



SAS[®] Visual Analytics for SAS[®] Viya[®]



SAS Institute Inc.

The correct bibliographic citation for this manual is as follows: SAS Institute Inc. 2020. *SAS® Visual Analytics for SAS® Viya®*. Cary, NC: SAS Institute Inc.

SAS® Visual Analytics for SAS® Viya®

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ISBN 978-1-952365-13-3 (Hardcover)

ISBN 978-1-952365-09-6 (Paperback)

ISBN 978-1-952365-10-2 (Web PDF)

ISBN 978-1-952365-11-9 (EPUB)

ISBN 978-1-952365-12-6 (Kindle)

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About This Book

What Is This Book About?

SAS Visual Analytics is a web-based product that leverages SAS High-Performance Analytics technologies to empower organizations to explore huge volumes of data very quickly to identify patterns, trends, and opportunities for further analysis. SAS Viya modernizes the SAS Platform with features like high availability for always-on answers, faster in-memory processing, and native cloud support. Resilient and scalable, SAS Visual Analytics on SAS Viya can handle more users, more data, and a wide range of BI and analytical workloads in a consistent and governed manner.

The book covers the material included in the [SAS® Certified Specialist: Visual Business Analytics 7.5/8.3](#) exam, which is designed for analysts who are using SAS Visual Analytics to analyze data and design reports. It covers the following three main areas:

- Adding and manipulating data items within SAS Visual Analytics
- Analyzing data with SAS Visual Analytics
- Designing and sharing reports using SAS Visual Analytics

Is This Book for You?

SAS Visual Analytics with SAS Viya is written for anyone in an organization who wants to create, share, and collaborate on insights from data with SAS Visual Analytics, including decision makers, business analysts, report creators, and citizen data scientists. No SAS programming skills are necessary.

The first part of the book introduces the basics needed to prepare and explore your data, make discoveries, and create a report in SAS Visual Analytics. The second section introduces more advanced topics, including using automated explanation and creating advanced interactive reports with parameters using SAS Visual Analytics

What Should You Know about the Examples?

This book includes demonstrations and practices for you to follow to gain hands-on experience with SAS Visual Analytics.

Software Used to Develop the Book's Content

SAS Visual Analytics on SAS Viya (Version 8.5 and 8.3).

Example Code and Data

The data sets used in the book's demonstrations and practices are provided to download.

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

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Chapter 1: Introduction to SAS Visual Analytics

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1.1 Introduction

This chapter gives you an overview of SAS Visual Analytics and explains the main difference in architecture between SAS Visual Analytics and SAS Visual Analytics in SAS Viya. We then describe the different roles or levels of permission available in Visual Analytics and introduce the business scenario and data that are used in the first part of the book.

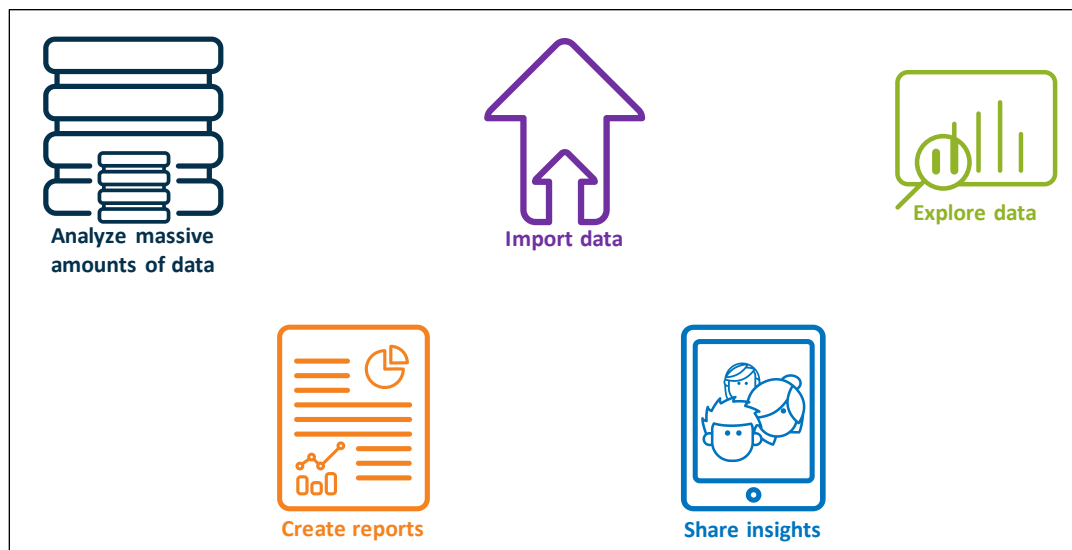
Each chapter contains demos to reinforce the content and a quiz or exercises, and practices so you can test your new skills. The solutions of the quizzes, exercises, and practices can be found at the back of the book.

SAS Visual Analytics

SAS Visual Analytics enables you to explore and analyze massive amounts of data, easily create reports, and share insights.

In traditional reporting, the resulting output is well defined up front. That is, you know what you are looking at and what you need to convey. However, data discovery invites you to plumb the data, its characteristics, and its relationships. Reports can then be made available on a mobile device or on the web. In addition, users can create powerful statistical models (if SAS Visual Statistics is licensed) and work with factorization machines, forests, gradient boosting, neural networks, and support vector machines (if SAS Visual Data Mining and Machine Learning is licensed).

Figure 1.1: SAS Visual Analytics Features



SAS Visual Analytics in SAS Viya

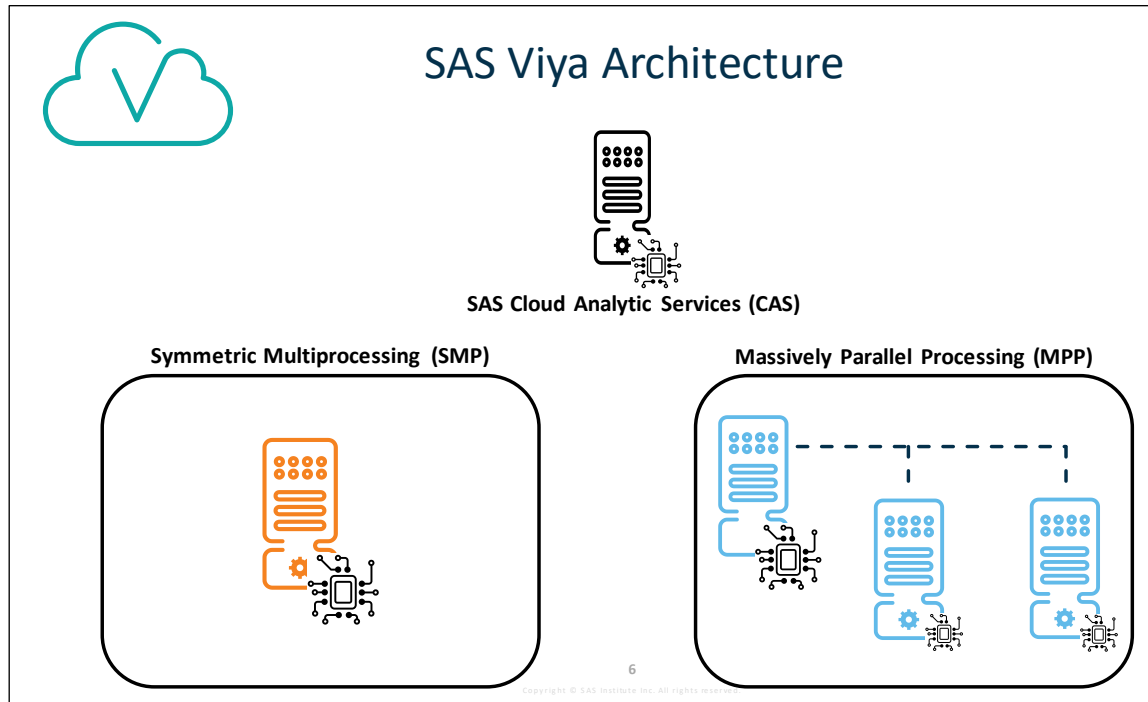
SAS Viya is an open, cloud-enabled, analytic run-time environment with a number of supporting services, including SAS Cloud Analytic Services (CAS). CAS is the in-memory engine on the SAS Platform.

