MicroStrategy | 10

Advanced Reporting

JS

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Reporting in MicroStrategy Web

Introduction to reports in MicroStrategy Web

MicroStrategy Web is a highly interactive, intuitive, and simple-to-use interface for reporting, analysis, and continuous business monitoring. With a look and feel that is exceptionally crisp and clean, MicroStrategy Web has been designed specifically to fit the needs of business users. Boardroom-quality reports can be generated using a wide range of charting and formatting options.Using virtually any browser, Web users can access the full spectrum of MicroStrategy's analytics capabilities, from viewing reports and dossiers to digging deeper with data discovery.

In this course, we will focus on creating reports and documents in MicroStrategy Web. A MicroStrategy Web report allows you to gather business insight through data analysis, often an essential starting point for further business intelligence investigations. Documents are used to format data from multiple reports in a single display of presentation quality. We will discuss Documents further on in the course.

MicroStrategy supports a wide variety of reporting styles. In its most basic form, a report consists of two parts:

- A report template, the underlying structure of the report.

- The objects placed on the template, such as attributes, metrics, filters, and prompts.

Activity: Open a MicroStrategy report

Use the steps below to open a sample report to explore a standard grid report in MicroStrategy.

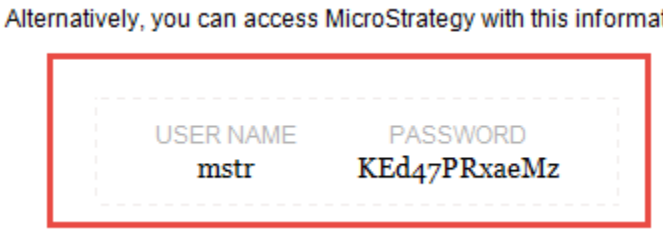
Log into the MicroStrategy Cloud environment

1 In the Welcome to MicroStrategy Cloud email, click **Access MicroStrategy Platform**.

2 In the Login MicroStrategy web page, scroll down, and click **Credentials.**

The system displays the option to log in.

3 In the User name and Password boxes, type (or copy and paste) the login credentials provided in the Welcome to MicroStrategy on AWS email.

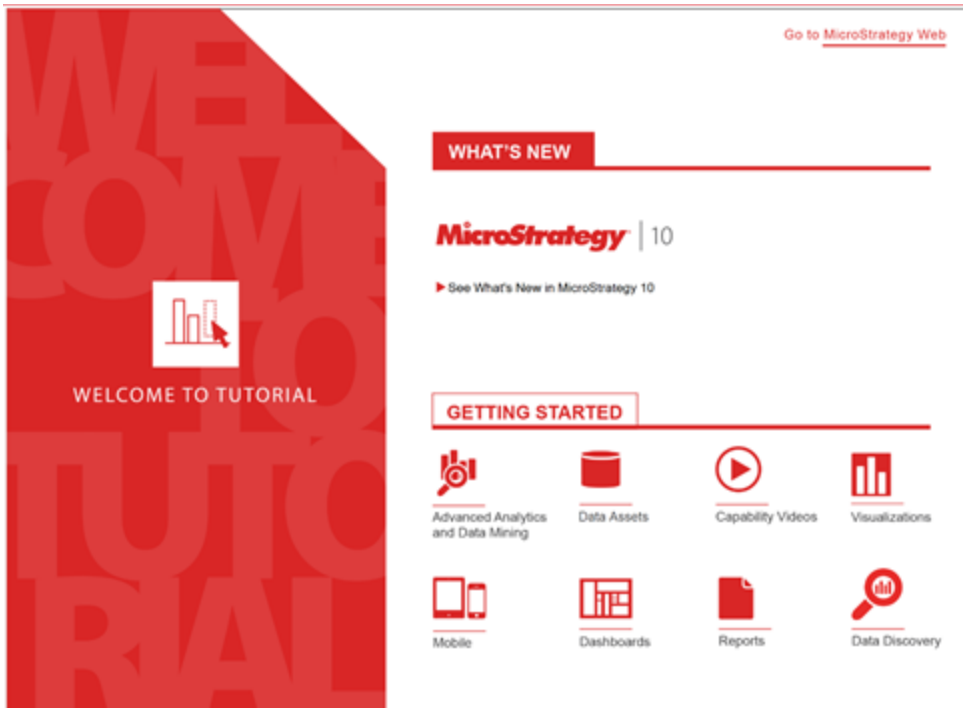


4 Click **Login**. The MicroStrategy Cloud landing page displays in the Chrome browser window of your cloud environment.

Open MicroStrategy Web

5 On the landing page, hover over **MicroStrategy Web** and click **Launch**.

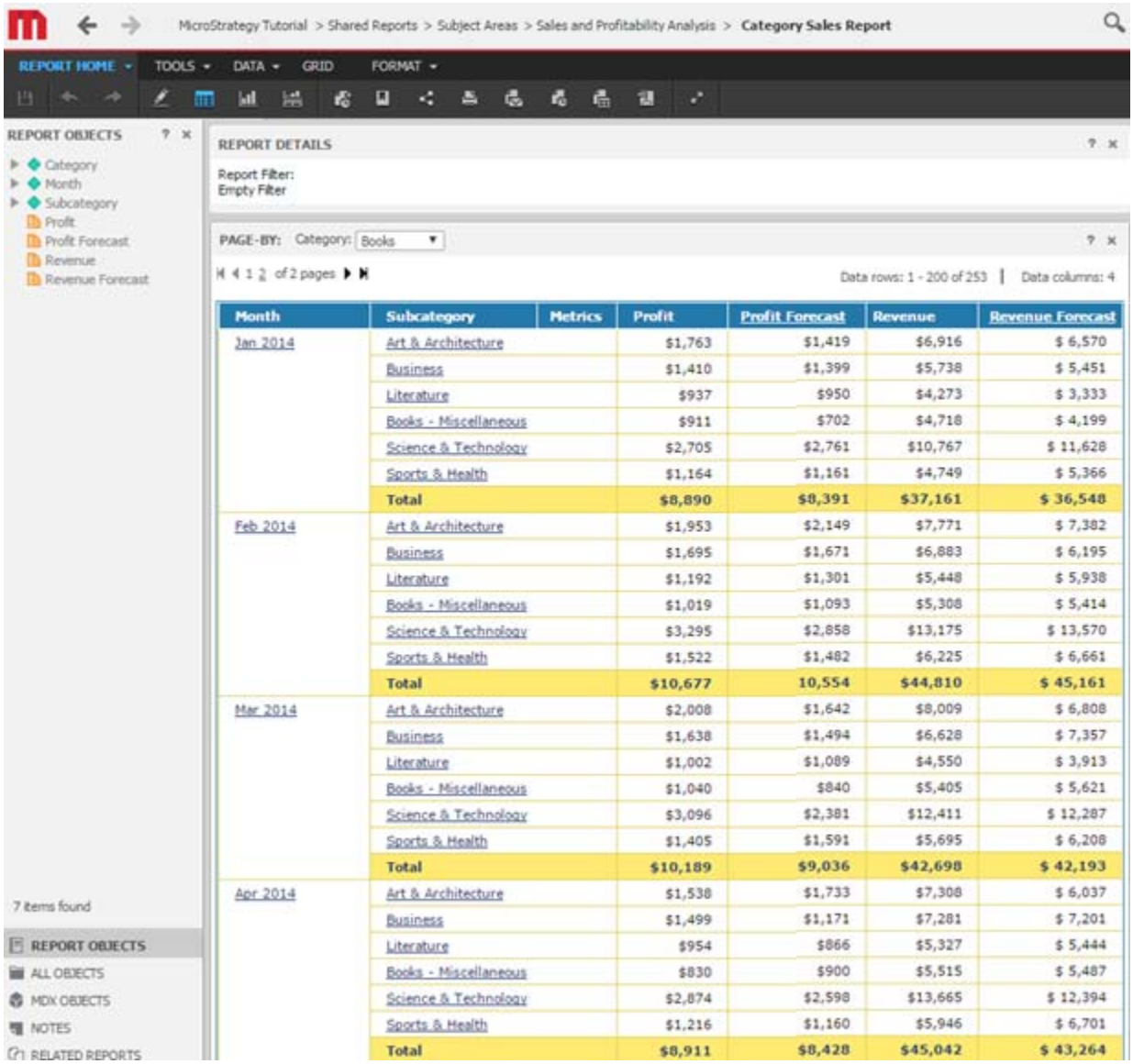
You will arrive at the MicroStrategy Tutorial Home page.



6 Click **Go to MicroStrategy Web** to open the Shared Reports folder of the MicroStrategy Tutorial project.

Open a report

1 Click the **Subject Areas** folder, then click the **Sales and Profitability Analysis** folder, and select **Category Sales Report** to run the report and see the sample data results. This is a MicroStrategy grid report.



Month	Subcategory	Metrics	Profit	Profit Forecast	Revenue	Revenue Forecast
Jan 2014	Art & Architecture		$1,763	$1,419	$6,916	$ 6,570
	Business		$1,410	$1,399	$5,738	$ 5,451
	Literature		$937	$950	$4,273	$ 3,333
	Books - Miscellaneous		$911	$702	$4,718	$ 4,199
	Science & Technology		$2,705	$2,761	$10,767	$ 11,628
	Sports & Health		$1,164	$1,161	$4,749	$ 5,366
	Total		**$8,890**	**$8,391**	**$37,161**	**$ 36,548**
Feb 2014	Art & Architecture		$1,953	$2,149	$7,771	$ 7,382
	Business		$1,695	$1,671	$6,883	$ 6,195
	Literature		$1,192	$1,301	$5,448	$ 5,938
	Books - Miscellaneous		$1,019	$1,093	$5,308	$ 5,414
	Science & Technology		$3,295	$2,858	$13,175	$ 13,570
	Sports & Health		$1,522	$1,482	$6,225	$ 6,661
	Total		**$10,677**	**10,554**	**$44,810**	**$ 45,161**
Mar 2014	Art & Architecture		$2,008	$1,642	$8,009	$ 6,808
	Business		$1,638	$1,494	$6,628	$ 7,357
	Literature		$1,002	$1,089	$4,550	$ 3,913
	Books - Miscellaneous		$1,040	$840	$5,405	$ 5,621
	Science & Technology		$3,096	$2,381	$12,411	$ 12,287
	Sports & Health		$1,405	$1,591	$5,695	$ 6,208
	Total		**$10,189**	**$9,036**	**$42,698**	**$ 42,193**
Apr 2014	Art & Architecture		$1,538	$1,733	$7,308	$ 6,037
	Business		$1,499	$1,171	$7,281	$ 7,201
	Literature		$954	$866	$5,327	$ 5,444
	Books - Miscellaneous		$830	$900	$5,515	$ 5,487
	Science & Technology		$2,874	$2,598	$13,665	$ 12,394
	Sports & Health		$1,216	$1,160	$5,946	$ 6,701
	Total		**$8,911**	**$8,428**	**$45,042**	**$ 43,264**

This grid report structures large amounts of data in Web for maximum readability and ease of navigation. You can quickly locate the information you need to easily understand data and inspire business action.

Building a report: Report objects

To create a basic report, you place at least one attribute, one metric, and an optional filter on the MicroStrategy report template. Objects placed on a report determine what data is gathered from your data source, how that data is calculated, and how the results are displayed when each report is run.

Example of a simple report, with one attribute and one metric

Category	Revenue
Books	$2,640,094
Electronics	$24,391,303
Movies	$4,098,943
Music	$3,893,367

On a typical report, each row represents a business concept, such as products, employees, customers, stores, and so on. These business concepts are called attributes, as they represent important attributes of a business. While the rows represent business concepts, the columns of a typical report represent financial calculations that are important to the business, such as inventory, sales, costs, profits, salaries, and so on. These calculations are called metrics.

As we'll explore in the next exercise, to create a report, you place the attributes, metrics, and filters into a report template. When a report is executed, you see a formatted collection of all of the data associated with the objects (the attributes and metrics) specified on the template that have satisfied the filtering conditions of the report filter.

Calculating business data: Metrics

Metrics are MicroStrategy objects that represent business measures and key performance indicators. Metrics are similar to formulas in spreadsheet software. The metric in the following report is Profit.

Metrics Example

Region	Call Center	Profit
Central	Milwaukee	$637,545
	Fargo	$126,778
Mid-Atlantic	Washington, DC	$473,200
	Charleston	$199,884
Northeast	Boston	$224,495
	New York	$1,076,237
Northwest	San Francisco	$156,330
	Seattle	$110,655
South	New Orleans	$504,990
	Memphis	$301,966
Southeast	Atlanta	$157,963
	Miami	$178,713
Southwest	San Diego	$449,553
	Salt Lake City	$111,779
Web	Web	$583,538

Most of the decisions you make about the other objects to include on a report depend on the metrics you use on the report. Questions such as: "What were the sales for the Eastern region during the fourth quarter?" or "Are inventory counts being consistently replenished at the beginning of each week?" can easily be answered by metrics.

Specifically, metrics define the analytical calculations to be performed against data that is stored in your data sources. A metric is made up of data source facts and the mathematical operations to be performed on those facts, so that meaningful business analysis can be performed on the results.

A fact is a schema object that represents a column in a data warehouse table and contains basic or aggregatable numbers-usually prices, sales in dollars, or inventory counts.

Business context on a report: Attributes

Attributes are the business concepts reflected in your data source and provide meaning to the numerical data. While knowing your company's total sales is

useful, knowing when and where the sales took place provides the analytical depth users require on a daily basis.

Attributes Example

Region	Call Center	Profit
Central	Milwaukee	$637,545
	Fargo	$126,778
Mid-Atlantic	Washington, DC	$473,200
	Charleston	$199,884
Northeast	Boston	$224,495
	New York	$1,076,237
Northwest	San Francisco	$156,330
	Seattle	$110,655
South	New Orleans	$504,990
	Memphis	$301,966
Southeast	Atlanta	$157,963
	Miami	$178,713
Southwest	San Diego	$449,553
	Salt Lake City	$111,779
Web	Web	$583,538

Attribute elements

The elements of a business attribute are the unique values for that attribute. For example, 2015 and 2016 are elements of the Year attribute, while New York and London are elements of the City attribute. On a report, attributes are chosen to build the report, but once the report is executed, the attribute's elements are displayed in the rows or columns.

In the image above, Call Center is an attribute whose elements include Milwaukee, Fargo, Washington DC, and Charleston, which are specific names of various call centers. The Region attribute has attribute elements such as Central, Mid-Atlantic, Northeast, and so on.

Attribute forms

Attribute forms are additional descriptive information about a business attribute mapped to columns in your data source. The ID column in your data source provides a unique identifier for each attribute element and the Description column provides the name of each attribute element. In MicroStrategy, only the IDs are used to identify the datasets to find corresponding parent-child relationships for calculation purposes.

The ID and the Description are both attribute forms, but an attribute can have many other forms. For example, the attribute Customer has the forms ID, Last Name, First Name, Address, and Email, as shown below.

Customer ID	Customer Last Name	Customer First Name	Customer Address	Customer Email
7796	Aaby	Alen	864 Kalispell Dr	aaaby54@yahoo.demo
1874	Aadland	Miko	415 Virginia Ave	maadland63@hotmail.demo
3771	Aadland	Warner	725 Old Highway 49 S	waadland57@hotmail.demo
4432	Aadland	Constant	4205 Derby Rd	caadland14@hotmail.demo
7923	Aafedt	Wendy	15504 Olive Branch Dr	waafedt64@aol.demo

Report designers and project designers can take advantage of MicroStrategy's variety of attribute forms when creating a report. A project designer, for example, find that displaying the attribute's ID is more useful. For most business users, displaying the Description (DESC) form of an attribute is more useful. However, as you can see with the example of the Customer attribute above, displaying several attribute forms can also be useful, depending on user needs.

What are some examples of attributes and metrics that your business uses?

Narrowing data: Report filters

A filter sifts the data in your data source to bring back the information that answers what you require. For example, say you want to determine if sales decreased during winter of 2005 that may have been due to bad winter weather in the northeastern U.S. Without a filter, you would have to sift through a lot of report data on your own. By creating a filter that includes Northeast Region, December 2005, January 2005, and February 2005, and using that filter on the report, the data displayed when the report is executed is limited to that geographical region and season.

A filter is displayed with this icon in Web:  .

Grouping related attributes: Hierarchies

Data must be calculated within the context of a business attribute—but which attribute? Most reports contain more than one attribute. For example, on a report containing the Revenue metric and the attributes Month and Year, is revenue calculated and displayed by month? Or is it calculated and displayed by year?

Another way to ask this question is, at what level is the Revenue metric calculated? Is it calculated at the higher-level Year attribute or the lower-level

Month attribute? To understand an attribute's level, picture a hierarchy of related business attributes. A hierarchy is made up of a group of attributes that are conceptually related. An example is shown below:

The attribute Year is higher than Quarter, Month, or Day, because it appears above those other attributes. The highest level attribute is usually the attribute that reflects the most-inclusive business concept. In this hierarchy, Day is the lowest-level attribute and reflects the least-inclusive or most granular business concept.

Drilling into related data

Drilling allows you to explore the data beyond what is immediately visible and lets you retrieve more information after a report has been executed to investigate the data quickly and easily. Drilling automatically runs another report based on the original report to get more detailed or supplemental information.

For example, the Geography hierarchy contains the attributes of Country, Region, Call Center, and Employee. A report displays profit values for the Region attribute, as shown below:

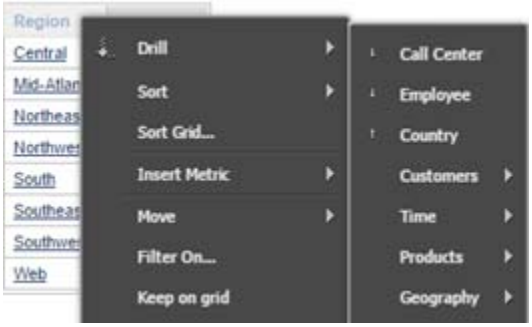
Region	Revenue
Central	$5,029,366
Mid-Atlantic	$4,452,615
Northeast	$8,554,415
Northwest	$1,761,187
South	$5,389,280
Southeast	$2,239,951
Southwest	$3,694,132
Web	$3,902,762

From Region, you can drill up to Country, to display revenue values for each country.

Country	Revenue
USA	$31,120,946
Web	$3,902,762

To drill, you right-click an attribute element or attribute header, and select the destination. For example, to drill from Region to Country, right-click Region, point to Drill, and select Country.

Drilling from Region to Country



If the Drill option is not available on the right-click menu, the report designer has disabled the function on the report. A report designer can also restrict the drilling destinations.

Creating a report

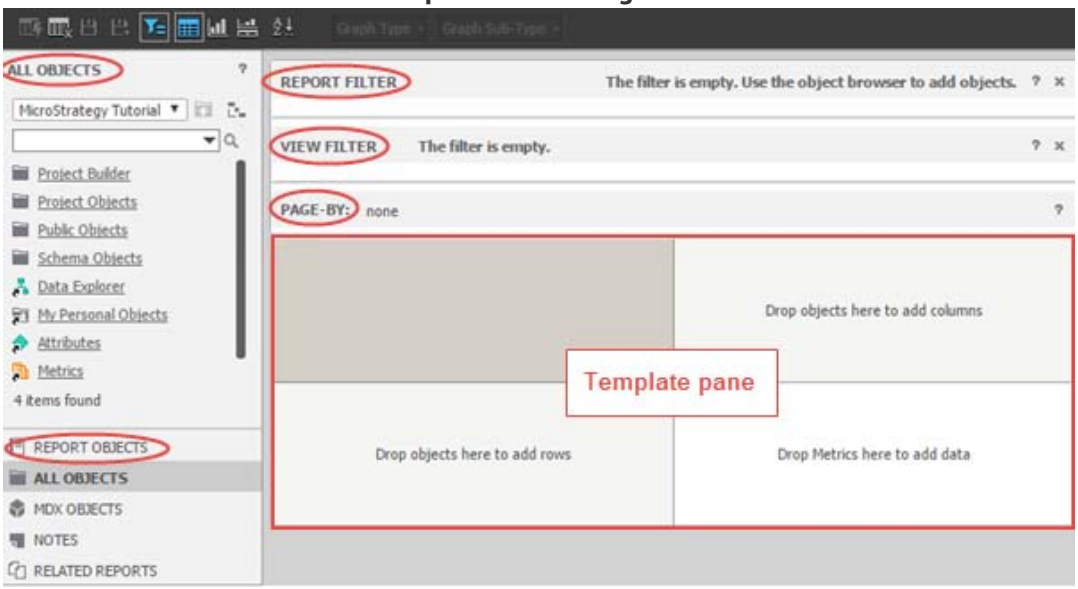
You can create a report in MicroStrategy Web using any of these methods:

- Starting from scratch with a blank report
- Using a pre-designed report from either and out-of-the-box MicroStrategy report or a pre-designed report that you have already created
- Using a pre-made template

You use the Report Editor to create a new report or modify an one. The Report Editor displays the report as it will be seen by the user and includes toolbars, menus, and panels that allow you to change how the report is displayed.

A new report automatically opens in Design Mode of the Report Editor. In Design Mode, you can create or edit the report's template and definition, which is the definition of all the objects that are included on the report when the report is designed, as well as any formatting applied to the report.

Report Editor: Design Mode



These are the most frequently used panes of the Report Editor:

- **All Objects pane**: Lets you search for and select objects within the project, to add them to the report. These are all the project objects that can be added to the report.
- **Report Objects pane**: Displays all objects included in the report, even if the object is not displayed on the report's grid or graph.

- **Report Filter pane**: Use to add filtering conditions to a report. Simple filters can be conveniently created by dragging and dropping objects from the All Objects pane into this pane to create a filter for the report data.
- **View filter pane**: Lets users apply a filter on-the-fly to any attribute or metric on the report. A view filter is applied to the executed report. Since the report does not have to be re-executed against the data source, view filters can help improve report execution performance. In addition, multiple reports can be created from the same parent report.

  If you are familiar with SQL, view filters do not modify the SQL for the report like normal report filters do. Instead, view filters are applied to the overall result set after the SQL is executed and results are returned from the data source.
- **Page-By pane**: Use to create separate pages, or subsets of your report results. Drag and drop objects from the All Objects pane into this pane to create pages.
- **Template pane**: Allows you to define your report layout by dragging and dropping objects from the All Objects pane onto this report template pane.

Reports can be executed and viewed in the Report Editor or in other applications.

Building reports from scratch

Attributes, metrics, and filters are the most basic report objects. When building a report form scratch, adding these objects begins to add meaning to your data.

For example, if you create a report with just one attribute, such as Customer, the report returns a list of all the attribute elements for that attribute. Here, you would see a list of names for every customer who has done business with your company and is in your data source. Likewise, if you add just one metric to a blank report, you see one amount—all revenue data for all time, for all regions.

If you add a metric and an attribute to the same report, such as the Customer attribute and the Revenue metric, the report data starts to become useful -- you can view what revenue each customer brought to your stores. However, for most organizations, this is still a prohibitively large report.

You can quickly and easily modify the report contents by filter based on attributes, metrics, and other objects. Leverage these filters to further narrow down the results of a given report. For example, you can filter for specifics quarters or products to view specific aspects of the report results.

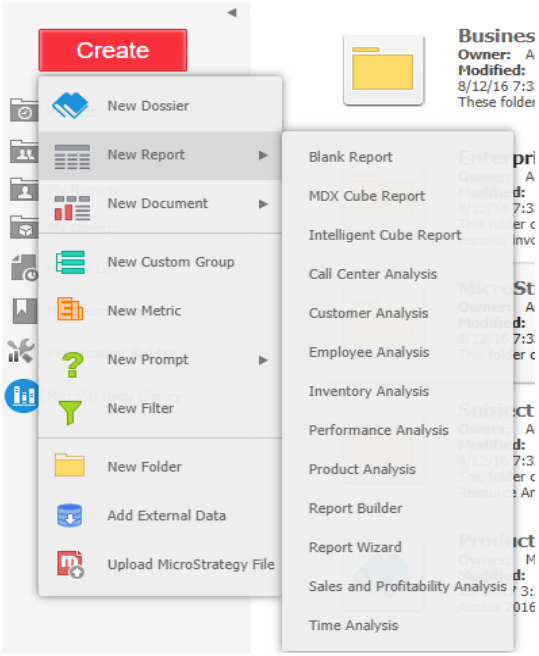
Exercise 1.1: Create a simple report

In this exercise, we will create a report from scratch to display profit data for subcategories. We will use the Blank Report as a starting point and add the following objects to the template: Region, Subcategory, Profit, and Profit Margin.

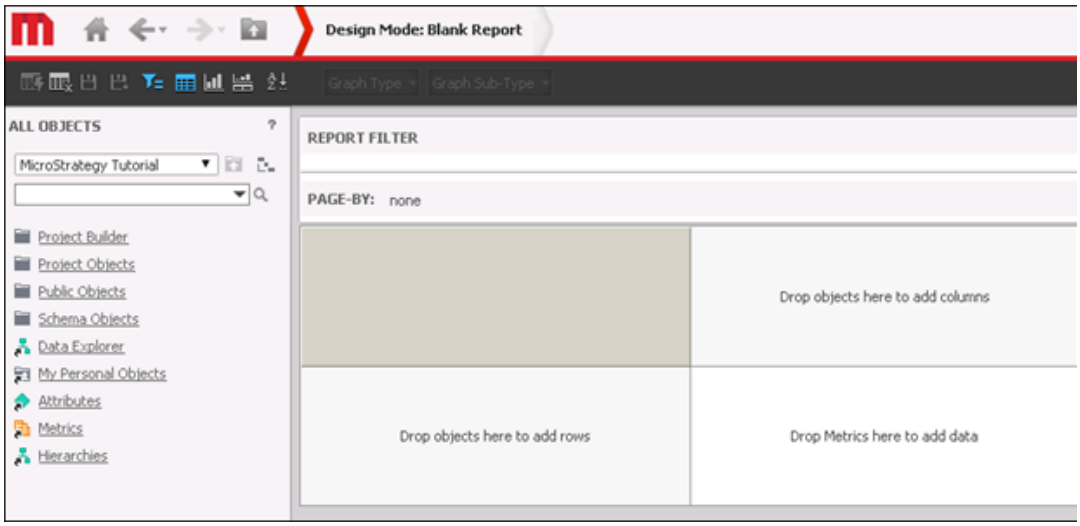
Create a report using the Blank Report template

1 In the Tutorial project, on the Shared Folder home page, **Create Report** on the left of the screen

2 Select **New Report**, then click **Blank Report**.



An empty report template is displayed, with drop zones showing you where to drag and drop objects.



Select the attributes for the report

3 Add the **Region** attribute to the rows. Click **Attributes** on the All Objects pane, then select the Geography folder. Double click **Region** to add it to the report.

4 Add the **Subcategory** attribute to the right of Region. In the All Objects pane, click the **Up One Level** icon , and then click **Products**. Double click **Subcategory**.

