytics and Business Intelligence Platforms (Figure 3.1).

Figure 3.1 Tableau remains a Leader in the 2022 Gartner Magic Quadrant™.
Source: Gartner, March 2022.

1. https://investor.salesforce.com/press-releases/press-release-details/2019/Salesforce-Signs-Definitive-Agreement-to-Acquire-Tableau/default.aspx

> **note**
>
> According to Gartner's Magic Quadrant™, "Leaders demonstrate a solid understanding of the key product capabilities and the commitment to customer success that buyers in this market demand. They couple this understanding and commitment with an easily comprehensible and attractive pricing model that supports proof of value, incremental purchases, and enterprise scale. In the modern ABI platform market, buying decisions are made, or at least heavily influenced, by business users who demand products that are easy to buy and use. They require these products to deliver clear business value and enable the use of powerful analytics by those with limited technical expertise and without upfront involvement from the IT department or technical experts. In a rapidly evolving market featuring constant innovation, Leaders do not focus solely on current execution. Each also ensures it has a robust roadmap to solidify its position as a market leader and thus helps protect buyers' investments."[2]

Why Tableau?

Tableau's stated mission is to help analysts "see and understand" their data, focusing on enabling "powerful analytics for everyone." To facilitate this, the company offers a suite of software products designed to meet the needs of a diverse group of users, from experienced analysts at enterprise-level organizations to academic users, data journalists, and other visual data storytellers who want to visualize data. All Tableau products excel at displaying data visually, using Tableau's proprietary VizQL technology to enable an intuitive, drag-and-drop canvas on top of embedded and augmented analytics.

Our primary tool to apply the lessons learned in this book, Tableau Desktop can connect to a wide variety of data, stored in a variety of places on-premises or in the cloud—from SQL databases to local spreadsheets, and even many cloud database sources, such as those offered by Google Analytics, Amazon Redshift, and Salesforce. Although Tableau can mimic Excel by providing the capability to analyze rows and columns of numbers, its focus is on interactive, visual data exploration through its out-of-the-box analytic capabilities as well as dashboarding and storytelling features—no programming required. For more advanced users, Tableau offers augmented analytics powered by artificial intelligence (AI) and machine learning (ML) to streamline time to

2. Gartner.com.

insight through statistics, natural language, and smart data prep, as well as predictive modeling and other data science techniques. Data scientists can integrate and visualize results from R, Python, Einstein Discovery, MATLAB, and other extensions to scale models. Content created in Tableau Desktop can be shared in a variety of methods, depending on the user's specific needs.

> **note**
>
> Tableau Exchange is a "one-stop shop" for offerings to jumpstart your Tableau analysis, get answers to questions, and activate data quickly. Further information about accelerators, dashboard extensions, and connecters for Tableau Desktop can be accessed at exchange.tableau.com.

> **note**
>
> Tableau maintains an expansive, ongoing program to rapidly develop product features. This text attempts to capture product updates that affect fundamental learners in versions 2022.3 and 2022.4.

Founded in 2003 by an Academy Award–winning professor, a computer scientist from one of the world's most prestigious universities, and a data-passionate business leader,[3] Tableau has become synonymous with data visualization in today's analytics space. In the years since its inception, it has moved beyond a tool to become a required specialized software skill—and one that is at the top of the list for many employers. As described in a 2019 paper published by *IEEE Computer Graphics and Applications*, my fellow researchers and I mined data from Labor Insight (Burning Glass), an analytics software company powered by the largest and most sophisticated database of labor market data, in an effort to analyze data visualization–related IT job descriptions posted between March 2017 and February 2018 across the United States. In the nearly 31,000 such jobs posted within that time frame, Tableau ranked as the second most in-demand specialized software skill for visual analysts (42% of such listings), outranked only by SQL.[4] When the same study was repeated in 2022, in the data visualization–related IT job descriptions posted between March 2021 and March 2022, Tableau remained the second most in-demand specialized software skill (once again behind SQL), now being mentioned in 48% of those listings (Figure 3.2).

3. www.tableau.com/about

4. Ryan, L.; Silver, D.; Laramee, R.; & Purdue, D. "Teaching Data Visualization as a Skill." *IEEE Computer Graphics and Applications* 39, no. 2 (2019): 95–103.

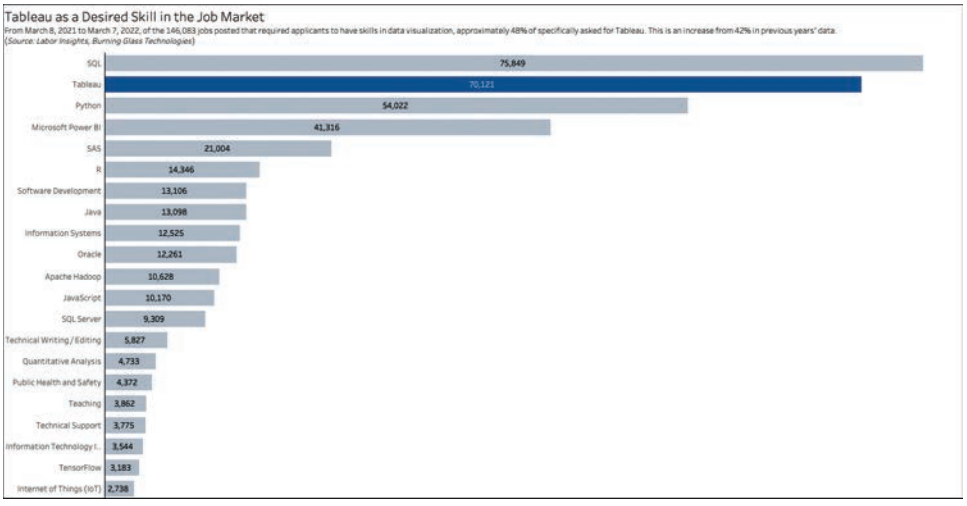


Figure 3.2 From March 8, 2021, to March 7, 2022, of the 146,083 jobs posted that required applicants to have skills in data visualization, approximately 48% of specifically asked for Tableau.

