

Mastering Data Visualization with Tableau

Empowering business decisions with Tableau

Dr. Arpana Chaturvedi

Prof. Praveen Malik



First Edition 2024

Copyright © BPB Publications, India

ISBN: 978-93-55517-524

All Rights Reserved. No part of this publication may be reproduced, distributed or transmitted in any form or by any means or stored in a database or retrieval system, without the prior written permission of the publisher with the exception to the program listings which may be entered, stored and executed in a computer system, but they can not be reproduced by the means of publication, photocopy, recording, or by any electronic and mechanical means.

LIMITS OF LIABILITY AND DISCLAIMER OF WARRANTY

The information contained in this book is true to correct and the best of author's and publisher's knowledge. The author has made every effort to ensure the accuracy of these publications, but publisher cannot be held responsible for any loss or damage arising from any information in this book.

All trademarks referred to in the book are acknowledged as properties of their respective owners but BPB Publications cannot guarantee the accuracy of this information.

To View Complete
BPB Publications Catalogue
Scan the QR Code:



Dedicated to

To my late mother, Smt. Nirmala Awasthi, and my loving family and wonderful children.

– Dr. Arpana Chaturvedi

To my late father, Sh. Tejpal Singh Malik, and my loving family and wonderful children.

– Prof. Praveen Malik

About the Authors

- **Dr. Arpana Chaturvedi** holds a Ph.D. in Computer Science, where she proposed security solutions for DigiLocker and UIDAI. Throughout her 32-year tenure, she has extensively contributed to fields such as IT, security, AI, and ML, supported by her numerous published papers and patents. As a Microsoft Certified Power BI Data Analyst Associate, Dr. Arpana Chaturvedi has significantly impacted the academic growth of undergraduate and postgraduate students. Her proficiency spans a variety of programming languages including Java, Python, C, and C++. Additionally, she imparts knowledge across diverse disciplines such as Linux, Data Structure, Oracle, web technologies, Business Intelligence, Data Visualization, Data Analytics, and Advanced Excel. Her teaching method enriches the curriculum by incorporating practical case studies, preparing students to meet real-world challenges effectively.

Moreover, she ventured into digital marketing and SEO, significantly boosting the digital presence of one institution she was affiliated with for nearly 18 years, where she also developed and managed their website. Her ongoing projects with DST and MSME, along with her research on Ayushman Bharat's impact in UP East Region, demonstrate her active involvement in significant empirical studies. Dr. Chaturvedi's career exemplifies her commitment to blending theoretical knowledge with practical applications, establishing her as a key figure in the educational sector.

- **Prof. Praveen Malik** is a seasoned educator and data analyst with over 19 years of experience in teaching and consulting. As a Microsoft Certified Power BI Data Analyst Associate and expert in MS Excel and Tableau, Mr. Malik has significantly contributed to the academic and professional growth of undergraduate and postgraduate management students. He has developed and taught courses on Business Intelligence, Data Visualization, Data Analytics, and Advanced Excel, integrating real-world case studies and projects. Additionally, Mr. Malik has provided consultancy and conducted numerous Management Development Programs (MDPs) for corporate houses, focusing on advanced data analysis and business intelligence. Passionate about fostering analytical skills and a data-driven mindset, Mr. Malik blends theoretical knowledge with practical insights to create an engaging and impactful learning environment.

Acknowledgements

This book, *Mastering Data Visualization with Tableau: Empowering business decisions with Tableau*, represents a fusion of our passion for data visualization and the powerful capabilities of Tableau in the business arena. The journey to create this manuscript has been enriched and made possible by the tremendous support and encouragement from many outstanding individuals.

I am profoundly grateful to my family: my husband, Rajesh Kumar Chaturvedi, whose unwavering support has been my anchor; my daughter, Aayushee Chaturvedi, whose sweet nature and enthusiasm brighten my days; and my tech-savvy son, Aayush Chaturvedi, whose timely reminders and keen interest in technology have not only kept me on track but have also infused this project with energy and insight, thank you for your endless patience and inspiration.

A special tribute is dedicated to my late mother, Smt. Nirmala Awasthi, whose life as a dedicated educator and resilient single mother has profoundly shaped my values and commitment to education. Her legacy of resilience and empowerment continues to inspire and motivates me daily to empower others through knowledge. Her life's work as a principal and advocate for women's empowerment has left an indelible mark on my heart.

We are indebted to our professional peers and the academic community at the New Delhi Institute of Management. Their insights and feedback have been invaluable, ensuring the content we offer is both practical and cutting-edge.

My heartfelt thanks also extend to the highly dedicated editorial team at BPB Publications, whose expertise and patience helped shape this manuscript into its final form. Their meticulous attention to detail and commitment to excellence have ensured that the content is both practical and cutting-edge.

I deeply appreciate my co-author, Prof. Praveen Malik. Your extensive knowledge and valuable insights in Data Analytics were crucial in shaping this book's content. Collaborating with you has enriched this work immensely, infusing it with a depth of expertise that greatly enhanced the final outcome.

Lastly, thanks to you, our readers, who are dedicated to enhancing your business decisions through sophisticated data visualization. We hope this book not only serves as a valuable learning tool but also as a catalyst for innovation and success in your professional journeys.

– *Dr. Arpana Chaturvedi*

Writing *Mastering Data Visualization with Tableau: Empowering business decisions with Tableau* has been a deeply gratifying journey, and I attribute its success to the unwavering support and encouragement of numerous exceptional individuals.

First and foremost, I wish to express my deepest gratitude to my beloved family. To my wife Alpana, your steadfast support, understanding, and motivation have been my rock throughout this endeavour. Your continuous inspiration and resilience have been invaluable, and I am eternally thankful. To my daughter Anushka and my son Vivaan, your curiosity and enthusiasm have been a driving force, reminding me of the significance of this undertaking.

I must acknowledge and sincerely thank my co-author, Dr. Arpana Chaturvedi.

Your expertise, insights, and dedication have played a pivotal role in shaping the content of this book. Your collaboration and hard work have greatly enriched this project.

A special acknowledgment to BPB Publications for their belief in this endeavour and for providing the necessary resources and support to bring this book to fruition. The professionalism and expertise demonstrated by BPB Publications have made this journey smoother and more rewarding.