With SAS Visual Analytics in SAS Viya, the compute engine of SAS Visual Analytics 7.x, SAS LASR Analytic Server, has been replaced by the CAS server. The main difference from the SAS LASR Analytic Server is that data preparation is no longer executed by a SAS program on the head node. The CAS server brings its own data preparation capabilities, spreading its workload to all workers across a distributed environment. This enables data management transformations to take place on larger data volumes with short execution times because the operations are done in parallel across the worker nodes.

SAS Viya Architecture

At the heart of SAS Viya, CAS provides the run-time environment for data management and analytics. It uses scalable, high-performance, multi-threaded algorithms to rapidly perform analytical processing on in-memory data of any size. CAS is designed to run in a single-machine symmetric multiprocessing (SMP) or a multi-machine massively parallel processing (MPP) configuration, supporting multiple platform and infrastructure configurations.

Figure 1.2: SAS Viya Architecture



SAS Viya Applications

SAS Drive is a hub for the SAS Viya applications that enables you to easily view, organize, and share your content from one place.

The availability of the features in SAS Drive depends on the applications that have been installed, and the features and permissions that have been specified by your administrator. To access SAS Drive, enter the URL provided by your administrator (for example, <https://prod.host.com/SASDrive>). SAS Drive is always available from the Applications menu in the upper left. From SAS Drive, you can access your installed applications, including those in Table 1.1 below.

Table 1.1: SAS Viya Applications

Application	Description
SAS Drive	Collaborative interface for accessing, organizing, and sharing content
SAS Visual Analytics	Visualize data interactively, create interactive reports, build statistical models, view reports in a browser
SAS Visual Analytics App	View reports on a mobile device or tablet
SAS Data Studio	Prepare data using data transforms
SAS Graph Builder	Create customized graph objects
SAS Environment Manager	Manage the environment
SAS Theme Designer	Create custom themes for the application or reports

Application	Description
SAS Cloud Analytic Services (CAS)	Cloud-based, run-time environment server for data management and analytics
SAS Studio	Perform programming tasks
SAS Data Explorer	View, reload, and import data to CAS
SAS Lineage Viewer	View and understand relationships between objects (tables, plans, reports)

1.2 SAS Visual Analytics Process

To help you make sense of the growing data within your organization, SAS Visual Analytics provides an interactive user experience that combines advanced data visualization, an easy-to-use interface, and powerful in-memory technology. This enables a wide variety of users to visually explore data, execute analytics, and understand what data means. Then they can create and deliver reports wherever needed via the web, mobile devices, or Microsoft Office applications.

Figure 1.3: SAS Visual Analytics Methodology



Table 1.2: SAS Visual Analytics Methodology Phases

Phase	Description
Access	In the Access phase, you identify analysis tables that will be used in Visual Analytics and load those tables into CAS.
Investigate	In the Investigate phase, you inspect the tables to determine whether any changes are needed for data items due to data inconsistencies or data quality issues, as well as identify any new data items that need to be calculated.
Prepare	In the Prepare phase, you correct any data quality issues and create any new calculated items needed for analysis.

Phase	Description
Analyze	In the Analyze phase, you explore the data to identify any patterns, relationships, and trends.
Report	In the Report phase, you develop interactive reports that can be shared via the web or a mobile device.

Understanding Roles

Not all users have all permissions to carry out all parts of the process above. Your capabilities from SAS Drive are based on the role that your SAS Visual Analytics administrator assigned to you. The roles exist to define how users interact with the application. For example, a user assigned the consumer role reviews reports or analyses. In contrast, they don't need to access the advanced functionality. SAS provides an initial set of rules to control your users' access to functionality. By default, initial rules are created at installation for the following users:

- **All authenticated users** – Users can access selected functions within applications, such as the Dashboard, Data, Servers, and Content pages in SAS Environment Manager and functionality in SAS Visual Analytics. Users can also perform operations on folders and on the objects that the folders contain.
- **SAS administrators** – Users can access everything that is under the control of the general authorization system.

Figure 1.4: SAS Visual Analytics Users

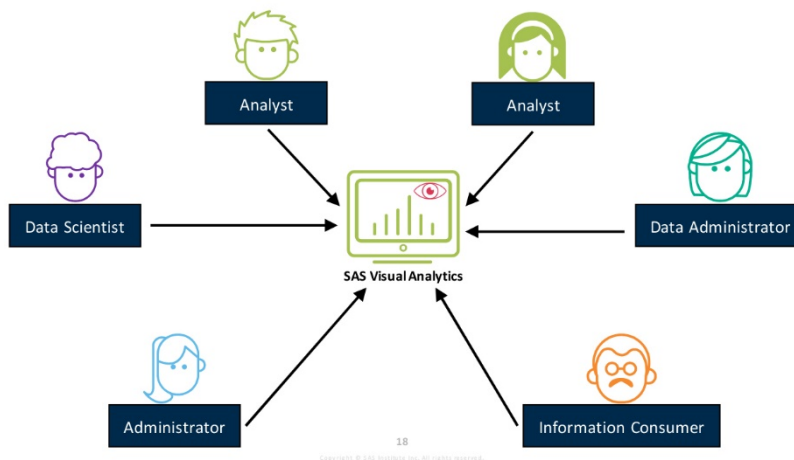


Table 1.3: SAS Visual Analytics User Roles

Role	Description
Consumer	Views the reports, analytics, and dashboards for content. Can use a desktop or mobile device to consume the reports. Consumers might be internal or external to the organization based on how SAS Visual Analytics is configured.
Content Builder	Such as an analyst or data scientist. Creates content like reports, explorations, and dashboards for consumers. This role might produce the data sets or use those made available from the data administrator.

Role	Description
Data Administrator	Schedules and loads data tables into SAS Visual Analytics. Makes data from multiple data sources available to the application.
Platform Administrator	Manages the SAS Visual Analytics environment and platform, which includes controlling the folder structure, user accounts, and access to the content.

Depending on an organization's size, some users might fill more than one role. In a smaller organization, one person might be responsible for creating content and administering the system. In larger organizations, there might be entire departments devoted to each role.

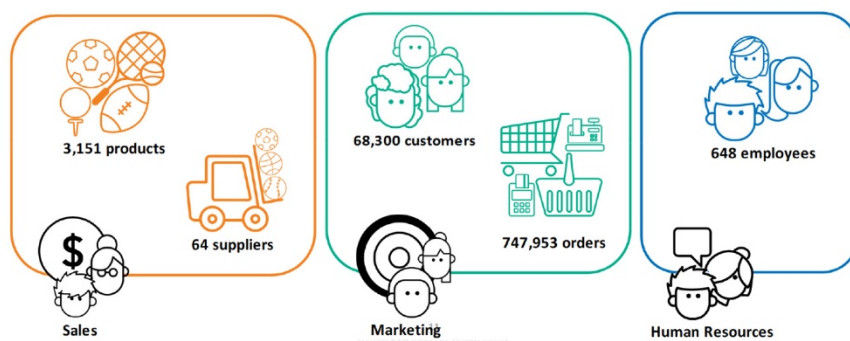
For more information about managing roles and their capabilities, refer to the SAS Visual Analytics Administration Guide for your release.

Introducing the Data

The data used in the first part of this book is taken from a sports store called Orion Star Sports & Outdoors. The business scenario we use is that you have been hired as an analyst and report designer at the store, and you will be asked to explore and build certain reports from the data. We explore and report on the variables such as products, suppliers, customers, orders, and employees.

Figure 1.5: Orion Star Sports & Outdoors

You have been hired as an analyst and report designer at Orion Star Sports & Outdoors.



