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Interactive Reports in SAS® Visual Analytics
Advanced Features and Customization
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Interactive Reports in SAS® Visual Analytics: Advanced Features and Customization

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About This Book

What Does This Book Cover?

This book contains a variety of examples that enable you to create interactive reports in SAS Visual Analytics using advanced features and customization. You can create interactive links to external websites, use parameters to give the viewer more control over the report, create and add custom graphs and third-party visualizations, execute SAS code using SAS Viya jobs, and even embed report content in your own web pages and apps.

This book does not discuss basic functionality in SAS Visual Analytics, like how to create reports, use report objects, apply filters, or add basic actions or links. It is intended for users that are already familiar with both basic and advanced functionalities in SAS Visual Analytics and want to create more advanced interactive reports that enable viewers to exert more control over their report-viewing experience.

Is This Book for You?

This book is intended for users who are familiar with both basic and advanced features in SAS Visual Analytics. If you do not have any experience with SAS Visual Analytics, see "An Introduction to SAS Visual Analytics: How to Explore Numbers, Design Reports, and Gain Insight into Your Data" by Tricia Aanderud, Rob Collum, and Ryan Kumpfmiller. You can also take the SAS Visual Analytics 1 for SAS Viya: Basics course and the SAS Visual Analytics 2 for SAS Viya: Advanced course.

What Are the Prerequisites for This Book?

Before reading this book and working with the examples, you should know how to do the following:

- Access SAS Visual Analytics
- Build a basic report
- Create calculated items and aggregated measures and understand the difference between the two
- Use objects in SAS Visual Analytics to build reports
- Modify roles and options for report objects
- Create basic filters, actions, links, display rules, and ranks

How to Use This Book

This book can be used as a resource for you to incorporate more advanced functionality and interactivity into your SAS Visual Analytics reports. You don't have to read the book in order! There are many ways you can approach learning and applying the information in this book:

- ***Just-in-time learning***: Use the chapters and examples as you need them. For example, if you need to learn different ways that you can create advanced links, see **Chapter 3: Linking to External Websites**.
- ***Learn more about using the Data pane***: Focus on creating more advanced data items using the Data pane and apply them to your reports. For this approach, see **Chapter 2: Creating Advanced Data Items and Filters**, **Chapter 4: Applying Numeric Parameters**, **Chapter 5: Using Character Parameters**, and **Chapter 6: Working with Date Parameters**.
- ***Learn more about customizations***: Focus on creating your own custom graphs and experiences. For this approach, see **Chapter 7: Using SAS Graph Builder to Create Custom Graphs**, **Chapter 8: Using Data-Driven Content to Create Custom Graphs**, **Chapter 9: Working with Jobs in SAS Visual Analytics**, **Chapter 10: Sharing Reports**, and **Appendix B: Working with Data-Driven Content**.
- ***Learn about using date data items***: Focus on creating and using date data items for your reports. For this approach, see the following examples:
  - **Chapter 2**- Example: Creating a Calculated Item and a Basic Filter
  - **Chapter 4**- Example: Viewing Data for the Next N Years
  - All examples in **Chapter 6: Working with Date Parameters**
- ***Learn about Geo maps***: Learn about creating different types of geographic data items (using predefined roles, using latitude and longitude, and using custom polygonal shapes). For this approach, see the following examples:
  - **Chapter 3**- Example: Linking to a File (coordinate geo map using latitude and longitude)
  - **Chapter 3**- Example: Viewing a Map Location (coordinate geo map using latitude and longitude)
  - **Chapter 3**- Example: Linking to a Parameterized Report (region geo map using predefined geographic roles)
  - **Chapter 4**- Example: Grouping Values Based on a Threshold (region geo map using predefined geographic roles)
  - **Chapter 4**- Example: Viewing Data for the Next N Years (coordinate geo map using latitude and longitude)
  - **Chapter 5**- Example: Selecting a Region (region geo map using custom predefined geographic roles and custom polygonal shapes)
  - **Chapter 6**- Example: Highlighting a Selected Month (coordinate geo map using latitude and longitude)
  - **Chapter 6**- Example: Viewing 10 Years after a Selected Year (coordinate geo map using latitude and longitude)
  - **Chapter 7**- Example: Building a Custom Map (coordinate geo map using latitude and longitude)

- **Chapter 7**- Example: Building a Custom Map with Polygon Layers (region geo map overlaid with coordinate geo map using custom polygonal shapes and latitude and longitude)
- **Chapter 9**- Example: Adding Data to a Table (coordinate geo map using latitude and longitude)
- **Chapter 9**- Example: Updating Data in a Table (coordinate geo map using latitude and longitude)
- **Chapter 9**- Example: Deleting Data from a Table (coordinate geo map using latitude and longitude)

Note: For more information about creating and using custom polygonal shapes in SAS Visual Analytics, see **Appendix A: Loading Geographic Polygon Data to CAS**.