I extend my heartfelt thanks to all, including my friends, for their invaluable support and encouragement. Your unwavering belief in both me and my work has been a constant source of inspiration, propelling me to create an exemplary book. Your encouragement, feedback, and insights have been essential in shaping its content and ensuring its quality.

I am truly grateful to each and everyone of you for your valuable contributions. This book is as much yours as it is mine.

– Prof. Praveen Malik

Preface

In the era of big data, the ability to visualize complex datasets has become crucial for effective decision-making. *Mastering Data Visualization with Tableau: Empowering business decisions with Tableau* is designed to equip professionals across industries with the tools they need to harness the full potential of Tableau, one of the leading data visualization software in the market. This book provides a comprehensive exploration of Tableau’s capabilities, from basic functionalities to advanced features, ensuring readers can build compelling, insightful visualizations that drive strategic decisions.

Through step-by-step instructions, practical examples, and detailed explanations, this book aims to transform readers from beginners to proficient users of Tableau. Whether you’re a business analyst, a data scientist, or someone interested in making informed decisions using data, this guide will help you leverage data visualization to its fullest potential.

Chapter 1: Introduction to Data Visualization and Visual Analytics– Explore the evolution and significance of data visualization and learn how visual analytics plays a crucial role in decision-making. This chapter sets the stage with a historical overview and introduces the foundational concepts that underpin modern data visualization practices using Tableau.

Chapter 2: Getting Started with Tableau Desktop– Begin your journey with Tableau Desktop, covering installation, navigation, and basic functionalities. Learn how to transform raw data into meaningful visual insights through practical, hands-on examples, preparing you for more advanced features and applications.

Chapter 3: Connecting to Data Sources and Data Interpretation– Learn to connect Tableau to a variety of data sources and discover how to interpret and manage your data effectively. This chapter covers the integration of disparate data sources and provides a deep dive into the tools Tableau offers for robust data analysis.

Chapter 4: Basic Data Visualization and Graphs in Tableau– Focus on building your foundational skills in data visualization with Tableau by exploring a variety of graph types and their applications. Understand how to select and create effective visual representations to communicate data insights clearly and efficiently.

Chapter 5: Dynamic Interaction: Parameters, Set, Hierarchies, and Sorting– Delve into advanced Tableau functionalities that enhance interactivity and user engagement in your visualizations. This chapter covers the use of parameters, sets, and sorting to tailor visualizations to specific analytical needs.

Chapter 6: Dynamic Interaction Using Filter and Action on Worksheet– Expand your interactive skills by applying dynamic filters and actions within Tableau worksheets. Learn how these tools can enhance the analytical flexibility and interactivity of your dashboards.

Chapter 7: Advanced Data Visualization and Graphs in Tableau– Explore sophisticated visualization techniques that allow for deeper data exploration and presentation. This chapter introduces advanced charts and analytical tools that enable you to uncover and present complex data patterns effectively.

Chapter 8: Calculations in Tableau– Uncover the power of calculations within Tableau to enhance your data analysis. This chapter provides insights into creating calculated fields and using expressions to refine and enhance your data visualizations.

Chapter 9: Dashboard Design and Story Creation– Learn the principles of effective dashboard design and the art of storytelling with data in Tableau. This chapter guides you through creating compelling and informative dashboards that narrate your data’s story effectively.

Chapter 10: Enhancing Dashboards: Sharing and Collaboration– Explore features that enhance the functionality and engagement of your Tableau dashboards. Learn about sharing, publishing, and collaborating using Tableau’s rich set of features to make your visualizations more accessible and impactful.

Chapter 11: Integrating AI in Tableau: An Overview– Investigate the integration of AI and machine learning technologies within Tableau. This chapter discusses how AI can automate insights, enhance data processing, and bring advanced analytical capabilities to your visualizations.

Chapter 12: Data Cleaning and Preparation Using Tableau Prep Builder– Focus on the critical steps of data cleaning and preparation with Tableau Prep Builder. This chapter ensures that you are equipped with the necessary tools and techniques to prepare your data effectively for complex analyses and visualizations.

Teacher resources: This book concludes with a section dedicated to practice exercises and multiple-choice questions that test your knowledge and reinforce the skills acquired throughout the book.

Through this structured exploration of Tableau, readers will gain not only the skills needed to effectively use the software but also an appreciation of the strategic value of data visualization in making informed business decisions. Whether you are a business professional, academic, or data enthusiast, *Mastering Data Visualization with Tableau: Empowering business decisions with Tableau* provides the essential knowledge and skills to transform data into actionable insights.

Tableau Files and Coloured Images

Please follow the link to download the
Tableau Files and the *Coloured Images* of the book:

<https://rebrand.ly/c05b0f>

The Tableau files for the book is also hosted on GitHub at

<https://github.com/bpbpublications/Mastering-Data-Visualization-with-Tableau>.

In case there's an update to the code, it will be updated on the existing GitHub repository.

We have code bundles from our rich catalogue of books and videos available at

<https://github.com/bpbpublications>. Check them out!

Errata

We take immense pride in our work at BPB Publications and follow best practices to ensure the accuracy of our content to provide with an indulging reading experience to our subscribers. Our readers are our mirrors, and we use their inputs to reflect and improve upon human errors, if any, that may have occurred during the publishing processes involved. To let us maintain the quality and help us reach out to any readers who might be having difficulties due to any unforeseen errors, please write to us at :

errata@bpbonline.com

Your support, suggestions and feedbacks are highly appreciated by the BPB Publications' Family.

Did you know that BPB offers eBook versions of every book published, with PDF and ePub files available? You can upgrade to the eBook version at www.bpbonline.com and as a print book customer, you are entitled to a discount on the eBook copy. Get in touch with us at :

business@bpbonline.com for more details.

At www.bpbonline.com, you can also read a collection of free technical articles, sign up for a range of free newsletters, and receive exclusive discounts and offers on BPB books and eBooks.

Piracy

If you come across any illegal copies of our works in any form on the internet, we would be grateful if you would provide us with the location address or website name. Please contact us at **business@bpbonline.com** with a link to the material.