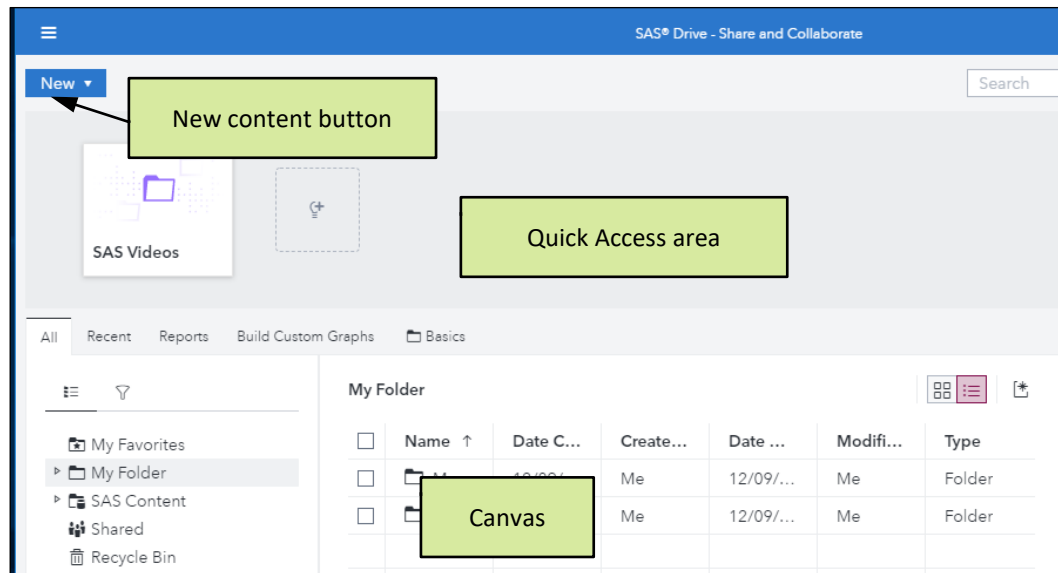
Before getting into the data, let's start by signing in and exploring the components of SAS Drive with a short demo.



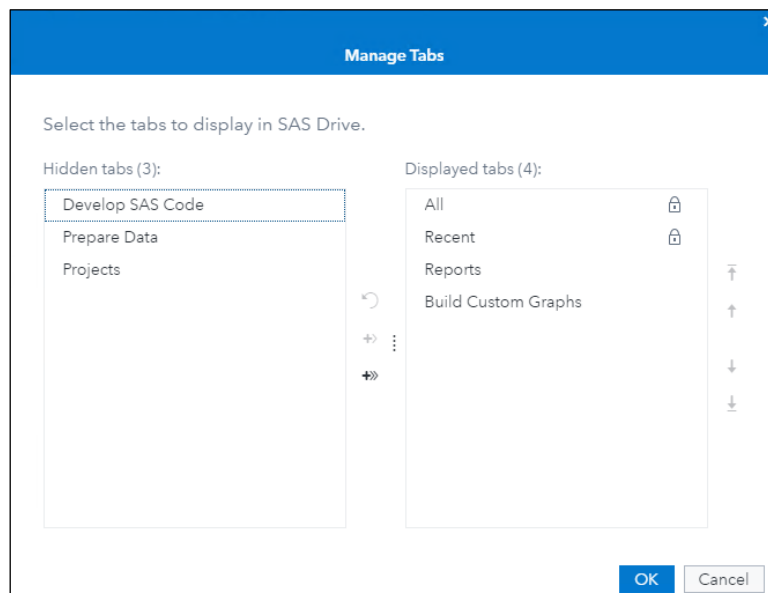
Demo 1.1: Exploring SAS Drive

This demonstration illustrates signing in and exploring the components of SAS Drive.

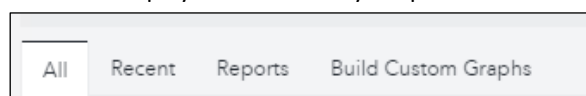
1. From the browser window, sign in to SAS Viya.
SAS Drive is displayed by default.



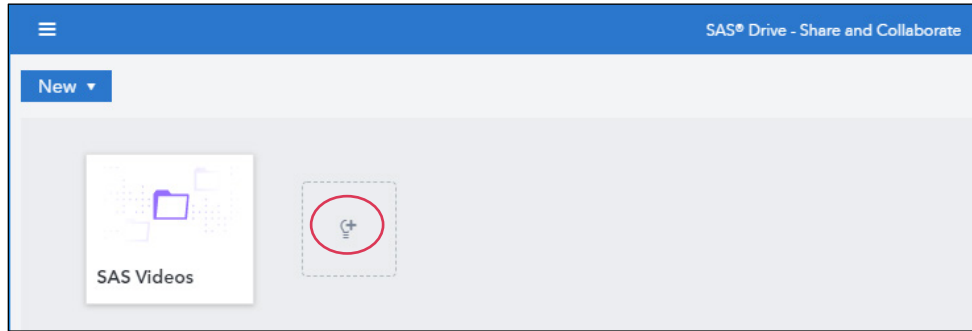
2. In the upper right corner, click (Menu) and select **Manage tabs**.
3. In the Displayed tabs list, select **Projects**.
4. Click (**Remove all**) to hide all the displayed tabs.
Note: All tabs are moved except the All tab and the Recent tab.
5. In the Hidden tabs pane, double-click **Reports** and **Build Custom Graphs** to add them to the Displayed tabs pane.




6. Click **OK**.
SAS Drive displays the tabs that you specified.

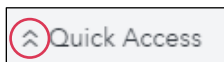


7. View the Quick Access area.

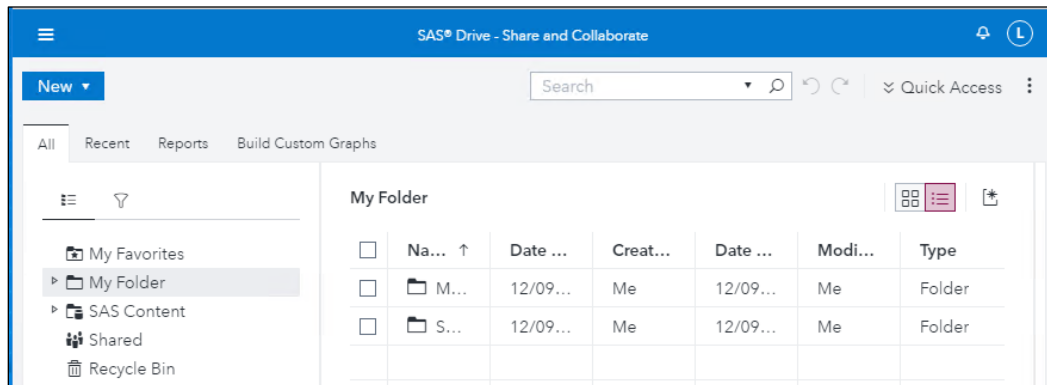


The Quick Access area is a location in SAS Drive where you can add content that you frequently access. Included in the Quick Access area is **Add recommendations**. This automatically adds recently viewed or accessed reports to the Quick Access area.

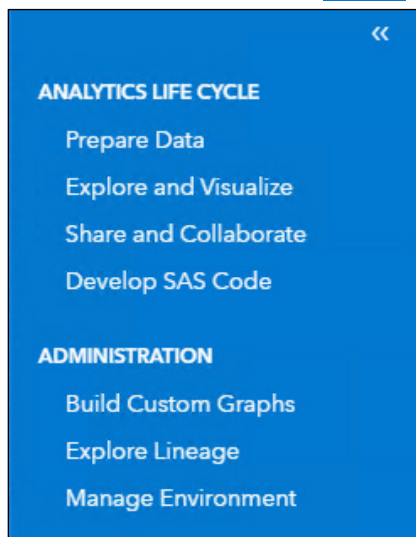
8. In the upper right corner, click the double arrow  to hide the Quick Access area.