TABLEAU IN DEMAND

In a recent analysis of Labor Insight (Burning Glass), approximately 146,038 jobs posted across the United States between March 1, 2021, and March 31, 2022. listed "data visualization" as a desirable skill. Among the most popular job titles were data analyst (6.4%), data scientist (5.9%), and BI analyst (2.6%). These findings are consistent with previous years' research, although the data scientist job title has now edged above BI analyst. All postings required, at a minimum, a bachelor's degree.

In addition to Tableau, other high-ranking software skills included Microsoft Office Suite (not including PowerBI; 113,000 jobs), SQL (76,000 jobs), Python (54,000 jobs), SAS (21,000 jobs), and R (14,000 jobs). When pitted against the intersection of other required baseline "soft" skills, those listed included communications (75,000 jobs), teamwork/collaboration (63,000 jobs), research (53,000 jobs), and problem solving (49,000 jobs). A separate but similar study found that the term "storytelling" is also making its mark on jobs in visual analytics, with 7,451 of 146,038 job postings, or 5.1%, also looking for qualified candidates experienced in data storytelling.

These analysis results are consistent with recent surveys that have looked at which tools are most in demand and in use by today's visual analytics

practitioners. One such resource is the Data Visualization Society's State of the Industry (SOTU) report, discussed in Chapter 1. Its 2021 survey marked the first year that respondents were asked which technologies they use *often*—rather than the more general question used previously, which simply asked about tools used, but did not differentiate between which tools were used on a regular basis versus used at all. Regardless, the top tools mentioned by respondents have remained consistent over the years the DVS has conducted this survey, with Tableau coming in second only to Excel. Interestingly, 2021 also marked the emergence of PowerPoint as a data visualization tool, based on 2020 write-ins for "other" in regard to tools used to proliferate results to stakeholders and other visualization audiences.

If you're wondering where these data visualization jobs are located, nearly 15% were in California, just shy of 10% in the New York/New Jersey metro area, and another 8% in Texas. Washington, home to Tableau's Seattle headquarters, accounted for fewer than 4% of the jobs. Note that these percentages are based on the count of total jobs posted and are not normalized for population. Top employers included PricewaterhouseCoopers, Deloitte, Humana, and Amazon.

The Tableau Product Portfolio

It's important to think of Tableau as a brand, rather than a product. The Tableau ecosystem includes several different products, and although Tableau Desktop is its cornerstone data visualization software product and the focus of this book, other environments are also offered in the Tableau application suite to support various levels of user needs. What unites all of these products is VizQL, Tableau's proprietary visual technology that enables simple drag-and-drop functions to create sophisticated visualizations. The primary differences between these core products are the different data sources users can connect to (connectivity), how visualizations can be shared with others (distribution), the ability to automatically update or refresh analysis (automation), and the level of governance required by the user and/or organization (security).

note

VizQL is Tableau's proprietary analysis technology. You can read more about VizQL at www.tableau.com/products/technology.

> **note**
>
> The Tableau pricing model is based on users and designed to scale as your organization's needs grow. Free software trials are also available, as well as free licenses for students and teachers. For more information, see www.tableau.com/pricing.

Tableau Desktop

Tableau's flagship product, Tableau Desktop, is an application that can be installed on either Windows or Mac machines. It allows connection to data on premises or in the cloud, and facilitates the entire visual discovery and analytics process from connecting to data to sharing visualizations, dashboards, and interactive stories using Tableau Server and Tableau Cloud. The software also includes a device designer to help users design and publish dashboards optimized for various form factors. Tableau Desktop enables users with intuitive visual analytics experiences and augmented analytics (powered by AI and ML). Advanced analysts can also integrate and visualize results from R, Python, Einstein Discovery, MATLAB, and other extensions.

> **note**
>
> Work in this book, in terms of both hands-on work and the figures presented throughout, relies on Tableau Desktop version 2022, unless otherwise stated. A number of features are consistent across Tableau Desktop, Server, and Cloud, but their functionality does differ. If you are not already an active Tableau user, it's recommended that you download Tableau Desktop to follow along with the discussion. Information on Tableau's free trial offerings can be found in the Introduction.

Tableau Server

From small businesses to *Fortune* 500 companies, Tableau Server extends the value of data across the entire organization for enterprise-wide deployments and is intended for organization-wide provision of visual analytics outputs through a central repository for Tableau work. It provides organizations with centralized governance, visibility, and control, while allowing users to curate, publish, and share data sources as well as collaborate, engage, and explore data. Data visualizations and dashboards are typically stored within the organization.

Tableau Cloud

Formerly called Tableau Online, Tableau Cloud is a full-hosted, cloud-based, enterprise-grade solution. It provides similar functionality as Tableau Server, but has the advantages of cloud distribution and automation and is hosted off premises.

Tableau Prep

Tableau's newest offering, Tableau Prep provides a modern approach to data preparation. Tableau Prep can connect to data on premises or in the cloud, and provides robust data preparation capabilities using Tableau's familiar visual interface. Outputs can be opened in Tableau Desktop, Server, or Cloud to fit seamlessly into an analytic workflow, reducing friction between data prep and analysis.

Tableau Public

One part data visualization hosting service, one part social networking, Tableau Public is a free service that allows users to publish interactive data visualizations online. These visualizations can be embedded into websites and blogs, shared via social media or email, or made available for download to other users, but must remain in Tableau's public cloud.

> **note**
>
> You can follow me and see many of the visualizations included in this book on Tableau Public at https://public.tableau.com/app/profile/lindy.ryan.

Tableau Reader and Tableau Viewer

Finally, Tableau offers two products that allow anyone, from experienced users to casual users, to access and interact with content created by Tableau creators. While both products are similar, they do have some notable differences.

Tableau Reader

Tableau Reader is a free desktop application that allows users to open and interact with data visualizations built in Tableau Desktop in a view-only mode (or, conversely, to distribute content built in Tableau Desktop). Tableau Reader lacks governance, security, and administration capabilities, so it is not possible for users to make any changes to visualizations provided in Tableau Reader. Thus, the application is essentially a distribution platform with no analytic capabilities.

