



# Pro Power BI Theme Creation

JSON Stylesheets for Automated  
Dashboard Formatting

—  
Adam Aspin

Apress®

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Any source code or other supplementary material referenced by the author in this book is available to readers on GitHub via the book's product page, located at [www.apress.com/9781484270677](http://www.apress.com/9781484270677). For more detailed information, please visit <http://www.apress.com/source-code>.

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*To Karine and Timothy.*

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# About the Author



**Adam Aspin** is an independent business intelligence consultant based in the United Kingdom. He has worked with SQL Server for over 25 years and now focuses on the Power BI ecosystem. During this time, he has developed several dozen BI and analytics systems based on the Microsoft BI product suite. Adam has been creating JSON theme files since the feature was first introduced in Power BI Desktop and has delivered corporate Power BI themes for dozens of clients across Europe.

Adam is a graduate of Oxford University. He has applied his skills for a range of clients in finance, banking, utilities, telecoms, construction, and retail. He is the author of *SQL Server 2012 Data Integration Recipes*; *Business Intelligence with SQL Server Reporting Services*; *High Impact Data Visualization in Excel with Power View*; *3D Maps, Get & Transform and Power BI*; *Pro Power BI Desktop*; and *Data Mashup with Microsoft Excel Using Power Query and M*.

# About the Technical Reviewer



**Natalie Jayne Heger** is a business intelligence developer/consultant based in the West Midlands of England.

She has worked in the IT industry for over 20 years. She started professional development using VB6 and Microsoft Access in the late 1990s until discovering SQL Server was a far more robust database solution and worked with DTS/SSIS, SSRS, and SSAS for many years for a broad range of companies.

She now works in the construction industry developing solutions with Power BI and enjoys thinking outside the box in producing quality reporting solutions, particularly in relation to D365 integration.

# Acknowledgments

Writing a technical book can prove to be a daunting challenge. So I am all the more grateful for all the help and encouragement that I have received from so many friends and colleagues.

First, my heartfelt thanks go, once again, to Jonathan Gennick, the commissioning editor of this book. Throughout the publication process, Jonathan has been an exemplary mentor. He has shared his knowledge and experience selflessly and courteously and provided much valuable guidance.

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When delving into the arcane depths of technical products, it is all too easy to lose sight of the main objectives of a book. Fortunately, my good friend and former colleague Natalie Jayne Heger, the technical reviewer, has worked unstintingly to help me retain focus on the objectives of this book. She has also shared her considerable experience of Power BI Desktop in the enterprise and has helped me immensely with her comments and suggestions.

Finally, my deepest gratitude has to be reserved for the two people who have given the most to this book. They are my wife and son, who have always encouraged me to persevere while providing all the support and encouragement that anyone could want. I am very lucky to have both of them.

# Introduction

As a Power BI user, you are used to delivering eye-catching analytical dashboards. However, formatting and reformatting dozens or even hundreds of visuals across a set of dashboards can be a time-consuming and needlessly repetitive task. This effort can require heroic levels of concentration and patience when you are faced with the task of creating a unified look and feel for a suite of reports or standardizing an enterprise-wide analytics suite in Power BI.

This book is about helping you to minimize the time and effort you need to spend on formatting and tweaking dashboard visuals. It shows you how a small investment in time up front can save you hundreds of hours later when it comes to delivering analytics. All this is done by defining a theme file that can be used to specify – once and for all – the presentation of each and every visual that is built in to Power BI Desktop.

Applying theme files makes your dashboards adopt instantly the look and feel that you have designed. Not only that but any changes that you make later to the theme can be reapplied in a couple of clicks to update the presentation to match the latest definition. This is not only time saved, it is also a liberation from the drudgery of manual formatting. This means that you are now free to concentrate on delivering powerful analytics and data journeys that entrance and motivate your users.

Winning back this wasted time requires only a small up-front investment. You have to learn how the formatting pane in Power BI Desktop maps to JSON elements in a theme file. Then you discover how the theme file is structured to define visual formatting. In case you are not a JSON expert, this book also introduces you to the core elements of JSON that you need to understand in order to create powerful theme files.

You can, if you wish, read this book from start to finish, as it is designed to be a progressive self-tutorial. However, as Power BI Desktop themes can be applied at several levels of complexity (requiring progressively more advanced skills), the book is broken down into chapters (or groups of chapters) that correspond to the various levels and methods of theme generation. They are as follows:

Chapter 1 provides a high-level overview of what a theme file can do to accelerate dashboard production.

## INTRODUCTION

Chapter 2 explains how to create theme files directly inside Power BI Desktop. This serves as a basic introduction to how themes work in practice and how you can develop usable JSON files without writing a line of JSON code.

Chapter 3 shows how to create high-level theme files directly in JSON using theme classes to simplify theme file creation. This can avoid theme developers having to go into all the intricate layers of detail needed to apply visual formatting while producing effective themes quickly and easily.

Chapter 4 describes the techniques required for generic theme definition. These are theme files that can set common attributes of multiple visuals. This approach can help theme creators produce simple yet powerful theme files in a relatively short time.

Chapters 5 through 12 are a complete reference that explain each and every attribute of all the visuals currently available in Power BI Desktop. These chapters explain each detail of how every standard visual can be formatted in a JSON file. Every option and selection is explained so that you can tweak dashboard presentation down to the finest and most intricate level of detail.

Chapter 13 extends your knowledge by introducing the concept of cascading style definitions. These allow you to specify formatting attributes that apply at selected levels of formatting. This approach can make the maintenance of theme files considerably easier.