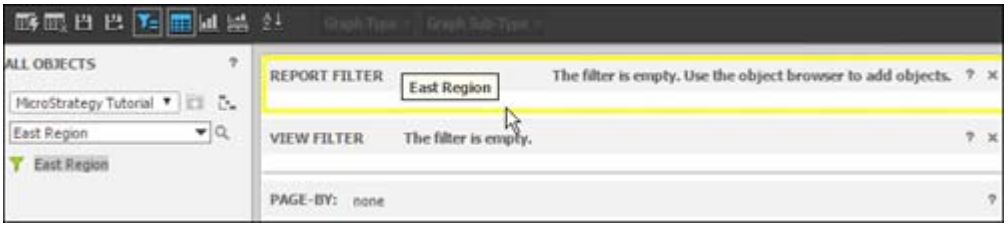
Select the metrics for the report

5 Add the Profit and Profit Margin metrics to the columns. At the top of the All Objects pane, select **Metrics** from the drop-down list. In the **Search For** box, type **Profit**, then click the **Search** icon . Double-click **Profit** and then **Profit Margin** to add them to the columns of the template. (Metrics are automatically added to the columns.)

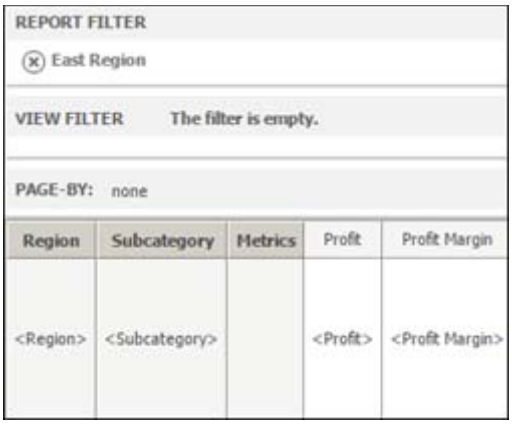
Add a filter to the report

6 In the drop-down menu at the top of the All Objects pane, select **MicroStrategy Tutorial**. In the **Search For** box, type **East Region** (which is the name of the filter) and click the **Search** icon .

7 Drag **East Region** from the All Objects pane and drop it into the Report Filter pane.



The report looks like the following:



Save the report

8 Click the **Save** icon. Name the report **Profit for Subcategories in Eastern Regions** and save it in the My Reports folder.

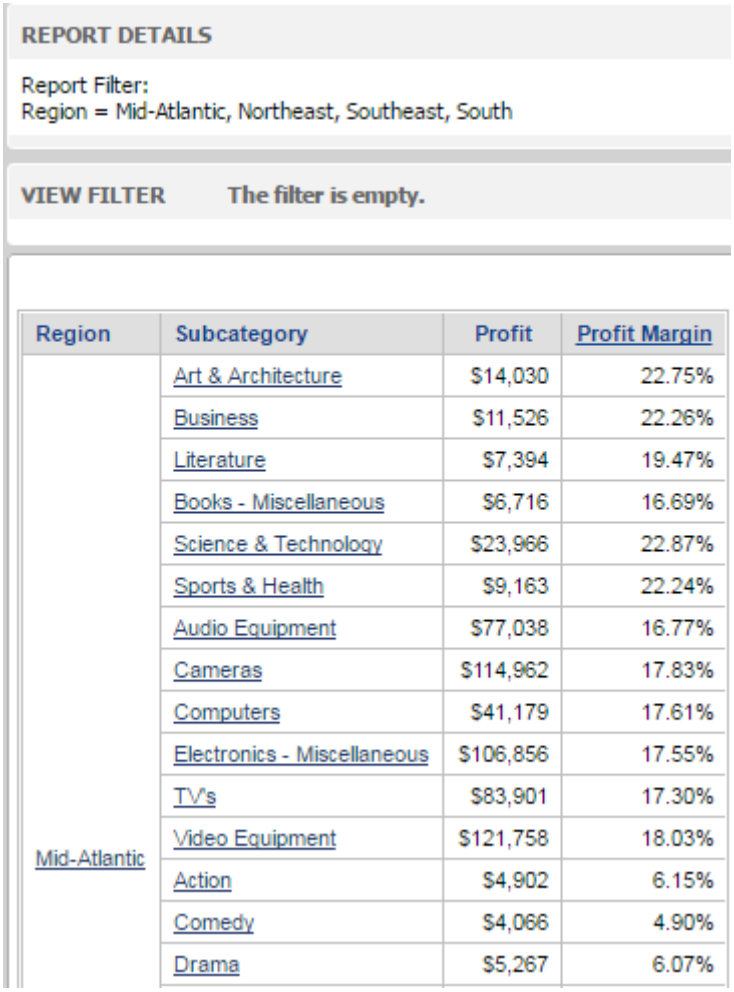
Review the results

9 In the Report Saved window, click **Run newly saved report**.

Check your results against the image below. Only the following regions should be displayed:

- Mid-Atlantic
- Northeast
- Southeast

- South



REPORT DETAILS

Report Filter:
Region = Mid-Atlantic, Northeast, Southeast, South

VIEW FILTER The filter is empty.

Region	Subcategory	Profit	Profit Margin
Mid-Atlantic	Art & Architecture	$14,030	22.75%
	Business	$11,526	22.26%
	Literature	$7,394	19.47%
	Books - Miscellaneous	$6,716	16.69%
	Science & Technology	$23,966	22.87%
	Sports & Health	$9,163	22.24%
	Audio Equipment	$77,038	16.77%
	Cameras	$114,962	17.83%
	Computers	$41,179	17.61%
	Electronics - Miscellaneous	$106,856	17.55%
	TV's	$83,901	17.30%
	Video Equipment	$121,758	18.03%
	Action	$4,902	6.15%
	Comedy	$4,066	4.90%
	Drama	$5,267	6.07%

10 Close the report.

Report types

You can view a MicroStrategy report in three different modes:

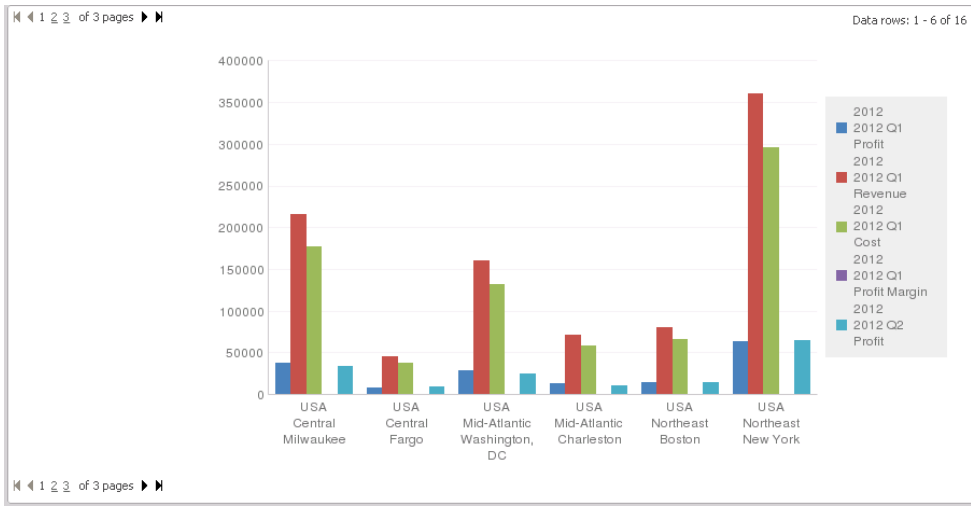
Grids

A grid report is the most commonly used type of report. Grid view displays grid reports using a formatted, cross-tabular display of the report data. This is a popular view for performing business intelligence analysis.

Category	Item	Revenue	Cost	Profit Margin
	100 Places to Go While Still Young at Heart	$67,992.60	$50,216.19	26.14%
	Art As Experience	$23,733.05	$18,247.74	23.11%
	The Painted Word	$22,323.30	$19,697.86	11.76%
	Hirschfeld on Line	$50,442.00	$38,153.05	24.36%
	Adirondack Style	$39,101.40	$29,093.88	25.59%
	Architecture : Form, Space, & Order	$41,378.40	$31,302.96	24.35%
	50 Favorite Rooms	$26,502.30	$20,253.47	23.58%
	500 Best Vacation Home Plans	$17,728.80	$14,049.36	20.75%
	Blue & White Living	$24,668.60	$19,020.04	22.90%
	Ways of Seeing	$23,776.50	$18,280.60	23.11%
	Gonzo, the Art	$41,469.40	$32,975.94	20.48%
	Cabin Fever : Rustic Style Comes Home	$17,570.80	$13,944.61	20.64%
	American Bungalow Style	$40,985.00	$30,994.86	24.38%
	Building With Stone	$22,673.25	$17,589.43	22.42%
	Voyaging Under Power	$19,827.45	$16,340.60	17.59%
	Working With Emotional Intelligence	$26,733.00	$20,819.34	22.12%
	Attention to Detail	$24,061.95	$18,543.51	22.93%
	The 48 Laws of Power	$26,513.10	$20,266.82	23.56%
	Don't Step in the Leadership	$17,711.20	$14,037.04	20.74%
	Topgrading	$28,070.60	$20,373.63	27.42%
	Career Intelligence	$29,256.50	$23,877.75	18.38%
	Cubicle Warfare	$28,061.80	$22,881.56	18.46%
	The Wisdom of Teams	$18,668.00	$13,670.40	26.77%
	The Power to Get in	$26,526.60	$21,092.53	20.49%
	Don't Sweat the Small Stuff	$22,354.00	$16,577.83	25.84%

Graphs

A graph report is a representation of data in a visual format that can help you see overall trends easily, identify medians and exceptions, and so on. You can use switch from Grid to Graph View by clicking to Graph icon .



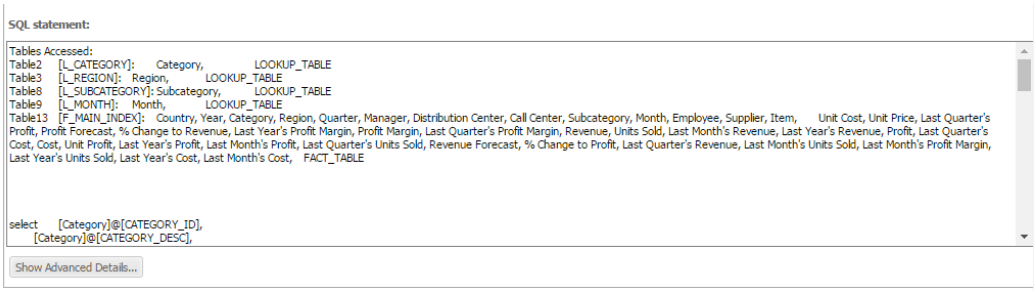
There are different graph styles you can choose from to display your report data most effectively.

Graphs can help you see trends across certain business areas. The grid report is generally more useful than a graph report for identifying specific numbers you may need for financial reports, for example.

SQL View

MicroStrategy engines automatically create the SQL (structured query language) to generate your report results. If you are familiar with SQL, you can view the SQL used to generate your report in Web. Viewing the SQL provides a good way to troubleshoot and fine-tune the selection of data that is retrieved in your report. You can create your own SQL in MicroStrategy Developer.

To view SQL for your report in Web, from the Tools menu click **Report Details Page**.



10.712 MicroStrategy Engines & SQL takes an in-depth look at how the MicroStrategy Engine develops SQL to gather data in a variety of reporting scenarios.

Building reports based on pre-designed reports and templates

In addition to creating reports from scratch, you can build a report based on a pre-designed report by either:

- Using a pre-designed template that comes out-of-the-box with MicroStrategy
- Using a report you have previously created

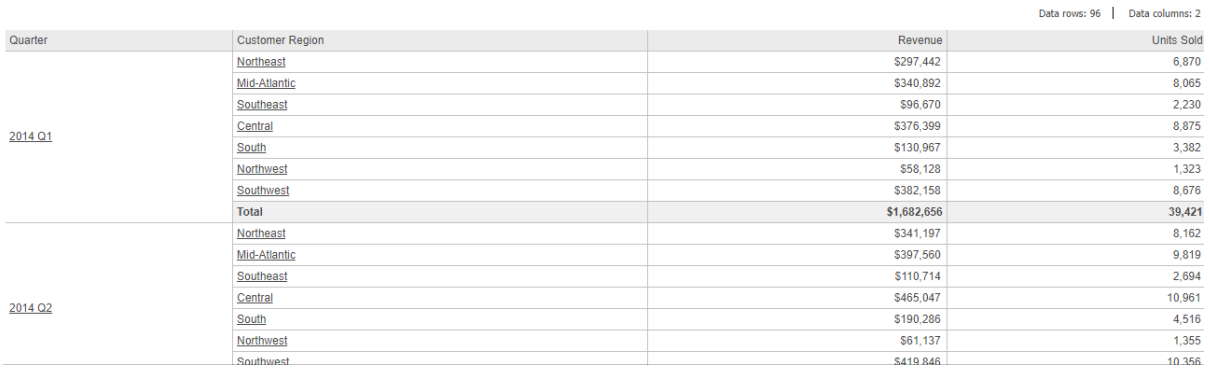
MicroStrategy comes with pre-designed report templates in various business areas, including:

- Business roles, such as billing managers, brand managers, executives, operations managers, and so on.
- Documents and scorecards, providing a distilled view of the business, with interactive visualizations.
- Enterprise reporting documents, such as managed metrics reports, production and operational reports, invoices, and so on.
- MicroStrategy platform capabilities, such as reports with a variety of graph styles, ad hoc reporting with sorting and thresholds features, and so on.
- Subject areas, such as customer analysis, performance management, human resources analysis, sales and profitability analysis, and so on.

Exercise 1.2: Create a report using the Customer Analysis template

You want to create a report detailing customer revenue and units sold by customer city and region. Instead of searching for the objects you need, you will use the Customer Analysis template. This template provides quick access to the related metrics and attributes. We will add the Quarter and Customer City attributes and the Revenue and Units Sold metrics. We will display the total by Quarter.

The final report should look like the following. (Only two quarters of the report are shown in this sample.)



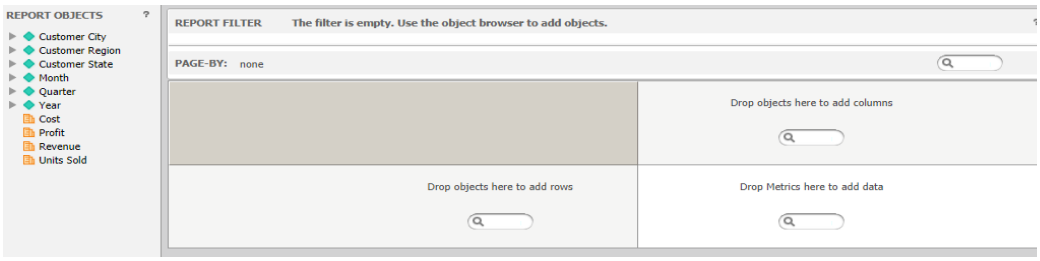
Data rows: 96 | Data columns: 2

Quarter	Customer Region	Revenue	Units Sold
2014 Q1	Northeast	$297,442	6,870
	Mid-Atlantic	$340,892	8,065
	Southeast	$96,670	2,230
	Central	$376,399	8,875
	South	$130,967	3,382
	Northwest	$58,128	1,323
	Southwest	$382,158	8,676
	Total	**$1,682,656**	**39,421**
2014 Q2	Northeast	$341,197	8,162
	Mid-Atlantic	$397,560	9,819
	Southeast	$110,714	2,694
	Central	$465,047	10,961
	South	$190,286	4,516
	Northwest	$61,137	1,355
	Southwest	$419,846	10,356

Create a report using the Customer Analysis template

1 In the Tutorial project, on any folder page, click **Create**, point to **New Report**, and click **Customer Analysis**.

An empty report template is displayed, with drop zones to drag and drop objects. The Report Objects pane on the left lists only those objects relevant to creating a customer analysis report.



Select the attributes for the report

2 In the Report Objects pane on the left, double-click **Quarter** to add it to the rows of the report.

- *Quarter is an attribute, as indicated by the icon.*
- *Attributes are automatically added to the rows of a report, although you can drag and drop them onto the columns depending on how you want the report organized.*

3 Double-click **Customer Region** to add the attribute to the report.

Select the metrics for the report

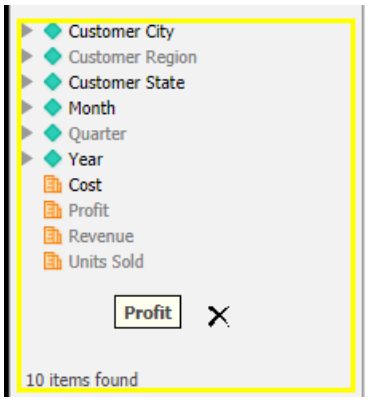
4 In the Report Objects pane on the left, double-click **Revenue** to add it to the columns of the report.

- *Revenue is a metric, as indicated by the icon.*
- *Metrics are automatically added to the columns of a report, although you can drag and drop them onto the rows depending how you want the report organized.*

5 Double-click **Units Sold** and **Profit** to add the metrics to the report.

6 You decide that Profit is not relevant to your employee analysis, so you want to remove it from the report template. Drag the **Profit** metric from the report template to the Report Objects pane.

By dragging a metric to the Report Objects pane, you are removing it from the grid report, not the report objects. If you remove the object from the report objects, it is no longer included as part of the calculations for the metrics on the report.



The report template should now match the image below:

Quarter	Customer Region	Metrics	Revenue	Units Sold
<Quarter>	<Customer Region>		<Revenue>	<Units Sold>

Save the report

7 Click the **Save As** icon .

8 In the Save As window, from the **Save In** drop-down list, select **My Reports**.

9 In the **Name** box, type **Customer Region Revenue by Quarter,** then click **OK**.

Review the results

10 In the Report Saved window, click **Run newly saved report**.

Check your results against the report sample at the beginning of the exercise -- the two reports are not quite the same. A sample of the current result is displayed below:

Data rows: 84 | Data columns: 2

Quarter	Customer Region	Metrics	Revenue	Units Sold
2014 Q1	Northeast		$297,442	6,870
2014 Q1	Mid-Atlantic		$340,892	8,065
2014 Q1	Southeast		$96,670	2,230
2014 Q1	Central		$376,399	8,875
2014 Q1	South		$130,967	3,382
2014 Q1	Northwest		$58,128	1,323

The original report:

- Displays the name of each region only once
- Does not display the word “Metrics”
- Displays quarterly subtotals

In the steps below you will format the report to reflect the requirements above.

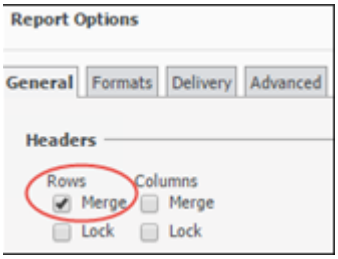
Display repeated row headers once

You can merge row headers that are repeated. All headers displaying the same value are automatically merged into one. In this report, the regions are repeated, but you want to see each region displayed only once.

You can also merge repeated column headers. For example, if multiple metrics are related to revenue, you can merge their column headers into a single header. In our report, the Revenue and Units Sold metrics are different, so you do not want to merge the columns.

1 From the **Tools** menu, select **Report Options**.

2 On the General tab of the Report Options window, select the **Merge** check box under **Rows**.

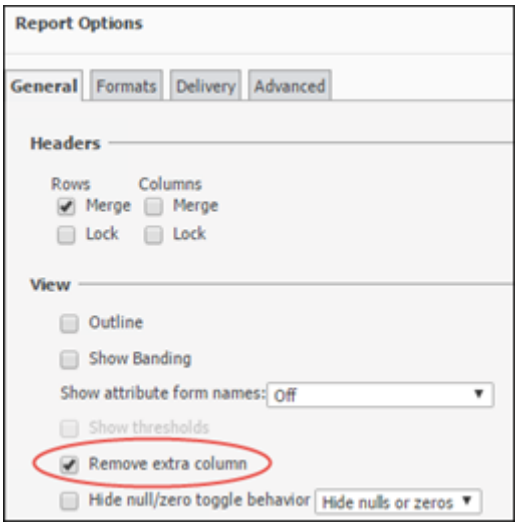


3 Click **OK**.

Remove the extra Metrics column

1 From the **Tools** menu, select **Report Options**.

2 On the General tab of the Report Options window, select the **Remove extra column** check box, in the View area.



3 Click **OK**.

Display regional subtotals

There are several options for calculating subtotals, including displaying Average and Median. You can also choose at which level to calculate the subtotal. For example, if you chose to calculate the subtotal by Customer Region instead of Quarter, you would get the total for all regions across each quarter.

To learn more about metrics and customizing reports, take the *Introduction to Analytics Reports 10.112* course.

1 From the **Data** menu, select **Show Totals**. Subtotals are automatically displayed for each quarter.

2 Click **OK**.

3 **Save** the report.

4 Compare your report with the sample provided at the beginning of this exercise. The reports should now match.

Drill to Customer State and sort Revenue in ascending order

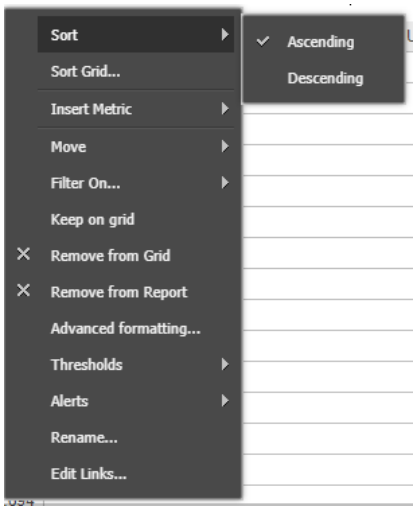
You have been asked to help the marketing team determine where to focus their efforts this quarter to boost sales. To do so, you would like to view overall revenue by State to see which state had the lowest revenue.

1 Right-click the **Customer Region** header in the grid.

2 Hover over **Drill** and select **Customer State**.

3 Right-click the **Revenue** header.

4 Hover over **Sort** and click **Ascending**.



5 To remove the Quarter metric from the grid, right-click the **Quarter** header.

6 Select **Remove from grid**.

Where should the marketing team focus their efforts? Is there an additional metric you would add to the grid to further help the team?

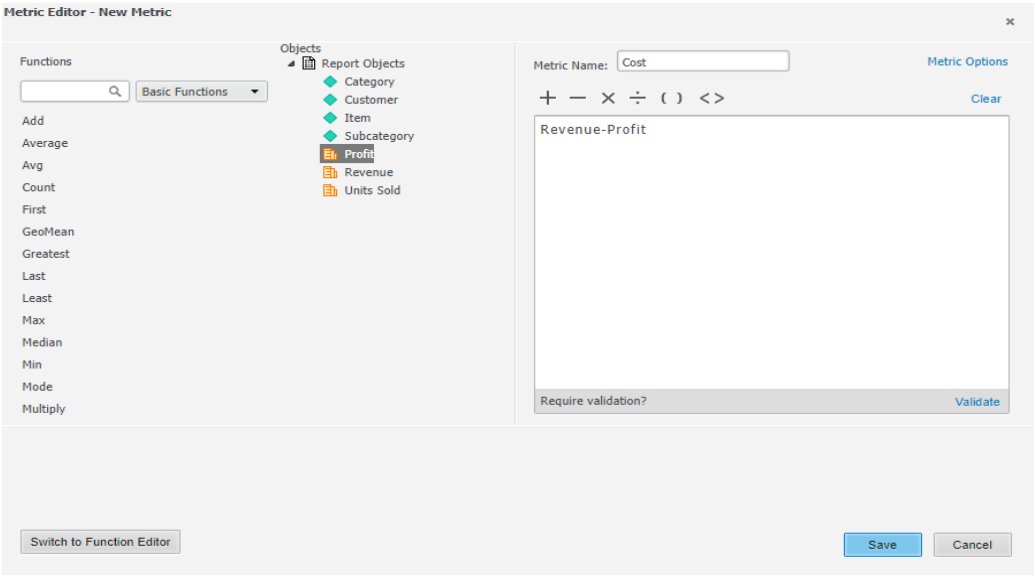
2

Creating Metrics and Filters

Creating metrics from other metrics

When creating reports, you may want to include a metric that is not included in your dataset objects. For example, in a Customer Sales report, you need to add cost for each quarter to the report. However, the Cost metric does not exist in your dataset. You can create the Cost metric by creating a **Derived Metric**, which is a metric created based on data already available in the report.

To create a derived metric, right-click a **metric** in the datasets panel. Select I**nsert New Metric**. In the Metric Editor window, create your metric using objects and functions, such as Revenue - Profit to create the Cost metric.



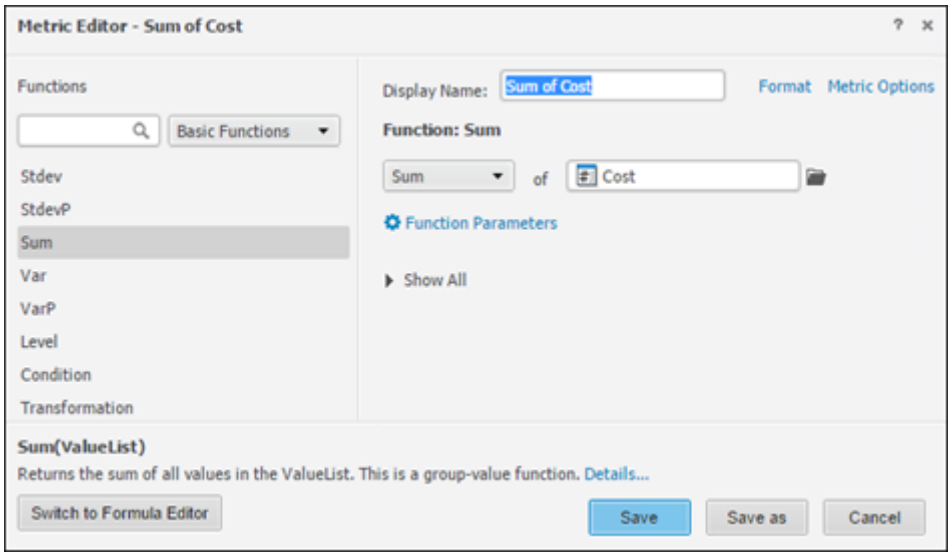
Building metrics from facts and attributes

Facts are one of the essential elements within the business data model. They relate numeric data values from the data warehouse to the MicroStrategy reporting environment. Facts generally represent the answers to the business questions on which users want to report. We will cover facts in greater detail during the *Enterprise Applications* course.

Metrics, as reviewed earlier, perform calculations on data stored in your database. The results are displayed on a report. For example, the revenue metric sums the revenue fact, while an average revenue metric averages the revenue fact. In MicroStrategy Web, you can build metrics by applying calculations to facts stored in your database.

As an example, your data source contains a Cost fact, which represents the cost per product item. You want to view the cost for each item on a report. To calculate

the cost, create a metric that add ups (or sums) the cost. The metric definition is shown below in the Metric Editor, the interface that you use to create metrics.