What Should You Know about the Examples?

This book includes tutorials for you to follow to gain hands-on experience with SAS. Before trying the examples, you need to load the data sets to SAS Visual Analytics and import the reports. Most chapters contain starter reports in which you can start working on the example and ending reports that have the final solution.

Note: An administrator might need to import the data and reports for the examples in your environment.

To access the starter reports and ending reports in SAS Viya, do the following:

1. Download the data and the JSON file.
   Note: There is a JSON file that contains all examples in the book and separate JSON files for each chapter. If you are using SAS Visual Analytics 8.5, download the files with the suffix _85. If you are using SAS Visual Analytics 2020.1 (November 2020) or later, download the files with the suffix _2020.1.
2. Using SAS Data Explorer, load data to CAS. You can choose any caslib that you have access to; just make a note of the name of the caslib. For this book, the **Public** caslib was used for most examples and a **Jobs** caslib was created for **Chapter 9: Working with Jobs in SAS Visual Analytics**. Make note of the caslib that you import to in your environment. You'll need this information in the next step.
3. In SAS Environment Manager, on the Content page, do the following:
   a. Click the **Import** icon.
   b. For the **Import file** field, navigate to the location where the JSON file is stored.
   c. On the left side of the Import tab, click **Mapping**.
   d. Click **Tables**.
   e. If your CAS server has a different name than the one used to create the JSON file (cas-shared-default), modify the **Target Server** field to match your server.
   f. If your caslib is different than the ones used to create the JSON file (**Public** and/or **Jobs**), modify the **Target Caslib** field to match your caslib.

g. Click **Import**.
The reports should be stored in the SAS Content/InteractiveReports folder and are organized by chapter.

To access the starter reports and ending reports in SAS®9, do the following:

1. Download the data and the SPK file.
Note: There is an SPK file that contains all examples in the book and separate SPK files for each chapter. If you are using SAS Visual Analytics 7.5 on SAS®9, download the files with the suffix _75.
2. Using self-service import in SAS Visual Analytics, load data to the SAS LASR Analytic Server. You can choose any LASR server and library that you have access to; just make a note of the name of the server and library. For this book, the **LASR Analytic Server** and the **Visual Analytics LASR** library were used for all examples. Make note of the library that you import to in your environment. You'll need this information in the next step.
3. In SAS Management Console, on the Folders tab, do the following:
   a. Right-click the folder where you want the book content to be stored and select **Import SAS Package**.
   b. For **Enter the location of the input SAS package file**, navigate to the location where the SPK file is stored.
   c. Click **Next**.
   d. Verify that all objects are selected and click **Next**.
   e. Click **Next** for the About Metadata Connections step.
   f. If your SAS Application Server has a different name than the one used to create the SPK file (SASApp), modify the **Target** field to match your server name and click **Next**.
   g. If you loaded the data to a different LASR library than the one used to create the SPK file (Visual Analytics LASR), modify the **Target** field to match your library name and click **Next**.
   h. Verify that all tables are available in the library you selected and click **Next**.
   i. View the Summary page and click **Next**.
   j. Click **Finish** when the objects are imported.
   The reports should be stored in the InteractiveReports folder and are organized by chapter.

Software Used to Develop the Book's Content

All the examples in this book were developed using SAS Viya 2020.1 (November 2020). All examples should work in later versions of SAS Viya and in SAS Visual Analytics 8.5, and some examples should work in SAS Visual Analytics 7.5. Any examples that will not work in earlier versions are noted in the text, and, in some cases, an alternative approach is suggested.