This book comes with several dozen theme files to help you both learn about themes in Power BI and create your own theme files. Some of these files cover a specific aspect of formatting a dashboard, some apply to a single visual so that you can delve into the intricacies of a specific object, and others are complete and detailed report theme files containing several thousand lines of JSON code.

This book also comes with a small sample data set that you can download from <http://www.apress.com/9781484270677> and use to create visuals. As the focus is on form and not analysis, I prefer to use an extremely simplistic data structure so that the reader is free to concentrate on formatting and not the data itself.

Inevitably, not every question about styling dashboards can be answered and not every issue can be resolved in one book. I truly hope that I have answered many of the essential Power BI stylesheet questions that you will face and have provided ways of solving most of the pre-formatting challenges that you may encounter. I wish you good luck in using Power BI Desktop when formatting your insights. And I sincerely hope that you have as much fun with themes as I had writing this book.

—Adam Aspin

## CHAPTER 1

# Introduction to Power BI Themes

Power BI has taken the world by storm when it comes to creating attention-grabbing dashboards that empower users. It has come to dominate the analytics arena with its ease of use, wide range of connectivity options, and the variety of available visuals.

However, formatting (and reformatting) dashboard visuals can prove time-consuming and repetitive – as can standardizing the presentation of multiple dashboards to create a unified look and feel for a suite of reports. Most users would rather spend their time analyzing and delivering meaningful insights as opposed to applying colors and font choices to charts and tables.

This is where the creation and application of Power BI *themes* comes in. A theme is a standardized definition of some – or all – of the formatting of a dashboard. This can range from defining a color palette and a selection of font choices to the detailed specification of each and every visual. Applying a theme allows you to format virtually every visual in a dashboard *instantly*. What is more, any changes that you subsequently make to a theme can be reapplied in a few clicks to update your dashboard's presentation. Themes can be created once, then applied to dozens or even hundreds of Power BI dashboards to guarantee a coherent and rigorously standardized presentation style across a department or even an entire organization.

Themes can be as simple – or as detailed – as you require. They can specify standardized fonts, text colors, and font sizes or set the tiniest details of how each individual type of visual is formatted. Indeed, themes are designed to work at multiple levels – starting with general elements and then progressing deeper and deeper into tightly specified definitions of the presentation of each element in a dashboard. This gives you a range of options when it comes to defining how you standardize Power BI dashboards.

# Theme Basics

Themes are, technically, JSON files. That is, they use the JSON (JavaScript Object Notation) format to store the definition of how dashboard objects are formatted. But don't worry if you have never used – or even heard of – JSON before now, as I will be explaining all you need to know about it during the course of this book. The only thing to retain for the moment is that themes are like external stylesheets for Power BI (very like the stylesheets that are used by Microsoft Word, for instance). The advantage of defining formats with external files is that you can simply send your colleagues themes as small text-based files that they can then apply in a few clicks to any of their own Power BI dashboards. Themes can also be integrated into Power BI templates to accelerate even further the dashboard creation process.

Themes are applied to Power BI Desktop files. Once loaded, they become an integral part of the Power BI Desktop .pbix file. The formatting is then, of course, carried over into the Power BI service when you publish the dashboard. Moreover, you can switch between different theme files in a few clicks to try out different formatting approaches or apply a completely different look and feel. Equally fortunately, there is nothing definitive about applying a theme file, as you can switch to another Power BI presentation style based on a different theme at any time. So you are free to experiment with different styles until you find the look and feel that suits the particular dashboard that you are creating.

A theme allows you to preset virtually anything that is defined in the Power BI formatting pane. Consequently, it can contain formatting definitions for

- The color palette
- The page
- Inserted objects (text boxes, shapes, buttons, and images)
- Built-in visuals (tables, charts, maps, and other visuals)

You can even apply a theme to the Power BI Desktop Filter pane. The principle is simple: if you can alter presentation in the formatting pane of Power BI Desktop, then you can define the format using a theme file.

The portable nature of dashboard themes means that there are now a wide range of different themes that are freely available to enhance the presentation of Power BI dashboards. You may even have experimented with some of the themes that are available as an integral part of Power BI Desktop or shared through the Web.

After reading this book and learning how these themes are created, you, too, will be able to develop themes that you can share – with friends, colleagues, or even the world.

## Anatomy of a Theme

It is important to understand from the start that themes operate at two distinct levels. Firstly, themes can be defined to operate in a “generic” way. That is, you can define a set of high-level specifications to set core aspects of a dashboard and the visuals it contains without going into low levels of detail. This way you can quickly and easily define

- Colors
- Standard font attributes
- Shared elements for all visuals
- Certain elements specific to certain types of visuals

You will discover how to create “generic” themes in Chapter 3.

Then, at a more detailed level (and once you have acquired a thorough understanding of how themes work), you can specify the *exact formatting for each and every element of each visual* to give you total control of the appearance of each element in a dashboard. An in-depth definition of the JSON that is required at the level of individual visuals is the subject of Chapters 5 through 12.

However, don’t get the idea that you have to choose between two different approaches. The truth is that a theme JSON file can “mix and match” the two approaches so that you can both define a set of overall style principles *and* then add highly specific definitions of the way that you want certain visuals to be displayed in a dashboard. The principle will always be that a more generic level of formatting applies unless a more detailed definition is found in the theme file.

## Themes and the Format Pane

A theme is nothing more than the definition of the formatting that you would otherwise apply manually using the Power BI format pane. It follows that you need to know what the format pane is and how it is used to format dashboard objects. I will not be explaining the intricacies of the Format Pane in this book, however, and refer you to my book *Pro Power BI Desktop* for full details on how to format dashboards manually.