SAS Drive should resemble the following:



9. In the upper left corner, click  (Show list of applications) to view the available applications.

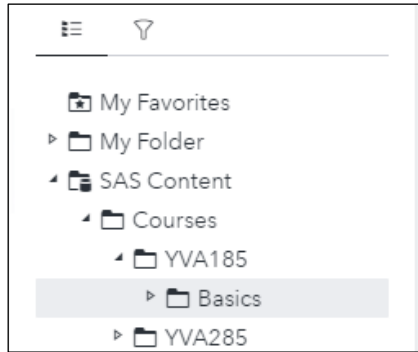


10. Click  (Hide applications menu) to close the applications menu.

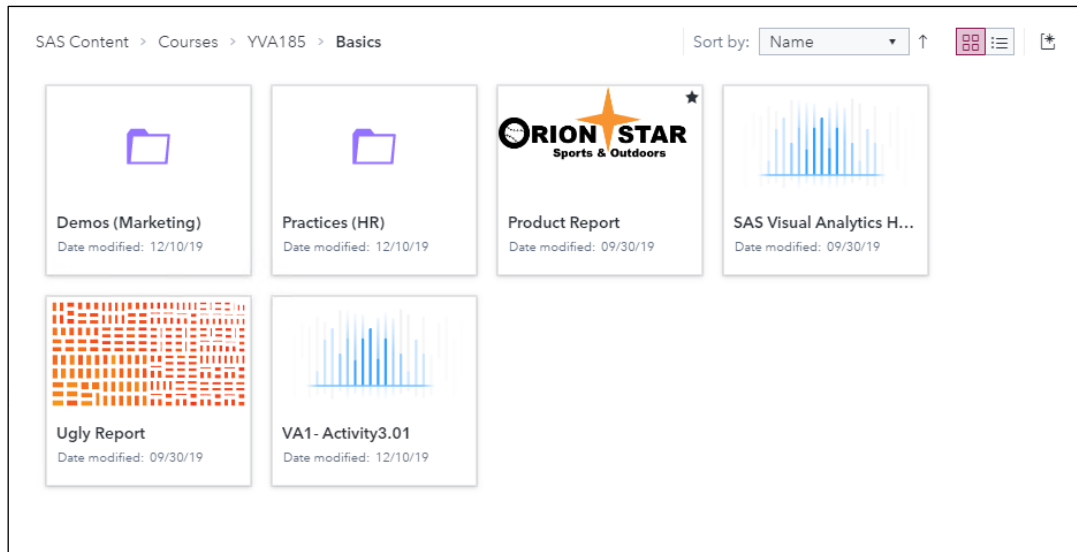
11. On the All tab, in the right corner, click  (Tile view).

12. On the All tab, expand **SAS Content** ⇒ **Courses** ⇒ **YVA185**.

13. Select the **Basics** folder.

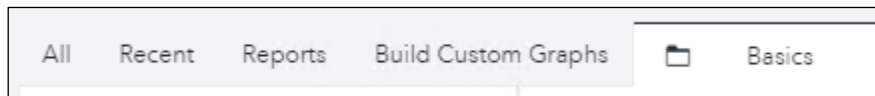


The Basics folder contains two folders and four reports.



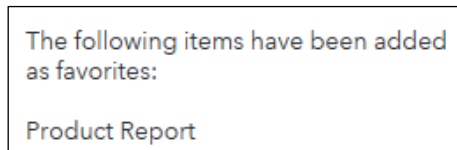
14. In the navigation pane, right-click the **Basics** folder and select **Make this a tab**.

A new tab is added to the canvas.



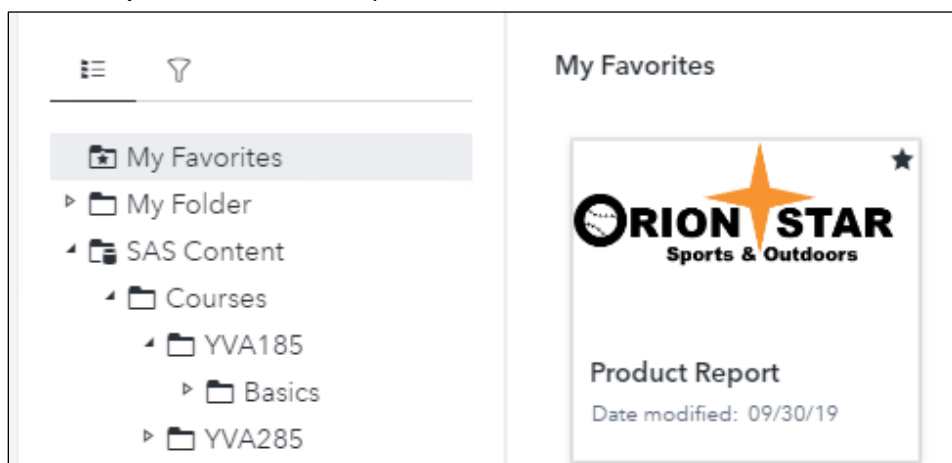
15. Right-click **Product Report** and select **Add to Favorites**.

A message appears.

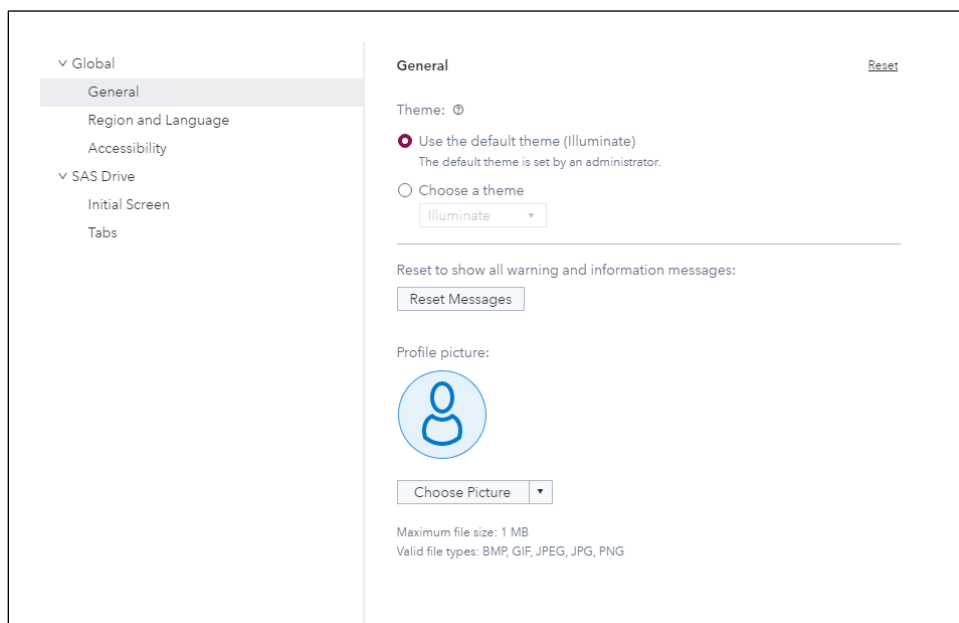


A favorites indicator (★) is added to the Product Report tile.

16. Click the **All** tab and select the **My Favorites** folder.
Product Report is added to the My Favorites folder.



17. View settings.
18. In the upper right corner, select **<user name>** ⇒ **Settings**.
19. If necessary, in the Global section, select **General**.

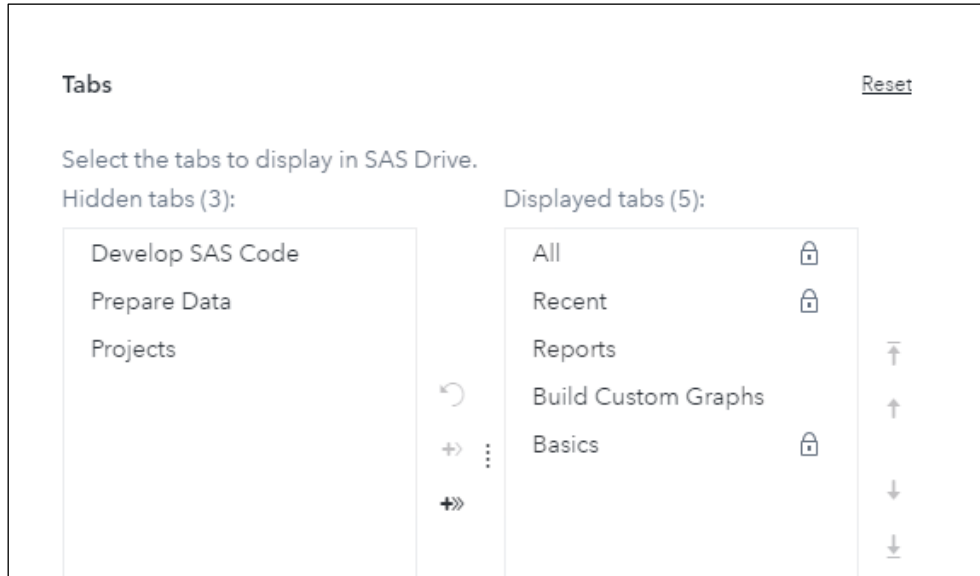


Global settings apply to all the SAS Viya applications.

