APPLIED DAX WITH POWER BI

FROM ZERO TO HERO
WITH 15-MINUTE LESSONS

Teo Lachev

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preface

DAX is growing in popularity thanks to the momentum surrounding Microsoft Power BI, Excel Power Pivot, and Analysis Services Tabular. Whether you are a business analyst or a BI pro, a good working knowledge of DAX is important for extending your models with custom business logic. You won't get far in Microsoft BI without DAX.

This book was born out of necessity and I've been working on it for a while. In my consulting practice, I had been teaching and implementing Power BI and Analysis Services Tabular, and people were constantly asking for DAX book recommendations. Indeed, DAX is not an easy topic and has its ways to humble even experienced practitioners. There are a few good reference books out there, but they could be somewhat overwhelming for novice users. So, I turned my classroom and consulting experience into this book and designed it as a self-paced guide to help you learn DAX one lesson at a time.

As its name suggests, the main objective of this book is to teach you the practical skills of how to take the most of DAX from whatever angle you'd like to approach it. You'll learn DAX methodically with self-paced lessons that progress from simple topics, such as calculated columns, to more advanced areas, such as time intelligence, joins, and security. Most lessons are five to six pages long, and it should take no more than 15 minutes to complete the lesson's exercises. And if you do one lesson per day, you'll be a DAX expert in a month!

With the growing popularity of Power BI, I decided to use this technology for the exercises. However, although this book teaches you DAX with Power BI, a nice bonus awaits you ahead because you're also learning how to program Excel Power Pivot and Analysis Services Tabular. So, if one day you find yourself working on a self-service model in Excel or an organizational model powered by Analysis Services Tabular, you'll find that you already have the knowledge.

Although this book is designed as a comprehensive guide to DAX, it's likely that you might have questions or comments. As with my previous books, I'm committed to help my readers with book-related questions and welcome all feedback on the book discussion forums on my company's web site (https://prologika.com/daxbook). Consider also following my blog at https://prologika.com/blog and subscribing to my newsletter at https://prologika.com to stay on the Microsoft BI latest.

Now, turn to the first lesson and get from zero to DAX hero at your own pace!

Teo Lachev
Atlanta, GA

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about the book

The book doesn't require any prior experience with DAX, but it assumes that you have experience in Power BI data modeling. If you don't, I recommend you start with my "Applied Microsoft Power BI" book, which teaches you how to create self-service data models. To get the most out of this book, read and practice the lessons in the order they appear in the book. That's because each lesson builds upon the previous ones, to introduce new concepts and reinforce them with step-by-step exercises.

Part 1, *Introduction*, starts with the fundamentals. It introduces you to the DAX origin and main constructs. You'll learn important data modeling techniques, including star schemas and relationships. You'll also learn about the Power BI storage engine and how storage affects DAX.

Part 2, *Calculated Columns and Tables*, teaches you to extend your tables with basic and advanced calculated columns, including columns for looking up, aggregating, and filtering data. You'll understand how calculated columns are evaluated and how to change the evaluation context. And you'll discover how calculated tables can help you implement role-playing dimensions, date tables, and summarized tables.

Part 3, *Measures*, explains how measures give you the needed programmatic power to travel the "last mile" and unlock the full potential of Power BI. After learning the measure fundamentals and filter context, it shows you how to create basic measures. Then, it moves to more advanced concepts, such as restricting and ignoring the filter context, as well as grouping and filtering data.

Part 4, *Time Intelligence*, further expands your knowledge of measures and teaches you how to implement time intelligence. It starts by teaching you how to work with built-in and custom date tables. After revisiting quick measures for time intelligence, it teaches you how to implement custom formulas for more advanced requirements, such as custom date filters and semi-additive measures. You'll learn how to centralize time intelligence formulas by using calculation groups.

Part 5, *Queries*, covers creating custom queries to test measures outside Power BI Desktop, exploring the model data, and implementing reports with other tools that require you to specify a dataset query, such as Power BI Report Builder. You'll also discover how to identify and address performance bottlenecks.

Part 6, *Advanced DAX*, starts by showing you how you can use DAX to implement different types of joins, including recursive (parent-child), many-to-many, inner, outer, and other joins. It explains how to implement row-level security (RLS) by applying DAX row filters. You'll also learn how to handle more complicated security policies, such as by externalizing secured policies in a separate table.

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acknowledgements

Welcome to the Applied DAX with Power BI book! Writing books is difficult and DAX doesn't make it any easier. Fortunately, I had people who supported me. This book (my eleventh) would not have been a reality without the help of many people to whom I'm thankful. As always, I'd like to first thank my family for their ongoing support. My daughter, Maya, contributed the most by polishing the manuscript.

Thanks to my technical reviewer John Layden, whom I had the privilege to work with previously on consulting engagements, for reviewing the manuscript, and providing valuable feedback. Thanks to Shay Zamir for another great cover design.

As a Microsoft Most Valuable Professional (MVP), Gold Partner (Data Analytics and Data Platform), and Power BI Red Carpet Partner, I've been privileged to enjoy close relationships with the Microsoft product groups. It's great to see them working together! Special thanks to the Power BI and Analysis Services teams.

Finally, thank *you* for purchasing this book!