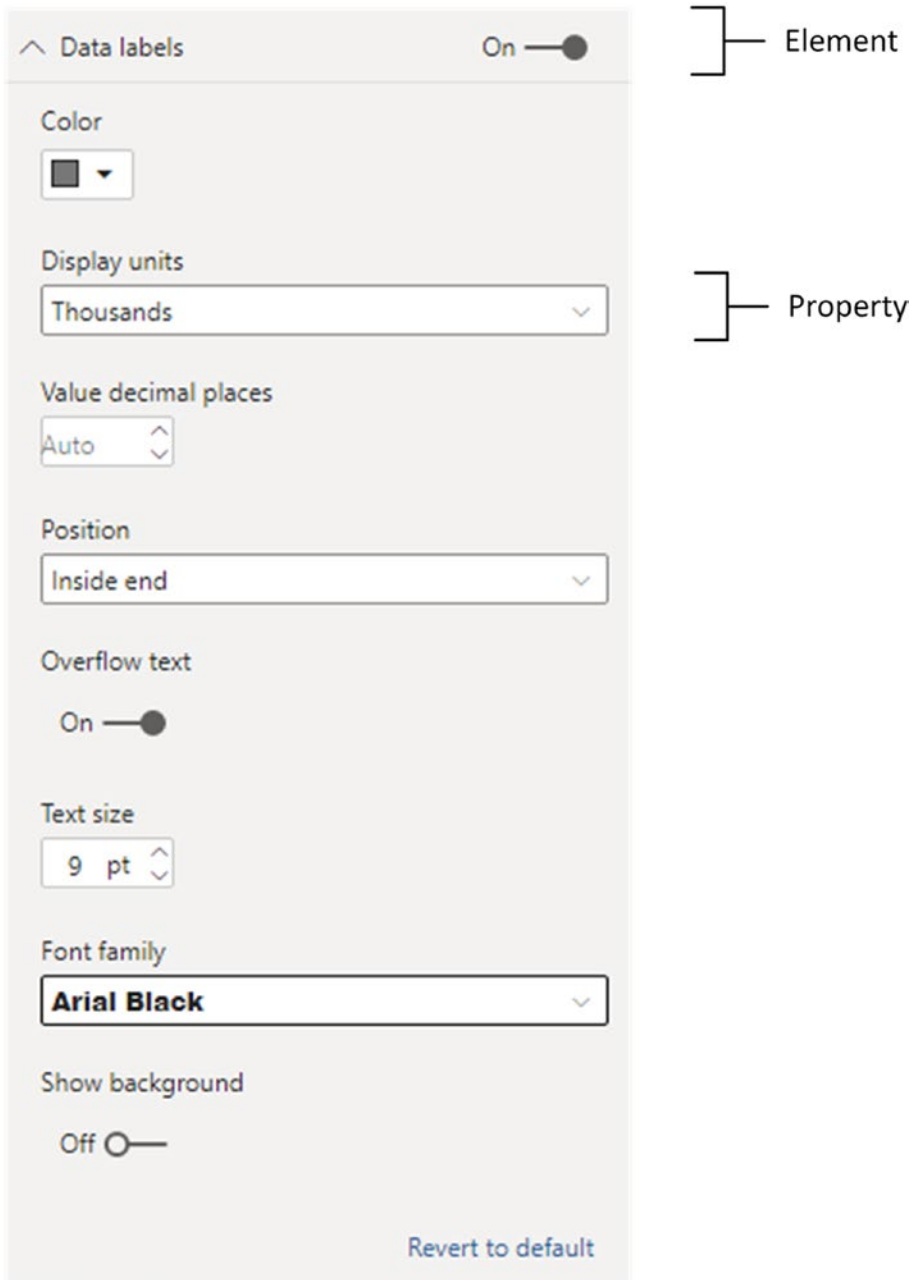


Nonetheless, it is worth reminding yourself of the core elements in the Format Pane and how formatting works at a generic level.

Essentially, formatting is a hierarchy of three elements:

- *Visual* (a table or chart – although this could be the page as well).
- *Element*: This is the aspect of a visual that you want to format. This corresponds to the expandable sections of the formatting pane in Power BI Desktop (they are also called tabs or cards). The X axis section for a chart is an example of this.
- *Property* (often referred to as an attribute): This is the specific setting you define. This could be the font color, for instance.

You can see this (for a stacked bar chart visual) in Figure 1-1, where the Data labels element is expanded to show all the available properties that you can set for data labels.



**Figure 1-1.** *The Format Pane*

It is important to bear this hierarchy in mind when creating theme files, as the entire JSON structure is predicated on this nested approach – as will be explained further in Chapter 3.

## Writing JSON Files

As you will have to write or adapt actual JSON files for all but the simplest theme files, you will need to choose a tool to carry out your modifications. As JSON is a text-based format, there is a plethora of tools that are available to do this. It is entirely up to you to select a tool that you are happy with. A few that I have used are

- Notepad
- Notepad++
- Visual Studio
- Visual Studio Code
- An online JSON editor

There are literally dozens of tools available, and the choice of an application to use is entirely up to you. My only advice is to find something that you are comfortable with and that provides you with the balance of usability and power that you require. Above all, it must be able to save or export text files. As, in practice, you are likely to test and revise your choices over and over again, the tool that you choose needs to have multiple levels of undo and redo as well as having a powerful search and replace capability.