20. In the SAS Drive section, select **Initial Screen**.



You can set the screen that appears when you sign in to SAS Viya.

21. Select **Tabs**.

The Displayed tabs list reflects the changes that you made earlier using **Manage tabs** and includes the new tab created from the Basics folder.

22. Click **Close**.

End of Demonstration

1.3 Viewing SAS Visual Analytics Reports

SAS Report Viewer (the report viewer) enables users who are not report designers or consumers to view a report using a web browser. To open a report in the report viewer from SAS Drive, double-click the report. Because the report viewer is not supported on mobile devices, mobile users are redirected to SAS Visual Analytics Apps when opening a report. SAS Visual Analytics Apps (formerly called SAS Mobile BI) are free mobile apps. You can download the apps from the following locations:

- Apple App Store (supported on iPhones and iPads)
- Google Play (supported on Android devices)
- Microsoft Store (supported on PCs and tablets running Windows 10)

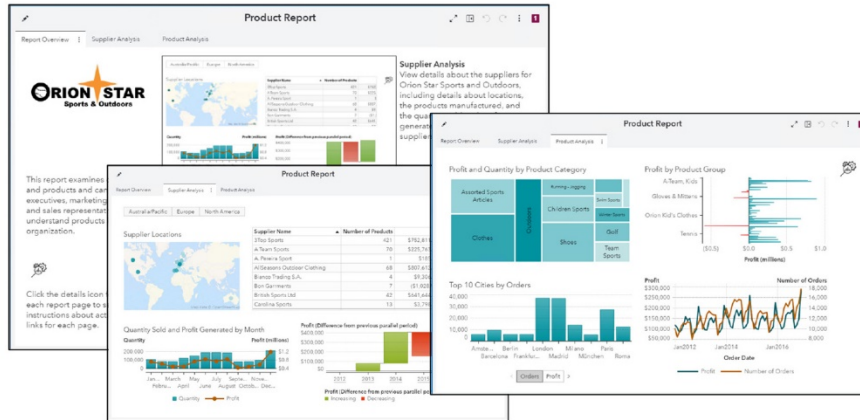
Using these apps, you can view and interact with SAS Visual Analytics reports, as well as share comments and observations with others. The apps support all charts and graphs that are available in SAS Visual Analytics.

You can customize the apps by using the SAS SDK.

In our example, the Product Report contains three visible pages: Report Overview, Supplier Analysis, and Product Analysis.

- The **Report Overview** page gives an overview of the report and describes the other pages of the report.
- The **Supplier Analysis** page gives details about the suppliers for Orion Star, including information about locations, the products manufactured, the quantity sold, and profit generated by each supplier.
- The **Product Analysis** page gives details about the products sold by Orion Star, including information about product categories and groups, the top 10 cities by orders and profits, and historical details.

Figure 1.6: Product Report



Note: Only users who have the appropriate capabilities can edit the report.

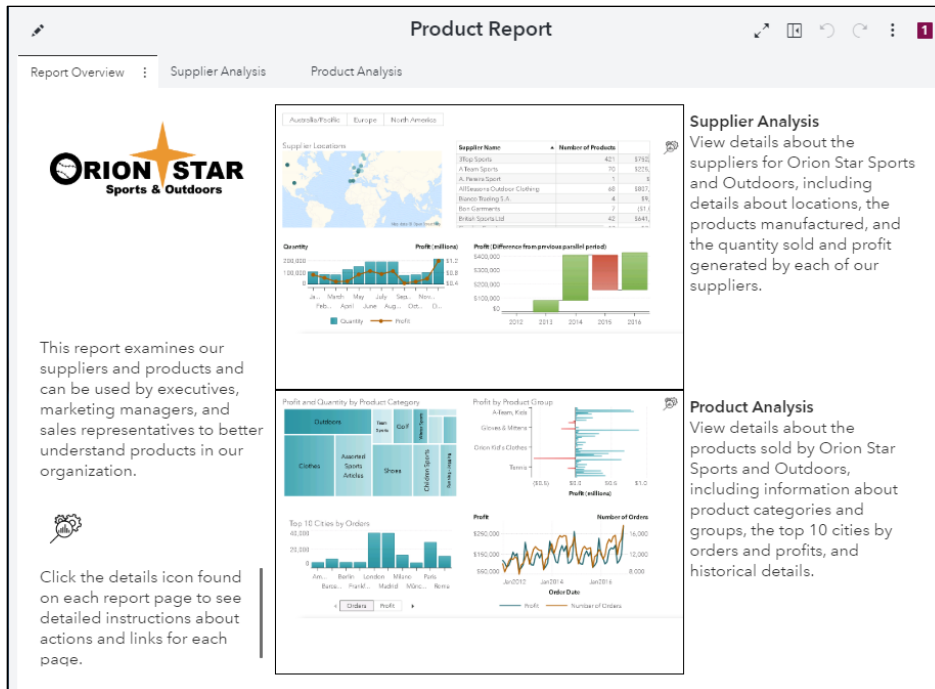
You can print or generate a link to a report or object from SAS Visual Analytics. In addition, an application administrator can distribute a report from SAS Visual Analytics.



Demo 1.2: Viewing Reports

This demonstration illustrates how to view a report in Visual Analytics.

1. From the browser window, sign in to SAS Viya.
SAS Drive is displayed by default.
2. View and interact with the Product Report.
 - a. In the Quick Access area, double-click **Product Report** to open the report.
The Product Report opens in Visual Analytics.

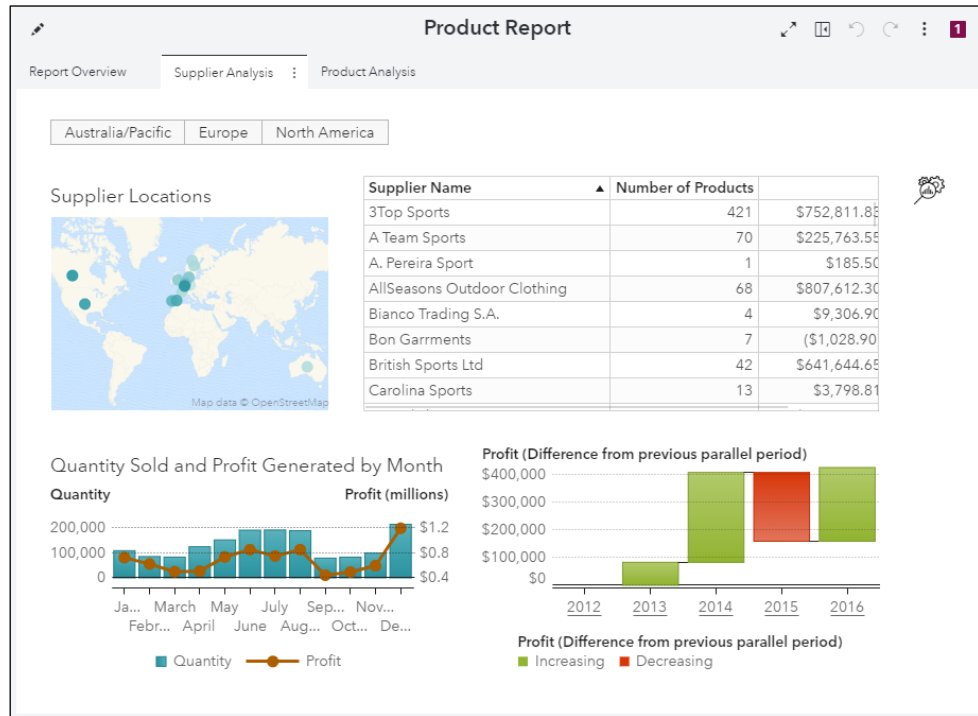


The initial section of the report is an overview section that describes the report and the pages within the report.

- b. Click the image next to the Supplier Analysis information or click the **Supplier Analysis** tab at the top of the report to view the page.

Note: A page link action is established between the images on the Report Overview page and the Supplier Analysis and Product Analysis pages, respectively.


The Supplier Analysis page should resemble the following:




This page uses a button bar as a page prompt to filter data by continent.