Tableau Viewer

Tableau Viewer is a role-based license option on Tableau Server that allows users to access and interact with trusted content without putting the security of data at risk. Tableau Viewer users benefit from the security of a governed server-based deployment and can actively engage, interact, and collaborate with shared content.

> **note**
>
> See Appendix A, "Tableau Services," to learn about the range of services that Tableau offers to support your ongoing learning related to visual data analytics as well as the Tableau ecosystem.

GETTING SOCIAL WITH TABLEAU MOBILE

While Tableau Desktop natively includes many sharing capabilities (primarily through exporting or posting to Tableau Public), Tableau Server and Cloud users benefit from Tableau Mobile, a companion app that gives your audience access to your Tableau site on the go. The app is available for Android and iOS and allows your audience to interact with published visual content and discover data insights—even offline. Once you share content, recipients receive a notification and shared content appears in the "Shared with Me" channel on their home screen. Desktop users can also publish content to Tableau Server or Cloud, if this feature is enabled by their organization, by using the Share icon on the toolbar.

Learn more about Tableau Mobile at www.tableau.com/products/mobile.

Getting Started

To begin working in Tableau Desktop, the first thing you need to do is get your hands on a license. If you have not done so already, refer to the Introduction for guidance on how to start a free trial of Tableau Desktop. You can also visit the Tableau website to explore trial and purchase options. As previously noted, all exercises and tutorials contained in this book use Tableau Desktop 2022.

Installing Tableau Desktop

Before installing Tableau Desktop, make sure your machine meets the necessary requirements for the application. Tableau Desktop is available for Windows and Mac, and the minimum requirements as of this book's writing were as follows:

- **Windows Operating Systems**
  - Microsoft Windows 8/8.1, Windows 10 (x64)
  - 2 GB memory
  - 1.5 GB minimum free desk space
  - CPUs must support SSE4.2 and POPCNT instruction sets
- **Mac Operating Systems**
  - macOS Mojave 10.14, macOS Catalina 10.15, and Big Sur 11.4+
  - Intel processors
  - M1 processors under Rosetta 2 emulation mode
  - 1.5 GB minimum free disk space
  - CPUs must support SSE4.2 and POPCNT instruction sets

> **note**
>
> Research these and other minimum system requirements at www.tableau.com/products/techspecs.

Connecting to Data

When you first open Tableau Desktop, the Connect to Data screen appears (Figure 3.3). This "starting screen" is the first thing users see after launching the Tableau software.

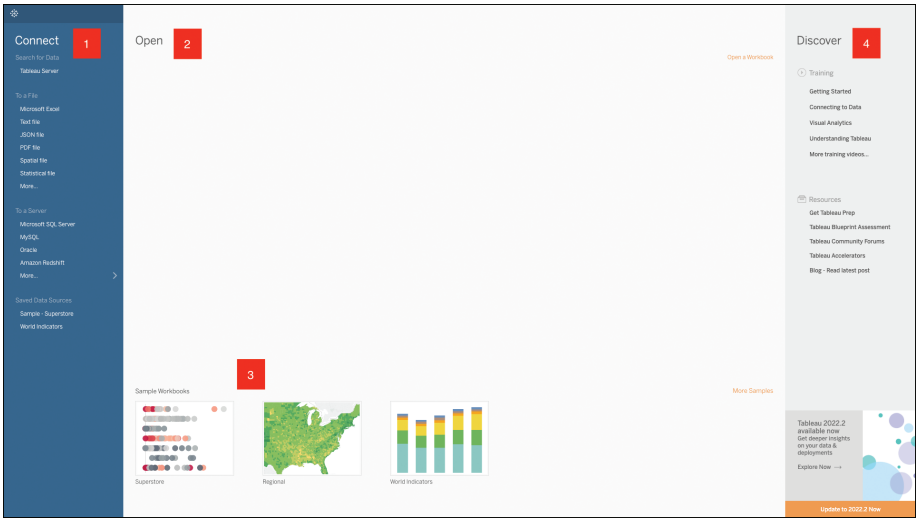


Figure 3.3 The Tableau Connect to Data screen.

There are several important elements to know on this screen:

- **Connect:** All possible data connections can be accessed here to connect to your data, including those stored locally or on servers. Additionally, two saved data sources—Sample-Superstore and World Indicators—are training data sets included natively within Tableau.
- **Open:** As you create your own workbooks, recently opened workbooks appear here for quick access.
- **Sample Workbooks:** Similarly to the saved data sources, these are default workbook samples provided by Tableau that can be used as simulations for training or other skills development. (Note: Beginning in Tableau 2022.4, these sample workbooks are now termed *Accelerators*.)
- **Discover:** This pane connects you to various Tableau training, visualization, and other resources. Announcements for upcoming Tableau events, Viz of the Day, and upgrade reminders also appear at the bottom of this pane.

> **note**
>
> This book focuses on the fundamentals of practicing visual analytics within the scope of data visualization and visual data storytelling; it is *not* a user manual for Tableau. For more granular learning on Tableau, review the Training videos provided by Tableau in the Discover pane or the resources listed in Appendix A of this book.

Connecting to Tables

Selecting a saved data source from the Connect pane will immediately take you to the Tableau worksheet canvas, bypassing the data preparation stage. We'll review this interface later in this chapter, but first let's take a look at how to prepare your data for analysis in Tableau.

> **Tip**
>
> For many exercises in this book, we'll use the Sample-Superstore training file provided on the Saved Data Resources section of the Connect to Data screen shown in Figure 3.3. It is a well-prepared, simple dataset for a global retailer that sells furniture, office supplies, and technology goods. You can connect to this data source simply by double-clicking on it on the Connect pane. We will also use an Excel-based dataset called Global Superstore, which contains similar but not the same data. This dataset, and others, can be downloaded by visiting the resources provided in the Introduction and Appendix A of this book.

For our purposes, we'll connect to a very common file format—an Excel spreadsheet. You can connect to any Excel spreadsheet by clicking the Excel option under the Connect menu and navigating to the file's location on your machine. Once connected to your data file (or any other file or database connection), Tableau opens the Data Source page (Figure 3.4).