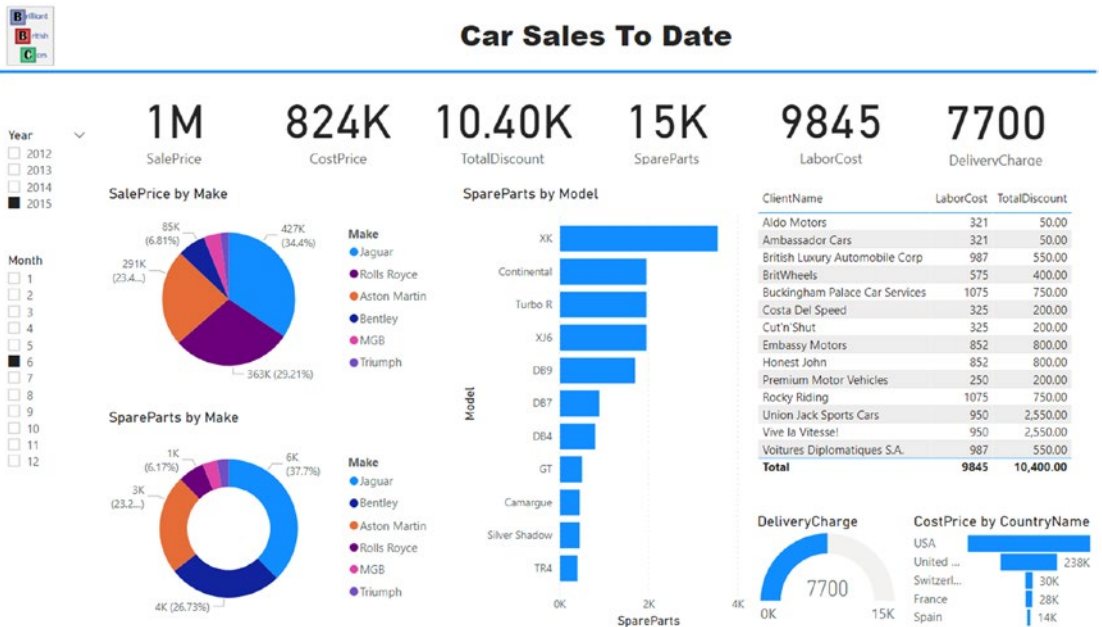
A tool that displays JSON in an easy-to-read format is a must when writing theme files for Power BI. This is because the JSON structure used by Power BI Desktop can get intricate, and consequently it helps considerably to be able to see the nested levels of text and how they are structured. However, I don't want to get too far ahead, yet, so will come back to this later in the book.

If you have not yet made up your mind, I suggest downloading Notepad++. This is a free text editor that can display JSON in a very readable format.

## Applying Themes

Before looking at how you create your own themes, it is probably best that I remind you of the far-reaching effects that themes can deliver. Hopefully, this will incentivize you to want to learn more and encourage you how to create your own theme files.

Take, for instance, a very simple dashboard like the one shown in Figure 1-2. (This is the file SampleDashboard.pbix from the sample files.)



**Figure 1-2.** An unformatted dashboard

This dashboard is strictly “plain vanilla.” That is, no formatting has been applied at all. Imagine that this dashboard were a 15-page report and that you have to make it not only presentable but also mapping to a corporate standard. This could take hours in a worst-case scenario.

However, you are fortunate enough to have a theme JSON file available that defines all the corporate standards. To apply it, all you have to do is

1. Click View to activate the View ribbon.
2. Click the Themes popup.
3. Click Browse for themes.
4. Navigate to the sample files and select the theme file (BaseTheme.json in this example).
5. Click Open. After a few seconds, you will see the dialog in Figure 1-3.

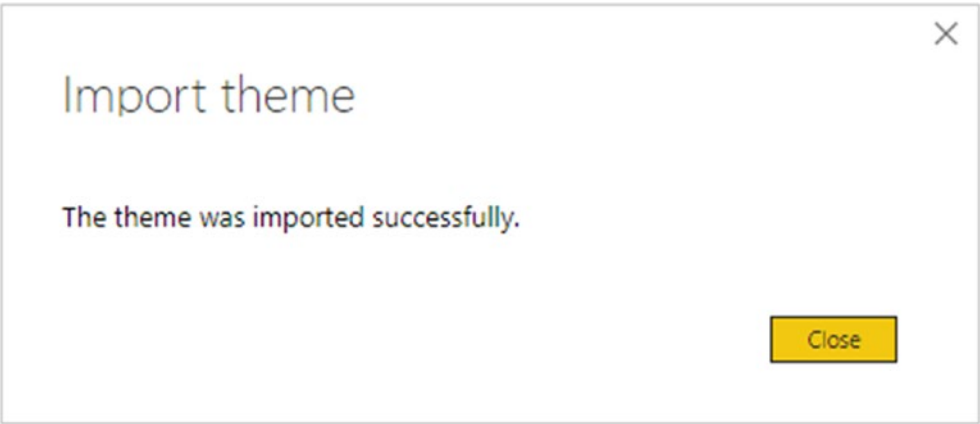


Figure 1-3. Successful theme file import

6. Click Close.

That is it! Your dashboard (every object on every page) is now formatted, instantly. The result is shown in Figure 1-4.