Notice that Sum is selected in the list of functions on the left and the function is applied to the Cost fact.

Place the metric on a report with the Item attribute. When you run the report, the cost is calculated for each item. A portion of the report is shown below.

Item	Sum of Cost
100 Places to Go While Still Young at Heart	21,230
Art As Experience	9,177
The Painted Word	12,324
Hirschfeld on Line	16,175
Adirondack Style	11,357
Architecture : Form, Space, & Order	11,995
50 Favorite Rooms	8,518

The metric values are not shown as currency because we did not format the metric or the report.

The Sum of Cost metric uses a fact, but metrics can also be built using attributes or other metrics. For example, the Employee Headcount metric applies the Count function to the Employee attribute.

Place the metric on a report with the Region and Call Center attributes. When you run the report, the Employee Headcount is calculated for each Call Center, as shown below:

Region	Call Center	Employee Headcount
Central	Milwaukee	3
	Fargo	1
England	London	2
France	Paris	1
Germany	Berlin	2
Mid-Atlantic	Washington, DC	3
	Charleston	5
Northeast	Boston	3
	New York	3
Northwest	San Francisco	2
	Seattle	1
South	New Orleans	2
	Memphis	1
Southeast	Atlanta	2
	Miami	2
Southwest	San Diego	4
	Salt Lake City	1
Web	Web	1

If you are familiar with data warehousing concepts, facts reflect data values from your data source that represent business performance. Facts are MicroStrategy objects which do not appear on a report.

- *Facts are typically numerical.*
- *Facts are mapped to columns in your schema. The fact object serves as a bridge between fact values stored in your data source and the metrics that users want to see on reports.*
- *Facts are used to define metrics.*
- *Metrics perform aggregations on fact columns.*

Fact objects provide the following benefits:

- *Report designers and end users do not need to understand the structure of the data source when they build reports.*
- *The data source can contain columns with different names that store the same type of fact data; they are all resolved with a single-named fact object in MicroStrategy.*

- *You do not have to resolve discrepancies in the data source to make reporting seamless for users.*

Exercise 2.1: Create simple metrics using facts

In this exercise, you are an analyst for an online book company. Your team has asked you to determine which category of books has the highest revenue and most units sold. To do so, you will create:

- A Units Sold metric and save it in a new folder called My Metrics Exercises.
  - Define the Units Sold metric as a sum of the Units Sold fact.
- A Revenue metric and save it in your My Metrics Exercises folder.
  - Define the Revenue metric as a sum of the Revenue fact.
  - Format the values as currency with two decimal points. Format the values so that negative numbers display in red with no negative sign or parentheses.
- A report that contains the Category attribute and your new Cost and Revenue metrics. Save the report as Category, Units Sold, and Revenue Report, then run it.

  The report should match the image below:

Category	Revenue	Units Sold
Books	$2,640,094	192,668
Electronics	$24,391,303	83,734
Movies	$4,098,943	287,517
Music	$3,893,367	283,554

Create the simple metric: Units Sold

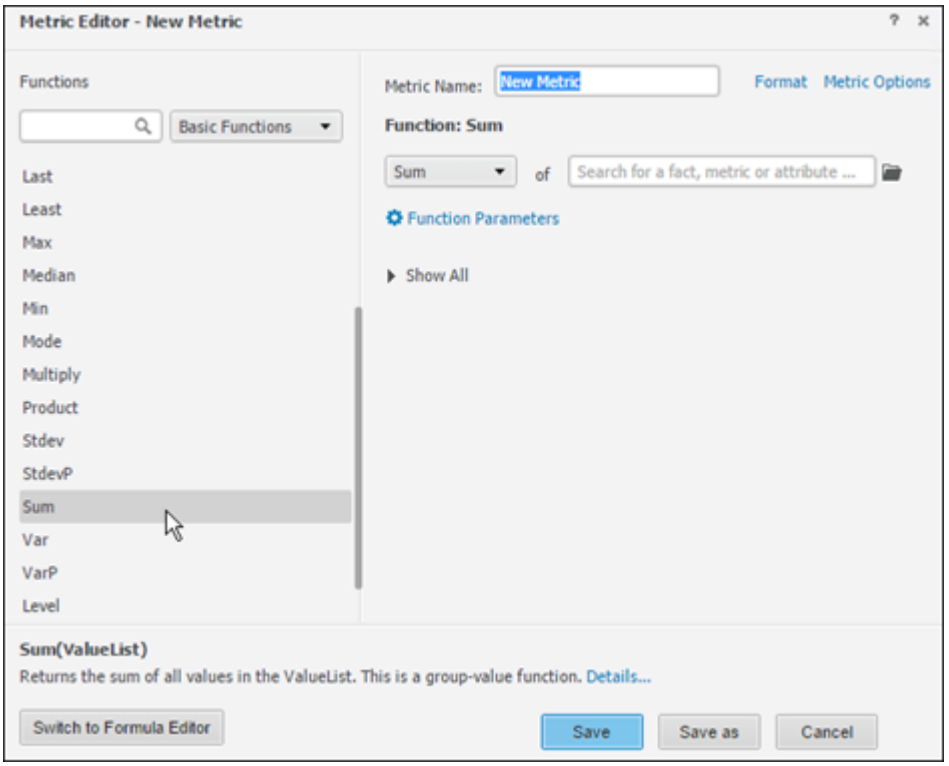
1 On any MicroStrategy Web page, click **Create** and select **New Metric**.

The Metric Editor opens in Function Editor mode. The Function Editor allows you to quickly and easily create and edit a metric.

- *Use the Function Editor to create a metric that uses a function. The Function Editor provides an easy-to-use interface.*

- *To type the metric formula directly or create a metric that combines multiple metrics or contains custom expressions, you can use the Formula Editor instead, by clicking Switch to Formula Editor. We will discuss the Formula Editor when we create a compound metric later in this chapter.*

2 From the **Functions** list on the left, double-click **Sum** to add it to the metric definition window. You may need to scroll to find the function in the alphabetical list.



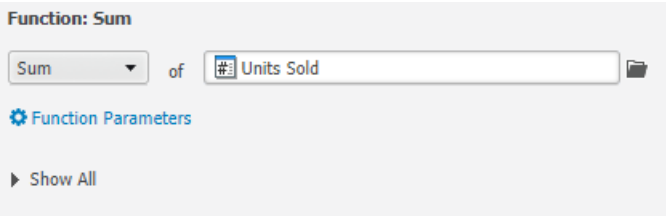
When you select a function, its description is displayed at the bottom of the Metric Editor. You can click Details to view the syntax and examples for the function.

3 Select the Units Sold fact:

a Click the **Browse** icon next to the **Search for a fact, metric or attribute** box.

b Click the **Facts** folder.

c Click the **Units Sold** fact.



Save the Units Sold metric

4 Click **Save As**, then navigate to the **My Objects** folder.

5 Click **Create New Folder**.

6 In the Create Folder window, type **My Metric Exercises**, then click **OK**.

7 Click the **My Metric Exercises** folder.

8 Save the new metric as **Units Sold**.

9 Click **OK** on the message that the metric was saved.

The MicroStrategy Tutorial project already contains another Units Sold metric, but it is saved in a different folder.

Create a simple metric: Revenue

1 On any MicroStrategy Web page, click **Create** and select **New Metric**.

2 From the **Functions** list on the left, double-click **Sum**.

3 Find and add the Revenue fact.

Format the metric's values

4 Click **Format** at the top right of the Metric Editor.

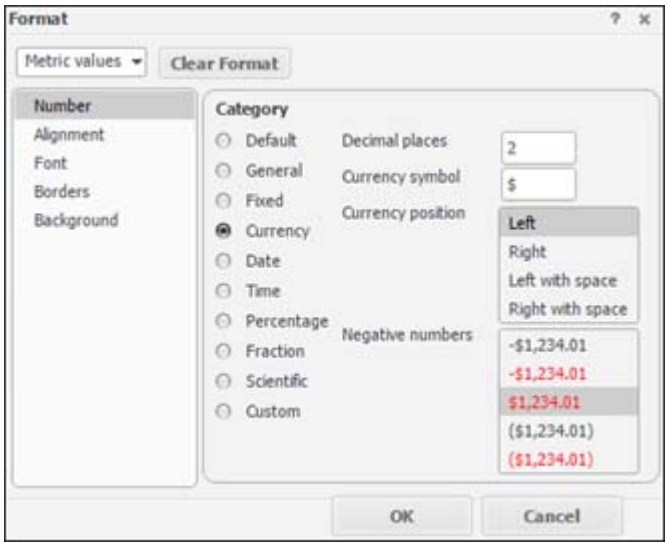
This formatting applies to the metric regardless of the report that it is placed on.

5 In the Format window, select **Metric Values** from the drop-down list.

You can select different formatting options for metric column headers (the title of the metric) and metric values (the numbers calculated by the metric and displayed in the report).

6 Under Category, select **Currency**. By default, Decimal Places is set to 2 and Currency Symbol is set to $, which is the formatting that we want.

7 Select the **Negative Numbers** to display in red with no negative sign and no parentheses.



8 Save the metric in the My Metrics Exercises folder as **Revenue**.

The MicroStrategy Tutorial project already contains another Revenue metric, but it is saved in a different folder.

Use the new metrics in a report

1 On any MicroStrategy Web page, click **Create**, point to **New Report**, then select **Blank Report**.

2 In the All Objects pane on the left, click **Attributes**, and click the **Products** folder.

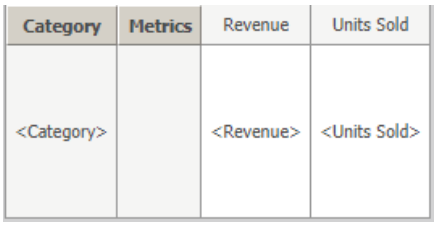
3 Drag **Category** to the rows of the template definition pane.

4 In the All Objects pane, navigate to **My Personal Objects**.

5 Click the **My Objects** folder, and then the **My Metrics Exercises** folder.

6 Drag the **Revenue** metric to the columns of the template definition pane.

7 Drag the **Units Sold** metric to the right of Revenue in the template definition pane. Your report template should look like the following:



8 Click **Save As**.

9 Save the report in the My Reports folder as **Category, Revenue, and Units Sold Report**.

10 Click **Run Newly Saved Report**. Compare your results to the expected report at the beginning of this exercise.

Compound metrics: Metrics made up of other metrics

A compound metric is created by combining one or more other metrics using mathematical operations. The following example of a metric formula uses an arithmetic operator to create a compound metric out of existing simple metrics:

```
Sum(Cost) + Sum(Profit)
```

where `Cost` and `Profit` are metrics. The addition operator (+) between the two metrics makes this a compound metric. The metric formula of a simple (non-compound) metric is made up of a mathematical function and the business facts stored in your data source. For a compound metric, the formula contains other metrics.

If you familiar with function types, a metric that uses a non-group function such as an OLAP function or a scalar function is also a compound metric. The following example shows a compound metric that uses a non-group function, the running average:

```
RunningAvg(Cost)
```

where `Cost` is a metric.

You create compound metrics using the Formula Editor mode of the Metric Editor. This mode allows you to view the metric formula, type the metric formula directly, and create compound metrics.

Derived metrics are discussed in depth in the MicroStrategy course: *10.112 Introduction to Analytics Reporting*.

Building filters to narrow data

A filter screens data from your source to determine whether the data should be included in, or excluded from, the calculations of the report results. Filters are helpful in reducing large quantities of data and displaying only the pertinent subsets of that data to create the report you need. Applying filters to reports allows you to tailor a single report to a specific scenario or business question to be answered.

Filter Examples

If you are familiar with SQL syntax, it may help to know that a filter is equivalent to the WHERE clause in a SQL statement.

You can create:

- **Report filters**: Are used in the SQL that is generated to retrieve the report results from the data source. Report filters can use any object in the project, whether or not it is part of the report.
- **View filters**: Are applied to the report results after the SQL is executed and the results are returned from the data source. View filters do not modify what data is retrieved from the data source which can help improve report execution. A view filter is created on the fly in a report, based only on those objects that exist in the Report Objects pane.

Using both report filters and view filters on a report is advantageous -- you can create a report filter to display a comprehensive set of data tailored to a larger audience. Then, another user can apply a view filter to change the data displayed

in their specific report as the view filter does not trigger re-execution against the data source.

Limiting data displayed on the report: View filters

View filters are created within a report based only on the objects in the Report Objects pane. The view filter restricts data based only on the report results already displayed on the screen. This feature allows analysts to create multiple reports out of a larger parent report without stressing the system or your data source. It also allows different users to access the same report cache but see different data according to their needs.

You can create the view filter conditions within the View Filter pane. A condition defines what the data must meet to be included on the report. The View Filter pane also displays the view filter conditions that are applied to your report.

View Filter Pane

Exercise 2.2: Create a view filter

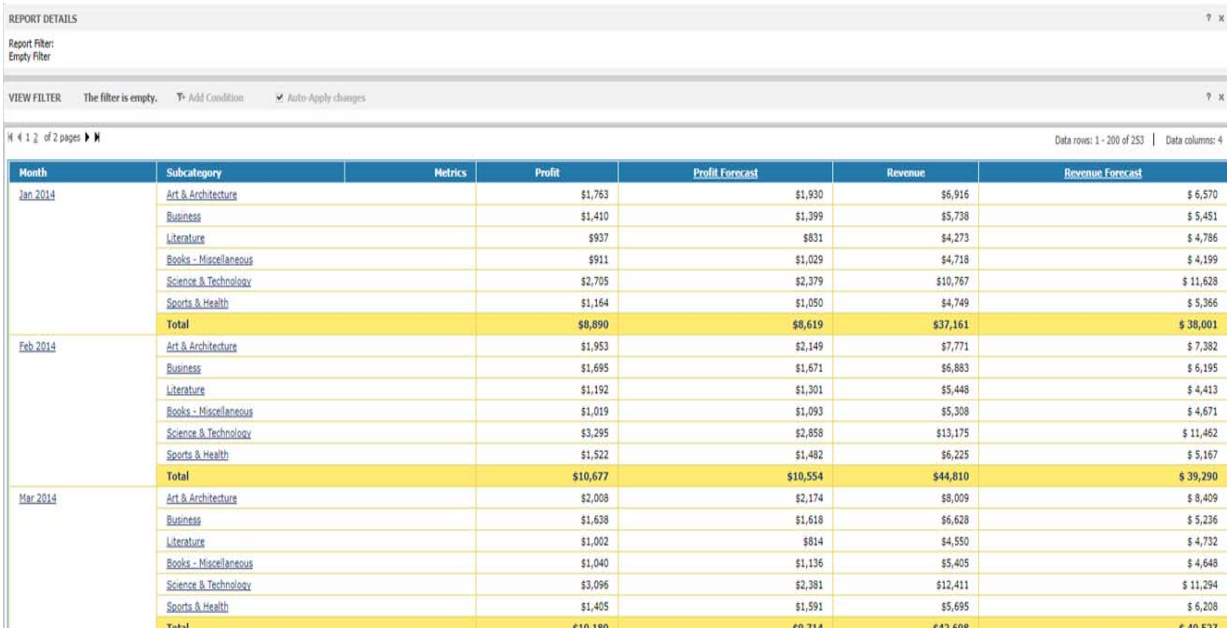
We will create a metric-based view filter to restrict an existing report to show data for 2016.

Open the report

1 In the MicroStrategy Tutorial home page, click **Go To MicroStrategy Web** to go to the **Shared Reports** folder.

2 Click **Subject Areas**, then **Sales and Profitability Analysis**, and click the report named **Category Sales Report** to run it.

The resulting report looks like the following. The report contains 253 rows.


REPORT DETAILS

Report Filter:
Empty Filter

VIEW FILTER The filter is empty. Add Condition Auto-Apply changes

1 2 of 2 pages Data rows: 1 - 200 of 253 | Data columns: 4

Month	Subcategory	Metrics	Profit	Profit Forecast	Revenue	Revenue Forecast
Jan 2014	Art & Architecture		$1,763	$1,930	$6,916	$ 6,570
	Business		$1,410	$1,399	$5,738	$ 5,451
	Literature		$937	$831	$4,273	$ 4,786
	Books - Miscellaneous		$911	$1,029	$4,718	$ 4,199
	Science & Technology		$2,705	$2,379	$10,767	$ 11,628
	Sports & Health		$1,164	$1,050	$4,749	$ 5,366
	Total		$8,890	$8,619	$37,161	$ 38,001
Feb 2014	Art & Architecture		$1,953	$2,149	$7,771	$ 7,382
	Business		$1,695	$1,671	$6,883	$ 6,195
	Literature		$1,192	$1,301	$5,448	$ 4,413
	Books - Miscellaneous		$1,019	$1,093	$5,308	$ 4,671
	Science & Technology		$3,295	$2,858	$13,175	$ 11,462
	Sports & Health		$1,522	$1,482	$6,225	$ 5,167
	Total		$10,677	$10,554	$44,810	$ 39,290
Mar 2014	Art & Architecture		$2,008	$2,174	$8,009	$ 8,409
	Business		$1,638	$1,618	$6,628	$ 5,236
	Literature		$1,002	$814	$4,550	$ 4,732
	Books - Miscellaneous		$1,040	$1,136	$5,405	$ 4,648
	Science & Technology		$3,096	$2,381	$12,411	$ 11,294
	Sports & Health		$1,405	$1,591	$5,695	$ 6,208

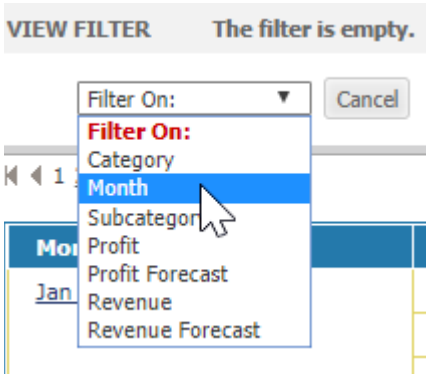
Create a view filter

1 From the **Tools** menu, select **View Filter**, to open the View Filter pane.

2 In the View Filter pane, click **Add Condition**.

Data must meet the defined condition to be included on the report.

3 From the **Filter On** drop-down list, select **Month**.

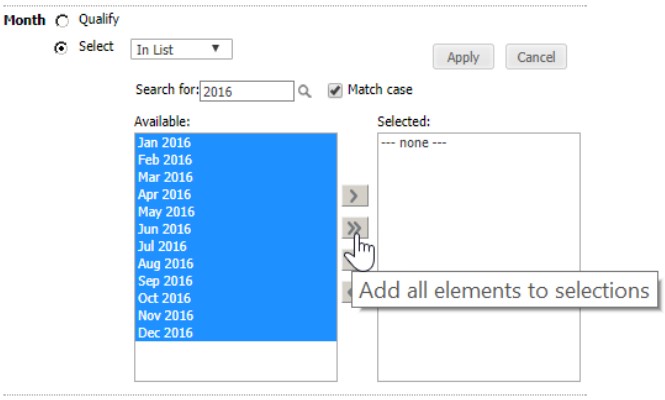


The Filter On list contains only the objects on the report.

4 By default, a view filter based on an attribute allows you to create a list of the attribute elements to include in the report. You can instead use the list to exclude elements (by selecting Not in List). To narrow the available elements to 2016, type **2016** in **Search For**, click **Apply**.

The elements of an attribute are the unique values for that attribute. In this case, the attribute is Category, and its elements are Books, Electronics, Movies, and Music.

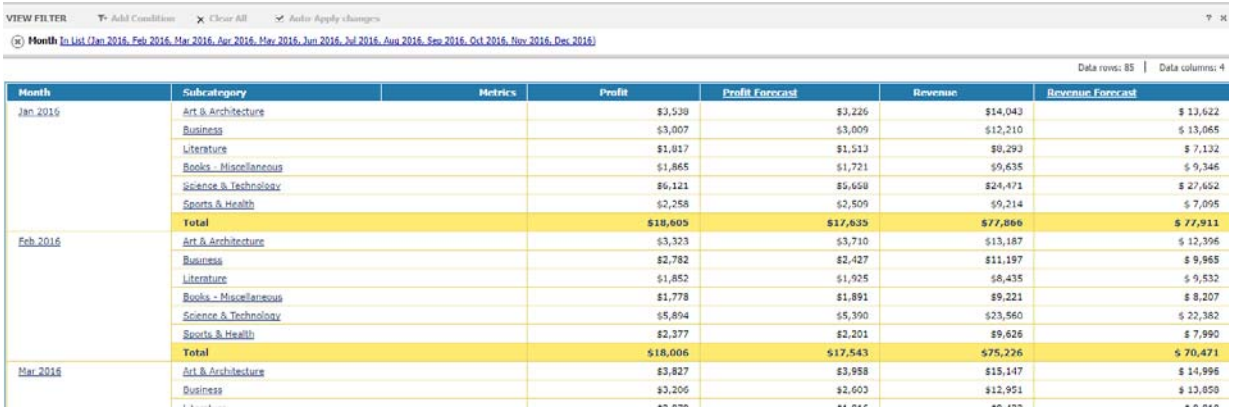
5 Highlight all the available attribute elements, then click the **Add all elements to selection** icon. This creates a view filter showing only data for month in 2016.



The number of rows has decreased from 253 to 85 and the totals for each month have decreased.

- The number of rows has decreased because only 2016 was included in the report.

- The calculations of the totals for all months have been affected because we are now excluding data from 2014 and 2015. However, the calculations for each subcategory are not affected.



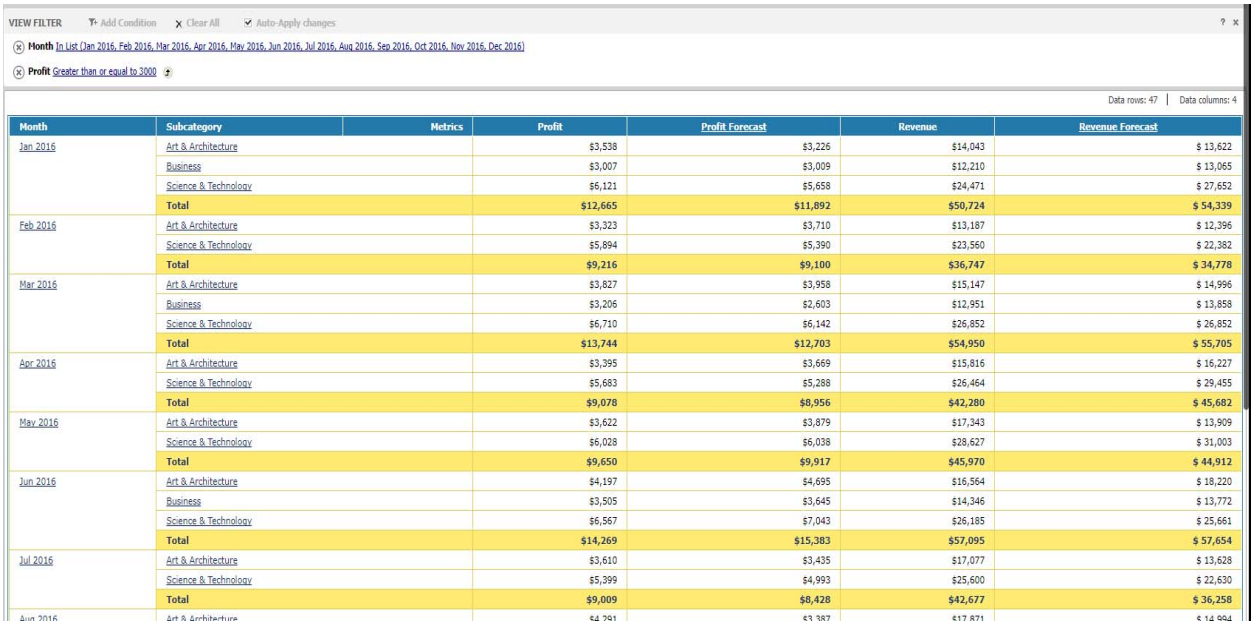
Month	Subcategory	Metrics	Profit	Profit Forecast	Revenue	Revenue Forecast
Jan 2016	Art & Architecture		$3,538	$3,226	$14,043	$ 13,622
	Business		$3,007	$3,009	$12,210	$ 13,065
	Literature		$1,017	$1,513	$8,293	$ 7,132
	Books - Miscellaneous		$1,865	$1,721	$9,635	$ 9,346
	Science & Technology		$6,121	$5,658	$24,471	$ 27,652
	Sports & Health		$2,258	$2,509	$9,214	$ 7,095
	Total		**$18,805**	**$17,635**	**$77,866**	**$ 77,911**
Feb 2016	Art & Architecture		$3,323	$3,710	$13,187	$ 12,396
	Business		$2,782	$2,427	$11,197	$ 9,965
	Literature		$1,852	$1,925	$8,435	$ 9,532
	Books - Miscellaneous		$1,778	$1,891	$9,221	$ 8,207
	Science & Technology		$5,894	$5,390	$23,560	$ 22,382
	Sports & Health		$2,377	$2,201	$9,626	$ 7,990
	Total		**$18,006**	**$17,543**	**$75,226**	**$ 70,471**
Mar 2016	Art & Architecture		$3,827	$3,958	$15,147	$ 14,996
	Business		$3,206	$2,603	$12,951	$ 13,858

Save the report

1 Save the report in the My Reports folder as **View Filter**, and close the report.

Qualification filters

Instead of creating a list, you can create a qualification, which compares the attribute to a specific value. In the example, below, the Category Sales Report has a view filter to show only profit greater the $3,000 in 2016.