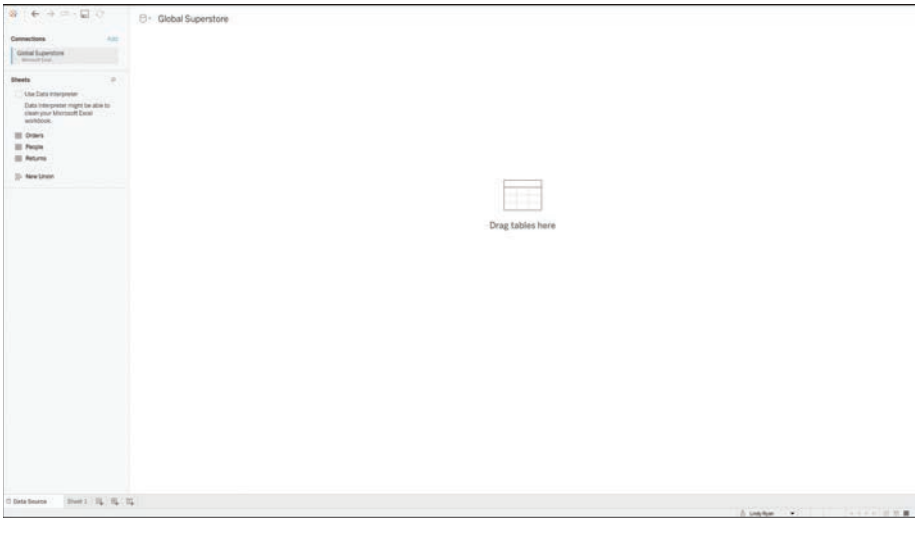


Figure 3.4 The Data Source page.

Before we look at options to make changes to the data at this point, it's important to note that whatever changes are made create metadata and have no impact on the underlying data source. This means you can make specific changes and prepare data directly in Tableau without affecting the data's existing infrastructure.

The Data Source page provides several options to help you prepare this file for analysis in Tableau.

- **Connections:** You can add additional data sources by clicking Add. You can also edit the name of the connection or remove it as desired by clicking the drop-down arrow to the right of the filename. (You can also rename the connection by clicking its title on the canvas to the right.)
- **Sheets:** This pane displays all the sheets in the Excel file, corresponding to the names of individual worksheet tabs. Sheets in Excel are treated the same as tables in a database, and you can choose to connect to a single table or join multiple tables. To connect to a sheet, simply drag and drop it into the data connection canvas to the right (you will notice a "Drag tables here" prompt) or by double-clicking the sheet desired. After you connect to a sheet, three things happen (Figure 3.5), which allow you to further explore the capabilities of this screen:
  - The sheet name appears in the data connection canvas.
  - The data is displayed in the preview pane below the data connection canvas.
  - A Go To Worksheet icon is displayed.

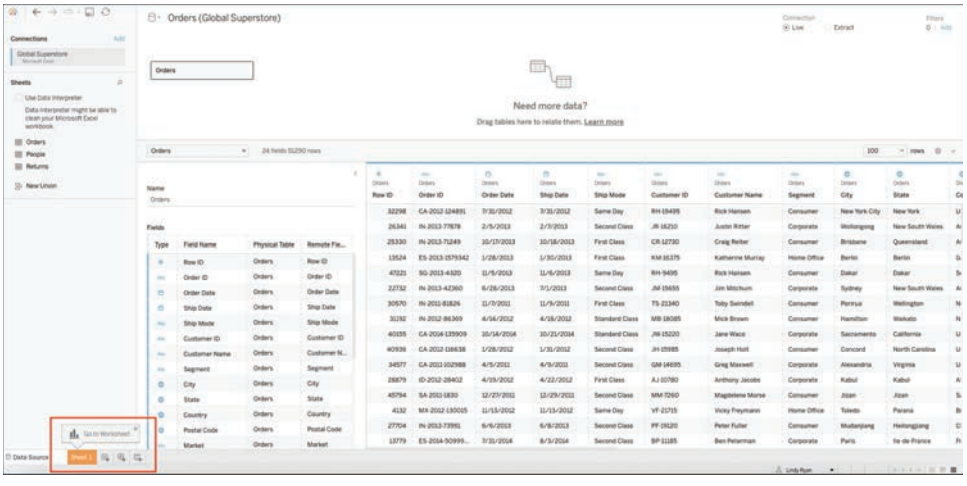


Figure 3.5 You have connected to the Orders table of the Excel file, populating the data preview pane. Tableau also provides the prompt to Go To Worksheet, which allows you to begin visually exploring the data if you are ready.

Before moving on, there are a few more things to take note of on this screen.

First, if you aren't satisfied with any individual column name, you can click the drop-down arrow to the right of the name and select Rename. Additionally, clicking the data type icon allows you to change the default data type for that column (Figure 3.6).

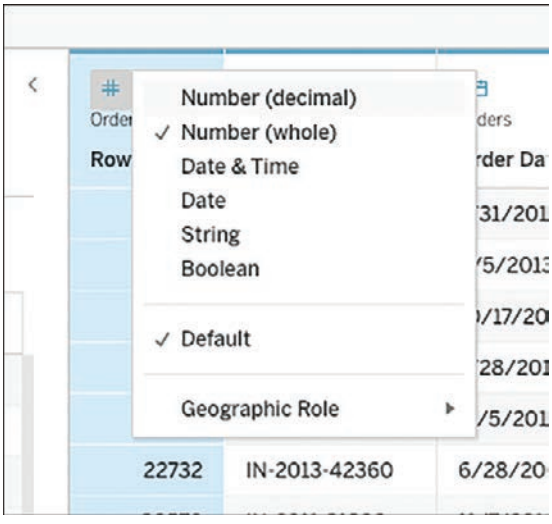


Figure 3.6 Clicking the data type icon allows you to change the default data type for that column. This determines how the fields are displayed on your worksheet in the next step.