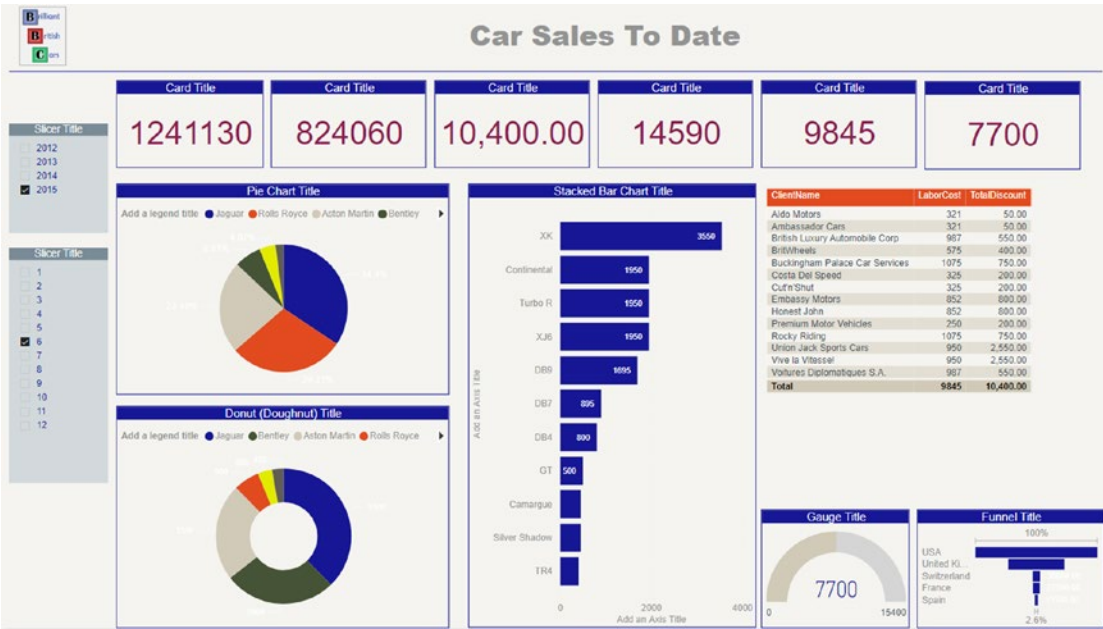


Figure 1-4. A dashboard after applying a theme file

You can now add any final formatting that you require to override the theme at the level of individual elements (a theme, after all, is a time-saver – not a straitjacket). The end result is almost certainly that you have saved a vast amount of time adding presentational touches and have ensured that your dashboard conforms to a standard look and feel.

---

**Note** The theme file that you applied in this example is not designed to show off subtleties of dashboard design – nor is it based on cutting-edge design principles. It is, however, designed to illustrate how quick and easy it is to reformat an entire dashboard using a theme file.

---

## Conclusion

In this chapter, you have seen what themes are all about and exactly how powerful they can be. It is time, now, to move on to creating your own themes. Initially, we will begin by using Power BI Desktop to write the JSON for you – as you will discover in the next chapter.

## CHAPTER 2

# Create and Customize a Theme in Power BI Desktop

If you do not come from an IT background (or have never used JSON files before), and the thought of hand-crafting complex text structures fills you with dread, then now is the time to relax and breathe deeply, because it is ridiculously easy to define a simple yet powerful Power BI theme file *without writing or modifying a single line of code*.

This is because Power BI Desktop allows you to specify (in a few clicks) a core subset of formatting attributes that will apply to your entire dashboard. Not only that, but once you have defined these attributes, Power BI Desktop will write the JSON theme file for you so that you can use it in other dashboards – or share with colleagues. All this is done using the *Customize current theme* option of the Themes button in the View menu.

While this approach does not let you craft every precise formatting attribute of each individual type of visual, it does allow you to create a standard presentation style in a few minutes at most – and you can subsequently take this theme as a basis for further development. What is more, the resulting theme file is an excellent introduction to how JSON themes function in Power BI.

Be aware, nonetheless, that creating themes using the Power BI Desktop interface does *not* allow you to attain the sophisticated levels of presentation that you can deliver using “hand-crafted” JSON. So it is best to consider the techniques that you will discover in this chapter both as a practical introduction to the subject of themes and also as an extremely fast way of developing simple style principles that can be applied to entire dashboards.

To provide a little structure to the process, this “interactive theme generation” directly inside Power BI Desktop breaks down the theme elements that you can alter into the following five categories:

- *Name and colors*: Where you can give your theme a name and specify the color palette and key colors to use in a dashboard
- *Text*: Where you can define core text attributes such as font, size, and color for various elements in a dashboard
- *Visuals*: Where you can specify key common attributes of all visuals
- *Page*: Where you can set basic attributes of the dashboard pages
- *Filter pane*: That allows you to specify the way that the filter pane appears