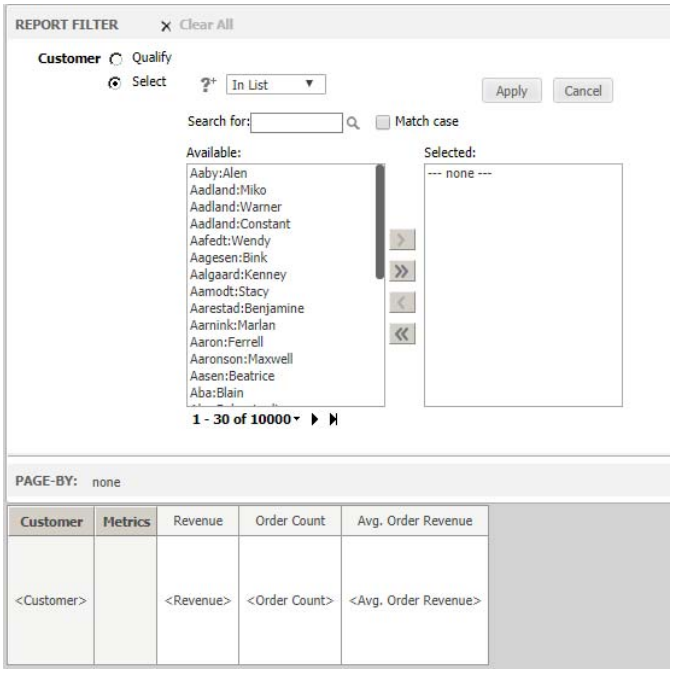
Month	Subcategory	Metrics	Profit	Profit Forecast	Revenue	Revenue Forecast
Jan 2016	Art & Architecture		$3,538	$3,226	$14,043	$ 13,622
	Business		$3,007	$3,009	$12,210	$ 13,065
	Science & Technology		$6,121	$5,658	$24,471	$ 27,652
	Total		**$12,665**	**$11,892**	**$50,724**	**$ 54,339**
Feb 2016	Art & Architecture		$3,323	$3,710	$13,187	$ 12,396
	Science & Technology		$5,894	$5,390	$23,560	$ 22,382
	Total		**$9,216**	**$9,100**	**$36,747**	**$ 34,778**
Mar 2016	Art & Architecture		$3,827	$3,958	$15,147	$ 14,996
	Business		$3,206	$2,603	$12,951	$ 13,858
	Science & Technology		$6,710	$6,142	$26,852	$ 26,852
	Total		**$13,744**	**$12,703**	**$54,950**	**$ 55,705**
Apr 2016	Art & Architecture		$3,395	$3,669	$15,816	$ 16,227
	Science & Technology		$5,683	$5,288	$26,464	$ 29,455
	Total		**$9,078**	**$8,956**	**$42,280**	**$ 45,682**
May 2016	Art & Architecture		$3,622	$3,879	$17,343	$ 13,909
	Science & Technology		$6,028	$6,038	$28,627	$ 31,003
	Total		**$9,650**	**$9,917**	**$45,970**	**$ 44,912**
Jun 2016	Art & Architecture		$4,197	$4,695	$16,564	$ 18,220
	Business		$3,505	$3,645	$14,346	$ 13,772
	Science & Technology		$6,567	$7,043	$26,185	$ 25,661
	Total		**$14,269**	**$15,383**	**$57,095**	**$ 57,654**
Jul 2016	Art & Architecture		$3,610	$3,435	$17,077	$ 13,628
	Science & Technology		$5,399	$4,993	$25,600	$ 22,630
	Total		**$9,009**	**$8,428**	**$42,677**	**$ 36,258**

- The number of rows decreased because the subcategories that have less that a $3,000 profit are no longer displayed.
- The calculations for each subcategory are not affected.

Limiting the data retrieved from the data source: Report filters

There are two ways to create a Report Filter:

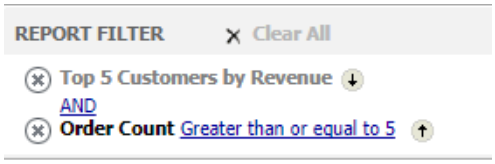
- You can create a dynamic filter directly in the report. This kind of filter cannot be used on other reports. Unlike the view filter, any object in your data source can be used, whereas a view filter utilizes only those objects on the report. In the example below, the report author is adding a dynamic filter by customer name.



- As a stand-alone filter created as an independent object. Once a stand-alone filter has been created, you can add it to a report to filter the data displayed in the report. You can use stand-alone filters to simultaneously change the data displayed in multiple reports.

In Design Mode, a dynamic report filter displays the filter definition, while a stand-alone filter displays its name. In the example below, the stand-alone filter is

named Top 5 Customers by Revenue, while the dynamic report filter uses the Order Count metric in its definition.



Filter types

A filter is composed of at least one qualification. A qualification defines the condition that the data must meet to be included in a report, for example, "Region = Northeast" or "Revenue > $1 million". To learn how to create qualification filters, such as filters based on elements or filters based on a metric's value, take *Introduction to Analytics Reporting 10.112*.

You can also create advanced qualifications such as attribute-to-attribute qualifications and prompted filters. For more information on all types of advanced filters, take *Advanced Analytics Reporting 10.412*.

3

ADVANCED REPORTING

Introduction to advanced reporting

In addition to the basic reporting concepts covered throughout this course, there are many additional features that allow you to perform more complex data analyses. In this lesson, we will explore the following features:

- Enable smart totals for compound metrics using **smart metrics**
- Modify the context of data with **level metrics**
- Compare values from different time periods with **transformation metrics**
- Create a customized collection of elements with **custom groups**
- Ask users questions about the report data they wish to view with **prompts**

Add smart totals to compound metrics: Smart metrics

Compound metrics are metrics made up of other metrics. For example, `Sum(Cost) + Sum(Profit)` is a compound metric. An advantage of compound metrics compared to simple metrics is that compound metrics can use smart totals.

Smart totals define the order in which objects are calculated by MicroStrategy's Analytical Engine, or evaluation order, for the final calculation.

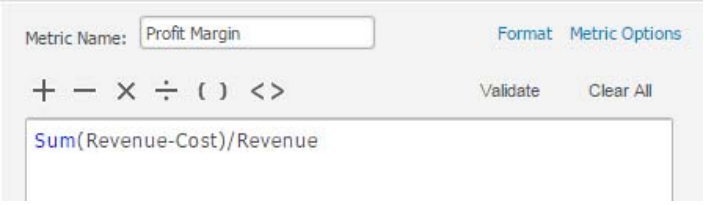
The default order of calculations is as follows:

- Compound smart metrics
- Consolidations
- Report limits
- Subtotals

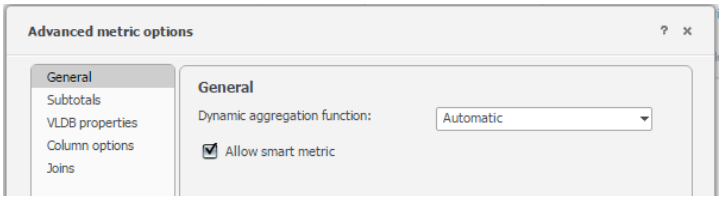
Compound metric calculations occur first, whereas standard report subtotals are the last to be calculated.

A smart total calculates subtotals on individual pieces of the compound metric, while a regular total calculates subtotals by adding all the values for each row of the report. For example, a smart metric uses the formula: `Sum (Metric1)/Sum (Metric2)` rather than `Sum (Metric1/Metric2)`. A compound metric with smart totals enabled is often called a smart metric.

For example, say that you have created a compound metric named **Profit Margin** using the calculation below.



Smart totals are enabled by clicking **Metric Options** and selecting **Allow Smart Metric** from the Advanced metric options window.



How does a smart metric differ from a compound metric on a report?

Assume that we have added the compound Profit Margin metric to a report. We also added the same compound metric with smart totals enabled onto the same report, and named the smart metric Profit Margin-Smart.

	98 Degrees & Rising	$38,379.25	$34,720.26	9.53%	9.53%
	Aretha Franklin's 30 Greatest Hits	$31,608.90	$26,403.02	16.47%	16.47%
	Never Say Never	$32,228.25	$27,521.79	14.60%	14.60%
	Total	$3,893,367.40	$3,713,323.40	501.13%	4.62%
Total		$35,023,708.15	$29,730,084.52	4514.57%	15.11%

Notice the stark difference between the values in the Total column.

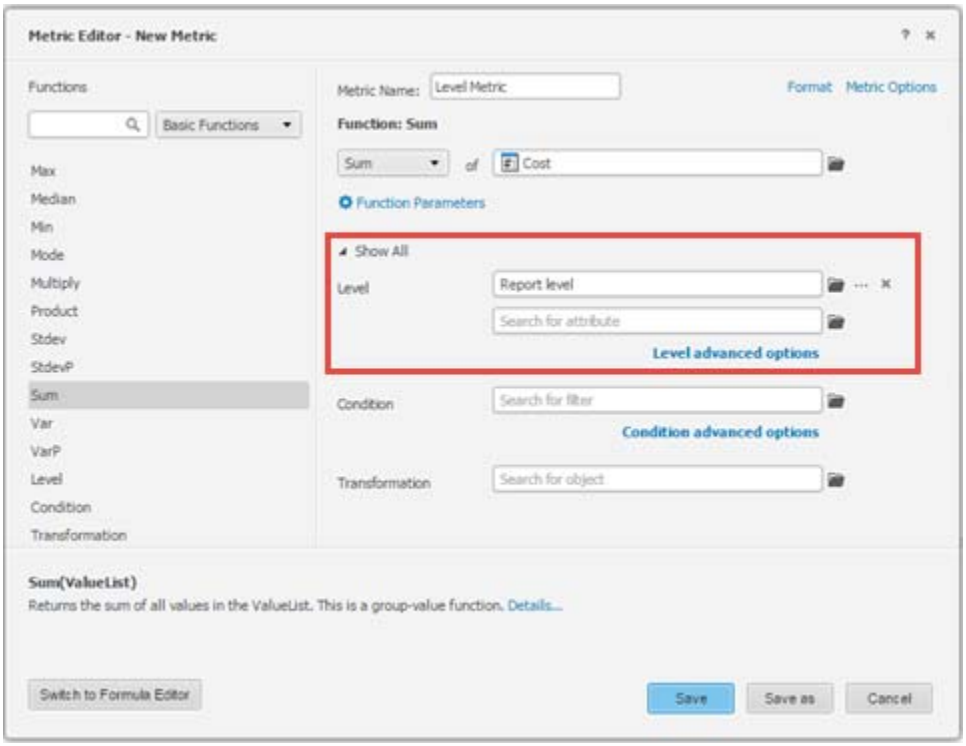
- The totals for the Profit Margin metric (the third metric displayed) are high, at 501.13% and 4514.57% because this column is displaying a sum of all the metric values. In other words, the metric is calculated for each row of the report then rolled up to the correct level.
- The totals for the Profit Margin-Smart metric (the last metric displayed) are more reasonable, at 4.62% and 15.11% because smart metrics calculate subtotals on individual elements of the compound metric. The smart metric adds all the revenue values together, adds all the cost values together, subtracts the cost sum from the revenue sum, and divides that by the revenue sum.

Specify the attribute to use in the metric calculation: Level metrics

By default, metrics are evaluated at the level of the attributes on the report called the report level. For example, a Revenue metric is set to the report level. When the metric is placed on a report containing Region, the metric calculates regional revenue. When it is placed on a report containing Customer, the revenue is calculated for each customer.

You can set the level within the metric, allowing you to specify the attribute(s) to use in the metric calculation, regardless of what is contained on any report the

metric is placed on. When creating a new metric, you can change the level at which the metric calculates.



In the example below two different metrics have been added to the report. The level of each metric is indicated in the metric name:

- Revenue: Report Level
- Revenue: Item

	1	2
Region / Metrics	Revenue: Report Level	Revenue: Item
Central	$5,029,366	$35,023,708
Mid-Atlantic	$4,452,615	$35,023,708
Northeast	$8,554,415	$35,023,708
Northwest	$1,761,187	$35,023,708
South	$5,389,280	$35,023,708
Southeast	$2,239,951	$35,023,708
Southwest	$3,694,132	$35,023,708
Web	$3,902,762	$35,023,708
Total	**$35,023,708**	**$35,023,708**

The Revenue: Report Level calculates the revenue for each region. The Revenue: Item metric calculates the revenue for all items and all regions. The number is therefore the same for each row as the metric does note differentiate between regions (the report level attribute). The number is the same as the grand total for the report.

Example of level metrics in action

Level metrics allow you to determine the contribution of one object to the whole. In the example below, the level metrics **% of all Revenue (by product)** and **% of all Profit (by product)** allow you to view each product's contribution to the total Revenue and Profit.

Product (Metrics)	Revenue	% of all Revenue (by Product)	Profit	% of all Profit (by Product)
Ladies Home Journal	$5.99	0.01%	$0.30	0.00%
Seventeen	$5.99	0.01%	$0.60	0.01%
Vegetarian Times	$5.99	0.01%	$0.60	0.01%
W Magazine	$5.99	0.01%	$0.60	0.01%
Airport Business	$5.99	0.01%	$0.60	0.01%
Business Alabama Monthly	$5.99	0.01%	$0.60	0.01%
Customers.Com	$21.99	0.03%	$1.10	0.02%
Permission Marketing	$21.99	0.03%	$1.10	0.02%
Advertising on the Internet 2nd Edition	$21.99	0.03%	$1.54	0.02%
Competing on the Edge	$21.99	0.03%	$1.10	0.02%

Components of a level metric

Three elements are needed to specify the level of a metric:

- **Target**: The attribute level at which the metric calculation groups.
- **Grouping:** Determines how the metric aggregates.
- **Filtering:** How the report filter interacts with the metric calculation.

More information on creating and using level metrics can be found in the MicroStrategy course: *10.412 Advanced Analytics Reporting.*

Make time-based comparisons: Transformation metrics

Transformation metrics are used to compare values at different times, such as comparing last month's revenue to this month's revenue. Transformations allow you to apply an attribute-based offset to compare metric data. You can create your own or choose from the numerous prebuilt transformations.

Time-based transformations

Although transformations can be applied to any attribute hierarchy, the Time hierarchy is used most often. For the Time hierarchy, the offset can be set as a fixed number of days, weeks, months, or years. Some examples of time transformations include:

- The Last Year transformation that maps each time period to its corresponding time period last year.
- The Month-to-Date transformation that maps each time period to a set of time periods that comprise the entire month to date.

In the image below, the Actual Amount metric displays revenue values from the current quarter. The Last Quarter transformation is applied to the Actual Amount metric to create the Actual Amount - Last Quarter metric, which displays last quarter's revenue numbers. The difference between the sets of numbers can then be calculated and displayed in the Actual Amount - Last Quarter Difference metric.

Account Type (Metrics)	Actual Amount	Actual Amount - Last Quarter	Actual Amount - Last Quarter Difference	% Variance
Salaries	$328,633	$302,762	$25,871	8.55%
High-Tech and Communications Expense	$37,312	$39,709	($2,397)	(6.04%)
Recruiting Expense	$1,163	$2,326	($1,163)	(50.00%)
Travel and Entertainment (T&E)	$411	$1,284	($873)	(68.02%)
Casual Labor	$3,022	$6,923	($3,901)	(56.35%)
Communications	$9,806	$9,675	$130	1.34%
Shipping, Printing, Supplies	$13,109	$12,497	$612	4.90%
Consulting and Advisory	$31,320	$12,908	$18,412	142.64%
Depreciation	$66,033	$73,998	($7,964)	(10.76%)
Other General and Administrative	$878	$10,395	($9,516)	(91.55%)
Insurance	$311,031	$326,598	($15,567)	(4.77%)
Cost of Goods Sold	$112	$586	($473)	(80.85%)
Total	**$802,830**	**$799,659**	**$3,170**	**0.40%**

Transformations are useful for such time-series analyses which are relevant to many industries, including retail, banking, and telecommunications.

Non-time-based transformations

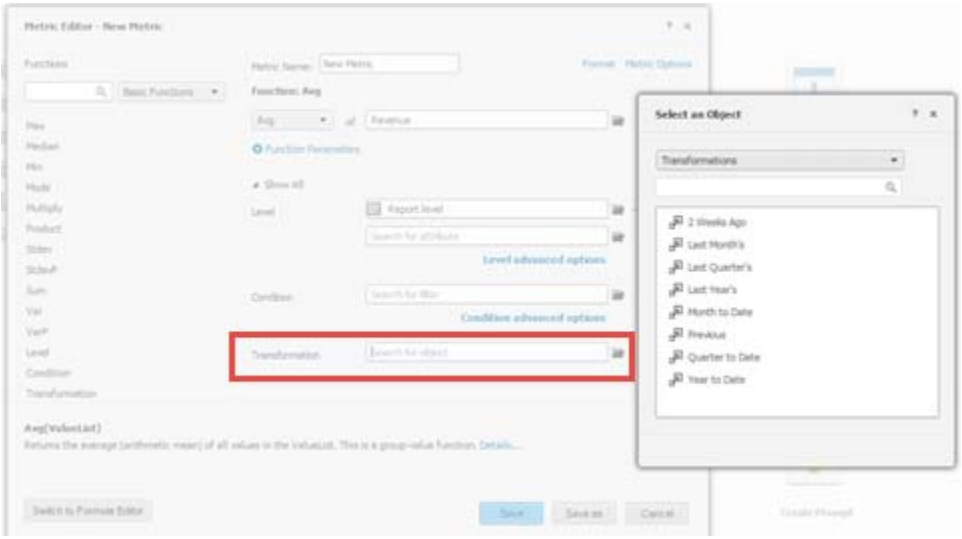
While transformations are most often used for discovering and analyzing time-based trends in your data, not all transformations need be time-based. For example, a transformation can map defunct product codes to new ones, called This Catalog/Last Catalog, which can subtract a number from an old product code to convert it into the new one.

If you are familiar with MicroStrategy functions, transformation-style analysis can also be supported using the Lag and Lead functions. These functions can be used to define metrics that compare values from different time periods without the use of transformation metrics.

Add a transformation to a metric

This step assumes that the transformation already exists. Generally, you will use transformations already prebuilt within MicroStrategy. If you need to create a new transformation, this must be done by the project designer in MicroStrategy Developer.

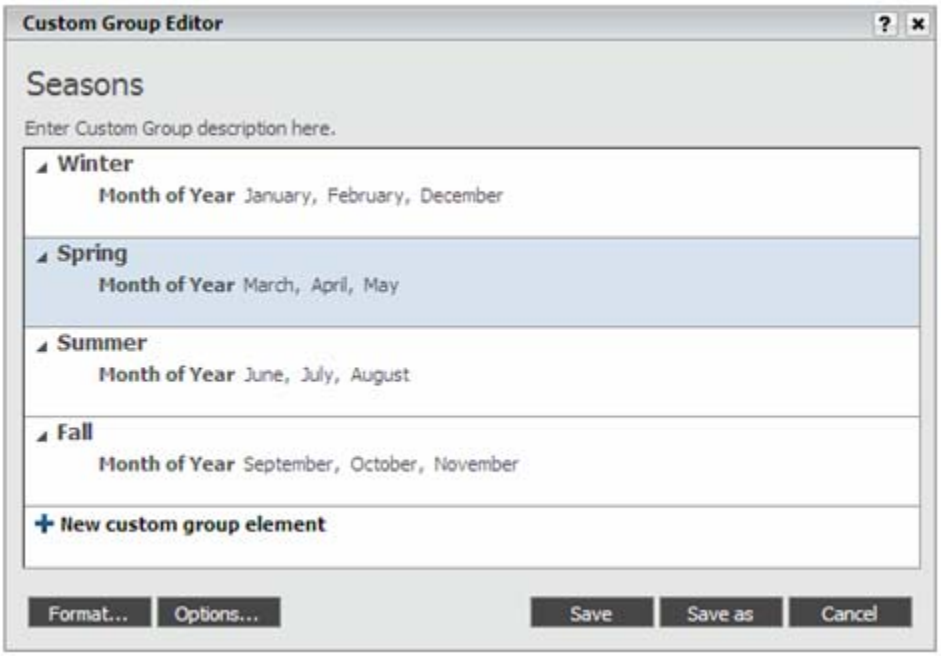
When creating a new metric, you can add a transformation from the Metric Editor- New Metric function editor window.



Grouping attribute elements: Custom groups

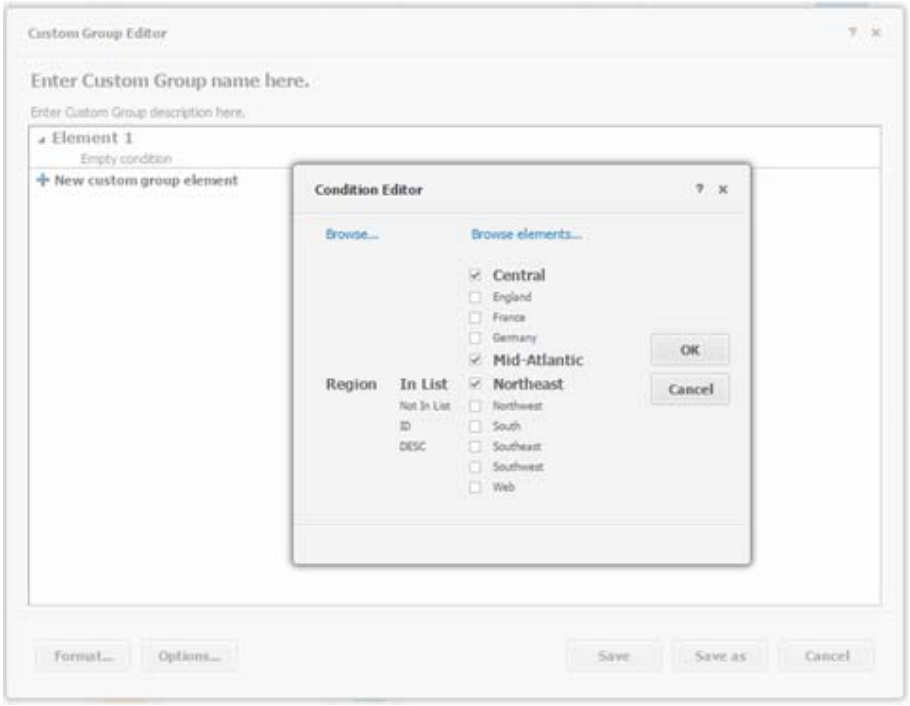
A custom group collects attribute elements together in a way that is not defined in the data warehouse. For example, you want to display data in a report for each

season in a year, but you do not have a Season attribute. You can create a custom group with elements representing each season, such as Winter and Spring, then add a filter to each custom group element to display data only for months in a specific season. In the image below, the Winter custom group element displays data for the months of December, January, and February; the Spring element displays data for March, April, and May; and so on.



A custom group is made up of an ordered collection of components called custom group elements, each consisting of a header and one or more filter qualifications that must be met for data to be included in the custom group element. Using filters, custom groups create virtual attributes that are similar to a collection of smaller reports.

You create a custom group using the Custom Group Editor. In the example below, elements of the Region attribute are being included in a custom group.



More information on custom groups, and how to add them to your report, can be found in the MicroStrategy course *10.412 Advanced Analytics Reporting*.

Dynamically modify the contents of a report: Prompts

A prompt is a question the system presents to a user when the report is executed. How the user answers the question determines what data is displayed on the report. You can make different prompt selections each time you run the report.

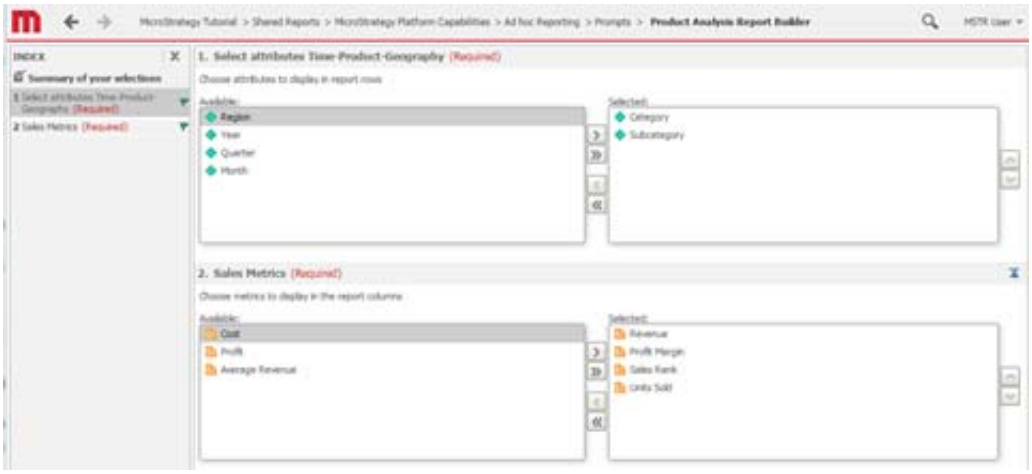
A report designer can include one or more prompts in any report. Prompts are an effective tool to:

- Allow each user who executes the report to request individualized sets of data from your data source when he or she answers the prompts and runs the report. Effectively, each user creates his or her own filter for the report.
- Allow the report designer to create a smaller number of reports overall, using more inclusive objects rather than having to create numerous, more specific reports that are individualized to each analyst.
- Allow the report designer to ensure that the objects on a report are the latest available objects in the project using a search object in a prompt. When a user

launches a prompt by running a report, the search object retrieves the most recent objects that fit the search criteria the report designer defined. No matter when the prompt was created, each time a user executes the report, the user chooses prompt answers from a list of the most up-to-date objects available in the project, including objects that may not have existed when the prompt was created.

- Allow users to keep the objects on their saved reports up-to-date. Users can save a prompted report so that the objects within the prompt remain connected to the objects that they were originally based on when the prompt was created. If objects are modified or deleted, the report can reflect those changes the next time the prompted report is run.

When you open an prompted report, you see a page similar to the image below. Once you make your selections and run the report, only data for the selected objects will be displayed.

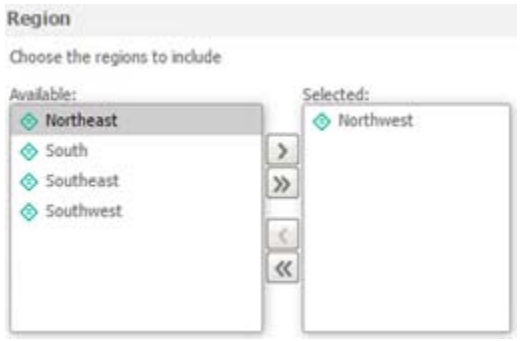


Types of prompts

The correct prompt type to create depends on what report objects you want users to be able to filter on:

- **Attribute Element List prompts**: based on attribute elements. Users select prompt answers from a limited list of specific attribute elements.

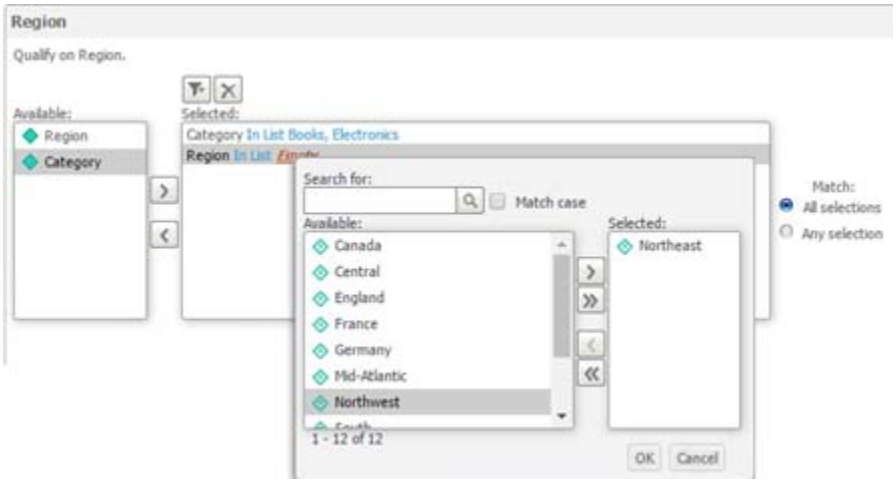
Attribute Element List Prompt



This prompt is the most restrictive of the attribute and hierarchy prompts because the user has the fewest number of attribute elements from a single attribute to select answers from.