If you are interested in becoming an author

If there is a topic that you have expertise in, and you are interested in either writing or contributing to a book, please visit **www.bpbonline.com**. We have worked with thousands of developers and tech professionals, just like you, to help them share their insights with the global tech community. You can make a general application, apply for a specific hot topic that we are recruiting an author for, or submit your own idea.

Reviews

Please leave a review. Once you have read and used this book, why not leave a review on the site that you purchased it from? Potential readers can then see and use your unbiased opinion to make purchase decisions. We at BPB can understand what you think about our products, and our authors can see your feedback on their book. Thank you!

For more information about BPB, please visit **www.bpbonline.com**.

Join our book's Discord space

Join the book's Discord Workspace for Latest updates, Offers, Tech happenings around the world, New Release and Sessions with the Authors:

<https://discord.bpbonline.com>



Table of Contents

1. Introduction to Data Visualization and Visual Analytics	1
Introduction	1
Structure	1
Objectives	2
Importance of data visualization in decision-making	2
Timeline of data visualization	2
<i>Origins of visual representation</i>	3
<i>Early maps and diagrams: Pre-17th century</i>	3
<i>14th century: Innovative visual concepts</i>	4
<i>16th century: Progress in observation and measurement</i>	4
<i>A leap in geographic visualization</i>	4
<i>17th century: The dawn of scientific visualization</i>	5
<i>18th century: Creative maps and graphical breakthroughs</i>	7
<i>19th century: A century of innovations in data visualization</i>	8
<i>1801-1830: Pioneering visualizations</i>	8
<i>1830-1850: Innovations in data visualization</i>	10
<i>1850-1900: The golden age of statistical graphics</i>	11
<i>20th Century: A new era of data visualization</i>	15
<i>21st century: A new era of data visualization</i>	16
<i>Evolution of data visualization: A journey through centuries</i>	17
Popular data visualization tools	18
Overview of Tableau in data visualization	18
<i>Tableau products</i>	19
<i>Advantages of Tableau</i>	20
<i>Disadvantages of Tableau</i>	20
Overview of Power BI in data visualization	20
<i>Power BI products</i>	21
<i>Advantages of Power BI</i>	21
<i>Disadvantages of Power BI</i>	21
Key differences between Power BI and Tableau	21
Usage of Power BI and Tableau	22
<i>Power BI usage</i>	22
<i>Tableau usage</i>	22
Choosing the best Business Intelligence tool	23
Merits of Power BI and Tableau	24
<i>Advantages of Power BI</i>	24
<i>Advantages of Tableau</i>	24

Conclusion	24
Key facts	25
Practical exercises.....	25
2. Getting Started with Tableau Desktop	27
Introduction	27
Structure	27
Objectives	27
Introduction to Tableau Desktop	28
<i>Installation Process</i>	28
<i>Downloading Tableau</i>	28
<i>Installation</i>	28
<i>First launch</i>	29
Installation and Interface of Tableau Desktop	29
<i>Step-by-step installation of Tableau Desktop on Windows</i>	29
Navigating Tableau Desktop Interface	32
<i>Tableau Navigation</i>	33
<i>Change my Tableau Repository Location (Optional)</i>	34
Working with Workbook Data and Worksheets	35
<i>Working with Worksheets</i>	37
Creating basic data visualizations using the “Show Me” feature	38
Understanding Dimensions and Measures in Tableau.....	38
Conclusion	40
Practice exercises	40
3. Connecting to Data Sources and Data Interpretation	43
Introduction	43
Structure	43
Objectives	44
Overview of Tableau Desktop and Data Integration.....	44
<i>Significance of Data Integration</i>	44
Evolution of Tableau’s data management features	45
<i>Evolution with recent versions</i>	46
Navigating Data connection options in Tableau	47
Introduction to Data sources in Tableau.....	48
<i>Connecting to Files</i>	49
<i>Connecting to Servers</i>	49
Components of the Start Page for Data Connections	50
Launching Tableau Desktop	51
Connecting to Excel Data Sources in Tableau	52
<i>Starting the Connection</i>	52
<i>Accessing the Data Source page</i>	54

Key components of the Data Source page	55
<i>Refreshing your Data Source</i>	58
<i>Adding Data Sources to existing Connections</i>	59
Tableau Data types.....	60
Editing Data Sources in Tableau	61
<i>Editing Sample Superstore Data Source connection</i>	61
Navigating the Data Grid in Tableau	62
<i>Sorting data in Sample-Superstore</i>	62
<i>Rename and Reset Field Names</i>	63
<i>Renaming a column</i>	63
<i>Resetting Field names</i>	63
<i>Calculations in Tableau</i>	63
<i>Copying Values from 'Quantity' column</i>	64
Combining Data in Tableau: Relationships and Joins	64
<i>Using Relationships vs Joins</i>	65
<i>Joining tables in Tableau</i>	65
<i>Understanding types of Joins in Tableau</i>	68
<i>Understanding Join clauses in Tableau</i>	68
<i>Types of Join clauses</i>	69
<i>Handling Null values in Join Keys</i>	69
<i>Cross-Database Joins in Tableau</i>	69
Visualization in Tableau	70
Tableau Design Flow	70
Tableau File types.....	72
Tableau Desktop Navigation: Introduction to Tableau Interface.....	72
<i>File Menu</i>	73
<i>Data Menu</i>	73
<i>Worksheet Menu</i>	74
<i>Dashboard Menu</i>	74
<i>Story Menu</i>	75
<i>Analysis Menu</i>	75
<i>Map Menu</i>	76
<i>Format Menu</i>	76
<i>Server Menu</i>	77
Exploring Tableau Workbook Navigation.....	77
Navigating Worksheets in Tableau Desktop.....	77
Dimensions and Measures.....	78
<i>Dimensions: Categorizing your data</i>	78
<i>Measures: Quantifying your data</i>	79
<i>Blue vs. Green Fields or Pills: Discrete vs. Continuous</i>	79