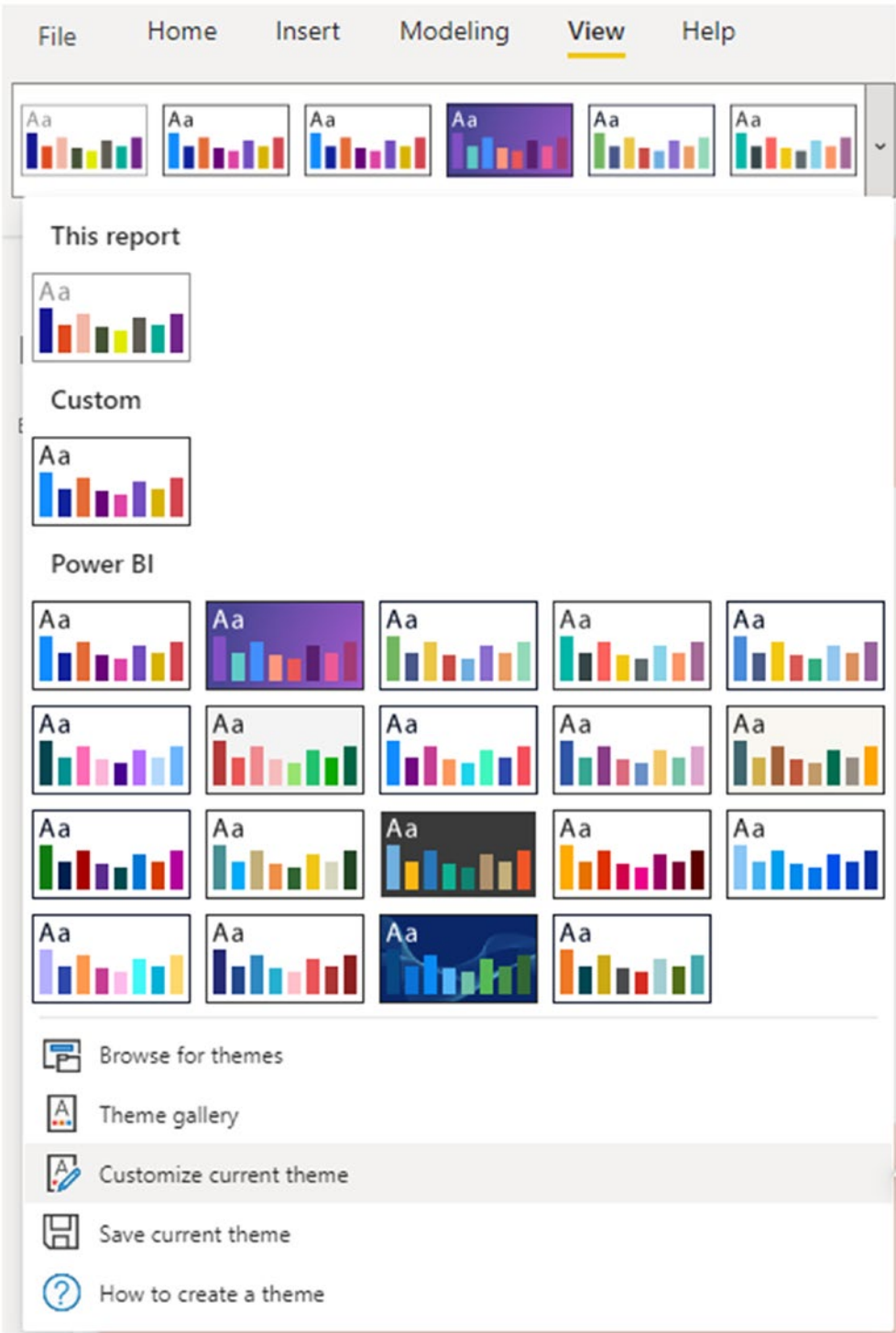
You do not have to specify every option that Power BI Desktop makes available in the Customize current theme dialogs. You can change a couple of options – or reset everything that is available (and all steps in between).

## Creating a Simple Theme

To get you started, let’s create a very simple JSON theme file that alters a few of the colors in the color palette that Power BI Desktop uses for color selection.

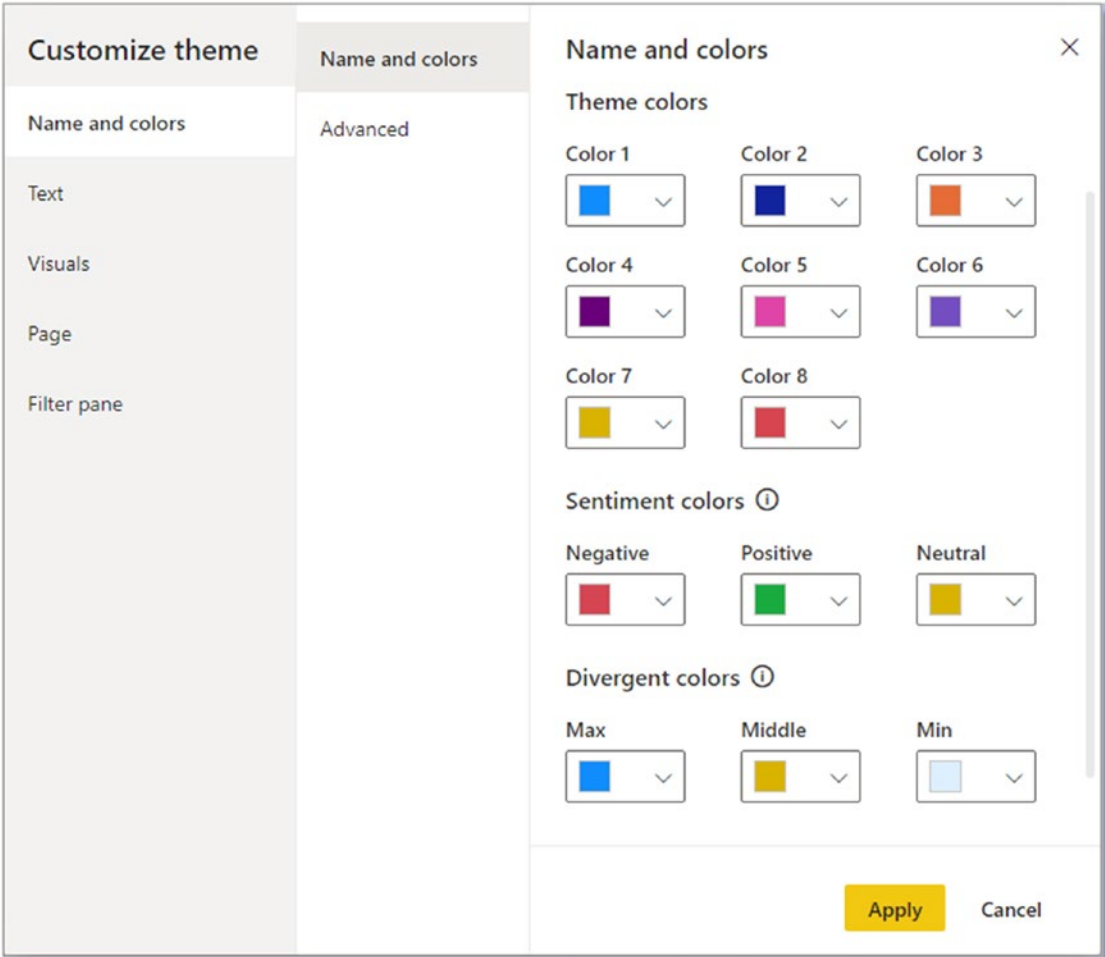
1. Activate the View menu.
2. Click the popup for the Themes. You will see something like the options shown in Figure [2-1](#).