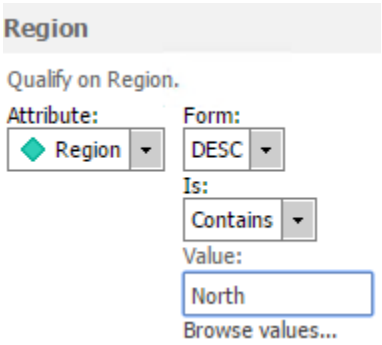
- **Attribute Qualification prompts**: based on an attribute form. Depending on how you create the prompt, users either:
  - Select from a list of all the attribute elements from specific attributes.

Attribute Qualification Prompt (Selection)



- Are guided through creating a qualification to filter on an attribute form.

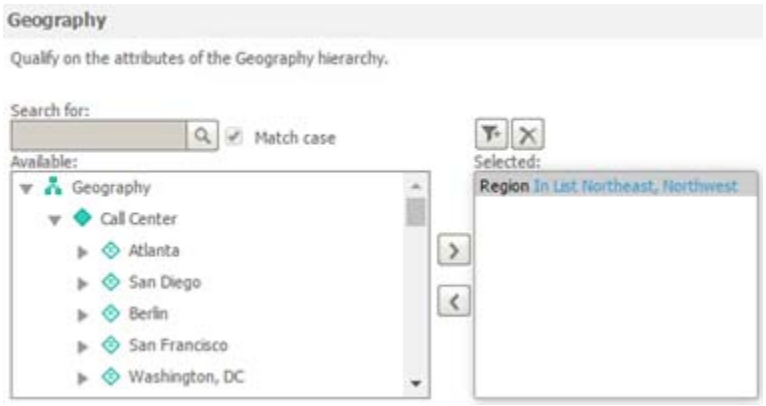
Attribute Qualification Prompt (Qualification)



This prompt is less restrictive than the attribute element list prompt, because the user can select from multiple attributes. It is more restrictive than the hierarchy prompt, because the user has fewer attributes to select answers from.

- **Hierarchy Qualification prompts**: based on attribute elements from one or more attributes in a hierarchy. Users select attribute elements from a list of attributes.

Hierarchy Qualification Prompt

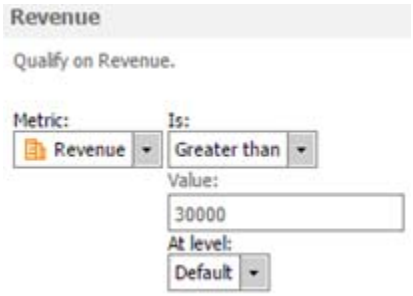


This prompt lets you give users the largest number of attribute elements to choose from when they answer the prompt to define their filtering criteria. Users can select multiple attributes from multiple hierarchies.

A hierarchy is a group of attributes that are conceptually related; for example, the Time hierarchy might consist of a Year attribute, a Month attribute, and a Day attribute.

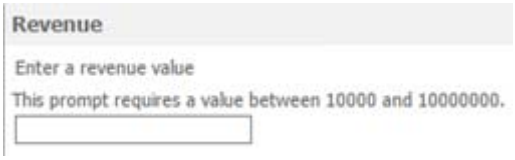
- **Metric Qualification prompts**: based on metrics. Users are guided through creating a metric qualification, which determines what data should be displayed for one or more specific metrics on the report.

Metric Qualification Prompt



- **Value prompts**: based on a value for any object. Users type a single value to filter the report data on. The value can be a date, text, or a number, including Big Decimal numbers.

Value Prompt (Numeric)

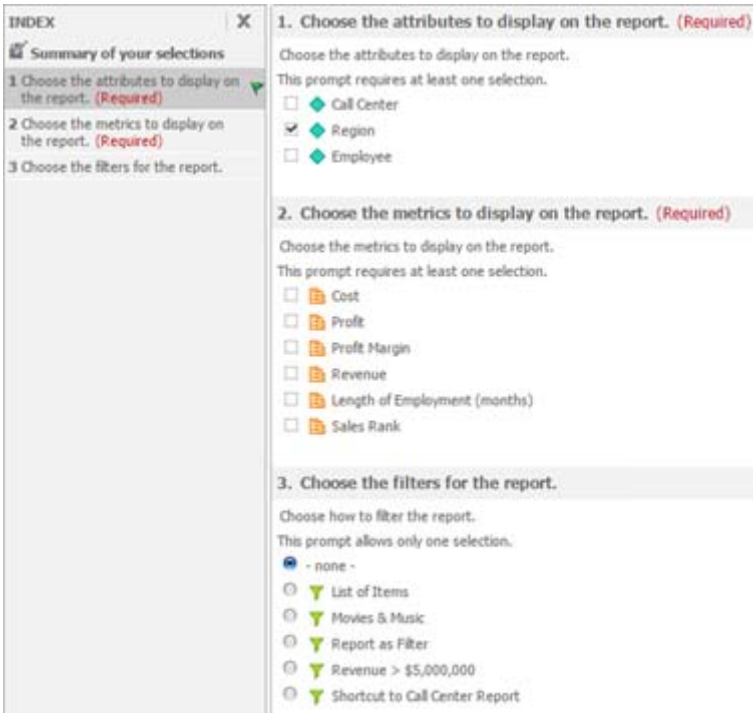


A value prompt is usually used in a filter, but a value prompt can also be used in a metric. The filter or metric is then placed on a report.

- **Object prompts**: based on any object. Users select objects to include in a report, such as attributes, metrics, or filters. Users can use this prompt to add

more data to a report, or choose from a selection of filters to apply a filter that is most useful for their analysis purposes.

Object Prompts



The correct prompt type to create also depends on where on and how you want to add the prompt:

To add a prompt to a **report**:

- On the report template, use:
  - Object prompt containing attributes or metrics
- On the report filter, use:
  - Attribute Element List prompt
  - Attribute Qualification prompt
  - Hierarchy Qualification prompt
  - Metric Qualification prompt
  - Object prompt containing filters or reports
- On the report's page-by pane:
  - Object prompt containing attributes or metrics

To add a prompt to a **metric**, use:

- Object prompt containing attributes, filters, or metrics
- Value prompt containing numbers

To add a prompt to a **filter**, use:

- Attribute Element List prompt
- Attribute Qualification prompt
- Hierarchy Qualification prompt
- Metric Qualification prompt
- Object prompt containing attributes, filters, or reports
- Value prompt containing dates, numbers, or text

Components of a prompt

The pieces that make up a prompt control how a prompt appears and how it functions. These components include the following:

- **Answer requirement:** Determines whether users are required to answer the prompt or an answer is optional. If an answer is required, a report cannot be executed until an answer is provided.
- **Default prompt answers**: Pre-selected answers for the prompt, which the user can then accept, replace with a different answer, or accept and add more answers.
- **Title and description**: Name and description for the prompt, which can significantly impact whether a user finds prompts to be simple or complex. These should be useful and descriptive.
- **Style**: Determines the appearance of the prompt and the layout of how users select answers for the prompt.

Stand-alone prompt vs. prompt as part of a report or filter

A stand-alone prompt is a prompt that is created as an independent MicroStrategy object. A stand-alone prompt can then be used on many different reports, as well as on filters, metrics, and other objects, and can be used by other report designers. A stand-alone prompt gives report designers flexibility.

Prompts can also be created as an intrinsic part of a given report, filter, or custom group, at the same time the report, filter, or custom group itself is being created. Prompts created as part of another object are saved with the definition of that object. Therefore, a prompt created as part of another object cannot be used on any other object.

More information on creating and adding prompts to reports, can be found in the MicroStrategy course *Advanced Analytics Reporting 10.412*.

4

Designing Documents

Introduction to documents

Business intelligence presented in grids and simple graphs help provide key information required to meet basic business needs. However, many organizations have complex and sophisticated questions that can only be answered through multi-faceted reporting and analytics. Businesses require both a holistic view of their organization and a granular look at their data while managing a simple way to distribute key information.

MicroStrategy supports these needs through production-ready Report Services documents and interactive documents. Leveraging document templates in MicroStrategy Web, you can build pixel-perfect scorecards, financial reports and documents, and other interactive dashboards that span various styles of BI. Documents deliver key business goals that many organizations have, such as:

- Communicate effectively to diverse and large audiences using compelling data visualizations.
- Easily explore business data at the enterprise, departmental, or personnel level.
- Reduce time needed to design and deploy scorecards, dossiers, or enterprise reports.

- Collaborate productively and easily, using verified and well-governed data.
- Give executives the ability to quickly access relevant Key Performance Indicator information.
- Create high-throughput production reporting.
- Present highly formatted views of information such as financial reports, budgets, or invoices.

Formatted data displays: Basic documents

A MicroStrategy Report Services document contains objects representing data coming from one or more reports with the ability to present information in an almost infinite number of ways. Documents are generally formatted to suit your business needs in a single display of presentation quality. When you create a document, you can specify the data that appears, control the layout, formatting, grouping, and subtotaling of data. To further customize your document you can insert pictures and draw borders in the document. High-quality, Pixel Perfect™ documents allow the display of business data in a user-friendly style that is suitable for the boardroom.

Document Example

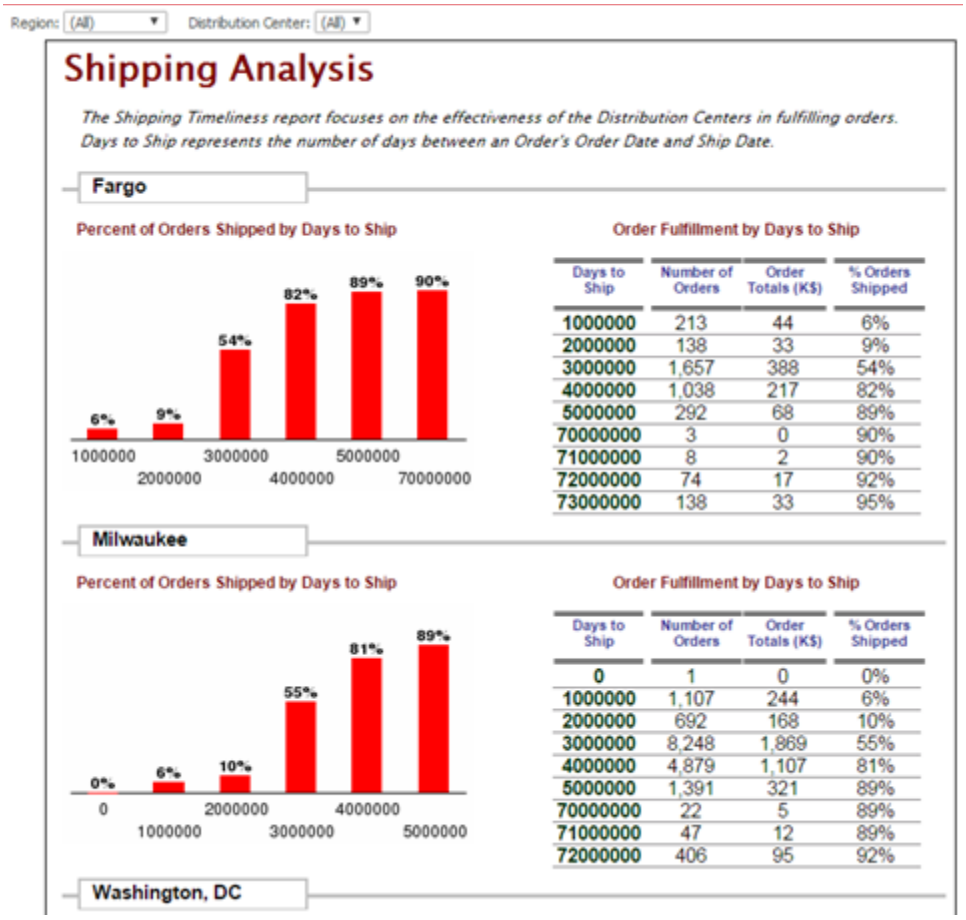
GROUPING: Category: Electronics ▼ Subcategory: Computers ▼ Region: (All) ▼

Category Sales and Profit Performance

	Current Month		Last Month		Last Quarter		Last Year	
	Sales Cost	Profit Margin	Sales Cost	Profit Margin	Sales Cost	Profit Margin	Sales Cost	Profit Margin
Category: Electronics								**Quarter Sales $782,468**
Subcategory: Computers								**Quarter Sales $72,630**
Region: Central								**Quarter Sales $13,544**
Oct 2014	$4,033 $3,219	$814 20.18%	$4,922 $4,047	$875 17.78%	$4,196 $3,584	$612 14.59%	$3,437 $3,584	$691 20.10%
Nov 2014	$4,797 $4,133	$665 13.85%	$4,513 $3,593	$920 20.39%	$4,670 $3,750	$919 19.69%	$3,481 $3,750	$495 14.21%
Dec 2014	$4,713 $3,929	$784 16.64%	$3,733 $3,137	$596 15.97%	$4,232 $3,429	$803 18.97%	$2,703 $3,429	$445 16.45%
Region: Mid-Atlantic								**Quarter Sales $3,953**
Oct 2014	$948 $762	$186 19.63%	$1,817 $1,481	$336 18.50%	$1,747 $1,394	$353 20.20%	$1,355 $1,394	$264 19.51%
Nov 2014	$1,865 $1,638	$227 12.17%	$1,850 $1,461	$389 21.02%	$2,024 $1,634	$390 19.28%	$1,883 $1,634	$301 15.98%
Dec 2014	$1,140 $989	$150 13.17%	$1,889 $1,652	$237 12.54%	$1,221 $992	$229 18.78%	$1,322 $992	$154 11.62%
Region: Northeast								**Quarter Sales $31,407**
Oct 2014	$11,200 $8,974	$2,226 19.87%	$12,459 $10,162	$2,297 18.44%	$10,671 $9,126	$1,545 14.48%	$9,565 $9,126	$1,872 19.58%

Activity: Open a MicroStrategy document

1. From the MicroStrategy Tutorial Home page, click **Go To MicroStrategy Web** to arrive at the Shared Reports folder.
2. Click the **Enterprise Reporting Documents** folder.
3. Open the **Shipping Analysis** document.
4. Use the **Region** and **Distribution Center filters** to narrow the data to specific locations.



Creating your document

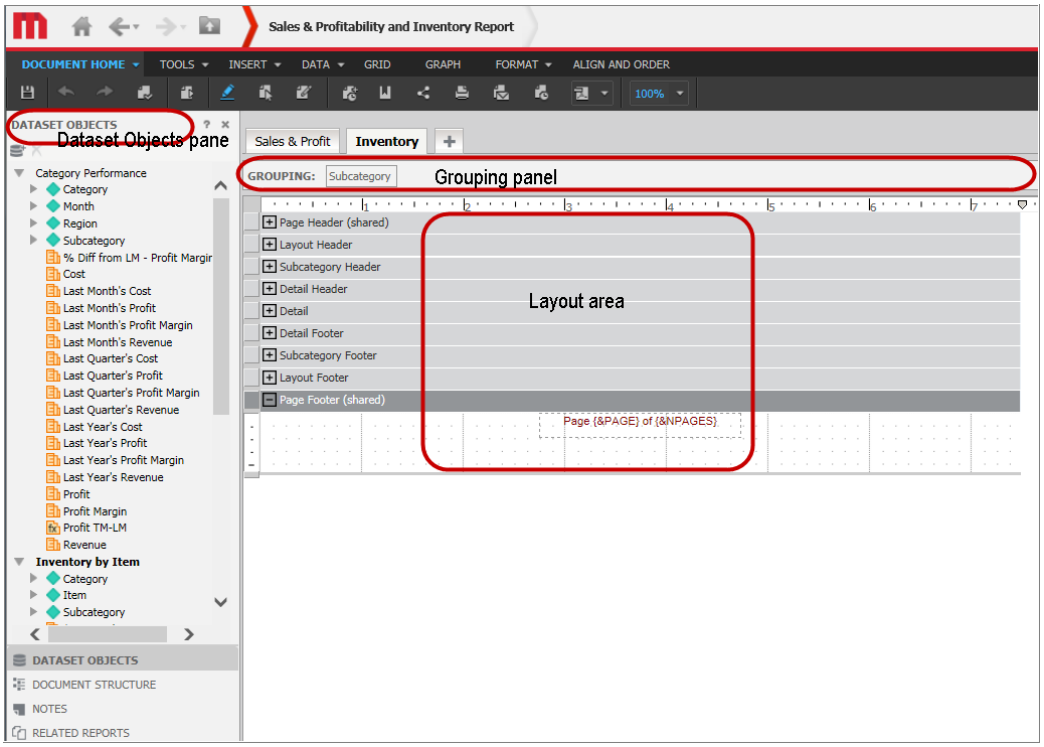
Document Editor

To create a new document or edit an existing document in MicroStrategy Web, use the Document Editor in Design Mode. Design Mode includes the following sections:

- Accordion with the following panes:
  - **Dataset Objects**: Contains all of the objects that can be placed on the document, organized by dataset.
  - **Document Structure**: Displays the sections and objects in the document as a hierarchical list.
  - **Notes**: Displays the notes or comments added to the document and allows you to add your own notes. Use this section to communicate with others about the document.
  - **Related Reports**: Displays links to documents, reports, and Intelligent Cubes that are saved in the same folder as the current document.
- **Layout area**: Displays the objects that will be displayed in the document. To add an object to the document, drag it from the Dataset Objects pane to the Layout area.

- **Grouping panel**: Displays the objects that the document is grouped by. Each attribute element of a grouping attribute is a subset, or group, of data that a user can view.

Document Editor



Document objects

In the upcoming exercise, you will learn more about the objects that can be added to a document. Below is a brief explanation of these document objects.

Visual displays of data: grids and graphs

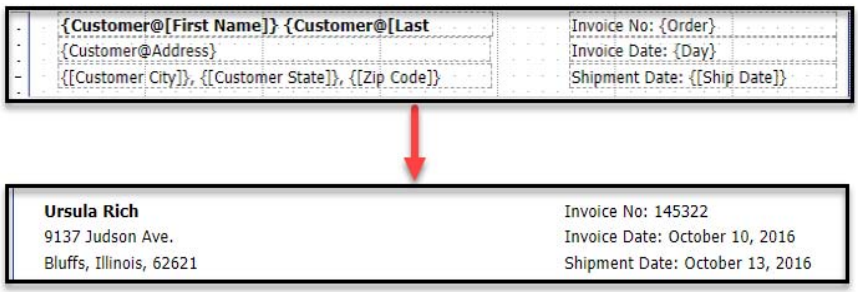
After you adding a dataset to the document, you can add the data to any header or footer section in the Layout area. When you drag a dataset into those sections, it becomes a grid/graph object. A grid/graph object displays like a MicroStrategy grid or graph report.

You cannot include grid/graphs in the Detail section -- this section displays rows of data.

Dataset objects: Attributes and metrics

You can add individual attributes or metrics from datasets to any document section. These objects can come from one or more datasets.

When you add these objects to the layout they are converted to dynamic text, meaning that the values can change based on other objects on the document. When the document is executed, all dynamic text is automatically populated from a dataset with data that originated in the data warehouse (or an Intelligence Server cache). In the sample below, the first image is shown in Design mode and the second image is in Presentation mode.



Attributes and Metrics that are dragged from the dataset onto the document are denoted with curly braces { }. For example, {Region}. MicroStrategy objects that contain spaces or special characters must be surrounded by square brackets [ ], for example, {[Call Center]}.

Formatting objects: Text

Using text boxes, you can insert text into any section of the document. These are referred to as static text, unlike their dynamic counterpart, the text does not change when the document is executed. Static text boxes can be used to:

- Label data, grids, or graphs
- Add additional information or instructions
- Add headings and titles

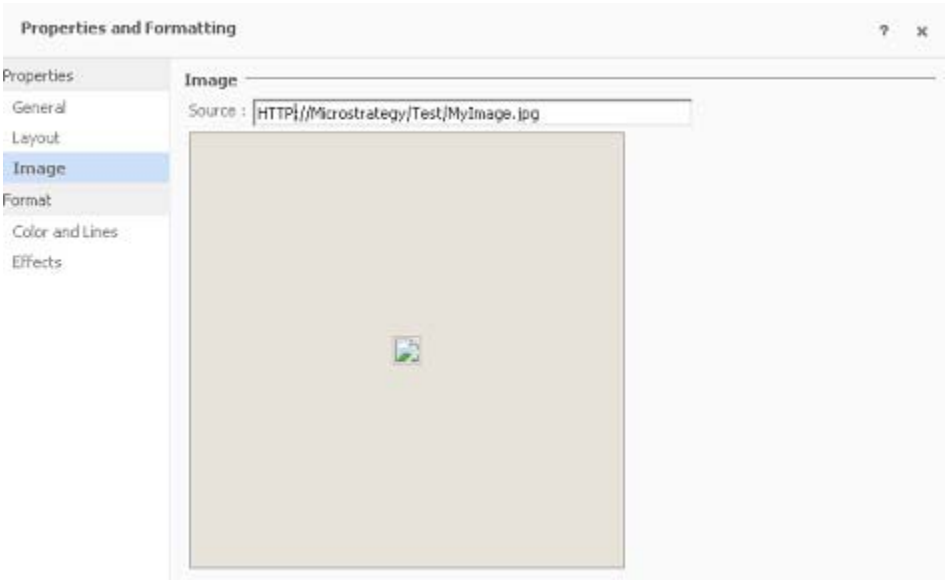
Formatting objects: Images

Images can also be inserted into any section of a document. The image must be available to both the Intelligence Server and to the designers of the document. Without access to the image, designers cannot view the image while creating the document.

To ensure that the image is available as needed you can use the following options:

- An http reference to a central Web server machine, such as `http://microstrategy/Test/myimage.jpg` (example only).
- A full path to the image on a shared network drive, such as `\\my_computer\shared\myimage.jpg`.

Properties and Formatting: Image URL



Formatting objects: Lines and rectangles

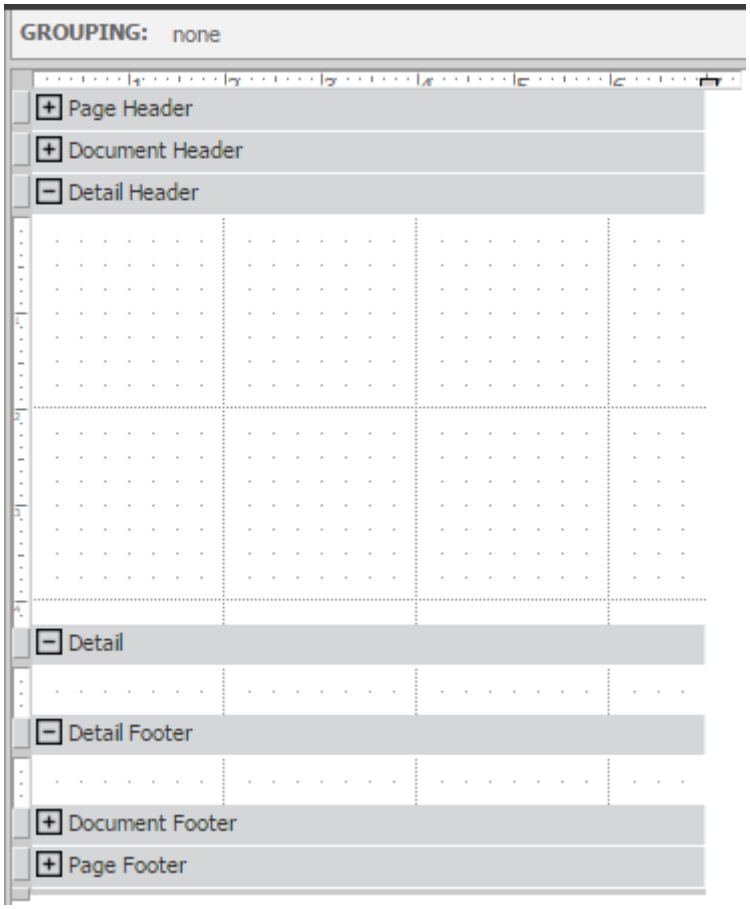
Lines and rectangles help enhance the appearance of your documents by delineating areas where data changes. You can add lines and rectangles to any section of a document

Organizing the document: Document sections

When you open a blank document, it is divided into the following sections:

- Page Header

- Document Header
- Detail Header
- Detail
- Detail Footer
- Document Footer
- Page Footer



Each section can be collapsed, expanded, or removed from the document. Sections are commonly used for a specific purpose or for certain sets of information.

Detail section

When you place attributes and metrics into detail section, the document displays data for each row that exists in the dataset. Generally, when the dataset used in a document contains multiple attributes and you would like the data displayed in the detail section, the best design approach is to use custom sections. You can create custom grouping, explained below.

Detail Section in Design Mode

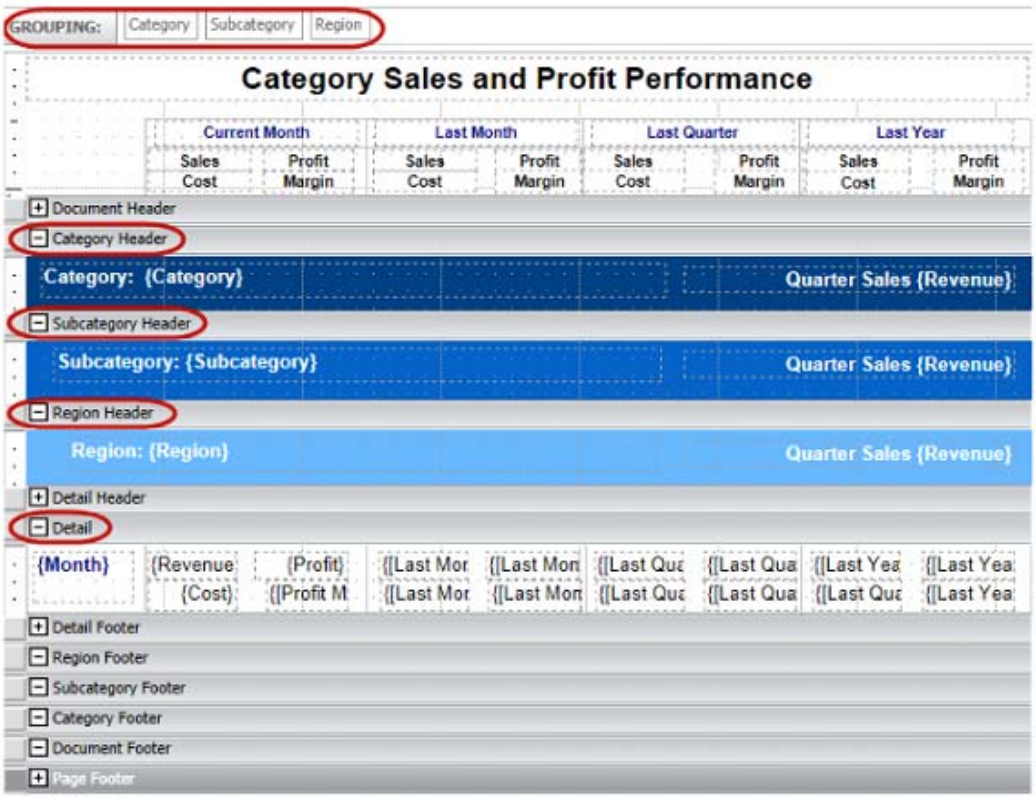
Grouping sections

Grouping is a powerful design technique that enables you to create custom bands to arrange and sort the data in an efficient and approachable layout.