Example Data

The following data sets are used in the examples in this book:

- **Accidental_Drug_Deaths**: This data set contains details about accidental drug-related deaths in Connecticut between 2012 and 2018. It has information about the geographic location and the person. This data set is used in the following examples:
  - **Chapter 6**- Example: Highlighting a Selected Month
  - **Chapter 7**- Example: Building a Custom Map with Polygon Layers

- **Austin_Intakes_By_Type**: This data set contains details about animals that were surrendered at an Austin animal shelter. It has information about the number of each type of animal surrendered by date. This data set is used in the following examples:
  - **Chapter 2**- Example: Creating a Moving Average
  - **Chapter 5**- Example: Choosing Multiple Measures

- **Books**: This data set contains details about book ratings from Goodreads (www.goodreads.com). It has information about the books (including the title, ISBN, publication year, authors, and a link to the cover image) and ratings. This data set is used in the following examples:
  - **Chapter 3**- Example: Creating a Web Link
  - **Chapter 8**- Example: Creating a Visualization
  - **Chapter 8**- Example: Incorporating a Visualization into SAS Visual Analytics
  - **Chapter 8**- Example: Using a Visualization as the Target of an Action
  - **Chapter 8**- Example: Highlighting Selected Values in the Visualization
  - **Chapter 8**- Example: Using a Visualization as the Source of an Action

- **Counties_States_US**: This data set contains polygon information for United States counties, states, and the country. The county polygon information was created using shapefiles from the Census. This data set is used in the following examples:
  - **Chapter 5**- Example: Selecting a Region
  - **Chapter 7**- Example: Building a Custom Map with Polygon Layers

- **Customers_Clean**: This data set contains details about customers who purchased products from a fictitious sports and outdoors store, Orion Star. It has information about the customers (including their geographic location) and their orders (including the order type, the amount purchased, and the order date). This data set is used in the following examples:
  - **Chapter 2**- Example: Grouping an Aggregated Measure
  - **Chapter 2**- Example: Creating a Tabular Aggregated Measure
  - **Chapter 3**- Example: Linking to a Parameterized Report
  - **Chapter 4**- Example: Showing Top Customers
  - **Chapter 5**- Example: Ranking Top or Bottom Values

- **Customers_Loc**: This data set contains details about customers who purchased products from a fictitious sports and outdoors store, Orion Star. It has information about the customers (including the distance from purchase, satisfaction, and geographic location) and products purchased (including the brand, make, style, prices, costs, and quality). This data set is used in the following examples:
  - **Chapter 3**- Example: Linking to a File
  - **Chapter 4**- Example: Highlighting Values below a Threshold
  - **Chapter 7**- Example: Syncing Hierarchies
  - **Chapter 8**- Example: Using a Circle Packing Plot
  - **Chapter 8**- Example: Using and Modifying a Sunburst Plot

- **Employees_Clean**: This data set contains details about employees who work for a fictitious sports and outdoors store, Orion Star. It has information about the employees (including their department, job title, salary, hire date, and profits generated) and their managers. This data set is used in the following example:
  - **Chapter 2**- Example: Using a Common Filter

- **Forecast_Of_Injuries**: This data set contains a forecast of injuries from motor vehicle accidents in California. It was created from the **MVAINJURIES** data set. This data set is used in the following example:
  - **Chapter 7**- Example: Creating a Chart with Overlays

- **Honey_Prices**: This data set contains details about average honey prices by year for all states within the United States. This data set is used in the following example:
  - **Chapter 4**- Example: Grouping Values Based on a Threshold

- **Insight_Toy_Company_2017**: This data set contains details about orders for a fictitious toy company, Insight Toy Company, for the year 2017. It has information about the orders, facilities (including geographical information, number of employees, and efficiency), customers (including geographical information, distance, and satisfaction), units (including age, capacity, production, and yield), products (including brand, line, style, prices, costs, and quality), and sales reps. This data set is used in the following example:
  - **Chapter 7**- Example: Building a Custom Map

- **Jobs**: This data set contains details about jobs available in New York City. It has information about the jobs, including the title, category, career level, salary range, minimum requirements, and preferred skills, as well as a job description. This data set is used in the following example:
  - **Chapter 5**- Example: Searching for a String

- **MVAINJURIES**: This data set contains details about injuries from motor vehicle accidents in California for the 1990s and the 2000s. It has information about the injuries, the number of vehicles, the number of drivers, and the population. This data set is used in the following examples:
  - **Chapter 6**- Example: Viewing the Last Five Years of Available Data
  - **Chapter 7**- Creating a Chart with Overlays

- **Orders43K**: This data set contains details about orders placed at a fictitious sports and outdoors store, Orion Star. It has information about orders (including totals, costs, dates, and notes), vendors, facility locations, and products. This data set is used in the following examples:
  - **Chapter 2**- Example: Creating a Periodic Aggregated Measure and Adding Time Filters
  - **Chapter 6**- Example: Displaying Data within a Selected Range
  - **Chapter 9**- Example: Returning SAS Results
  - **Chapter 9**- Example: Returning SAS Results Using an HTML Form