*Figure 2-1. The Themes popup*

- 3. Click Customize current theme. The dialog shown in Figure 2-2 will appear.



**Figure 2-2.** The Customize theme dialog

- 4. Select different colors for the first few Theme colors in the dialog (these correspond to the colors in the standard Power BI color palette, from left to right starting at the third column). It is worth noting that you cannot alter the first two (monochrome) colors in the color palette.
- 5. Click Apply. The selected colors will be applied to the current dashboard.

6. Click View ► Themes ► Save current theme. The Save As dialog will appear.
7. Browse to a suitable directory and enter a name for the theme file. This file *must* have the extension *.json*.
8. Click Save.

That is it! You now have a fully functioning JSON theme file that you can apply to other dashboards. You can see the effect of the theme simply by displaying the Color popup for any element in a dashboard where this theme file has been applied. You will see that the top row of the available colors has changed to display the colors that you selected in step 4 earlier (well, for all but the first two colors which will always remain white and black).

The choices that you just made are, fortunately, not set in stone. So you can alter the theme settings at any time by repeating the process that you just applied and selecting any of the available options and resaving the theme file.

---

**Note** When you resave a theme file, Power BI Desktop does **not** remember the name that you last used and will default to *Theme.json*. Remember to select the previous file name before clicking Save if you want to update the existing file. You will, of course, have to confirm that you wish to overwrite the existing file.

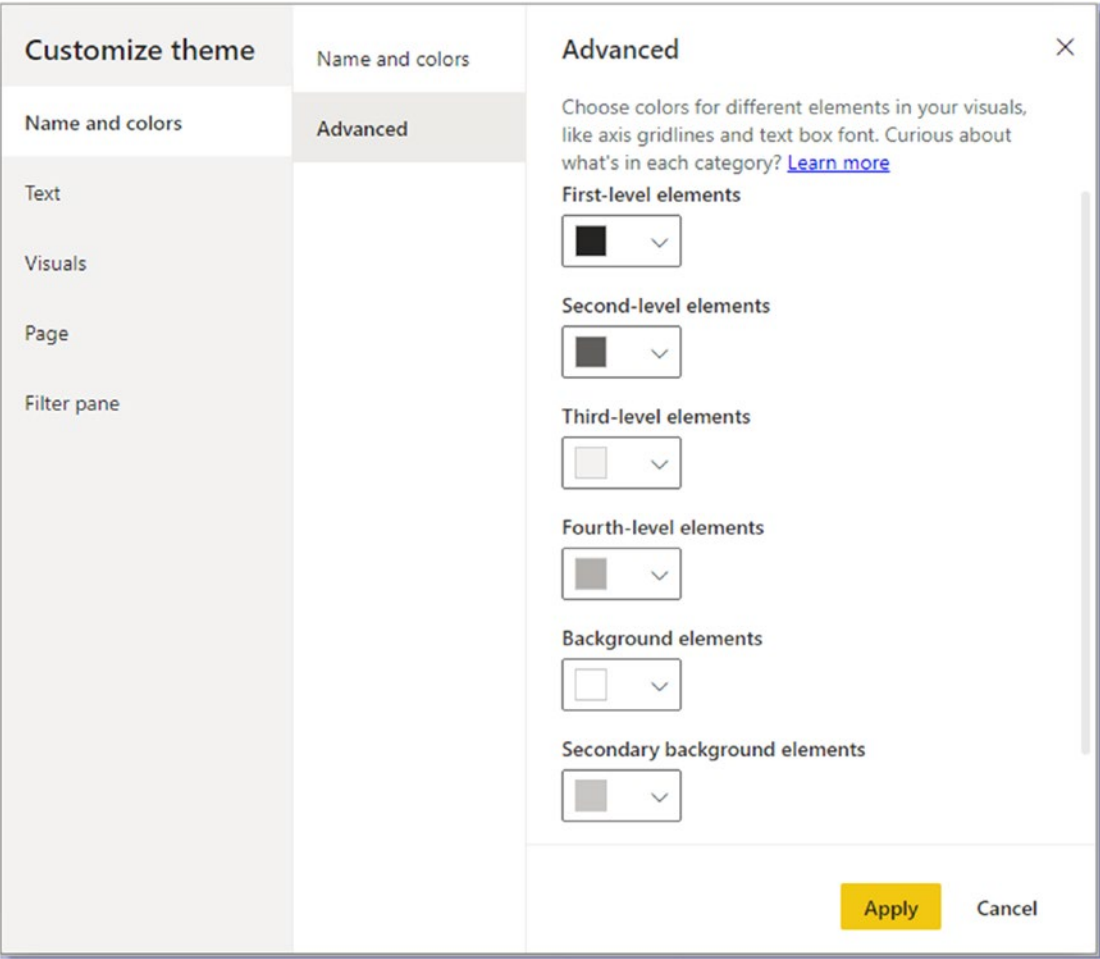
---

## Name and Color Settings

A customized theme can define much more than simply the color palette. So, now that the basics have been explained, it is time to review all the customizable options that are available using the Power BI Desktop theme interface. These are all available in the dialog that you saw in Figure 2-2.