<i>Field combinations in Tableau views</i>	79
<i>Aggregation in Tableau</i>	80
Conclusion	80
Practical exercise	81
<i>Connecting to Data Sources and Data Interpretation using Tableau Desktop</i>	81
4. Basic Data Visualization and Graphs in Tableau	83
Introduction	83
Structure	83
Objectives	83
Importance of Data visualization and graphs	84
Basic chart types in Tableau Desktop.....	84
<i>Types of charts in Tableau</i>	84
Selecting the ideal chart type in Tableau	85
<i>Chart types and their applications</i>	85
<i>Change Over Time</i>	85
<i>Correlation</i>	86
<i>Magnitude</i>	87
<i>Deviation</i>	88
<i>Distribution</i>	90
<i>Part-to-whole</i>	91
<i>Spatial</i>	93
Other basic charts in Tableau	95
<i>Area charts</i>	95
<i>Box plots in Tableau</i>	97
<i>Highlight Table in Tableau</i>	103
<i>Heat Map in Tableau</i>	107
<i>Packed Bubble charts</i>	108
<i>Text Tables</i>	111
<i>Combination charts in Tableau</i>	115
Understanding the usage of different charts	120
Conclusion	122
Practical exercises.....	122
5. Dynamic Interaction: Parameters, Set, Hierarchies, and Sorting	125
Introduction	125
Structure	125
Objectives	125
Hierarchies in Tableau.....	126
<i>Creating custom hierarchy</i>	126
<i>Practical application: Building a product hierarchy</i>	126

Grouping data in Tableau	128
<i>Example from sample superstore dataset</i>	128
Creating a group in Tableau	129
Including an 'Other' group.....	129
Editing a group	129
Coloring a view using groups	129
Correcting data errors or combining dimension members.....	129
<i>Example: Implementing groups in Tableau with sample superstore</i>	129
Utilizing parameter.....	131
Creating parameter.....	132
Editing a parameter.....	132
Scenario 1: Creating a top N parameter.....	132
Scenario 2: Creating date field parameters in Tableau	135
Utilizing sets	137
Creating dynamic sets	138
Creating fixed sets	139
Modifying set members	143
Using sets in visualizations	143
Combining sets.....	143
Sorting data in Tableau	143
Sorting techniques in Tableau	143
Sorting at the data source level	144
Sorting data within Tableau visualizations	145
Ascending or descending sorting in Tableau	147
Sorting by a specific field in Tableau	151
Nested sorting in Tableau.....	152
Sorting with top N filter in Tableau.....	153
Sorting using a parameter in Tableau.....	154
Alphabetical sorting in Tableau.....	156
Sorting by data source order in Tableau.....	157
Sorting by Pills.....	157
Computed sorting in Tableau	159
Conclusion	160
Practice exercises.....	160
<i>Practice exercises using Sample Superstore Dataset</i>	161
Parameters exercises.....	161
Sets exercises	161
Sorting techniques exercises.....	162

6. Dynamic Interaction Using Filter and Action on Worksheet	163
Introduction	163
Structure	163
Objectives	164
Filters in Tableau	164
<i>Functions of filters in Tableau</i>	<i>164</i>
Types of filters in Tableau	164
Extract filters	165
<i>Extract vs. Live connection</i>	<i>165</i>
<i>Creating an Extract filter in Tableau.....</i>	<i>165</i>
Filter conditions in Tableau	167
Use case 1: Select from List use case	167
<i>All and None: Select from List filter options.....</i>	<i>168</i>
Use case 2: Custom Value List in Tableau's Filter Screen	172
<i>Creating a Custom Value List.....</i>	<i>172</i>
Use case 3: Use All option in Tableau	174
Use case 4: Wildcard Filtering in Tableau.....	174
Use case 5: Filter on Condition in Tableau.....	176
<i>Range of Values option in Tableau</i>	<i>177</i>
Use case 6: Top or Bottom Filters in Tableau	178
Filter by Field	178
Filtering by Formula	179
Data source filters in Tableau	180
<i>Setting up a data source filter.....</i>	<i>180</i>
Context filters in Tableau	183
Working of Context Filters.....	183
Applying Context filters in a worksheet.....	184
Benefits of Context filters	185
Example of Context filter usage.....	185
Removing Context filters.....	186
Dimension filters in Tableau.....	186
Applying a dimension filter.....	187
Features of dimension filters.....	187
Example of using dimension filters	187
Measure filters in Tableau.....	188
Applying a Measure filter	188
Table calculation filters in Tableau.....	190
Understanding table calculation filters.....	190
Applying a table calculation Filter.....	190
Quick filter	192

<i>Understanding Quick filters</i>	192
<i>Applying Quick filters</i>	192
User filter	193
<i>Understanding User filters</i>	193
<i>Applying User filters</i>	193
Filter Order of Operations in Tableau	193
<i>Significance of the Order of Operations</i>	194
Understanding actions in Tableau	194
<i>Strategies used to implement Tableau Actions</i>	194
Navigational actions in Tableau.....	194
Functional actions in Tableau	195
<i>Filter action</i>	195
<i>Steps to create a Filter Action in Tableau</i>	195
<i>Objective of Filter action</i>	196
<i>Field matching in Filter Actions</i>	200
<i>Highlight action</i>	200
<i>Methods to Highlight Marks</i>	201
<i>Example: Highlighting product categories and subcategories</i>	201
<i>Creating an Action Highlight</i>	202
<i>Go to URL Action in Tableau</i>	204
<i>Example: State/Province Wise Sales</i>	204
<i>Create a Go to URL Action</i>	205
<i>Advanced uses of URL Actions</i>	208
<i>Go to Sheet Action in Tableau using Sample Superstore Dataset</i>	208
<i>Example: Navigating from a summary to a detailed worksheet</i>	208
<i>Steps to implement Go to Sheet Action</i>	209
<i>Parameter Actions in Tableau</i>	211
<i>Example: Implementing Parameter Actions in a Scatter Plot</i>	211
<i>Steps to implement Parameter Actions</i>	211
<i>Dynamic interaction</i>	218
<i>Set Actions in Tableau</i>	218
<i>Steps for implementation</i>	218
Conclusion	221
Practice questions.....	222
<i>Basic filtering exercise</i>	222
7. Advanced Data Visualization and Graphs in Tableau	223
Introduction	223
Structure	223
Objectives	224