If you would like to further refine your columnar data, you can find a few more options to prepare this data by clicking the drop-down arrow on the column (Figure 3.7):

- Rename the field.
- Copy values.
- Hide (or show) fields.
- Assign new names to individual dimension members via an Alias.
- Create calculated fields to create a new field before populating your Tableau worksheet.
- Create groups to combine different dimension members.
- Split fields by delimiter using an automatic or custom split. (Note: This option appears only if the data can be split.)

- Pivot data fields as necessary. (Note: You can do only one data pivot per data source.)
- The Describe option gives you additional information about the field.

Depending on the data type contained within the field, some options may not be available. Likewise, for quantitative fields, the string functions are not available, but an additional option, Create Bins, allows you to create equally sized bins—an ability useful for making histograms.

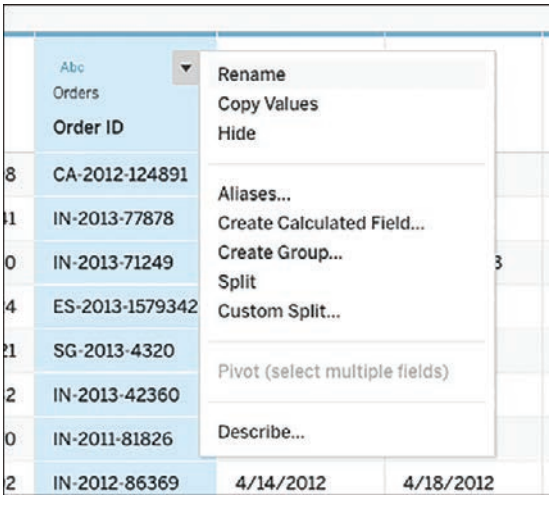


Figure 3.7 Clicking the drop-down arrow provides more options to prepare data.

Live Versus Extract

You might have noticed the option for a Live or Extract connection on the sheet canvas (Figure 3.8).

Figure 3.8 Options for connecting live or extracting data.

By default, most data sources will connect live with no filters. However, before you begin analyzing data, this decision might be something you want to consider. Be sure to understand the benefits and drawbacks of Live versus Extract connection options as described in Table 3.1.

Table 3.1 Pros and cons of Live versus Extract connection options

Connection	Pros	Cons
Live	• Leverage a high-performance database's capabilities. • See real-time changes in data. • Offers the best security in most organizations.	• Can result in a slower experience. • Some cloud-based data sources must be extracted.
Extract	• Can deter latency in a slow database. • Could reduce the query load on critical systems.	• Most Online Analytical Processing (OLAP) data sources cannot be extracted. • Must be refreshed periodically.

Finally, you have the ability to filter the entire data source before working with it in Tableau. These filters can be created with any combination of fields by clicking the blue Add text under Filters. Filtering may help eliminate clutter or extraneous fields by streamlining your view of the data and removing data that is not needed for analysis.

Connecting to Multiple Tables with Relationships and Joins

As mentioned earlier, you can connect to multiple data sources in Tableau. You can also connect to multiple tables in the same data source. Previously, connecting multiple tables, or data sources, in Tableau was achieved through joins. However, starting in Tableau 2020.2, a new logical layer was added to Tableau's data model, improving this functionality. While joins are still an option to connect multiple tables, this new logical layer uses "relationships" to normalize data sources with multiple tables at a different level of detail.

Relationships are a dynamic, flexible way to combine data for analysis, and generally a simpler process than working with joins. Therefore, Tableau recommends using relationships as a first approach to combining data.

To create a relationship, drag and drop or double-click the second sheet to which you want to connect. A "noodle" appears (Figure 3.9), which represents the relationship between the selected tables. Tableau automatically attempts to choose related fields, but users can manually adjust these—or choose another set of related fields.

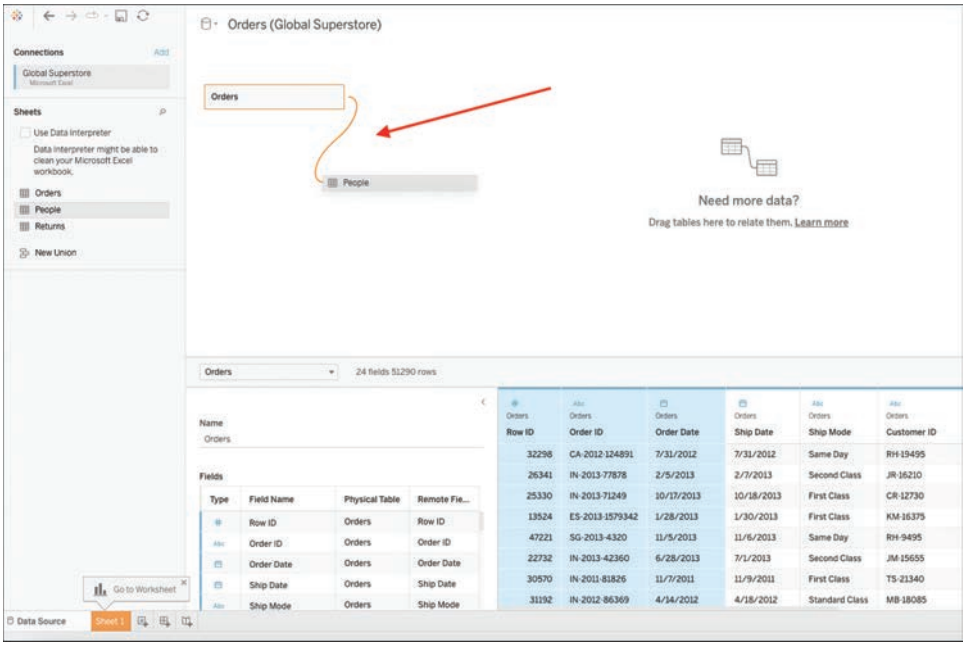


Figure 3.9 The relationship "noodle."

The data grid displays columns for each table, depending on which is selected on the upper pane. Although relationships do not merge tables together, Tableau automatically configures the join type, the right aggregation, and the handling of null values.

Relationships aside, there may be times when you still opt to create a join. To create a join, double-click on the first table, then drag out the second table. This will generate the same join experience as in previous versions of Tableau via the join canvas (Figure 3.10).