- *Name*: This field that appears at the top of the Customize theme/Name and colors tab (although it is not visible in Figure 2-2) allows you to add a text description inside the actual JSON file. This can be useful for tracking the evolution of your definition of themes – or simply reminding you what a particular theme is used for.

- *Sentiment colors*: These are used in KPI and waterfall charts to indicate positive, negative, or neutral results.
- *Divergent colors*: These are used in conditional formatting to show when data falls inside a range.
- *Advanced (colors)*: The advanced options allow you to set a series of six colors that will be applied to a wide range of Power BI dashboard elements. You can see the Customize theme/Advanced tab in Figure 2-3.

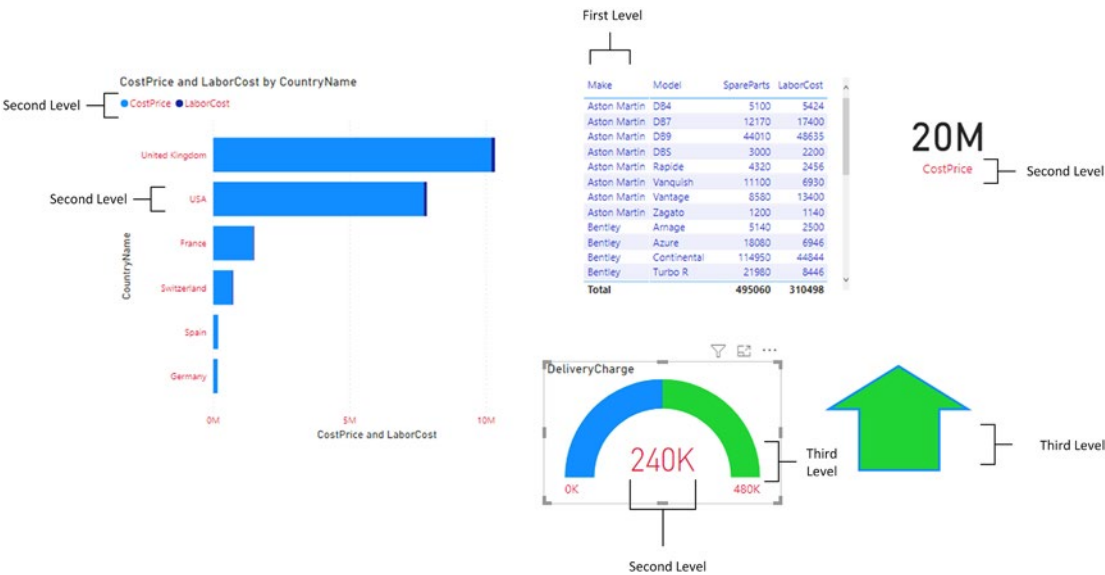


**Figure 2-3.** The Customize theme/Advanced tab

As the names of each of these color elements are somewhat abstract, here is the full list of the elements that each color setting will modify:

- *First-level elements:* (Labels background color (when outside data points), trend line color, textbox default color, table and matrix values and totals font colors, data bars axis color, card data labels, gauge callout value color, KPI goal color, KPI text color, slicer item color (when in focus mode), slicer dropdown item font color, slicer numeric input font color, slicer header font color, scatter chart ratio line color, line chart forecast line color, map leader line color, filter pane and card text color)
- *Second-level elements:* “Light” secondary text classes, label colors, legend label color, axis label color, table and matrix header font color, gauge target and target leader line color, KPI trend axis color, slicer slider color, slicer item font color, slicer outline color, line chart hover color, multi-row card title color, ribbon chart stroke color, shape map border color, button text font color, button icon line color, button outline color
- *Third-level elements:* Axis gridline color, table and matrix grid color, slicer header background color (when in focus mode), multi-row card outline color, shape fill color, gauge arc background color, applied filter card background color, disabled button outline color
- *Fourth-level elements:* Legend dimmed color, card category label color, multi-row card category labels color, multi-row card bar color, funnel chart conversion rate stroke color, disabled button text font color, disabled button icon line color
- *Background elements:* Labels background color (when inside data points), slicer dropdown items background color, donut chart stroke color, treemap stroke color, combo chart background color, button fill color, filter pane and available filter card background color
- *Secondary background elements:* Table and matrix grid outline color, shape map default color, ribbon chart ribbon fill color (when match series option is turned off), when background is not set to FFFFFFFF, the disabled button fill color, and the disabled button outline color

To give you some idea of how these formats are applied, take a look at Figure 2-4. Please note that this dashboard is not a complete reference – it just aims to show you how the principle of general color settings works.



**Figure 2-4.** Anatomy of high-level color customization

## Text Settings

As you might expect, there is also a set of text formats that you can define as part of a custom theme. Again, to make defining the elements easier, they are subset into a number (four in this case) of distinct elements. These subelements are

- *General:* Formats table and matrix column headers, matrix row headers, table and matrix grid, table and matrix values
- *Title:* Formats category axis title, value axis title, multi-row card title, slicer header
- *Cards and KPIs:* Formats card data labels, KPI indicators
- *Tab headers:* Formats key influencers headers