Bar-in-bar chart.....	224
<i>Creating effective bar-in-bar chart</i>	224
<i>Components of a bar-in-bar chart</i>	224
<i>Using bar-in-bar chart</i>	224
<i>Implementing bar-in-bar chart in Tableau</i>	225
Dual axis charts	227
<i>Key components</i>	228
<i>Using dual axis charts</i>	228
<i>Practical implementation</i>	228
Combo bar chart.....	231
<i>Using combo bar chart</i>	232
<i>Practical implementation</i>	232
Diverging bar chart.....	233
<i>Key components</i>	233
<i>Using diverging bar charts</i>	234
<i>Tableau diverging bar chart instructions</i>	234
Lollipop chart	237
<i>Key components</i>	238
<i>Using a lollipop chart</i>	238
<i>Practical implementation</i>	238
Animated graph or motion chart.....	241
<i>Key components</i>	241
<i>Using a motion chart</i>	242
<i>Practical implementation</i>	242
Racing bar chart.....	246
<i>Key components</i>	247
<i>Using racing bar chart</i>	247
<i>Practical implementation</i>	247
Sparklines in Tableau.....	251
<i>Key components</i>	251
<i>Practical implementation</i>	252
Word clouds in Tableau	254
<i>Purpose and application</i>	254
<i>Creating a Word Cloud in Tableau</i>	254
Calendar chart	256
<i>Purpose and application</i>	256
<i>Key components</i>	256
<i>Implementing calendar chart</i>	256
Donut chart	259
<i>Creating a donut chart with the Superstore Dataset</i>	259
Conclusion	263

Practical exercises.....	263
8. Calculations in Tableau.....	265
Introduction	265
Structure	265
Objectives	265
Calculated fields in Tableau.....	266
<i>Types of calculations for calculated fields.....</i>	<i>266</i>
<i>Steps to create a calculated field</i>	<i>266</i>
<i>Incorporating a calculated field into your Tableau visualization</i>	<i>268</i>
<i>Edit or update a calculated field in Tableau.....</i>	<i>269</i>
Level of detail expressions in Tableau	270
<i>Types of LOD expressions and their working</i>	<i>270</i>
<i>Structure of LOD expressions.....</i>	<i>271</i>
<i>Creating and integrating LOD Expressions in Tableau</i>	<i>271</i>
<i>Creating a Quick Fixed LOD expression</i>	<i>274</i>
Method 1: Quick Fixed LOD creation	274
Method 2: Using context menus.....	276
FIXED LOD expressions	277
Example of FIXED LOD.....	277
INCLUDE LOD expressions	278
Example 1 of INCLUDE LOD.....	278
Example 2 of INCLUDE LOD.....	279
EXCLUDE LOD expressions	280
Example 1 of EXCLUDE LOD.....	280
Example 2 of EXCLUDE LOD.....	281
Table-scoped LOD Expressions	282
Table calculations in Tableau	282
Table calculation functions.....	283
Scope and directions in table calculation	283
"Difference From" table calculations	288
Example:.....	289
Moving calculation	290
Analyzing sales trends with moving averages.....	290
Adding secondary calculation	290
Percent Difference From calculation	291
Analyzing monthly sales trends with percent difference calculations.....	291
Percent From calculation.....	292
Analyzing monthly sales trends.....	292
Percent of total calculation	293

<i>Quarterly and annual sales analysis</i>	293
<i>Percentile calculation</i>	294
<i>Monthly sales percentile ranking</i>	295
<i>Descending vs ascending sorting</i>	295
<i>Rank calculations in Tableau</i>	296
<i>Rank monthly sales data</i>	296
<i>Ascending vs. descending rankings</i>	296
<i>Different rank types in Tableau</i>	297
<i>Choosing the right rank type</i>	297
<i>Running total calculations in Tableau</i>	297
<i>Adding running total calculation in Tableau</i>	297
<i>Percent of Total</i>	299
<i>Calculating percent of total sales</i>	299
<i>Table calculation functions in Tableau</i>	300
<i>Applying table calculations in visualizations</i>	302
String functions in Tableau	302
<i>Creating a String calculation in Tableau</i>	303
<i>Practical application</i>	304
Conclusion	304
Practical exercise: Advanced data analysis with Tableau's Sample Superstore database	304
9. Dashboard Design and Story Creation	307
Introduction	307
Structure	307
Objectives	307
Dashboards in Tableau	308
<i>Types of dashboards in Tableau</i>	308
Creating effective dashboards in Tableau.....	310
<i>Creating a visually compelling and functional dashboard</i>	311
<i>Mobile, desktop, and laptop preview</i>	311
<i>Formatting dashboards and selecting canvas</i>	311
<i>Using tiled and floating objects in dashboards</i>	312
<i>Adding summary boxes, chart titles, captions</i>	312
<i>Incorporating images, text, shading, separator lines</i>	312
Tableau dashboard objects	313
<i>Creating a sales dashboard in Tableau Desktop</i>	314
<i>Practical exercise</i>	314
<i>Understanding Dashboard pane</i>	315
<i>Use of filters in Tableau Dashboards</i>	321
Format filters and set controls.....	322

<i>Formatting Filters</i>	323
<i>Set Controls</i>	323
Dashboard presentation and sharing in Tableau.....	324
Introduction to Tableau stories	326
<i>Getting started with Tableau stories</i>	326
<i>Navigating layout customizations</i>	330
<i>Exploring layout options</i>	330
<i>Bringing data to life with Tableau stories</i>	332
Conclusion	332
Practical exercises 1	333
<i>Exercise 1: Sales performance dashboard</i>	333
<i>Exercise 2: Customer Analysis Dashboard</i>	333
<i>Exercise 3: Inventory and sales efficiency dashboard</i>	334
Practical exercise 2	334
<i>Tasks</i>	335
10. Enhancing Dashboards: Sharing and Collaboration	337
Introduction	337
Structure	337
Objectives	337
Dashboard in Tableau.....	338
Dynamic titles in Dashboard	338
<i>Method 1: Utilizing worksheets for dynamic titles</i>	338
<i>Method 2: Creating dynamic titles with parameters</i>	340
Filter actions in Tableau dashboards	343
<i>Tableau action filters</i>	343
<i>Interactive visualizations with Tableau filter actions</i>	343
<i>Implementing Tableau highlight actions in Tableau dashboards</i>	348
<i>Enhancing Visuals with Tableau Dashboard URL Actions</i>	351
<i>The Go To Sheet action in Tableau Dashboard</i>	355
<i>Set Action in Tableau</i>	357
<i>Using Set Action in a Tableau Dashboard</i>	357
<i>Parameter action in Tableau</i>	360
<i>Implementing parameter actions in a Tableau Dashboard</i>	360
Publishing dashboards to PDF in Tableau	363
<i>Benefits of publishing Dashboards to PDF</i>	365
Exporting packaged workbooks for sharing.....	365
<i>Benefits of exporting Packaged Workbooks</i>	366
Publishing on Tableau Public.....	367
<i>Reason to publish visualization on Tableau Public</i>	367
<i>Benefits of publishing on Tableau Public</i>	368