To group a document, add attributes to the Grouping panel in the Document Editor. For each grouping attribute, a header and footer are displayed for unique attribute elements.

In the example below, the Customer, Category, and Subcategory attributes have been placed in the Grouping panel. Corresponding header and footer sections (Category Header, Subcategory Header, Region Header, Category Footer, Subcategory Footer, and Region Footer) display in the Layout area.

Grouped Document in Design Mode



Headers and footers

Header and footer sections can be used for:

- Labeling columns of data that display in the Detail section
- Displaying MicroStrategy grids or graphs
- Displaying totals and subtotals

Exercise 3.1: Create a basic document

In this exercise, you will create a basic document using MicroStrategy Web.

Create the document

1 In MicroStrategy Web, in the Shared Reports folder, click the red **Create** button.

2 Move the cursor to **New Document** and select **Blank Document**.

A new blank document is displayed in Design Mode in the Document Editor.

3 In the Dataset Objects pane, click the **Add Dataset** icon.

4 In the Select Dataset window, in the `Shared Reports\MicroStrategy Platform Capabilities\MicroStrategy Report Services\Datasets\Transactional Sales Detail Reports` folder, select the **Customer Sales** report. Click **OK**.

5 Leave the default prompt answer (Bloomfield) selected and click **Edit in Design Mode**.

6 On the toolbar, click the **Save** icon to save the document.

7 In the Save As dialog box, select the My Reports folder in the drop-down list. Name the document **Transactional Sales Detail by Custome**r.

8 Under Advanced, keep **Display prompt and use the current answers as default answers** selected.

9 Click **OK**.

10 Click **Run Newly Saved Document**.

11 Click the menu icon on the right and select **Edit** to return to Design Mode.

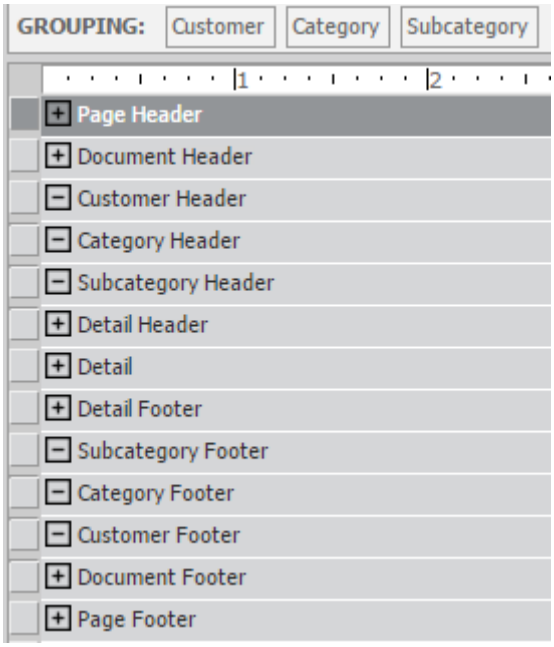
Group the document and start a new page for each group

1 To group the document by specific objects in Design Mode, drag the following attributes (in this order) from the Dataset Objects pane to the Grouping field:

- Customer
- Category
- Subcategory

The order of the attributes in the Grouping field is important as it creates a sort order for the data. The data is first sorted by the leftmost field in the Grouping panel, then by the next field, and so on. Your data will be sorted by Customer, Category, then Subcategory. To reorder the grouping, move the fields in the Grouping panel.

Notice that new sections have been added to the document. A header and a footer have been added for each of the grouping attributes as shown below:

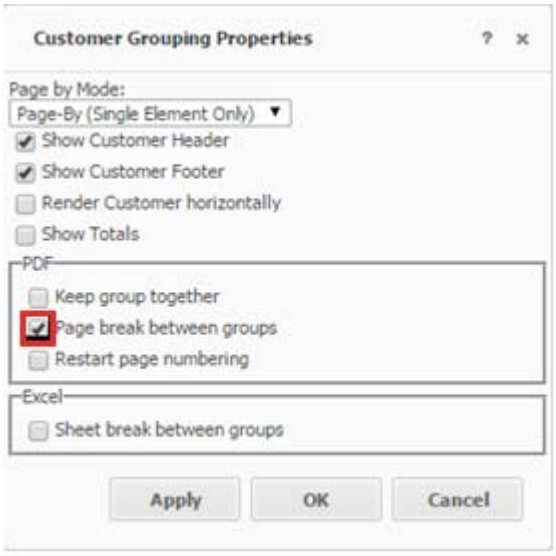


2 Right-click the Customer attribute in the Grouping field and select **Grouping Properties**.

3 In the Customer Grouping Properties window, in the **Page by Mode** drop-down list, select **Page-By (Single Element Only)**.

This mode allows you to view data one group at a time in Presentation Mode, but you cannot display all elements of the group simultaneously.

4 Under **PDF**, select **Page break between groups**, as shown below:



When the document is printed, each group begins on a new page.

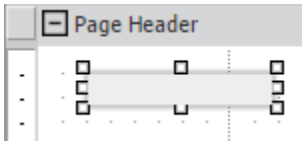
5 Click **OK**.

Add a title to the top of every page

1 The Page Header section displays at the top of every page in the document. Add a text box to display the title text in this document section.

a From the **Insert** menu, select **Text**.

b In the Layout area, click in the top corner of the Page Header section. A blank text box is added, as shown below:



c In the box, type Transactional Sales Report.

2 To format the title, right-click the text box and select **Properties and Formatting**. Format the text box using the following settings:

Property	Setting
Font	Tahoma; bold; 14 pt, black
Layout: Left	0
Layout: Top	0
Layout: Width	Fixed at 275 pixels
Layout: Height	Fixed at 37.5 pixels

3 Click **OK**.

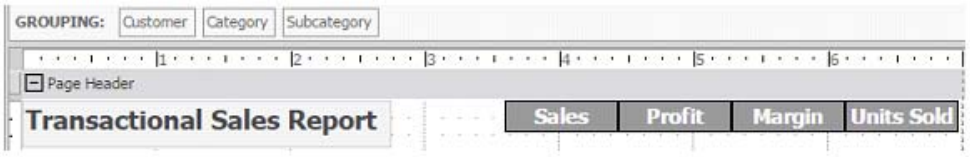
4 In the same way, add the following text boxes to the upper right side of the Page Header:

- Sales
- Profit
- Margin
- Units Sold

5 Format the new text boxes using the following settings. To format all four text boxes at the same time, select them, right-click the selected text boxes, and select **Properties and Formatting**.

Property	Setting
Font	Tahoma; bold; 11 pt; white
Alignment: Horizontal	Center
Color and Lines: Fill Color	Grey-40%
Color and Lines: Borders	All; thin; black
Layout: Top	0
Layout: Width	Fixed at 85 pixels
Layout: Height	Fixed at 24 pixels

The Page Header should resemble the following image:



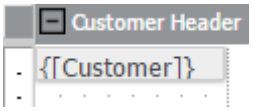
6 Save the document.

Display customer information in the Customer Header section

1 In the final document, the Customer Header displays for each customer in the dataset. Add text boxes to display customer information in this document section.

   a Click the Customer Header section in the Layout area to select it.

   b Right-click the **Customer** attribute in the Dataset Objects pane, and choose **Add to Section as Dynamic Text**.



   Dynamic text is a reference to a dataset object. When you view the document, the dynamic text boxes are replaced by actual data. In this case, the customer names (Abram, Ross and Aguilar, Nadim, for example) are displayed in Presentation Mode.

   Notice the difference between the static text that you added in the previous procedure and this dynamic text. Dynamic text is displayed within braces { }.

   c You can also add a dataset object by dragging and dropping it into the document section. Drag the **Revenue** margin from the Dataset Objects pane and drop it in the Customer Header section. Repeat with the **Profit**, **Profit Margin**, and **Units Sold** metrics

2 To format the Customer Header, right-click the **Customer Header** section, and select **Properties and Formatting**. Format the document section using the following setting:

Property	Setting
Colors and Lines: Fill Color	Indigo

3 Format the {[Customer]} text box using the following settings:

Property	Setting
Colors and Lines: Fill Color	No fill
Color and Lines: Borders	None
Font	Tahoma; bold; 11 pt; white
Layout: Left	0
Layout: Top	0
Layout: Width	Fixed at 192 pixels
Layout: Height	Fixed at 27 pixels

4 Format and align the metric text boxes using the following settings:

Metric	Property	Setting
Revenue	Layout	• Left: 348 pixels • Top: 0 pixels • Width: Fixed at 46 pixels
Profit	Layout	• Left: 433 pixels • Top: 0 pixels • Width: Fixed at 46 pixels
Profit Margin	Layout	• Left: 504 pixels • Top: 0 pixels • Width: Fixed at 46pixels
Units Sold	Layout	• Left: 588 pixels • Top: 0 pixels • Width: Fixed at 46 pixels
All	Colors and Lines	No Fill; no borders
All	Font	Tahoma; bold; 10 pt; white
All	Alignment	Horizontal: Right

The Customer Header should resemble the following image:

The no fill color setting of the text boxes allows the color of the document section to show through.

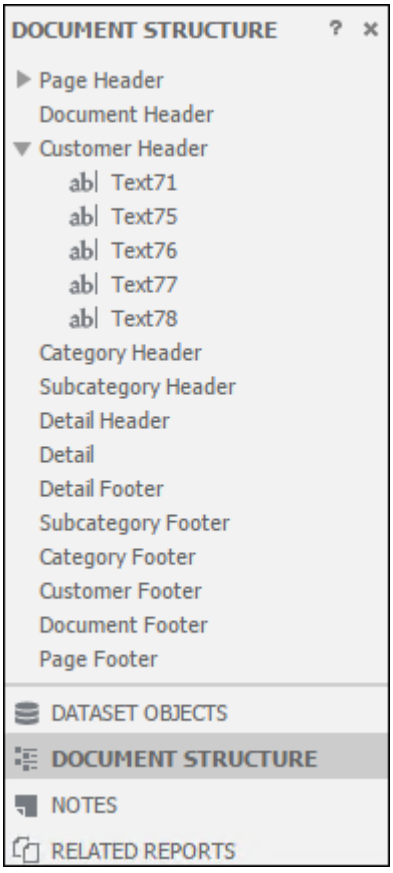
5 Save the document.

Display category and subcategory information in the Category and Subcategory Header sections

1 To provide a hierarchy and structure for the document and the data, a separate Category Header displays for each category under the Customer Header. Below each Category Header, a Subcategory Header displays for each subcategory.

Copy the dynamic text boxes from the Customer Header into the Category and Subcategory Headers.

a Click **Document Structure** in the accordion pane on the left. The Document Structure panel displays the sections and objects in a document as a hierarchical list.



b In the Document Structure panel, CTRL+click all the dynamic text boxes in the Customer Header.

c Right-click the selected text boxes and select **Copy**.

d Click the Category Header and select **Paste**. The formatting and location of the text boxes are copied along with their contents.

e Click the Subcategory Header and select **Paste**.

2 In the Layout area, select the {Customer} text box in the Category Header section and press F2. Change the text to {Category}, and then click out of the text box. In the same way, change {Customer} to {Subcategory} in the Subcategory Header.

3 In the Document Structure panel, select all the dynamic text boxes in the Subcategory Header.

4 Click **Format** to display the Format toolbar. The Multiple option in the first drop-down list indicates that you are formatting multiple objects. You can select different objects from the list.

5 Using the **Format** toolbar, change the color of all the Subcategory header text boxes to Black. From the **Text Color** drop-down list, select **Black**.

6 Format the Category Header and the Subcategory Header using the following settings:

- Category Fill color: Blue
- Subcategory Fill color: Grey-25%

7 Save the document.

Display item information in the Detail section

1 The Detail section provides the most detailed or granular information. In this document, it is the item information.

In the Document Structure panel, select all the dynamic text boxes in the Subcategory header. Copy and paste them into the Detail section.

2 Change the {Subcategory} text box to {Item@ID}.

The @ symbol denotes a form of the attribute. Attribute forms are additional descriptive information about a business attribute. Most attributes, such as Item, only have the forms ID and Description. But an attribute can have many other forms. For example, the attribute Employee has the forms First Name, Last Name, Address, Email, and so on.

3 Right-click the {Item@ID} dynamic text box and select **Duplicate**.

4 Change the duplicated {Item@ID} text box to {Item@DESC}.

5 Move the {Item@DESC} text box to the right of {Item@ID}. {Item@DESC} can overlap the blank space of the {Item@ID} text box. In the example below, {Item@DESC} has a gray fill so that you can see that the selected {Item@ID} overlaps it.

6 Change the font size of {Item@ID} to **9** using the Format toolbar.

7 Change the font size of {Item@DESC} and all four metrics to **8** and remove the bolding.

8 Apply conditional formatting to the Profit metric displayed for items. Conditional formatting is applied to data automatically when the data meets a specified value (the condition). The formatting allows you can easily see which data is critical for business decisions.

   a In the Detail section, right-click the **{Profit}** text box, point to **Conditional Formatting**, and select **Advanced**. This applies the conditional formatting to the Profit metric.

   b In the Conditional Formatting window, in the **Filter On** drop-down list, select **Profit**.

   c In the operator drop-down list, select **Less than**.

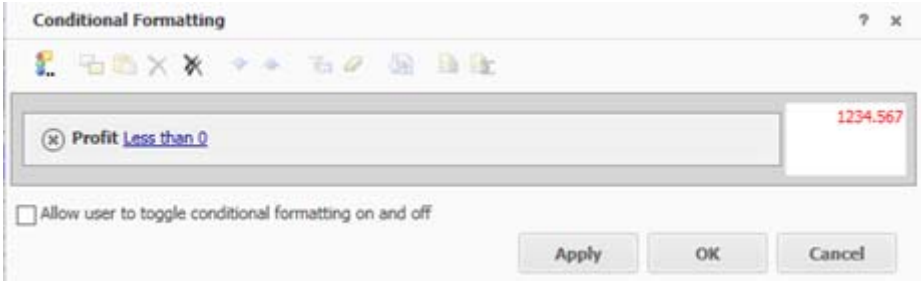
   d In the **Value** box, type **0**.

   e Click **Apply**. This creates the condition (Profit < 0) that determines when the formatting is applied.

   f Click the **Cell Formatting** icon.

   g On the Font tab, in the **Color** drop-down list, select **Red**.

h Click **OK**. This creates the format (red font) that is applied when the condition is met.

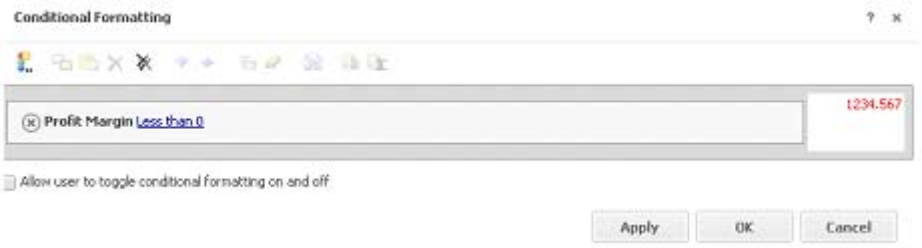


i Click **OK** to create the conditional formatting. Now, the Profit for an Item displays in red font when the Profit value is less than 0.

9 Repeat the step above, with the following changes, to create a conditional format on the Profit Margin metric:

a Right-click **{[Profit Margin]}** in the Detail section.

b Select **Profit Margin** in the **Filter On** drop-down list.



10 Add a tooltip to the Profit metric. A tooltip is pop-up text that is displayed when you hover the cursor over an object. Use tool-tips to provide extra information, such as a description of why a metric value is displayed in red font.

a Right-click the **{Profit}** text box and select **Properties and Formatting**.

b From the list of categories on the left, select **General**.

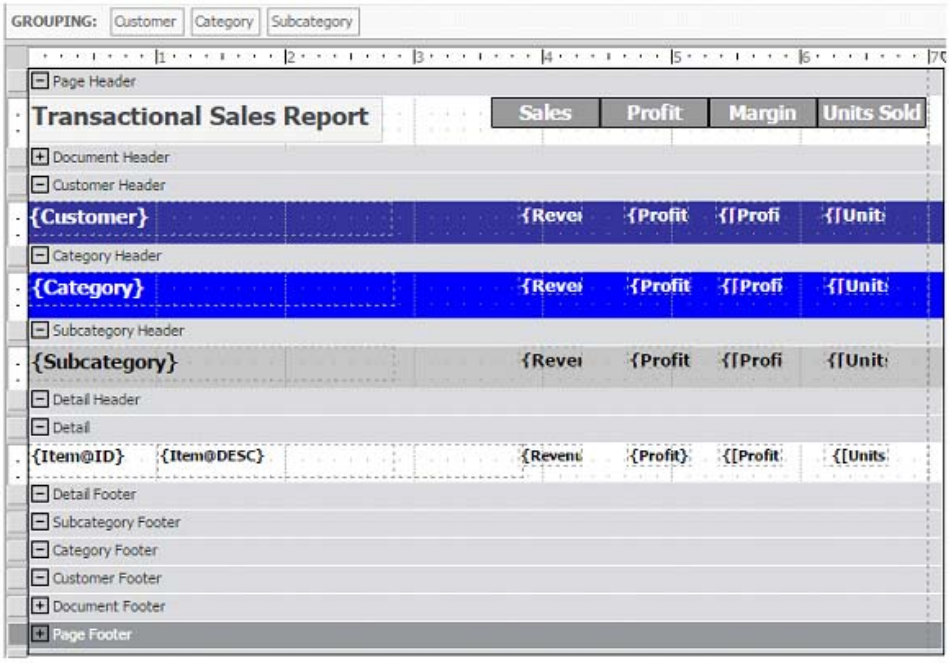
c In the **Tooltip** field, type **Profit below $0 is indicated in Red**.

d Click **OK**.

11 Repeat the steps above to add a tooltip to {[Profit Margin]}, replacing Profit with Profit Margin in the **Tooltip** field.

12 Save the document.

In Design Mode, the document should resemble the following image:

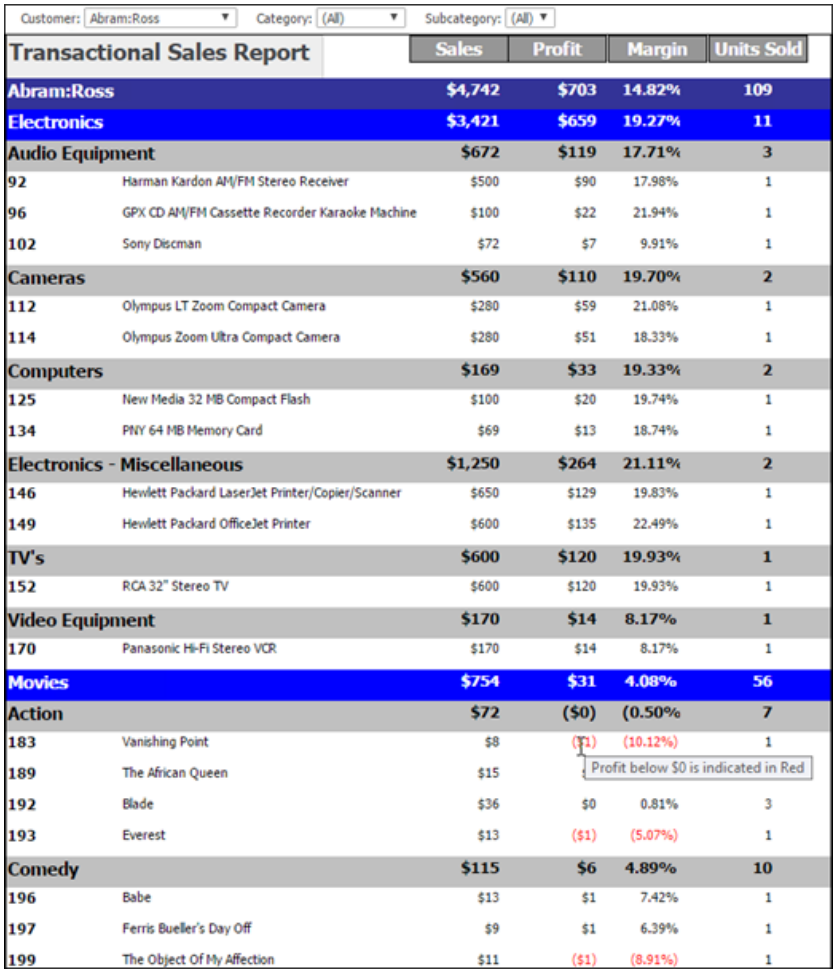


Shrink sections to fit their contents and repeat sections on every page

1. Each document section can expand to the size needed to fit its contents. You can also specify that each section can shrink to fit if the contents are smaller than the specified height. For each section used in the document, complete the following steps:
   a. Right-click the section and select **Properties and Formatting**.
   b. In the Properties and Formatting window, select **Layout** on the left.
   c. Under **Size**, select the **Height Can Shrink** check box.
2. A document section can be repeated on each page of the PDF.
   a. Right-click the Customer Header and select **Properties and Formatting**.
   b. In the Properties and Formatting window, select **Layout** on the left.
   c. Under **PDF**, select the **Repeat on each page** check box.
3. Repeat the previous step for the Category Header and Subcategory Header so they repeat on each page.
4. Save the document.

Run the document and export it to PDF

1 To run the report, click the Presentation Mode icon on the toolbar. The document's results are displayed.



Customer: Abram:Ross | Category: (All) | Subcategory: (All)

Transactional Sales Report		Sales	Profit	Margin	Units Sold
Abram:Ross		**$4,742**	**$703**	**14.82%**	**109**
Electronics		**$3,421**	**$659**	**19.27%**	**11**
Audio Equipment		**$672**	**$119**	**17.71%**	**3**
92	Harman Kardon AM/FM Stereo Receiver	$500	$90	17.98%	1
96	GPX CD AM/FM Cassette Recorder Karaoke Machine	$100	$22	21.94%	1
102	Sony Discman	$72	$7	9.91%	1
Cameras		**$560**	**$110**	**19.70%**	**2**
112	Olympus LT Zoom Compact Camera	$280	$59	21.08%	1
114	Olympus Zoom Ultra Compact Camera	$280	$51	18.33%	1
Computers		**$169**	**$33**	**19.33%**	**2**
125	New Media 32 MB Compact Flash	$100	$20	19.74%	1
134	PNY 64 MB Memory Card	$69	$13	18.74%	1
Electronics - Miscellaneous		**$1,250**	**$264**	**21.11%**	**2**
146	Hewlett Packard LaserJet Printer/Copier/Scanner	$650	$129	19.83%	1
149	Hewlett Packard OfficeJet Printer	$600	$135	22.49%	1
TV's		**$600**	**$120**	**19.93%**	**1**
152	RCA 32" Stereo TV	$600	$120	19.93%	1
Video Equipment		**$170**	**$14**	**8.17%**	**1**
170	Panasonic Hi-Fi Stereo VCR	$170	$14	8.17%	1
Movies		**$754**	**$31**	**4.08%**	**56**
Action		**$72**	**($0)**	**(0.50%**	**7**
183	Vanishing Point	$8	($1)	(10.12%)	1
189	The African Queen	$15			
192	Blade	$36	$0	0.81%	3
193	Everest	$13	($1)	(5.07%)	1
Comedy		**$115**	**$6**	**4.89%**	**10**
196	Babe	$13	$1	7.42%	1
197	Ferris Bueller's Day Off	$9	$1	6.39%	1
199	The Object Of My Affection	$11	($1)	(8.91%)	1

Profit below $0 is indicated in Red

2 Re-prompt the document.

a Click the menu icon on the right, and select **Re-prompt**.

b Select the city of **Bloomfield**, on the second page of the list.

c Click **Run Document**.

3 Note the metric values for Vanishing Point under the Action subcategory. They are both below 0 and therefore displayed in red font, according to the conditional formatting that you created. When you hover your cursor over the Profit or Margin values, the tooltip displays to explain the red font.

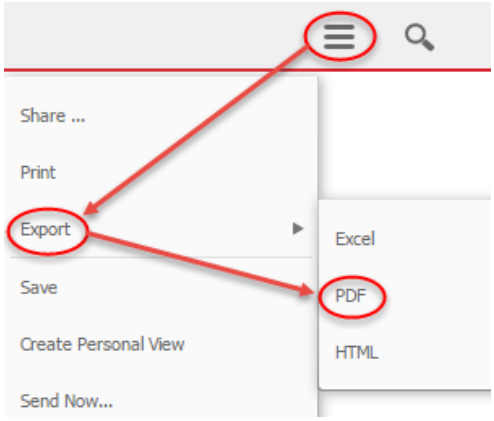
4 Scroll to the bottom of the page. Note the filter details and page number displayed as shown below:

Soul / R&B		$25	$3	11.93%	2
350	Al Green's Greatest Hits	$13	$2	12.35%	1
352	Soul Of A Woman	$12	$1	11.46%	1

Filter details: ({Customer City} = Bloomfield) And (Category = Electronics, Movies, Music)

Page 1 of 1

5 To export the document to a PDF file, click the menu icon , point to **Export**, then click **PDF**.



6 Because the document is grouped, you can select whether to export only the currently displayed page (in this case, Ross Abram's information) or all of the pages in the document. Select **Expand Page-by**.

7 The first page of the table of contents should resemble the image provided at the beginning of the exercise. Notice that all customers in Bloomfield are included, not just the one (Ross Abram) displayed in Presentation Mode.