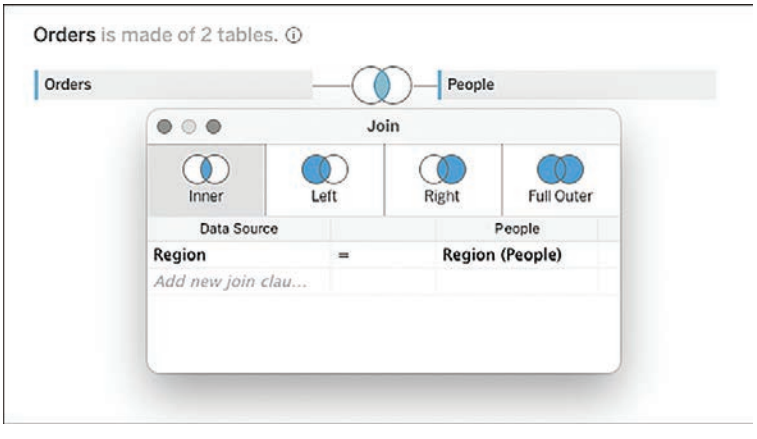


Figure 3.10 The join canvas.

The join icon with the blue center indicates that Tableau has automatically joined these tables as an inner join, making it the default join clause. Clicking the join icon

will display the details and give you the option to edit the join clause, or even create a new one.

While Tableau will automatically join your tables, it does so by guessing your matching ID. You can change this default by clicking on the fields, which shows a drop-down menu of all data fields available to join.

Overview of Join Types

Tableau provides four types of joins that you can use to combine your data: inner, left, right, and outer. Inner and left joins are the most common types of joins.

- **Inner join:** Joins records where there is a matching field in both datasets. Using an inner join to combine tables produces a new virtual table that contains values that have matches in both tables.
- **Left join:** Joins records from the left and right sides of your equation when there is a match. Using a left join to combine tables produces a new virtual table that contains all values from the left table and corresponding matches from the right table. When there is no corresponding match from left to right, you will see a null value.
- **Right join:** Joins all the records from the data on the right side of your equation and any matching records from the left side. The opposite of a left join, using a right join to combine tables produces a table that contains all values from the right table and corresponding matches from the left. Likewise, when a value in the right table doesn't have a corresponding match in the left table, you will see a null value.
- **Outer join:** Joins all the records from each dataset together, even when there is no join (this option is rarely used). Using a full outer join to combine tables produces a table that contains all values from both tables. If a value from either table doesn't have a match with the other table, you will see a null value.

WHAT ARE "NULLS"?

Occasionally as you work with data, you will discover a field name called null. What is that?

Null means that your data contains some empty cells and Tableau is, essentially, letting you know about their presence. These fields could have been left blank—either intentionally or unintentionally—or they may signify missing or unknown values. Checking fields and formatting for extraneous information is always important when doing data analysis because you want to ensure these blank fields do not skew the results. A null field might indicate an error in the data or some other inaccuracy. When null values exist in a connected dataset, Tableau displays an indicator that provides options to filter out these unknown values. We'll take a closer look at working with nulls in a later chapter.

ABOUT TABLEAU PREP

A relatively recent addition to the Tableau application suite, Tableau Prep is a separate product designed to make preparing data easy and intuitive. Expanding data preparation capabilities beyond those available in Data Interpreter, Tableau Prep can help you combine, shape, and clean your data for analysis in Tableau. As an additional tool, Tableau Prep is only lightly covered in this book. More in-depth information can be found at www.tableau.com/products/prep.

Adding and Replacing Data Sources

Sometimes, you might want to work with multiple data sources in the same Tableau workbook without joining or otherwise blending the data. Luckily, Tableau offers some options for performing this type of analysis—including recent feature updates in Tableau 2022.4 that make this process more seamless and flexible than ever before.

Once you've connected to your primary data source as usual, navigate to your worksheet. This worksheet will automatically utilize data from your first data source.

From here, use the top menu bar to select Data > New Data Source (Figure 3.11). You can then use the familiar Connect to Data screen to select and connect to your additional data source and, if needed, navigate to the Data Connection canvas to see and select fields for use as the new data source.

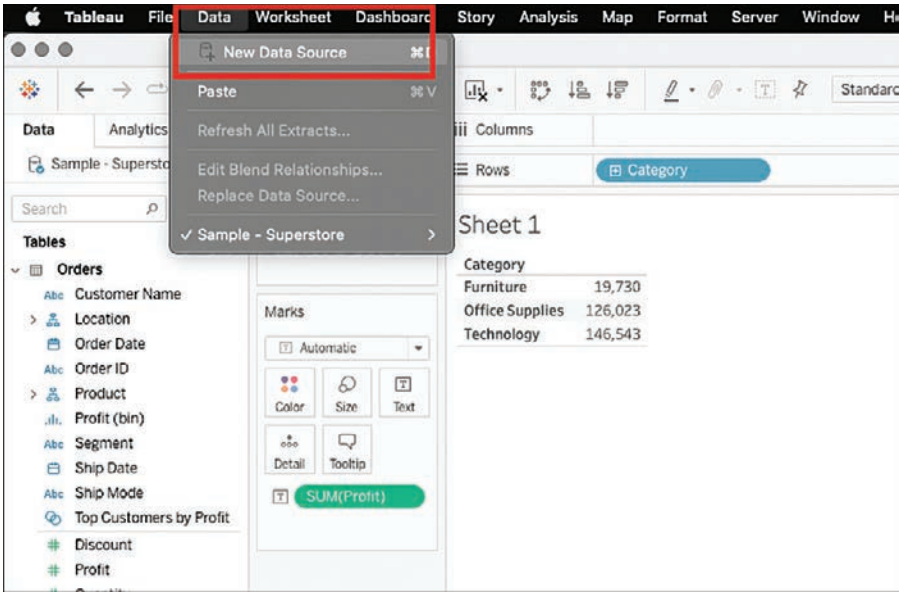


Figure 3.11 To add or replace data sources, first use the top menu bar to select Data > New Data Source.