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conventions

This book uses different typefaces to differentiate between code and regular English, and to help you identify important concepts. Code that you type is presented in this font:

```
EVALUATE DimSalesTerritory
```

Referencing columns follows the DAX Table[Column] notation. For example, DimEmployee-[FullName] refers to the FullName column in the DimEmployee table. Table relationships also follow the DAX syntax. For example, FactResellerSales[OrderDateKey] ⇨ DimDate[DateKey] denotes a many-to-one relationship between the OrderDateKey column in the FactResellerSales table and the DateKey column in the DimDate table. The relationship direction (many-to-one) is indicated by the direction of the arrow.

Exercises typically have the following sections although sections can be omitted:

Practice
This section identifies the steps you need to take to complete the exercise, such as the DAX code that you type in.

Output
This section highlights the result from the practice, such as a screenshot from a report that uses DAX calculations or results from a query.

Analysis
The Analysis section provides the author's explanation about the practice and output sections, such as line-by-line analysis of a DAX formula.

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source code

Applied DAX with Power BI doesn't require much to get you started. You can perform all practices with free software, and you don't need a Power BI license. **Table 1** lists the software that you need for all the exercises in the book. As you can see, most of the software is not required.

Table 1 The software requirements for practices and code samples in the book

Software	Setup	Purpose	Lessons
Power BI Desktop	Required	Implementing self-service data models	All
DAX Studio (https://daxstudio.org)	Recommended	Testing DAX queries	Part 5
Power BI Service (powerbi.com)	Optional	Testing data security	Part 6
SQL Server Management Studio (SSMS)	Optional	Testing DAX queries	Part 5
Power BI Report Builder	Optional	Creating a paginated report	Part 5
SQL Server Analysis Services Tabular 2019	Optional	Implement calculation groups	Part 4
Tabular Editor (https://tabulareditor.github.io/)	Optional	Implement calculation groups	Part 4

You can download the source code for the practices from the book page at https://prologika.com/daxbook. After downloading the zip file, extract it to any folder on your hard drive (I recommend C:\DAX\Source\). Once this is done, you'll see a folder for each part of the book. In each part folder, you'll typically find a file for each lesson and the file name matches the lesson name. This file includes the DAX formulas if you prefer to copy and paste them.

Start with the Adventure Works.pbix file in the \Source\Practice folder and keep on extending it as you go through the lessons. For your convenience, the Adventure Works.pbix file in each part folder includes the changes you need to make in the exercises in the corresponding part of the book, plus any supporting files required for the exercises. For example, the Adventure Works.pbix file in the \Source\Part2 folder includes the changes that you'll make during the Part 2 practices.

(Optional) Installing the AdventureWorksDW database

Extending the Adventure Works model with DAX doesn't require reimporting the data. However, Lesson 4 shows you how you can implement custom columns in Power Query, and this requires reimporting the affected tables. If you decide to do this exercise, you need to install the Adventure-WorksDW database. This is a Microsoft-provided database that simulates a data warehouse. You can install the database on an on-prem SQL Server (local or shared) or Azure SQL Database. Again, you don't have to do this (installing a SQL Server alone can be challenging).

NOTE Microsoft ships Adventure Works databases with each version of SQL Server. More recent versions of the databases have incremental changes and they might have different data. Although the book exercises were tested with the AdventureWorksDW2017 database, you can use a later version if you want. Depending on the database version you install, you might find that reports might show somewhat different data.

Follow these steps to download the AdventureWorksDW2017 database:

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1. If you don't have a SQL Server, download and install the free developer edition from https://microsoft.com/sql-server/sql-server-downloads.
2. Download the AdventureWorksDW2017 backup file from https://github.com/Microsoft/sql-server-samples/releases/download/adventureworks/AdventureWorksDW2017.bak.
3. Install SQL Server Management Studio (SSMS) from https://docs.microsoft.com/sql/ssms/download-sql-server-management-studio-ssms.
4. Open SQL Server Management Studio (SSMS) and connect to your SQL Server database instance. Restore the AdventureWorksDW2017 backup file. If you're not sure how to do so, read the instructions at https://github.com/Microsoft/sql-server-samples/releases/tag/adventureworks.

NOTE The data source settings of the sample Power BI Desktop models in the source code have connection strings to the AdventureWorksDW database. If you decide to refresh the data, you must update the AdventureWorksDW data source to reflect your specific setup. To do so in one step per file, open the *pbix file in Power BI Desktop, and then expand the Edit Queries button in the ribbon's Home tab, and click "Data source settings". Click the "Change source" button and change the server name to match your SQL Server name.

Reporting errors

Please submit bug reports to the book discussion list on https://prologika.com/daxbook. Confirmed bugs and inaccuracies will be published to the book errata document. A link to the errata document is provided in the book web page. The book includes links to web resources for further study. Due to the transient nature of the Internet, some links might no longer be valid or might be broken. Searching for the document title is usually enough to recover the new link.

Your purchase of APPLIED DAX WITH POWER BI includes free access to an online forum sponsored by the author, where you can make comments about the book, ask technical questions, and receive help from the author and the community. The author is not committed to a specific amount of participation or successful resolution of the question and his participation remains voluntary. You can subscribe to the forum from the author's personal website https://prologika.com/daxbook.

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