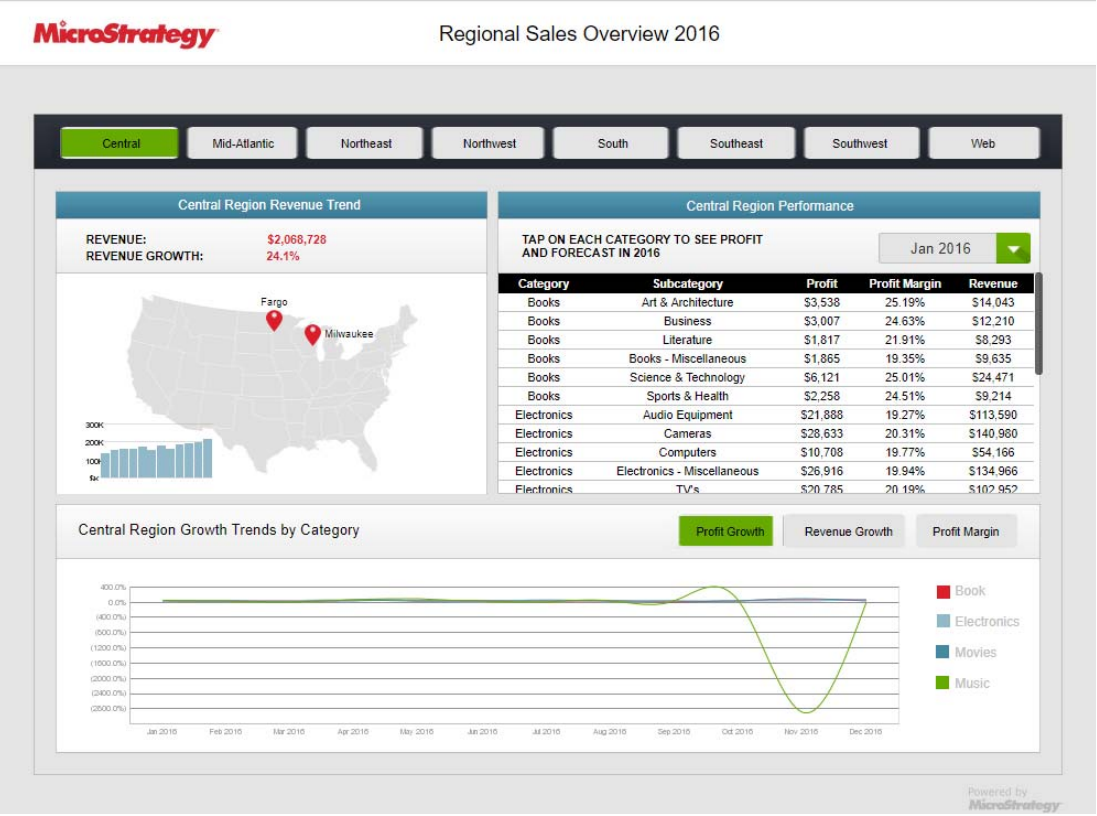
5

Interactive Documents

Introduction to interactive documents

Interactive documents, or dashboard-style documents, summarize key business indicators by presenting them in a visually intuitive, easy-to-read, interactive display of data. A broad selection of widgets and formatting options allow you to design a customized, interactive document.

Widgets are sophisticated visualizations that enable you to understand your data more effectively.



Interactive documents have the following key characteristics:

- **Emphasis on graphics**: A well-designed graphical representation often communicates more effectively than text alone.
- **Key Performance Indicators (KPIs)**: Documents highlight metrics, as well as other important data, that help business users make informed decisions.
- **Use of a single screen**: Users digest data more efficiently when it is displayed on a single screen.
- **Emphasis on summary-level data and exception reporting**.
- **Emphasis on customization**: Typically, the most effective documents target a specific audience and display visual indicators that appeal to that audience.

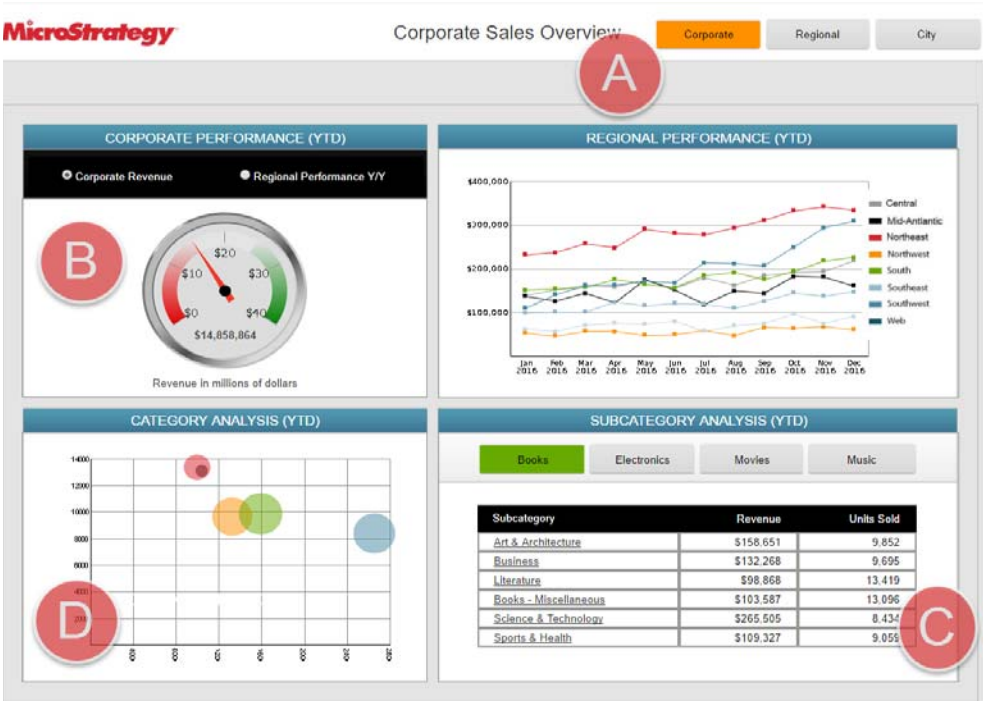
Activity: Open an interactive document

1 From the MicroStrategy Tutorial Home page, click **Go To MicroStrategy Web**.

2 Click the **Documents and Scorecards** folder.

3 Select the **Corporate Sales Overview** dashboard.

4 Follow the steps below to learn about the different components of a dashboard-style document.



a Click the **Regional** and **City** selector buttons to change the information on the interactive document.

- The information on this document is organized into a panel stack.
- A panel stack is a layer of data, which is used to group related objects.
- Use selectors to navigate between the different panels in the panel stack.

b On the Corporate panel, click **Regional Performance Y/Y**.

- The Key Performance Indicators section of the document is on a nested panel stack.
- A nested panel stack is a panel stack within a panel stack.
- This selector switches between the two panels.

c Click the different subcategory analysis buttons and watch the chart transform.

d Click the bubbles in the **Category Analysis (YTD)** interactive bubble chart widget to view the values.

5 Click **City** on the top right to open that panel.

One of the many useful features of an interactive document is the ability to view and create interactive visualizations, called widgets, that expand beyond the basic capabilities of standard graphs and grids. In this example you see the **Time Series Slider** widget (on the bottom right), and the Corporate Overview page contains an **Interactive Bubble Chart** widget.

Adding interactivity to a document

Grouping and layering data: Panels and panel stacks

You can display different objects in a document so that uses can navigate them as if they were pages, or subsets of the larger document. These pages, or layers of data, are called panels, and a group of panels is a panel stack. With panels and panel stacks, the designer can create several different views (or panels) of data, with each view (panel) containing a logical grouping of objects that display related data.

In the following image, the panel stack has four panels with different data displayed. You can navigate between the panels using a selector, which are the

buttons labeled: Book, Rates, Markets, and FX. Click the selector to switch panels in the stack.

Panel Stack Components

You can further customize your panel by specifying whether or not to display the panel stack's title bar. You can decide whether the title displays the name of the panel stack or of the panel currently being shown.

Switching between data: Selectors

A selector allows users to interact with the document by selecting:

- Which panel to display in a panel stack.
- Which attribute element or metric to display in a grid/graph.

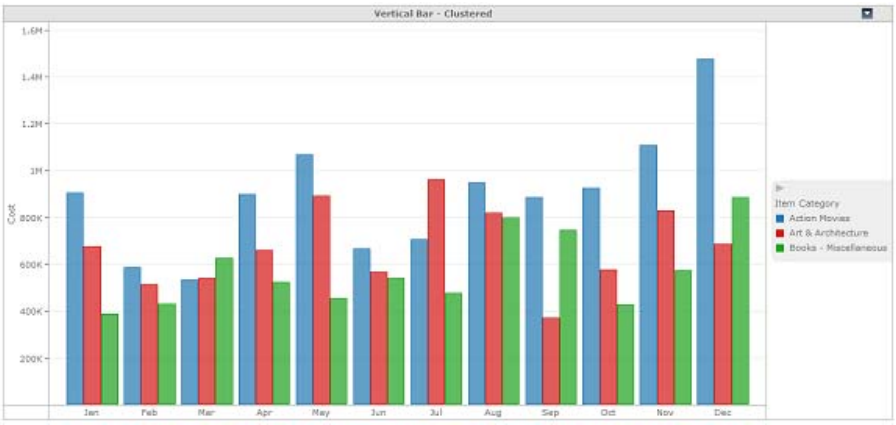
You can use buttons as a selector. A grid or a graph can also be used as the source for a selector.

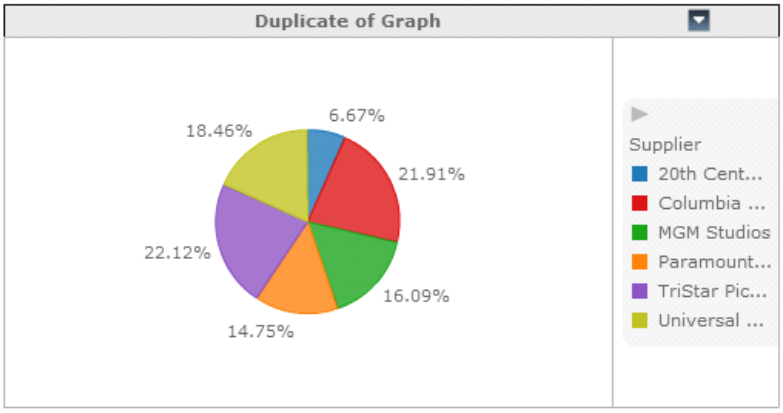
Data visualizations: Graphs

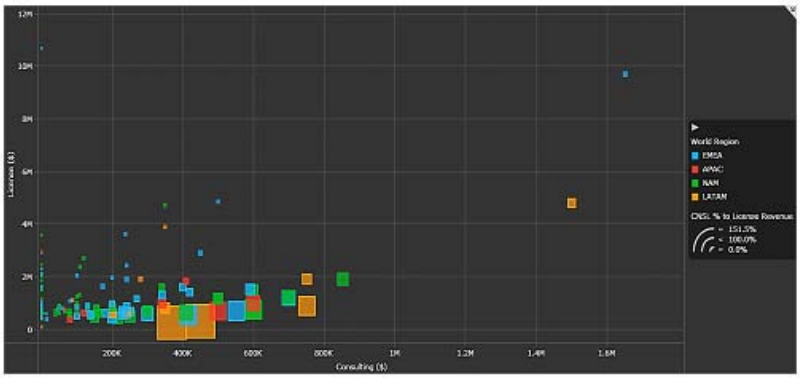
Basic graph types include:

- Bar charts
- Combination charts
- Line charts
- Pie charts
- Stacked Bar charts
- Ring/donut graph
- Scatter plots

Compare the following graphs and the types of analysis best performed with each graph.







Interactive graphs: Widgets

A widget is a interactive display of dataset results, allowing users to visualize data in different ways than a traditional report displayed as a grid or graph does.

Widgets are sophisticated visualization techniques that can combine with rich interactivity to enable users to understand their data more effectively.

Exercise 4.1: Create an interactive document

You will create an interactive document with sales and inventory data. The document contains two panels on its main panel stack with a button bar to switch between panels.

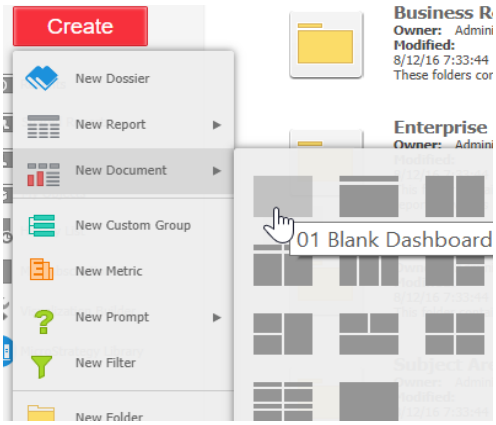
1. Sales Summary: As you create this panel, you will learn how to rename a panel, create a panel stack nested on another panel stack, add a panel, and create a panel stack selector.

2. Inventory Summary: As you create this panel, you will learn how to use a grid as a selector to control other objects on a panel. You will also add and name panels and create panel stack selectors.

Create the document

1. On any folder page in MicroStrategy Web, click **Create**, point to **New Document**, and select **01 Blank Dashboard**.

   A new, blank dashboard-style document is displayed in Design Mode in the Document Editor. Notice that this document contains only one document section, and already contains a panel stack (the gray rectangle in the middle of the Layout area).



Name the panel stack

2. Right-click the panel and select **Properties and Formatting**.

3 In the General properties, type **Main Panel Stack** in the **Name** box.

It is recommended that you assign meaningful names to document objects, such as panel stacks, selectors, grid and graph reports, and even text boxes, so that you can locate them by name once the document contains many similar objects.

4 Clear the **Show Title Bar** check box.

5 In the list of categories on the left, click **Layout**.

6 From the **Content Overflow** drop-down list, select **Clip**.

Clip displays only the contents that can fit within the dimensions of the panel stack. The default, which is scroll, displays a scroll bar to allow you to view all the content. Our content will easily fit inside our panel stack.

7 Click **OK**.

Create the Sales Summary panel

Rename the individual panel in the stack

1 Using the panel stack toolbar, rename the current panel for the main panel stack as **Sales Summary**.

a To view the toolbar, hover your pointer over the panel stack.

b Click the **Rename Panel** icon, as shown below.

c Type the new name and click **OK**.

Add a title to the document

2 Add a text box on the top left of the document above the Sales Summary panel, and type **Sales Volume Analysis** in it.

To add a text box, select Text from the Insert menu.

3 Set the font to **bold** and size **14**.

To format the text, right-click the text box, select Properties and Formatting, and click Font in the list of categories on the left.

To display all of the content, drag the sizing handles on the text box to enlarge it.

Add a dataset

4 In the Dataset Objects pane, click **Add a Dataset**.

5 Navigate to the Shared Reports\MicroStrategy Platform Capabilities\MicroStrategy Report Services\Datasets\Supply Chain Management Report folder.

6 Select the **Unit Sales Volume & Forecast, Filtered** report and click **OK**.

Add text boxes to display data

7 Add a text box below the Sales Volume Analysis text box and type **Units Sold**. Format the text as **bold** and size **12**.

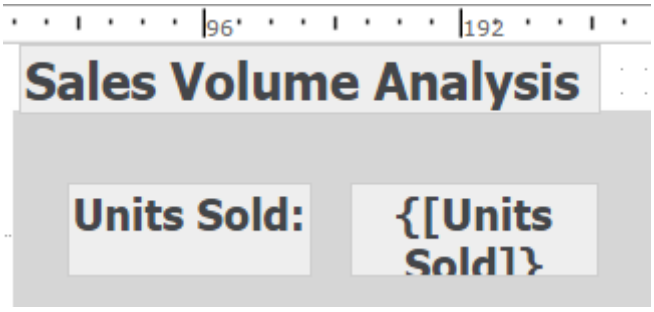
8 Add a dynamic text box to the right of the Units Sold text box.

a Click and drag the **Units Sold** metric onto the document to create the text box.

b Resize and align the text box so that it matches the Units Sold text box.

c Change the font size to **12**.

d Change the **Horizontal Text Alignment** to **Center**, in the Alignment properties of the Formatting and Properties window.



9 Save the document as **Sales Volume Analysis** in the My Reports folder. When prompted, click **Run newly saved document**.

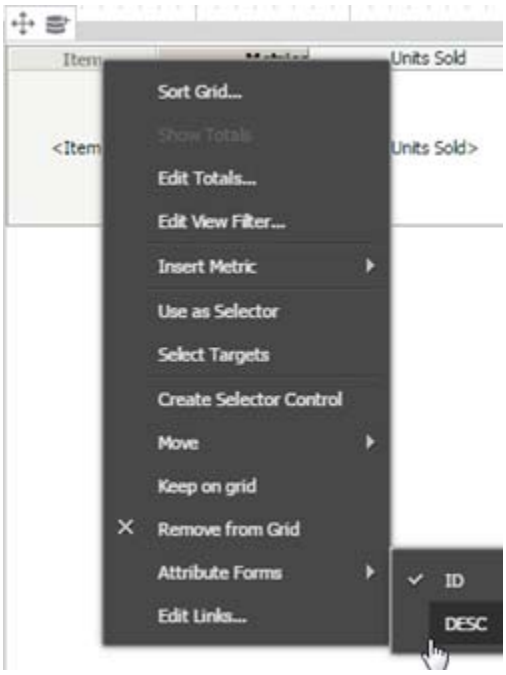
10 Return to Design Mode, by clicking the menu icon and selecting **Edit**.

Display the dataset as a graph

11 Drag and drop the **Unit Sales Volume & Forecast, Filtered** dataset from Dataset Objects to the upper right area of the Sales Summary panel. This creates a grid report in the document.

12 This report displays the items' IDs rather than the description. Description and ID are the attribute forms for the Item attribute. To display only the description:

a Right-click **Item** in the grid, point to **Attribute Forms**, and select **DESC**.



b Right-click **Item**, point to **Attribute Forms**, and clear **ID**.

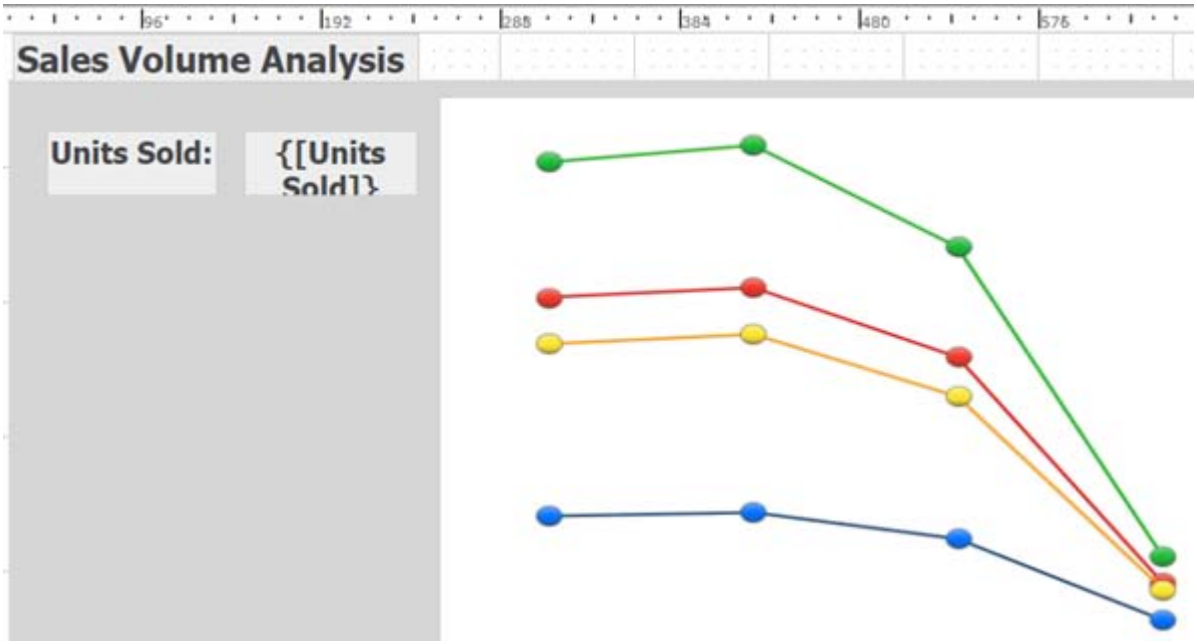
13 Change the grid to a vertical line graph:

a Select the grid.

b Click **Graph** on the toolbar.

c Click the **View: Graph** icon in the toolbar.

d In the drop-down list of graph types, select **Vertical Line**.



Create a nested panel stack on the Sales Summary panel

Add another panel stack

1 From the **Insert** menu, select **Panel Stack**.

2 Drag the panel stack to cover the bottom portion of the Sales Summary panel.

3 Define the new panel stack:

a Right-click the panel stack and select **Properties and Formatting**.

b In the General properties window, type **Nested Panel Stack** in the **Name** box.

c Clear the **Show Title Bar** check box.

d In the list of properties on the left, select **Layout**.

e From the **Content Overflow** drop-down list, select **Clip**.

f Click **OK**.

4 Using the panel stack toolbar, rename the current panel to **Category Sales**.

Add a new dataset

5 Click the **Add Dataset** icon on the Dataset Objects pane.

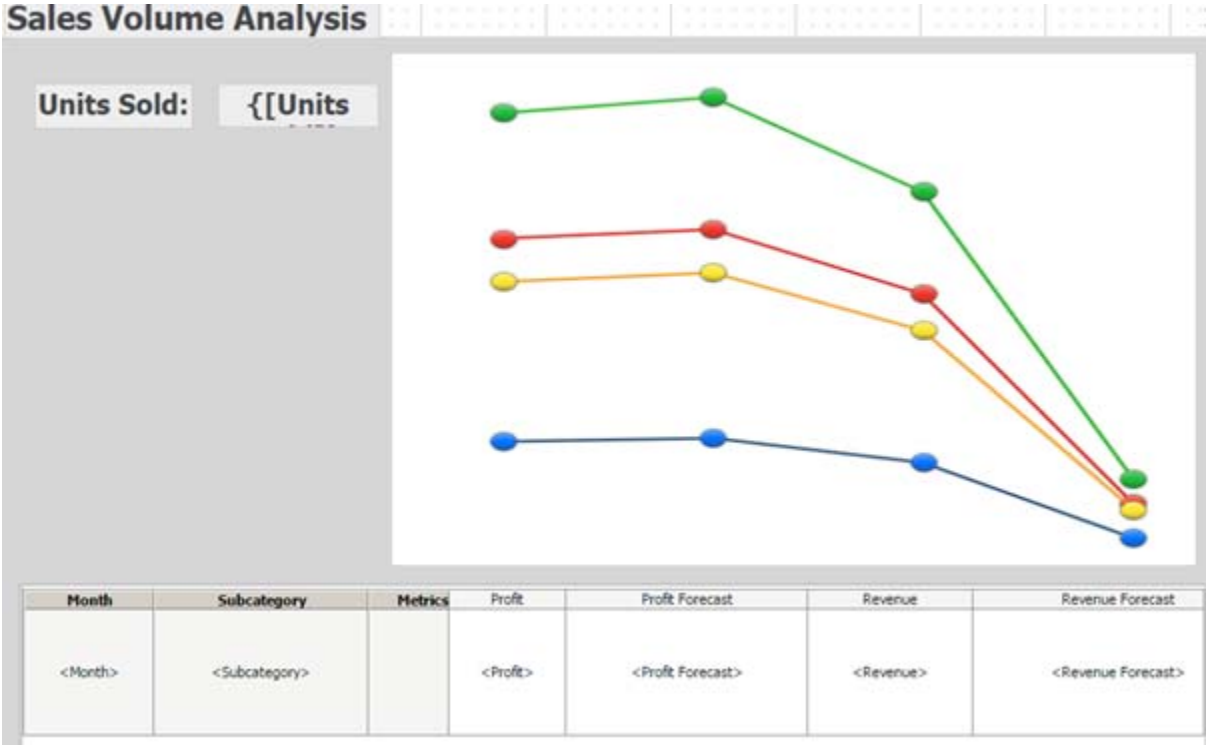
6 Navigate to the Shared Reports\Subject Areas\Sales and Profitability Analysis folder.

7 Select the **Category Sales Report**.

8 Click **OK**.

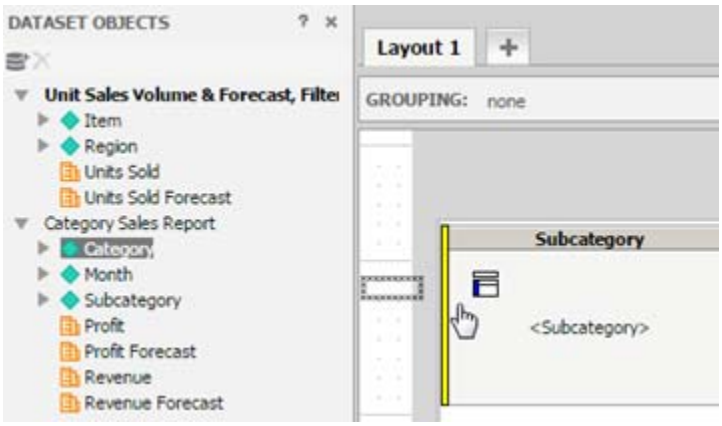
Display a report

9 Drag the **Category Sales Report** dataset and place it on the Category Sales panel. Resize the grid so it occupies the entire panel.



10 Remove the Month attribute from the grid, by right-clicking **Month** in the grid and selecting **Remove from Grid**.

11 Add Category to the grid, by dragging **Category** from Dataset Objects to the left of Subcategory in the grid, as shown below:



Add another panel to the nested panel stack

12 In the panel stack toolbar, click the **Add Panel** icon, as shown below, to add a second panel to the nested panel stack.

13 Use the panel stack toolbar to name the new panel **Monthly Breakdown**.

14 Drag the **Category Sales Report** dataset and place it on the Monthly Breakdown panel to create a grid.

15 Resize the grid so it occupies the entire panel.

16 Remove Subcategory from the grid.

Right-click Subcategory in the grid and select Remove from Grid.

17 Change the grid to a bar graph:

a Select the graph.

b Click **Graph** on the toolbar.

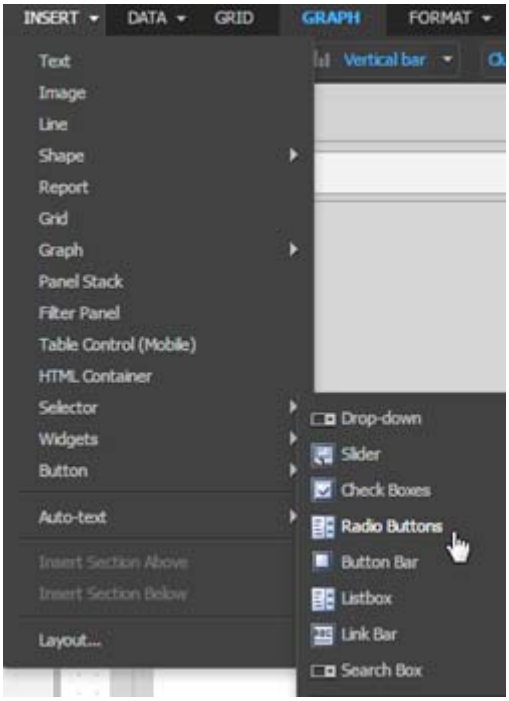
c Click the **View: Graph** icon in the toolbar.

d In the drop-down list of graph types, select **Vertical Bar**.