Once this process is complete, you will be able to see all connected data sources in the Data pane on your Tableau worksheet (Figure 3.12).

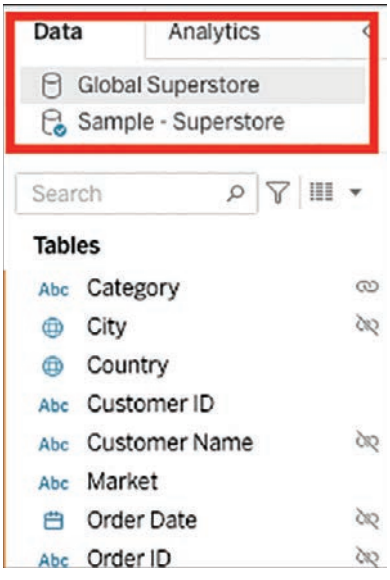


Figure 3.12 Review all connected data sources in the Data pane.

From here, as you begin to explore and analyze your data, you can selectively replace data sources at the worksheet level (in the past, replacing data sources would apply to all worksheets in the Tableau workbook). To replace the data set used, return to the Data menu and select Data > Replace Data Source. This option enables you to replace the data source with any other connected data source, at either the worksheet or workbook level (Figure 3.13).

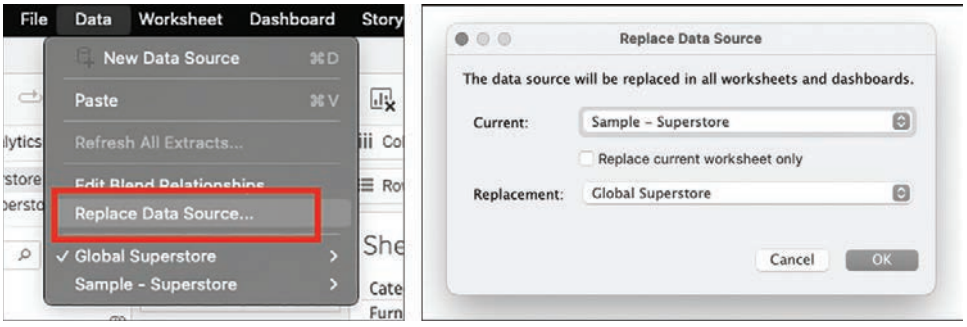


Figure 3.13 Data sources can be changed at either the workbook or worksheet level.

Basic Data Prep with Data Interpreter

Tableau Desktop delivers some features to help automatically reshape files to get them ready for analysis in Tableau without relying on additional tools (such as Tableau Prep) or other data prep tools. One is Data Interpreter, Tableau's built-in tool for preparing data for analysis. While many of the Excel files we'll use in this text are already nicely formatted and ready for analysis in Tableau, real-world data files are not always so well prepared. If you need to connect to a data table where minimal amounts of data prep is necessary, Data Interpreter is a handy resource.

When you connect to an Excel sheet in Tableau, the software can recognize issues such as missing column names, null values, and so on. To remedy these problems and clean the file for use in analysis, Tableau will suggest using Data Interpreter. (Refer to Figure 3.4 to locate the Data Interpreter option on the left pane of Data Source screen, directly between the list of data connections and the resultant tables.)

We will take a closer look at Data Interpreter in a later chapter, but for now it's sufficient to know that to use Data Interpreter, you simply click the check box to activate this tool. This executes a query to the Excel file and confirms its automated prep tasks, with a revised data preview pane addressing the issues Data Interpreter has identified. To get more specifics on what Data Interpreter has adjusted in the file, including a before-and-after view and an explanation table, click the link that is provided

following Data Interpreter's action to "Review the results." This opens an Excel file describing the changes. You can also clear the check box to undo these changes and revert to your original sheet.

After verifying the changes made to your data, you can go to your worksheet and begin exploring the Tableau interface and your data. You are ready to begin your analysis!

Navigating the Tableau Interface

Now that you have connected to some data in Tableau, you can click the prompt to Go To Worksheet and start getting to know the Tableau user interface (UI) in a more meaningful way. Like the Data Source page, the Tableau UI is a drag-and-drop interface that fosters rich interactivity between sheets, dashboards, and stories, allowing for in-depth visual exploration and powerful visual communication. Tableau is similar to Excel in that its files are called workbooks and the sheets inside the workbook are called sheets. Every Tableau workbook contains three elements:

- **Sheets:** For creating individual visualizations. Each workbook can contain multiple sheets—one for each data visualization you create.
- **Dashboards:** For combining multiple sheets as well as other objects like images, text, and web pages, and adding interactions between them like filtering and highlighting. Dashboards are great for looking at the interactions between multiple visualizations in a single view.
- **Stories:** These frameworks can be based on visualizations or dashboards, or they can be based on different views and explorations of a single visualization, seen at different stages, with different marks filtered and annotations added. However, stories are best suited to narrate the story in your data.

We'll cover dashboards and stories, and the differences between them, in more depth in later chapters. For now, let's focus on sheets and take a high-level view of the various areas of the Tableau worksheet canvas. As we begin to work directly with data to perform visual analytics and build visualizations, dashboards, and stories throughout this book, we'll explore these areas—and more—in detail through hands-on exercises. For now, this high-level overview is intended to orient you to the various aspects of the user interface.