- **Parks/National_Parks**: This data set contains details about national parks in the United States. It has information about the location of the park and the number of acres in each park. This data set is used in the following examples:
  - **Chapter 3**- Example: Viewing a Map Location
  - **Chapter 9**- Example: Adding Data to a Table
  - **Chapter 9**- Example: Updating Data in a Table
  - **Chapter 9**- Example: Deleting Data in a Table

- **PG1**: This data set contains details about courses attended by students who took the SAS Programming 1: Essentials course. It has information about training classes conducted within various SAS training centers (including the length of the course, the training center where the course was conducted, and the end date of the course). This data set is used in the following examples:
  - **Chapter 2**- Example: Creating a Calculated Item and a Basic Filter
  - **Chapter 3**- Example: Searching a Web Page

- **Products_Clean**: This data set contains details about products purchased from a fictitious sports and outdoors store, Orion Star. It has information about the products (including names, categories, and groups), suppliers (including geographic information), and orders (including dates, costs, and quantities). This data set is used in the following examples:
  - **Chapter 3**- Example: Creating a Static URL Link
  - **Chapter 3**- Example: Linking to a Parameterized Report
  - **Chapter 4**- Example: Displaying Countries with Orders above a Minimum

- **SolarEclipse_2021**: This data set contains details about solar eclipses starting in 2021 and extending through the year 3000. It has information about the eclipses, including the location, date, type, catalog (or identification) number, and Terrestrial Dynamical Time. This data set is used in the following examples:
  - **Chapter 4**- Example: Viewing Data for the Next N Years
  - **Chapter 6**- Example: Viewing 10 Years after a Selected Year

- **Species**: This data set contains details about species found in national parks in the United States. It has information about the park and the species (including the common and scientific name, the order, the seasonality, and the conservation status). This data set is used in the following example:
  - **Chapter 5**- Example: Selecting Characteristics for Indirect Filtering

- **Stocks**: This data set contains details about stock prices for three companies: IBM, Microsoft, and Intel. This data set is used in the following examples:
  - **Chapter 7**- Example: Using a Data-Driven Lattice
  - **Chapter 7**- Using Overlays with a User-Defined Lattice

- **Taxes2017**: This data set contains details about the number of tax returns for 2017 for various states and counties. This data set is used in the following example:
  - **Chapter 5**- Example: Selecting a Region

- **VA_Dummy_Data_Body**: This data set is a dummy data set that can be used for creating new data items that contain a list of values for use with character parameters. This data set was created by Stu Sztukowski in his paper *Mastering Parameters in SAS Visual Analytics*. This data set is used in the following examples:
  - **Chapter 5**- Example: Ranking Top or Bottom Values
  - **Chapter 5**- Selecting a Region

You can access the example code and data for this book by linking to its author page at https://support.sas.com/ball.

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About The Author

Nicole Ball, a Principal Technical Training Consultant at SAS, teaches courses on SAS Visual Analytics, SAS Data Quality, and the SAS programming language. Nicole is also a course developer for SAS Visual Analytics, which includes writing and updating courses and preparing customized training. Before coming to SAS, Nicole was an Economic Analyst at the Federal Reserve where she learned more about SAS code and how to apply it to real-world problems. She has an MS in Economics from the University of Texas at Dallas and a BA in Economics from Trinity University in San Antonio, TX. When she's not learning about new features in SAS software and trying to come up with neat solutions to student questions, Nicole loves to crochet and design stuffed animals, read fiction books of any kind, and do CrossFit. Nicole currently lives in Celina, TX, with her husband, Keith, and their dog, Winston.

Learn more about this author by visiting her author page at http://support.sas.com/ball. There you can download free book excerpts, access example code and data, read the latest reviews, get updates, and more.

Chapter 1: Introduction

Introduction

The introduction and evolution of technology has increased the amount of time available for analyzing data and presenting those findings to others. Data visualization is a useful part of any project because it fosters a better understanding of the data, which can help with identifying future areas for analysis. Because the human brain can process information displayed in a chart or graph more easily than lists of numbers in tables and spreadsheets, data visualization has quickly become one of the more popular ways to convey messages.