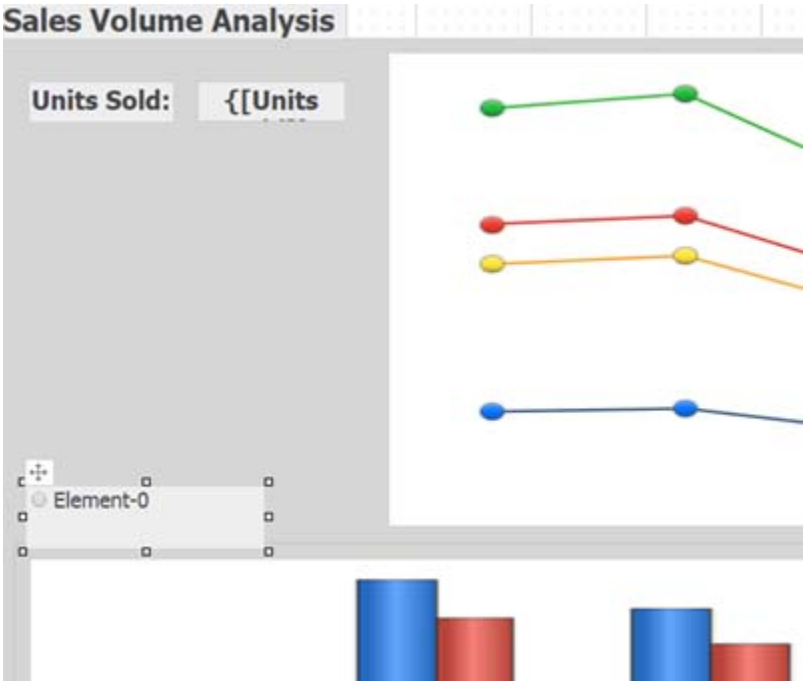
Add a selector to navigate the panels of the nested panel stack

18 Add a panel selector for the nested panel stack. A panel selector allows a user to flip through the panels in a panel stack.

a From the **Insert** menu, point to **Selector**, and select **Radio Buttons**.



b Add the selector immediately above the nested panel stack. (The selector displays with the text Element-0 as a placeholder.)



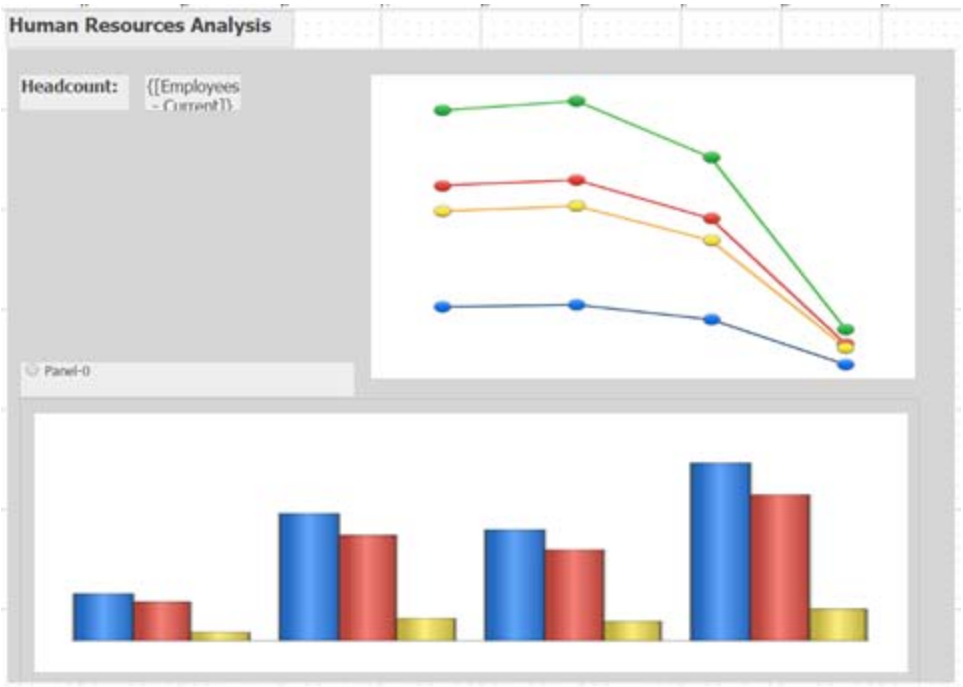
c Right-click the selector and select **Properties and Formatting**.

d In the list of properties on the left, click **Selector**.

e From the **Action Type** drop-down list, choose **Select Panel**.

f In the **Panel Stack** drop-down list, select **Nested Panel Stack**.

g Click **OK**. Notice that the selector placeholder is now labeled Panel-0, indicating that it displays and changes panels rather than attribute elements.



19 Save the document.

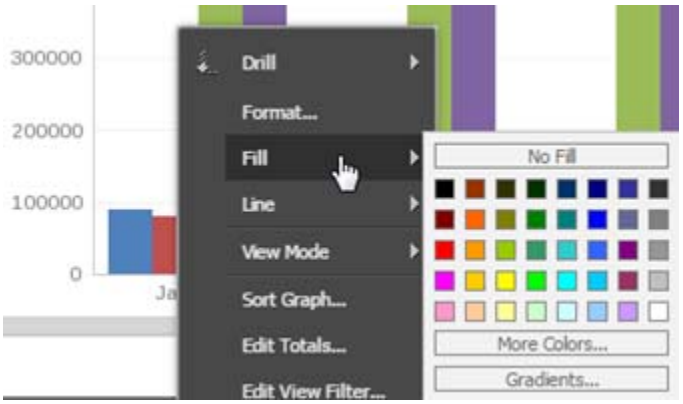
Format the bar graph

You can format graphs in Editable Mode, and also view the results of your changes to the data.

20 Click the **Editable Mode** icon in the toolbar.

21 The Profit values are shown in blue, while Profit Forecast is displayed in red. To better visually associate the two, change the Profit Forecast color. Right-click a

bar riser for Profit Forecast, point to **Fill**, and select a light blue from the color palette.



22 Similarly, the Revenue values are shown in green, while Revenue Forecast is displayed in purple. Right-click a bar riser for Revenue Forecast, point to **Fill**, and select a light green from the color palette.

23 Notice that the values on the left side of the graph (the Y axis) are not formatted as currency. Change their format:

a Right-click a value on the left side of the graph, and select **Format**.

b Select **Numbers** from the left menu.

c From the **Targets** drop-down list, select **Y Axis Values**.

d Select **Currency**.

e Type **0** (zero) in the **Decimal Places** box.

f Click **OK**.

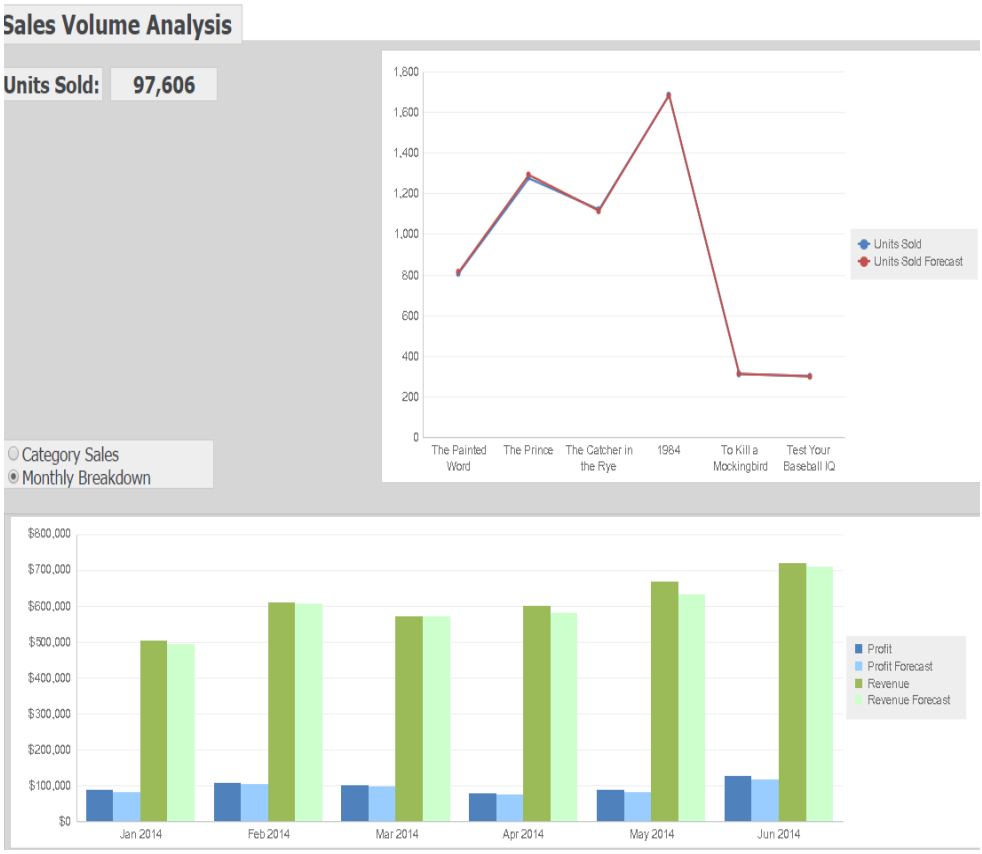
The graph should now resemble the following:

24 Save the document.

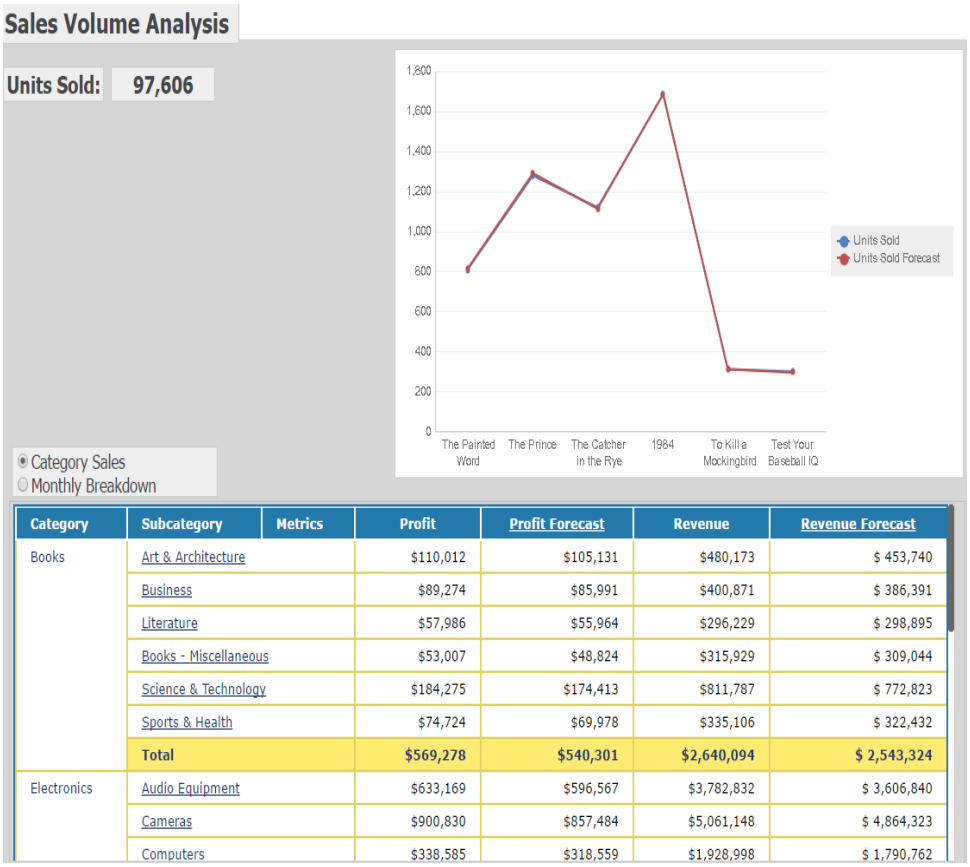
View the document to check the results

1 Click the **Presentation Mode** icon in the toolbar to view the results.

Your document should resemble the following:



2 Click the **Category Sales** radio button, to display the grid.



Category	Subcategory	Metrics	Profit	Profit Forecast	Revenue	Revenue Forecast
Books	Art & Architecture		$110,012	$105,131	$480,173	$ 453,740
	Business		$89,274	$85,991	$400,871	$ 386,391
	Literature		$57,986	$55,964	$296,229	$ 298,895
	Books - Miscellaneous		$53,007	$48,824	$315,929	$ 309,044
	Science & Technology		$184,275	$174,413	$811,787	$ 772,823
	Sports & Health		$74,724	$69,978	$335,106	$ 322,432
	Total		**$569,278**	**$540,301**	**$2,640,094**	**$ 2,543,324**
Electronics	Audio Equipment		$633,169	$596,567	$3,782,832	$ 3,606,840
	Cameras		$900,830	$857,484	$5,061,148	$ 4,864,323
	Computers		$338,585	$318,559	$1,928,998	$ 1,790,762

Create the Inventory Summary panel

1 Return to Design Mode, by clicking the menu icon and selecting **Edit**.

Add a new panel and dataset

2 Add a new panel to the Main Panel Stack and name it **Inventory Summary.**

Add a dataset

3 From the **Data** menu, select **Add Dataset**.

4 Navigate to the Shared Reports\Subject Areas\Inventory and Supply Chain Analysis folder.

5 Select the **Inventory Summary - BOH, EOH, Units Received, and Units Sold** report.

6 Click **OK**.

Display a report

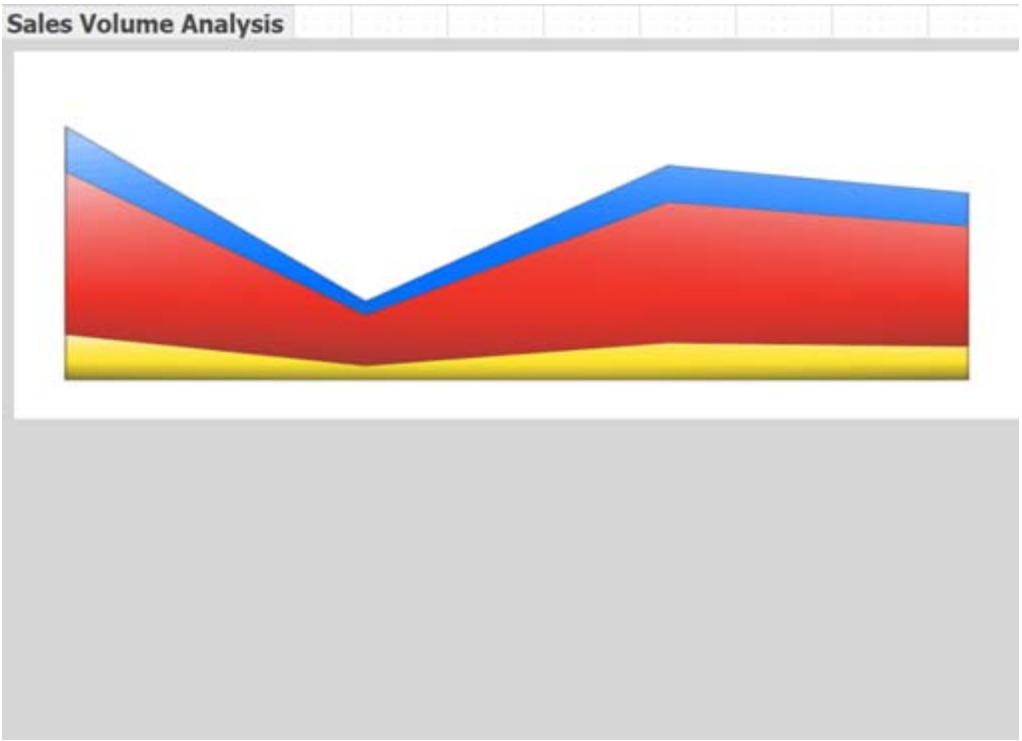
7 Add the Inventory Summary dataset as a grid report.

Drag the dataset from Dataset Objects to the panel.

8 Display the grid as a graph. Size the graph to take up only the top half of the panel. Switch to Editable Mode to choose the graph that best fits the data.

Click the Graph View icon, then select the graph type.

You can switch to Editable Mode to change graph types. This allows you to preview the data in any graph type that you select to determine how to best display the data. Return to Design Mode.



9 Click **Save**.

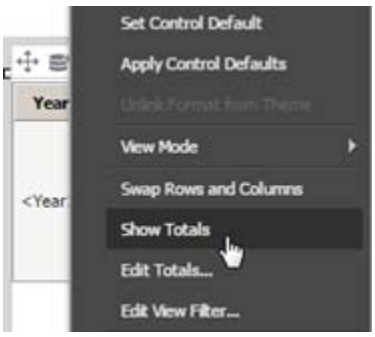
Add a grid

10 Add the Inventory Summary dataset as a grid report.

11 Add **Year** to the grid, before the Month column.

Drag Year from Dataset Objects to the grid.

12 In the grid, right-click **<Year>** (not the header, but the placeholder), and select **Show Totals**.



Use the grid as a selector for the graph

When you click a year in the grid, in Presentation Mode and Editable Mode, the graph will display the data for that year only.

13 Right-click **Year** in the grid and select **Use as Selector**.

By default, the objects in the panel are added as the target of the selector. In this case, the graph is the only object in the same panel, so the graph is updated when a year is clicked in the grid.

Add a panel stack selector

Now that we have two panels on the Main Panel Stack (Sales Summary and Inventory Summary), we need to add a selector to navigate between the panels.

1 From the **Insert** menu, point to **Selector,** and then click **Button Bar**.

2 Place the selector above the Main Panel Stack, and to the right of the Sales Volume Analysis text box.

3 Right-click the selector and choose **Properties and Formatting**.

4 In the list of properties on the left, click **Selector**.

5 From the **Action Type** drop-down list, choose **Select Panel**.

6 Ensure that **Main Panel Stack** is selected in the **Targets** area.

7 Click **OK**.

8 Click the **Editable Mode** icon in the toolbar.

9 Resize the button bar if needed.

Format a grid using Editable Mode

---

1 Select the grid.

2 Click **Grid** in the toolbar. This grid is displayed in the Columns format. Click **Columns** in the toolbar and select a new grid format. Hover your cursor over a format to see its name.

Remove the blank Metrics column

3 Right-click the grid, and select **Advanced Formatting**.

4 From the list of properties on the left, select **Grid**.

5 Select the **Remove Extra Column** check box.

This is the blank column labeled Metrics.

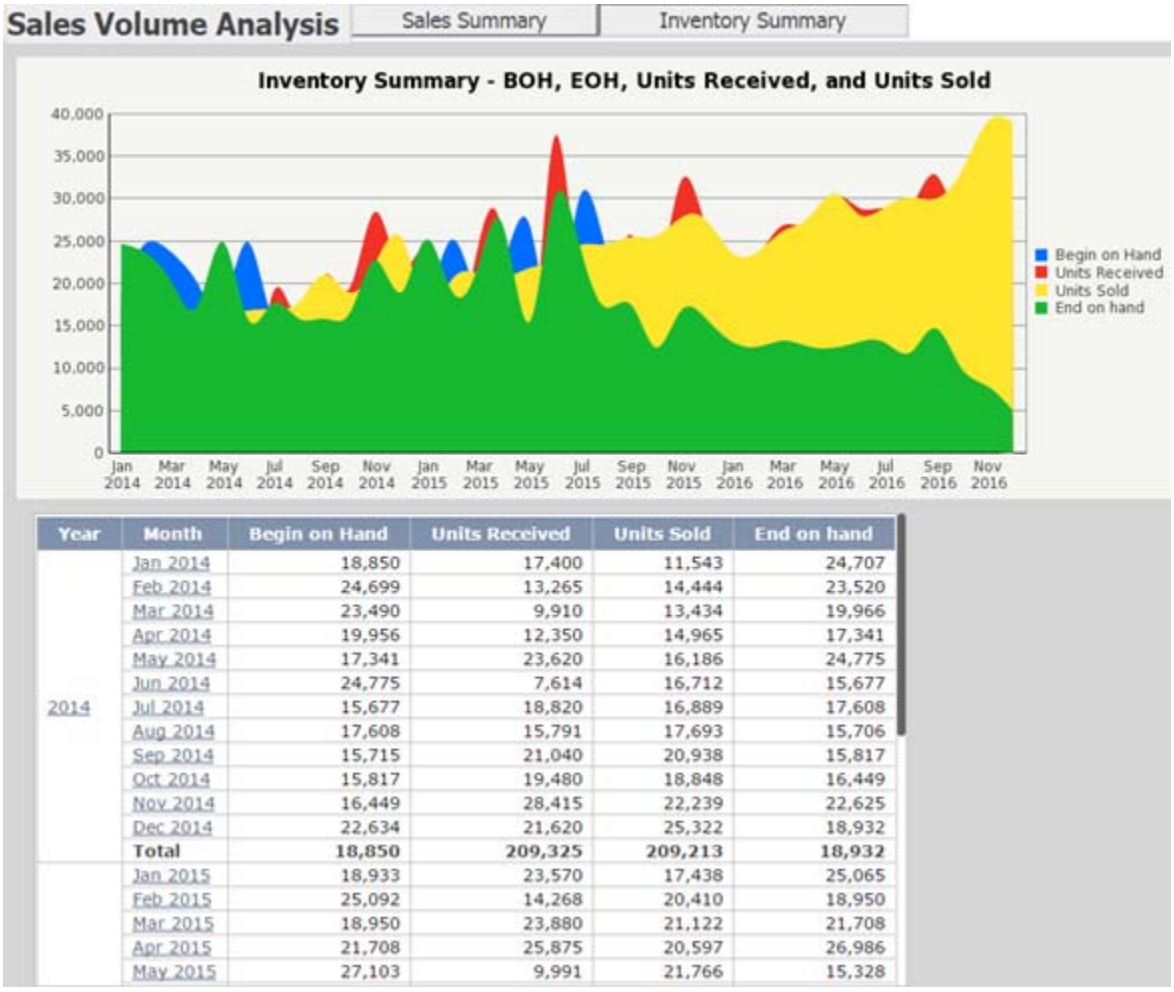
6 Click **OK**.

7 Click **Save**.

View the document results

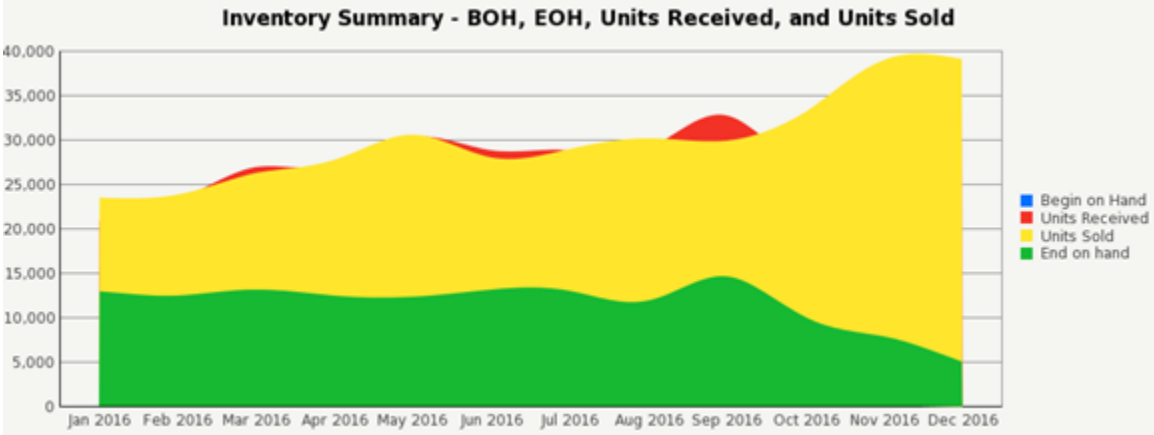
1 Click the **Presentation Mode** icon in the toolbar to view the results.

Compare your results to the image below. Your document will look slightly different depending on the graph type and grid format that you selected. The image below uses an Area Graph and Table grid design.



Year	Month	Begin on Hand	Units Received	Units Sold	End on hand
2014	Jan 2014	18,850	17,400	11,543	24,707
	Feb 2014	24,699	13,265	14,444	23,520
	Mar 2014	23,490	9,910	13,434	19,966
	Apr 2014	19,956	12,350	14,965	17,341
	May 2014	17,341	23,620	16,186	24,775
	Jun 2014	24,775	7,614	16,712	15,677
	Jul 2014	15,677	18,820	16,889	17,608
	Aug 2014	17,608	15,791	17,693	15,706
	Sep 2014	15,715	21,040	20,938	15,817
	Oct 2014	15,817	19,480	18,848	16,449
	Nov 2014	16,449	28,415	22,239	22,625
	Dec 2014	22,634	21,620	25,322	18,932
	Total	**18,850**	**209,325**	**209,213**	**18,932**
	Jan 2015	18,933	23,570	17,438	25,065
	Feb 2015	25,092	14,268	20,410	18,950
	Mar 2015	18,950	23,880	21,122	21,708
	Apr 2015	21,708	25,875	20,597	26,986
	May 2015	27,103	9,991	21,766	15,328

2 The graph displays data for multiple years. To focus on a specific year, click a year in the grid. The graph displays data only for the selected year.



3 To display all the years again, click the menu icon and select **Reset Selections**.

4 Click the **Sales Summary** button to switch panels, returning to the first panel that you created.

Your document is complete.

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Patent Information

7,016,480, 7,020,251, 7,039,165, 7,082,422, 7,113,993, 7,127,403, 7,174,349, 7,181,417, 7,194,457, 7,197,461, 7,228,303, 7,260,577, 7,266,181, 7,272,212, 7,302,639, 7,324,942, 7,330,847, 7,340,040, 7,356,758, 7,356,840, 7,415,438, 7,428,302, 7,430,562, 7,440,898, 7,486,780, 7,509,671, 7,516,181, 7,559,048, 7,574,376, 7,617,201, 7,725,811, 7,801,967, 7,836,178, 7,861,161, 7,861,253, 7,881,443, 7,925,616, 7,945,584, 7,970,782, 8,005,870, 8,051,168, 8,051,369, 8,094,788, 8,130,918, 8,296,287, 8,321,411, 8,452,755, 8,521,733, 8,522,192, 8,577,902, 8,606,813, 8,607,138, 8,645,313, 8,761,659, 8,775,807, 8,782,083, 8,812,490, 8,832,588, 8,943,044, 8,943,187. 8,958,537, 8,966,597, 8,983,440, 8,984,274, 8,984,288, 8,995,628, 9,027,099, 9,027,105, 9,037, 577, 9,038,152, 9,076,006, 9,086,837, 9,116,954, 9,124,630, 9,154,303, 9,154,486, 9,160,727, 9,166,986, 9,171,073, 9,172,699, 9,173,101, 9,183, 317, 9,195,814, 9,208,213, 9,208,444, 9,262,481, 9,264,415, 9,264,480, 9,269,358, 9,275,127, 9,292,571, 9,300,646, 9,311,683 9,313,206, 9,330,174, 9,338,157, 9,361,392, 9,378,386, 9,386,416, 9,391,782, 9,397,838, 9,397,980, 9,405,804, 9,413,710, 9,413,794, 9,430,629, 9,432,808, 9,438,597, 9,444,805, 9,450,942, 9,450,958, 9,454,594, 9,507,755, 9,513,770, 9,516,018, 9,529,850, 9,563,761, 9,565,175, 9,608,970, 9,640,001, 9,646,165, 9,680,908, 9,697,146, 9,697,350, 9,742,764, 9,742,781, and 9,743,235. Other patent applications are pending.

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