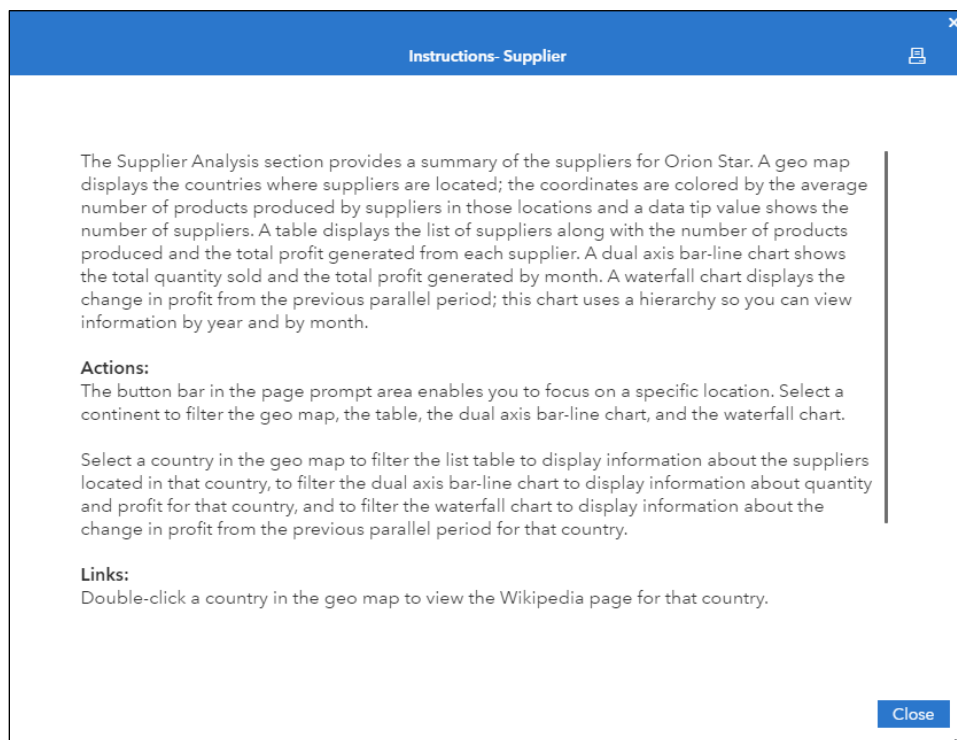



The Supplier Analysis page contains several report objects and filters.


- A geo map shows countries where suppliers for Orion Star are located. The locations are colored by the average number of products produced by suppliers in that country. Darker colors indicate a higher average number of products. Placing your cursor over a country in the geo map displays a data tip with the number of suppliers in that country and the average products produced by supplier.
 - A list table displays the names of suppliers, the number of products produced, and the total profit generated by each supplier. A gauge display rule indicates whether the profit values are below average (red), average (yellow), or above average (green).
 - A dual axis bar-line chart shows the total quantity sold and the total profit generated by month.
 - A waterfall chart displays the change in profit from the previous parallel period. This chart uses a hierarchy, so you can view information by year and by month.
- c. In the upper right corner of the page, click  (**Click here for more information about this page**).

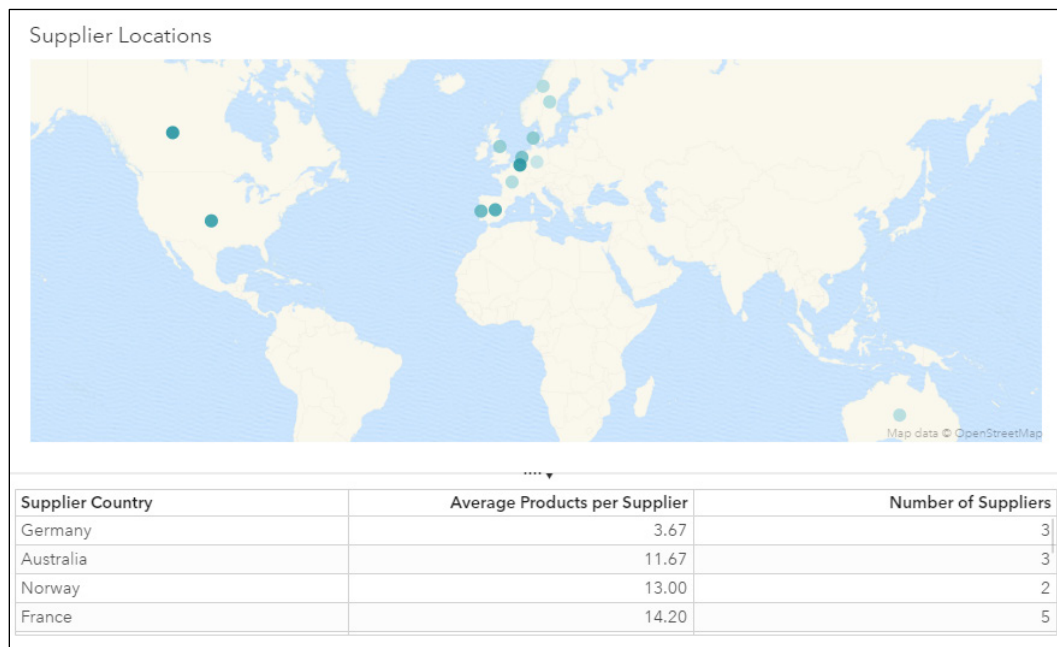
Note: The  icon is an image object with a link to a hidden page. This icon is used throughout the course to link to information about the page.

A hidden page is displayed as a pop-up window. This hidden page includes information about the page, including details about the report objects, actions, and links.



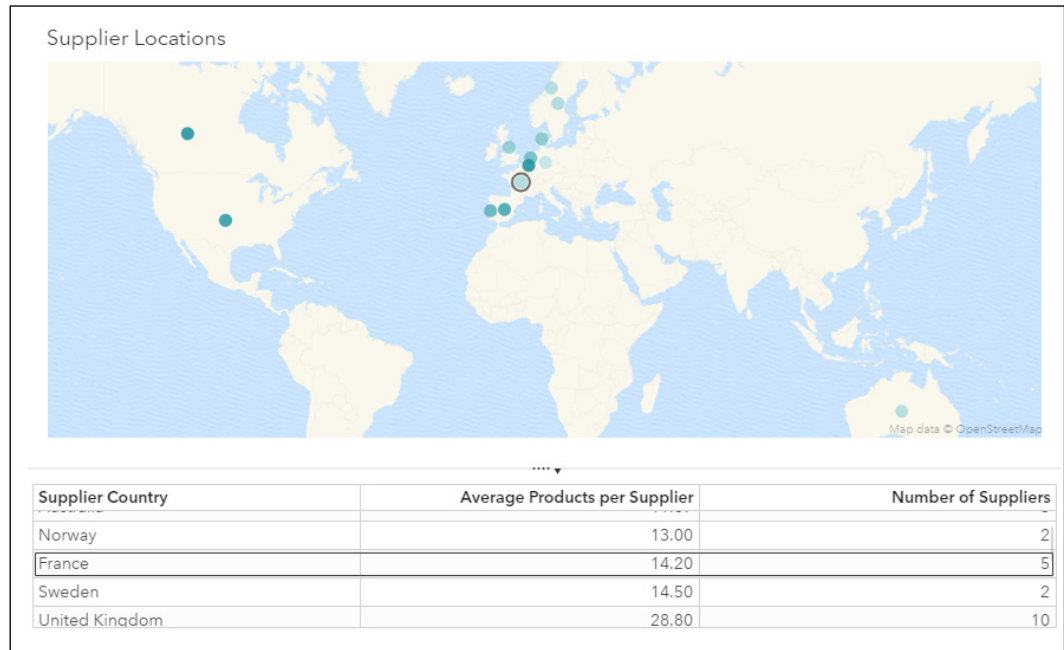
Note: You can resize this window by clicking and dragging  in the lower right corner.

- d. Click **Close** to close the hidden window.
3. View information about objects, and work with interactions and links.
 - a. Move the cursor to the upper right corner of the geo map and click  (**Maximize**).




A table of detail data appears below the geo map, showing the average products produced per supplier and the number of suppliers in each country.