Choosing the best visualization to showcase your data or tell your story is even more important. In fact, as data collection and preparation gets faster and easier, more emphasis is placed on ensuring that your reports are both nice looking and useful. Creating a beautiful, effective report is both an art and a science. Your reports must be visually appealing and easy to use. Creating user-friendly reports, however, can require extra time and effort from the report designer. Not only must the designer understand the audience and their requirements for the report, but the designer also needs to have an intimate knowledge of the reporting tool being used in order to implement the desired functionality.

This book will help you develop that knowledge. It contains a variety of examples that enable you to customize SAS Visual Analytics reports to enhance the viewer experience. Specifically, it walks you through creating interactive links to external websites, using parameters to give the viewer more control over the report, adding custom graphs and third-party visualizations, using SAS code to extend the functionality of the report, and even embedding report content in your own web pages or apps.

This book is recommended for users who are familiar with both basic and advanced functionality of SAS Visual Analytics in SAS Viya and who want to create reports that enable users to exert more control over their experience. This would be a great follow-up to *An Introduction to SAS Visual Analytics* or for students who have taken the SAS Visual Analytics 1 for SAS Viya: Basics course or the SAS Visual Analytics 2 for SAS Viya: Advanced course.

SAS Visual Analytics

SAS Visual Analytics is data visualization software that enables you to quickly identify trends and patterns in your data and use that insight to solve difficult problems, improve business performance, predict future performance, and mitigate risk.

SAS Visual Analytics is available both on SAS®9 and in SAS Viya. SAS Visual Analytics in SAS®9 uses the SAS LASR Analytic Server to store data in memory, whereas SAS Visual Analytics in SAS Viya uses SAS Cloud Analytic Services (CAS), a server that provides the run-time environment for data management and analytics with SAS. Although there are some differences in how each operates behind the scenes, the report designer is accessing data quickly and easily in both cases. In fact, a lot of the functionality between SAS Visual Analytics on SAS®9 (specifically version 7.5) and SAS Visual Analytics in SAS Viya is the same. Many of the examples in this book can be performed both in SAS®9 and in SAS Viya. However, SAS Viya does have many features that are not available in SAS®9 (for example, the examples in Chapter 8 and 10). Examples that can be implemented only in specific versions of SAS Visual Analytics are noted.

Starting in 2020, SAS Viya has been re-engineered to take advantage of the latest cloud technologies and has been designed to be delivered and updated continuously. This enables customers to access new features as they become available or even incorporate updates on their own schedule. Although this approach puts solutions into the hands of the customers more quickly, it makes it a bit challenging to differentiate between versions. Most of the examples in this book were created using SAS Visual Analytics 2020.1 but will also work in future versions and in SAS Visual Analytics 8.5.

SAS Viya

SAS Viya is a cloud-ready analytics and data management engine that uses CAS to process and analyze data. When performing analytics, CAS efficiently spreads big data processing across all nodes in the cluster, which results in very fast operations. In this configuration, CAS has a communications layer that supports fault tolerance, meaning it can continue processing requests even after losing connectivity to some nodes. It does this by distributing work to other nodes. This communications layer also enables you to dynamically delete and add nodes to the system while the server is running.

CAS is designed to run in a single-machine (symmetric multiprocessing, SMP) or multi-machine (massively parallel processing, MPP) configuration. For both configurations, the CAS server uses multi-threaded algorithms to rapidly perform analytic processing on in-memory data of any size. In fact, the CAS server can continue processing data even when the memory capacity of the server is exceeded.

In the single-machine configuration, all processing is completed on one node. The multi-machine configuration, however, consists of one controller and one or more worker nodes, and it provides optimal processing capabilities.

The following applications are available in SAS Viya and are used throughout this book (in no particular order):

- **SAS Studio**: The programming application that enables you to prepare and create SAS data sets and CAS tables using SAS code and tasks.
- **SAS Data Studio**: The data preparation application that enables you to prepare CAS tables and create CAS tables using transforms. In SAS®9, SAS Visual Data Builder enables users to prepare data and create new LASR tables.
- **SAS Visual Analytics**: The analysis and reporting application that enables you to visualize data, build statistical models, create interactive reports, and view reports in a browser.
- **SAS Graph Builder**: The custom graph application that enables you to create custom graph objects for use in building reports.
- **SAS Environment Manager**: The administration application that enables you to manage the environment.

In addition to using SAS Viya applications to access CAS, you can also use scripts via the command line interface (CLI), REST APIs, and third-party languages (such as Python, R, Lua, and Java).