As shown in Figure 3.14, the Tableau interface includes five basic elements:

1. Menus and toolbar
2. Data pane
3. Shelves and cards

4. The canvas workspace
5. Legends

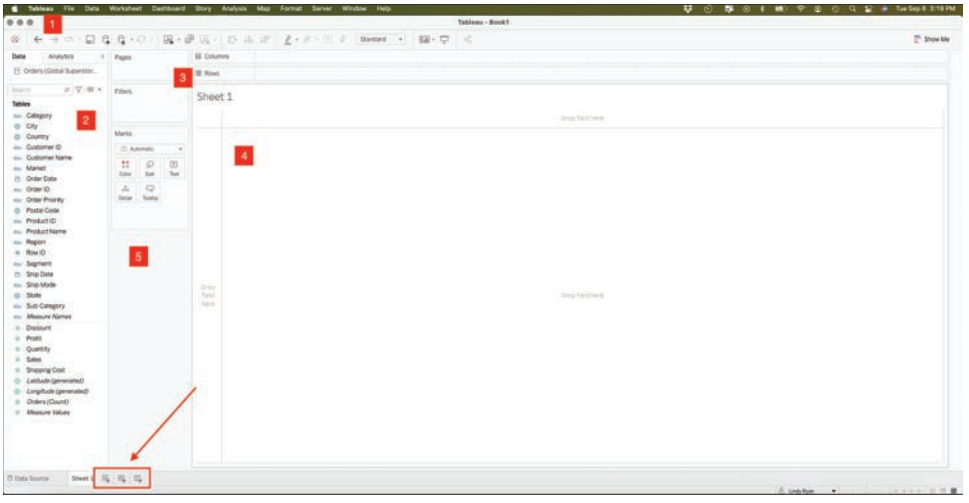


Figure 3.14 The Tableau user interface, a blank canvas.

Menus and Toolbar

Even though most of your Tableau work can be accomplished by interacting directly with the drag-and-drop canvas, the menu bar that launches with the software includes various menus that provide access to additional features and settings. This includes the File and Data menus, as well as the Worksheet, Dashboard, and Story menus, each of which contains specific controls for those canvas types. Additional menus, such as the Analysis, Map, Format, Server, Windows, and Help menus, contain even more functionality and controls.

At the top of the Tableau sheet is the toolbar, which is similar in concept to the ribbon in Microsoft Office products. The toolbar contains many powerful buttons that give you control over your Tableau experience and enable you to navigate from the data source all the way to story presentation mode. A few items of special note are highlighted here:

- **Logo:** The Tableau logo button brings you back to the original Connect to Data screen (clicking the icon from this screen returns you to your sheet).
- **Undo:** There is no limit to how much you can undo in Tableau, which is an important feature for exploration and discovery. The icon is grayed out until there is an action to undo.

- **Save:** There is *no automatic save* in Tableau. Be sure to save your work incrementally.

Another menu appears along the bottom of the sheet. This menu, similar in concept to a Tableau workbook, enables you to return to the Data Source screen; create new sheets, dashboards, or stories; and do things like rename, rearrange, duplicate, delete various sheets, and so on.

Data Pane

The pane on the left of the sheet is called the Data pane. It has two tabs: a Data tab and an Analytics tab.

Data

At the top of the Data tab is a list of all open data connections and the fields from that data source categorized as either dimensions or measures (discussed shortly).

Analytics

The Analytics tab enables you to bring out pieces of your analysis—summaries, models, and more—as drag-and-drop elements. We will review these functions later.

Shelves and Cards

Shelves and cards are some of the most dynamic and useful features of the Tableau UI.

- **Columns and Rows shelves:** Control grouping headers (dimensions) and axes (measures).
- **Pages shelf:** Lets you break a view into a series of pages so you can better analyze how a specific field affects the rest of the data.
- **Filters shelf:** Filters visualizations by dimensions or measures.
- **Marks card:** Controls the visual characteristics of a visualization, including encoding of color, size, labels, tooltip text, and shape.
- **"Show Me" card** (shown closed): A collapsible card that shows application visualization types for a selected measure and dimension.

Legends

Legends will be created and automatically appear when you place a field on the Color, Size, or Shape card. To change the order (or appearance) of fields in a visualization, drag them around in the legend. Hide legends by clicking on the menu and selecting Hide Card. Likewise, bring them back by selecting the Legend option on the appropriate space in the Marks card or by using the Analysis menu.

Understanding Dimensions and Measures

When you bring a data source into Tableau, the software automatically classifies each field as either a dimension or a measure. The differences between these two are important, though they can be tricky to understand for those who are new at analytics. Perhaps the best way to differentiate these two classifications is to think about them this way: Dimensions are categories, whereas measures are fields you can do math with.

Dimensions

Dimensions are things that you can use to group data by or drill down by. They are usually, but not always, categories (e.g., City, Product Name, or Color), and they can be logically grouped into strings, dates, or geographic fields. Dimensions can also be organized into Tableau groups and hierarchies, which we'll discuss shortly.

Measures

Measures are generally numerical data on which you want to perform calculations—summing, averaging, and so on. The definition of a field as a measure or dimension can be adjusted in the Data Source screen by clicking the data type icon. You can also change this directly in the sheet by either dragging and dropping a dimension to measure, and vice versa, or by clicking the drop-down menu by any field and selecting the Convert to Measure (or Dimension) option.

Continuous and Discrete

Generally, dimensions are discrete, whereas measures are continuous. We could break this down a little more into four types or levels of measurement:

- **Nominal measures** are discrete and categorical (e.g., for/against, true/false, yes/no).
- **Ordinal measures** have order but there are not distinct, equal values (e.g., rankings).
- **Interval measures** have order and distinct, equal values—or at least we assume they are equal (e.g., Likert scales).
- **Ratio measures** have order, distinct/equal values, and a true zero point (e.g., length, weight).

In Tableau, continuous fields produce axes, whereas discrete fields create headers. Continuous means "forming an unbroken whole, without interruption." Discrete means "individually separate and distinct." Be sure you understand the difference between these mathematical terms. Text and categories (dimensions) are inherently discrete. Numbers can be discrete if they can take only one of a limited set of distinct, separate values (e.g., a rating). Numbers, including dates, can be continuous if they can take on any value in a range.

COLORFUL PILLS

When a field is brought from the Data pane and dropped into the Rows and Columns shelves, Tableau creates a "pill." These pills are color coded: Blue pills represent discrete variables, whereas green pills are continuous. The data type icons also reflect these color codes (Figure 3.15).

Figure 3.15 Color-coded pills reflect continuous (green) measures and discrete (blue) dimensions.

Summary

This chapter introduced the Tableau product ecosystem. It then took a high-level view of the Tableau user interface, including connecting and preparing data and the core functionality of the Sheets canvas. In future chapters, you will put this knowledge into practice as you begin working hands-on with this functionality.

The next chapter addresses the importance of context in visual analytics.

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