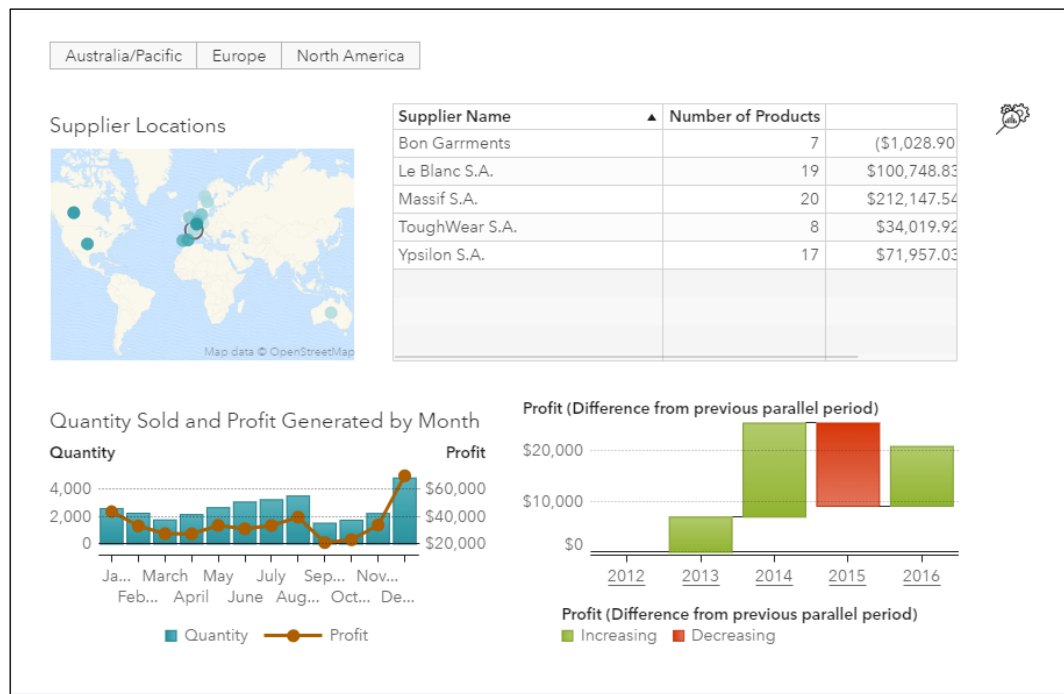
- b. Scroll through the list and select the row for **France**.
The country is highlighted in the geo map.




On average, each supplier in France produces about 14 products. When compared to other countries in Europe, we can see that although France has a larger number of suppliers, its production is not as diverse.

- c. In the upper right corner of the geo map, click  (**Restore**).

With **France** selected, the other objects in the section are updated to show information about suppliers in France.



- d. In the upper right corner, click  (**Show side pane**).
The side pane appears on the right.

- e. In the side pane, click **Data**.

The Data Settings pane displays the data items associated with each role for the geo map.

Data Settings

Supplier Products by Country ▼

Coordinate

▼ Geography

🌐 Supplier Country

▼ Color

📊 Average Products per Supplier

▼ Data tip values


📊 Number of Suppliers

🌐 Supplier Country

📊 Average Products per Supplier

Other

Due to the Viewer Customization level set for the Product Report (**Comprehensive edits**), viewers can view, but not modify, data assignments.

- f. In the side pane, click  (**Collapse**).
- g. In the list table, resize the **Supplier Name** column.

Supplier Name	Number of Products	
Bon Garrments	7	(\$1,028.90)
Le Blanc S.A.	19	\$100,748.83
Massif S.A.	20	\$212,147.54
ToughWear S.A.	8	\$34,019.92
Ypsilon S.A.	17	\$71,957.03

- h. Select the **Profit** column and drag it to the left of **Number of Products**.

Supplier Name	Profit	Number of Products
Bon Garrments	(\$1,028.90)	7
Le Blanc S.A.	\$100,748.83	19
Massif S.A.	\$212,147.54	20
ToughWear S.A.	\$34,019.92	8
Ypsilon S.A.	\$71,957.03	17

- i. In the side pane, click **Rules**.

The Display Rules pane provides details about the display rules used in the list table and enables viewers to subscribe to alerts based on those rules, if any.

- j. In the side pane, click (**Collapse**).
- k. In the list table, double-click **Bon Garrments**.

A hidden window displays information about products produced by that supplier.

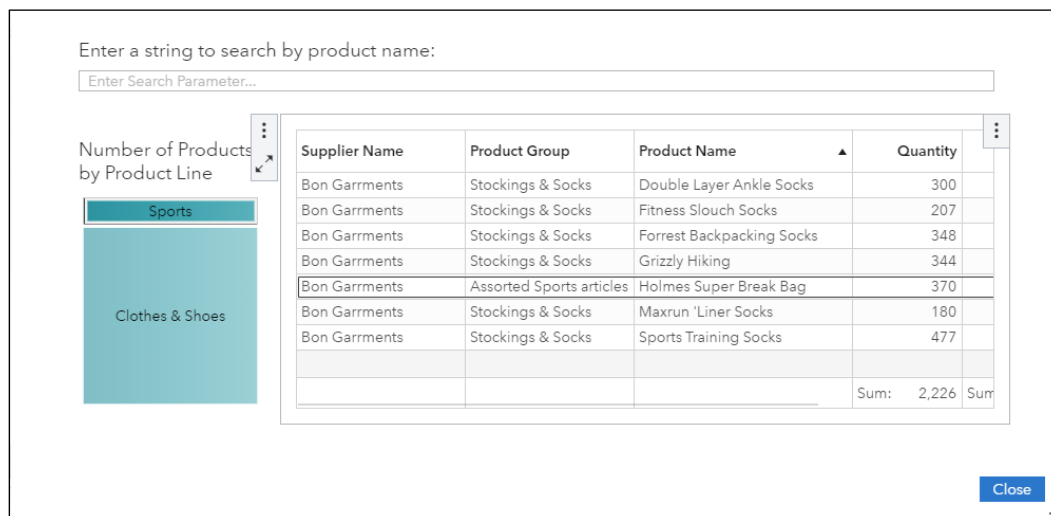
Supplier Name	Product Group	Product Name	Quantity
Bon Garrments	Stockings & Socks	Double Layer Ankle Socks	300
Bon Garrments	Stockings & Socks	Fitness Slouch Socks	207
Bon Garrments	Stockings & Socks	Forrest Backpacking Socks	348
Bon Garrments	Stockings & Socks	Grizzly Hiking	344
Bon Garrments	Assorted Sports articles	Holmes Super Break Bag	370
Bon Garrments	Stockings & Socks	Maxrun 'Liner Socks	180
Bon Garrments	Stockings & Socks	Sports Training Socks	477
Sum:			2,226

Because the list table and the objects in the hidden window are based on the same data source, an automatic filter is applied.

Bon Garrments produces seven products in two product lines: Clothes & Shoes and Sports. The list table displays details about each product along with total quantity sold, total profit generated, and total number of orders for each product.

- l. Click the row for the **Holmes Super Break Bag**.

A linked selection action is established between the treemap and the list table. Selecting a row in the list table highlights the associated tile in the treemap, and selecting a tile in the treemap highlights the associated rows in the list table.



- m. In the list table, scroll to the right to view details about the product.

Group	Product Name	Quantity	Profit	Number of Orders
Stockings & Socks	Double Layer Ankle Socks	300	\$420.00	188
Stockings & Socks	Fitness Slouch Socks	207	\$393.30	128
Stockings & Socks	Forrest Backpacking Socks	348	\$596.30	224
Stockings & Socks	Grizzly Hiking	344	\$516.00	232
Sports articles	Holmes Super Break Bag	370	(\$3,922.00)	215
Stockings & Socks	Maxrun 'Liner Socks	180	\$252.00	114
Stockings & Socks	Sports Training Socks	477	\$715.50	299
		Sum: 2,226	Sum: (\$1,028.90)	Total: 1,397

A majority of products produced by this supplier are profitable, except for the Holmes Super Break Bag, which generates large losses. Because this is the only product in the Assorted Sports Articles product line produced by this supplier, this might indicate high costs to break into this segment. It might be a good business decision for this supplier to specialize in the Stockings & Socks group, where they make average profits.