Conclusion	368
Practice exercises	368
<i>Exercise 1: Sales performance dashboard</i>	368
<i>Exercise 2: Product insights dashboard</i>	369
11. Integrating AI in Tableau: An Overview	371
Introduction	371
Structure	371
Objectives	372
Introduction to AI in data visualization with Tableau	372
<i>Necessary prerequisites</i>	372
<i>How AI works in Tableau</i>	372
<i>Benefits of AI in Tableau</i>	373
Visually driven AI and ML in Tableau.....	373
<i>Core themes of Tableau's AI and ML integration</i>	373
AI and ML throughout the analytics flow in Tableau.....	373
Tableau extensions: Enhancing visualization with AI and ML capabilities	374
<i>Overview of Tableau extensions</i>	374
<i>Functionality of Tableau extensions</i>	374
<i>Benefits of using Tableau extensions</i>	375
Tableau's AI features.....	375
Ask Data.....	376
Prerequisites	376
Steps to use Ask Data.....	376
Features of Ask Data	376
Steps to implement	377
Examples to use Ask Data with the sample superstore dataset	377
Benefits of Ask Data.....	377
Explain Data	378
Prerequisites	378
Steps to use Explain Data	378
Features of Explain Data.....	378
Steps to implement	379
Examples to use explain data with the sample superstore dataset	379
Benefits of Explain Data.....	380
Einstein Discovery in Tableau: Simplifying predictive analytics	380
Prerequisites	380
Steps to use Einstein Discovery in Tableau	380
Features of Einstein Discovery in Tableau.....	380
Steps to implement	381

<i>Examples of using Einstein Discovery in Tableau</i>	381
<i>Benefits of Einstein Discovery in Tableau</i>	382
<i>How Einstein Discovery enhances Tableau</i>	382
Tableau Analytics pane.....	383
Prerequisites	383
Steps to use.....	383
Features	383
Steps to implement.....	384
<i>Examples of using Tableau Analytics pane</i>	384
<i>Benefits of Tableau Analytics pane</i>	384
Integrating Python, R, and Matlab with Tableau for advanced analytics	385
<i>How script integration enhances Tableau</i>	385
<i>Benefits of script integration in Tableau</i>	385
Tableau Business Science	385
<i>Key features of Tableau Business Science</i>	386
<i>Examples of using Tableau Business Science</i>	386
<i>Benefits of Tableau Business Science</i>	387
Tableau GPT.....	387
<i>Overview of Tableau GPT</i>	387
<i>Key features of Tableau GPT</i>	387
Tableau Pulse	388
<i>Overview of Tableau Pulse</i>	388
<i>Key features of Tableau Pulse</i>	388
Use cases and applications of AI features in Tableau	389
<i>Benefits of AI Features</i>	389
<i>Challenges and ethical considerations</i>	390
Conclusion	390
12. Data Cleaning and Preparation Using Tableau Prep Builder.....	391
Introduction	391
Structure	391
Objectives	391
Introducing Tableau Prep	392
<i>Installing Tableau Prep</i>	392
<i>Data preparation fundamentals</i>	392
<i>Data Import and Configuration</i>	393
<i>Connection Pane to Connect Database</i>	393
<i>Practical implementation to create a flow using Sample Superstor Database</i>	394
<i>Using Tableau Prep Builder</i>	395
<i>Working with Order South Sub Directory:</i>	395

Settings.....	397
Tables	401
Data Sample	402
Changes	402
Filter Values	403
Working with Orders_Central Dataset	408
Working with Orders_West Dataset.....	411
Working with Orders_East Dataset.....	414
Cleaning Steps.....	416
Implementation of Cleaning Steps	417
Steps to clean Orders_Central Dataset.....	417
Moving to flow and back to Normal View	421
Spotting and addressing missing values	422
Change Log.....	423
Advanced data transformations	423
Orders_Central dataset : Combining Order Day, Month, and Year as Order Date	423
Steps to clean Orders_West Dataset:.....	428
Steps to clean Orders_East Dataset:.....	430
Union or combination or combining the data set	433
Settings: Post-Union Configuration Review	434
Rename the Union as all Orders	435
Add return reasons_new Dataset:.....	436
Required Cleaning in returns_reason_new dataset:.....	438
Join the Cleaning Notes data.....	441
Applied Join Clauses	442
Join Type.....	442
Summary of Join Results.....	443
Join Clause Recommendation.....	443
Final Cleaning Step for Orders+Returns:.....	445
Generating Output from Tableau Prep	449
Conclusion	453
Multiple choice questions	453
Index	457-464

CHAPTER 1

Introduction to Data Visualization and Visual Analytics

Introduction

In the vast realm of information and data, the age-old adage, *a picture is worth a thousand words*, has never been more pertinent. From ancient civilizations using rudimentary plots to chart the stars, to modern businesses harnessing the power of interactive dashboards, data visualization has been an instrumental tool in conveying complex ideas through comprehensible images. As we embark on this journey through the chapter, we will delve into the rich tapestry of data visualization's history, observing its evolution and understanding its enduring significance in a world inundated with data. Join us as we trace the lines, plots, and charts that have shaped our understanding of the world around us.