- n. Click **Close** to close the hidden window.

- o. In the list table, double-click **Massif S.A.**.

A hidden window displays information about products produced by that supplier.

Enter a string to search by product name:

Number of Products by Product Line

Supplier Name	Product Group	Product Name	Quantity
Massif S.A.	Winter Sports	Alpine Ski Bag 2-pair Black/Yellow	315
Massif S.A.	Winter Sports	Alpine Ski Bag Black/Yellow	126
Massif S.A.	Winter Sports	Massif Bandit L Ski Axial	1,472
Massif S.A.	Winter Sports	Massif Bandit Ski Parcel Axial	1,054
Massif S.A.	Winter Sports	Massif Cut X Super 9.9 Ski Parcel	1,736
Massif S.A.	Winter Sports	Massif Cut Z 9.6 Ski Parcel-Fdx95	268
Sum:			9,996

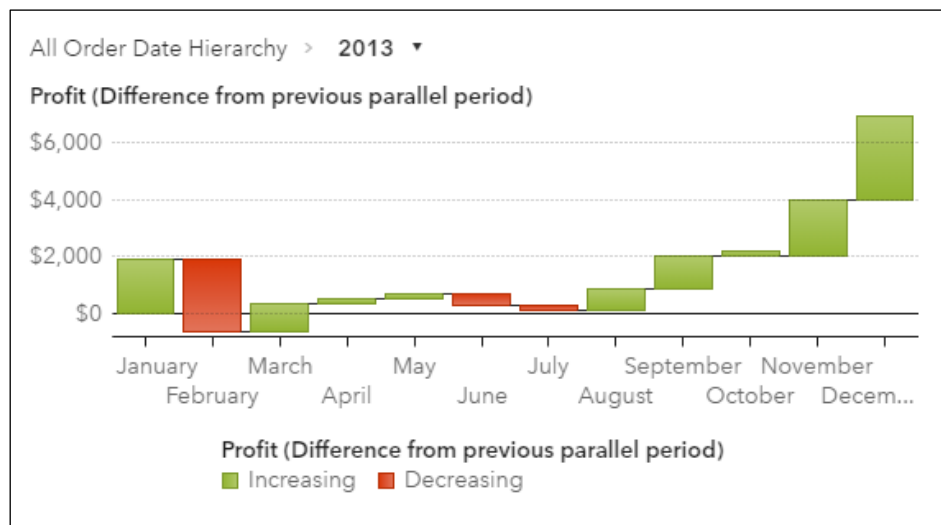
- p. In the **Enter a string to search by product name** field, enter **Jacket** and press the Enter key. The list table is updated to show information about products that contain the string **Jacket**.

Supplier Name	Product Group	Product Name	Quantity	
Massif S.A.	Ski Dress	Massif Men's Monitor Bomber Jacket	304	\$9,
Massif S.A.	Knitwear	Massif Men's Polar Fleece Jacket	533	\$2,
Massif S.A.	Ski Dress	Massif Men's Pro Jacket	207	\$15,
Massif S.A.	Ski Dress	Massif Men's Shell Jacket	195	\$13,
Sum:			1,239	\$40,

Note: Parameters are used to search the list table. The parameter is updated with the input value, and the list table is filtered for product names that contain that value. The search is case sensitive.

- q. Click **Close** to close the hidden window.
- r. On the waterfall chart, double-click the bar for **2013**.

The waterfall chart displays information about changes in profit from the same month in 2012.



- s. Right-click the waterfall chart and select **Change Waterfall chart to** ⇒ **Crosstab**.

Order Year	▲	Profit (Difference from previous parallel period)
2012	>	.
2013	>	\$6,881.95
2014	>	\$18,381.09
2015	>	(\$16,255.64)
2016	>	\$11,684.14

Due to the Viewer Customization level set for the Product Report (**Comprehensive edits**), viewers can change chart types.

4. Investigate printing options.

- a. In the upper right corner of the report, click  (**Menu**) and select **Print**.

The Print to PDF window appears.

Print to PDF

Document Setup

Select Objects

PAGE SETUP

Paper size:

Letter

Use page size

Orientation:

Portrait

Landscape

MARGINS

Units:

Inches

Top: 0.25

Right: 0.25

Left: 0.25

Bottom: 0.25

OPTIONS

Show page numbers

Show empty rows and columns in table

Include printed Table of Contents

Include appendix information

Include comments

Include details tables

Expand clipped and non-visible content

Include cover page

Include accessibility tags

Cover page text

Print

Cancel

You can specify options for the PDF document, including whether a table of contents and page numbers are displayed. You also have the option of choosing which objects appear in the PDF.

- b. In the PAGE SETUP area, select **Use page size**.

Note: The **Use page size** option lets you print a report based on the current size of your browser window.

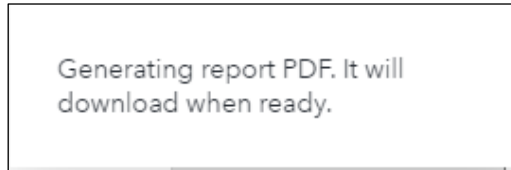
- c. In the OPTIONS area, turn off the following options:

Show page numbers

Include cover page

- d. Click **Print**.

A message appears.



- e. At the bottom of the window, click **Product Report on mm-dd-yyyy** to open the PDF.

The report opens in a new tab in the browser.

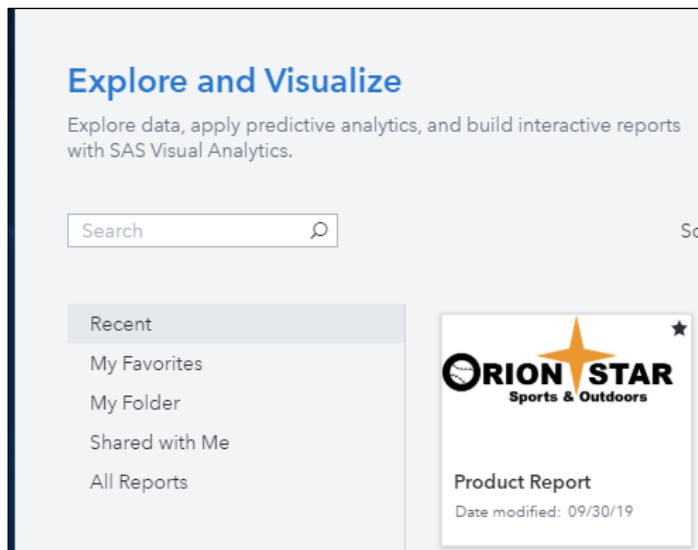
- f. Close the tab and return to Visual Analytics.

5. In the upper right corner of the report, click (**Menu**) and select **Restore default report state**.

6. Click (**Menu**) and select **Close**.

Note: It is a best practice to close a report when you are finished viewing it to conserve resources.

The home pane appears, and the Product Report is listed under **Recent**.



7. Double-click **Product Report** to reopen the report.

When you close a report that you were viewing, the viewer state is remembered. This includes the current page, any hierarchy drill-downs, selected filters, and so on. This means that the next time that you open the same report, you return to the same part of the report with all previous selections and actions in place. To prevent this, click **Menu** and select **Restore default report state** before closing the report.

End of Demonstration



Practice 1.1

1. Viewing a Report in Visual Analytics

- a. Open the browser and sign in to SAS Viya.
- b. Open and view the Product Report in Visual Analytics.
- c. View the Product Analysis page.
 - i. View information about the page and answer the following question:
What links are available for the Product Analysis page?
Answer:
 - ii. View report objects and use actions between the graphs to answer the following questions:
Which product category has the fewest number of orders? The lowest total profit?
Answer:
Which product groups are included in the Indoor Sports category?
Answer:
How many products are in the Fitness product group?
Answer:
Do any fitness products generate a loss?
Answer:
What are the top two cities by orders for fitness products? By profit?
Answer:
 - iii. Export the data for the dual axis time series plot filtered by *Indoor Sports* and *Fitness*.
- d. Close the report.

End of Practices

Quiz 1.1

Which of the following statements is true?

- a. All users have the ability to create reports.
- b. Administrators control access to reports.
- c. Only administrators can create reports.

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