In the upcoming chapters, we will discuss data visualization and visual analytics principles and practices, using Tableau as our primary tool. Through practical examples and case studies, we will explore how you can harness the power of data visualization to drive informed decision-making in your organization.

Structure

The chapter covers the following topics:

- Importance of data visualization in decision-making
- Timeline of data visualization
- Data visualization tools
- Overview of Tableau
- Overview of Power BI
- Key differences
- Choosing the visualization tools

Objectives

By the end of this chapter, the readers will be able to trace the historical milestones that shaped the field of data visualization and understand the significance and impact of pictorial data representation in various domains. The readers will also learn to trace the historical milestones that shaped the field of data visualization.

After going through this chapter, the readers will have a basic understanding of how to recognize the key figures and innovations that have propelled advancements in visualization techniques and how to set the foundation for exploring modern tools and trends in subsequent chapters.

Importance of data visualization in decision-making

In today's data-driven world, the volume of information we generate and handle is growing at an unprecedented rate. This explosion of data is changing the way we work and live. At the heart of this transformation is the science of data visualization and visual analytics playing an increasingly critical role in decision-making across various sectors.

The process of data visualization represents data graphically to highlight important trends, outliers, and patterns that may go unnoticed in raw, numerical data. It is a vital aspect of business intelligence because it allows decision-makers to see analytics visually, enabling them to comprehend complex concepts and identify new patterns with ease.

- **Enhancing comprehension:** The human brain is wired to understand visual information better and faster than textual or numerical data. This fact underpins the importance of data visualization. It converts large and complicated datasets into an easily interpretable format, enhancing our ability to comprehend and retain information. Thus, decision-makers can grasp difficult concepts or identify new patterns more readily.
- **Prompting action:** Data visualization transcends mere presentation, offering clear insights into patterns and trends that might remain obscured in raw data. By making these nuances visible, it equips leaders with the information they need to make swift, informed decisions, thereby enhancing both the efficiency and effectiveness of business operations.
- **Revealing hidden insights:** A well-crafted data visualization can reveal insights that were not evident or even thought of. This is particularly true in big data scenarios, where the volume, variety, and velocity of the data can be overwhelming. Visualizations can help tease out subtle correlations, trends, and patterns that could be the key to unlocking significant business value.
- **Facilitating collaboration:** Data visualizations can also facilitate collaboration among stakeholders. It is easier for teams to discuss and understand data in visual form. Whether it is identifying performance issues, forecasting future trends, or strategizing business moves, visual data provides a common language that everyone can understand.
- **Instilling a data-driven culture:** In the era of digital transformation, organizations that leverage data to drive their decisions have a competitive advantage. Data visualization is a cornerstone of this transformation. It allows businesses to communicate insights in a universal manner, promoting a data-driven culture. This culture encourages curiosity, exploration, and objective decision-making, ensuring a more resilient and innovative organization.

Data visualization is an invaluable tool in the decision-making process. It simplifies data interpretation, uncovers hidden insights, promotes quick action, fosters collaboration, and instills a data-driven culture. By leveraging the power of data visualization, organizations can navigate the complexities of the modern business landscape with increased precision and confidence.

Timeline of data visualization

Data visualization has a colorful history that is full of creativity and innovation. It can be considered a visual language that has evolved over time, turning data into meaningful stories. Imagine a world where pictures speak the language of numbers and information. People created these pictures to tell stories hidden in data, making it easier and more interesting to understand. From simple drawings to colorful charts, every image has played a role in making information come alive.

Why were these visualizations created, and what secrets do they reveal? We will explore these questions by diving into key moments that have shaped the world of data visualization. We will uncover brilliant ideas and transformative milestones that have changed how we see and interpret information. In this chapter, we will explore and unveil the fascinating stories hidden in the visual language of data. To further illuminate our exploration of data visualization's rich heritage, the following timeline (*Figure 1.1*) showcases key milestones that have defined the evolution of this dynamic field.

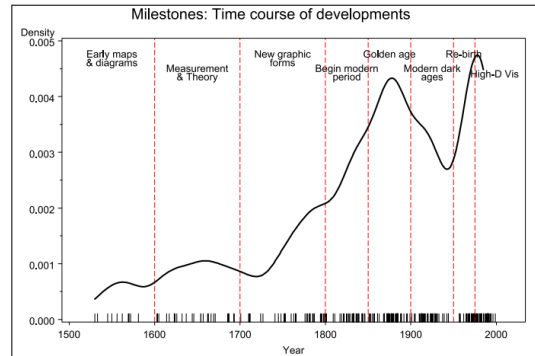


Figure 1.1: Timeline of Key Milestones in Data Visualization History¹

Origins of visual representation

A long time ago, before we had written history, people began using pictures to tell stories and share information. They would draw on cave walls or in the sand to express their ideas and experiences. For instance, the ancient cave paintings in Lascaux, around 40,000 years old, are believed to be early forms of guidebooks for hunting or even maps of the stars.

Early maps and diagrams: Pre-17th century

Our journey starts with simple geometric diagrams and maps, which were in use way before the 17th century. As far back as 200 BC, communities such as the ancient Egyptians used basic coordinates to plan towns and locate stars in the sky.

Claudius Ptolemy, between 85 and 165 AD, made significant contributions by creating earth map projections and setting standards that lasted until the 14th century.

Around 600 B.C., civilizations such as the Babylonians, Egyptians, Chinese, and Greeks began drawing maps on various materials like clay. These maps helped them navigate during travels and plan activities like farming.

In the 3rd century BC, Greek mathematician *Hipparchus* introduced one of the first coordinate systems to track stars, marking a significant advancement in data visualization. These early efforts laid the foundation for the rich field of data visualization that we see today. *Figure 1.2* elucidates the mechanics of this coordinate system.

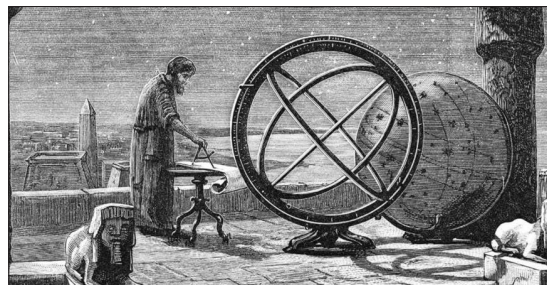
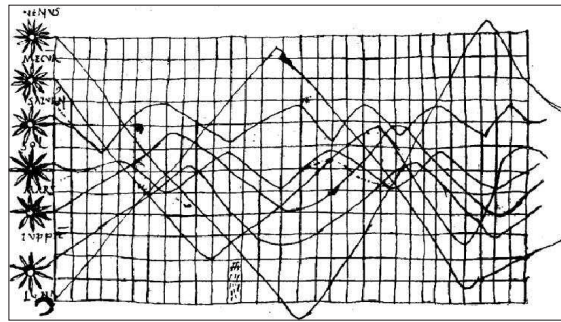


Figure 1.2: Hipparchus' innovative coordinate system²

1. https://www.researchgate.net/figure/The-time-distribution-of-events-considered-milestones-in-the-history-of-data_fig1_45858111
2. <https://www.brown.edu/academics/classics/news/2019/03/presenting-2019-david-pingree-prize-ancient-science>

In the 10th century BC, Islamic scholars used shapes and pictures to explain ideas about astronomy and math. They created detailed graphs that showed the positions of important stars and planets over time, as shown in *Figure 1.3*. These graphs resembled early versions of the coordinate grids and graph papers that were developed much later, in the 1600s and 1700s. These visuals helped people understand complex concepts in a simpler way.



*Figure 1.3: Celestial rhythms: A 10th-century visualization of planetary movements over time*³

14th century: Innovative visual concepts

In the 14th century, a brilliant thinker named *Nicole Oresme* (1323-1382) brought forward some revolutionary ideas. He started drawing theoretical functions, that is, he began using pictures to show and explain mathematical ideas and relationships. His drawings were like the bar graphs we see today, helping people to see and understand the connections between different values more clearly.

16th century: Progress in observation and measurement

Moving on to the 16th century, there was a wave of advancements in the ways people observed and measured things. One of the key figures of this time was *Tycho Brahe* (1546-1601), who made significant contributions by building massive instruments, like the *wall quadrant*, to study the sky more accurately.

During this time, new and important methods were also developed to improve mapping. A technique called **triangulation** was introduced by experts like *Frisius* in 1533 and *Tartaglia* in 1556. This technique made it possible to create more accurate maps by allowing precise locations to be determined and plotted.

A leap in geographic visualization

In the 16th century, maps evolved to include lines of latitude and longitude, enhancing geographic accuracy. To provide a visual context to the discussion on geographic accuracy and innovation in map-making, *Figure 1.4* illustrates how 16th-century cartographers enhanced maps with latitudes and longitudes, paving the way for more precise navigational charts.



*Figure 1.4: Enhancing Maps with Latitudes and Longitudes in the 16th Century*⁴

3. <https://www.semanticscholar.org/paper/Data-driven-Biased-Decision-making-Exploring-the-Bergram-Ochan/ec06dbae0efb397cd505862860dfe8517f2c681e>

4. <https://guides.loc.gov/maps-illustrated-guide/european-atlases>

Key innovations of this era include:

- **Camera Obscura (1545):** Invented by *Reginer Gemma-Frisius*, this tool improved object observation, marking a significant advancement in visualization.
- **Trigonometric tables (1550):** Created by *Georg Rheticus*, these tables refined mathematical calculations, improving data accuracy and representation.
- **First modern atlas (1570):** Abraham Ortelius introduced a comprehensive atlas, revolutionizing map compilation and presentation, setting a solid foundation for future developments in data visualization.

17th century: The dawn of scientific visualization

In this century, a harmonious blend of measurement and theoretical analysis paved the way for enriched scientific insights. Pioneers of this era meticulously intertwined empirical observations with theoretical frameworks, fostering a holistic approach to exploring and understanding various phenomena.

The 17th century was a vibrant era of discovery and innovation in science and mathematics. Pioneers of this age focused on precise measurements like time and distance, essential for astronomy and navigation.

Key milestones:

- **1613: First bar graph:** *Michael Florent van Langren* created the first known bar graph, marking a pivotal moment in the annals of data representation. Refer to *Figure 1.5*:

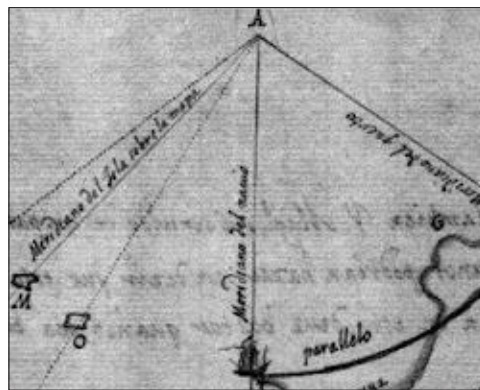


Figure 1.5: Michael Florent van Langren Bar Graph⁵

- o **1626-1630: Tracking sunspots:** *Christopher Scheiner* used small multiples to detail the changing positions of sunspots, enhancing the clarity of visual data. Refer to *Figure 1.6*:

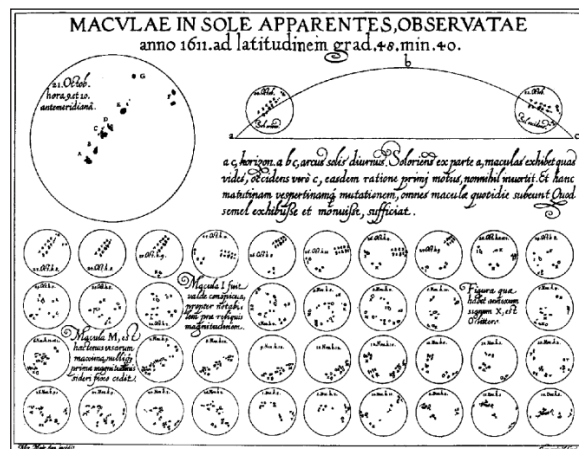


Figure 1.6: Scheiner's 1626 Illustration: Tracking the transformation of sunspots over time⁶

5. https://www.researchgate.net/figure/fig3_227369016
6. Source: Scheiner, 1626-1630