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# Data Analysis Using Power Pivot

WEEK 12

Vitezslav Novak

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# Data Analysis Using Power Pivot

## Introduction to Power Pivot

Power Pivot is a data modelling technology that allows us to create data models, relationships, and calculations using Data Analysis Expressions (DAX) in the Excel environment. It is an add-in that is an integral part of Excel.

In this chapter, we will first look at the creation of data models consisting of several tables and their use for the creation of pivot tables. Later, however, we will find out that even a data model made up of a single table makes sense, either for the possibility of having more than one million rows in the source table or for the possibility of additional calculations (calculated columns and measures) using the DAX language, which cannot be used without the Power Pivot add-in. Finally, we find that we will often use Power Pivot without physically opening it. It will just work in the background for us.

The Power Pivot add-in is an integral part of Excel, so it does not need to be installed or activated in any way. You can open it using the **DATA** tab with the **MANAGE DATA MODEL** button. If you have not created a data model, an empty Power Pivot will open. If you have a data model created, the Power Pivot environment will look like Excel. There are also sheets with tables, it is possible to perform additional calculations here (calculated columns and measures), but the fundamental difference compared to Excel is that the data in Power Pivot is intended for reading only, it cannot be changed here.



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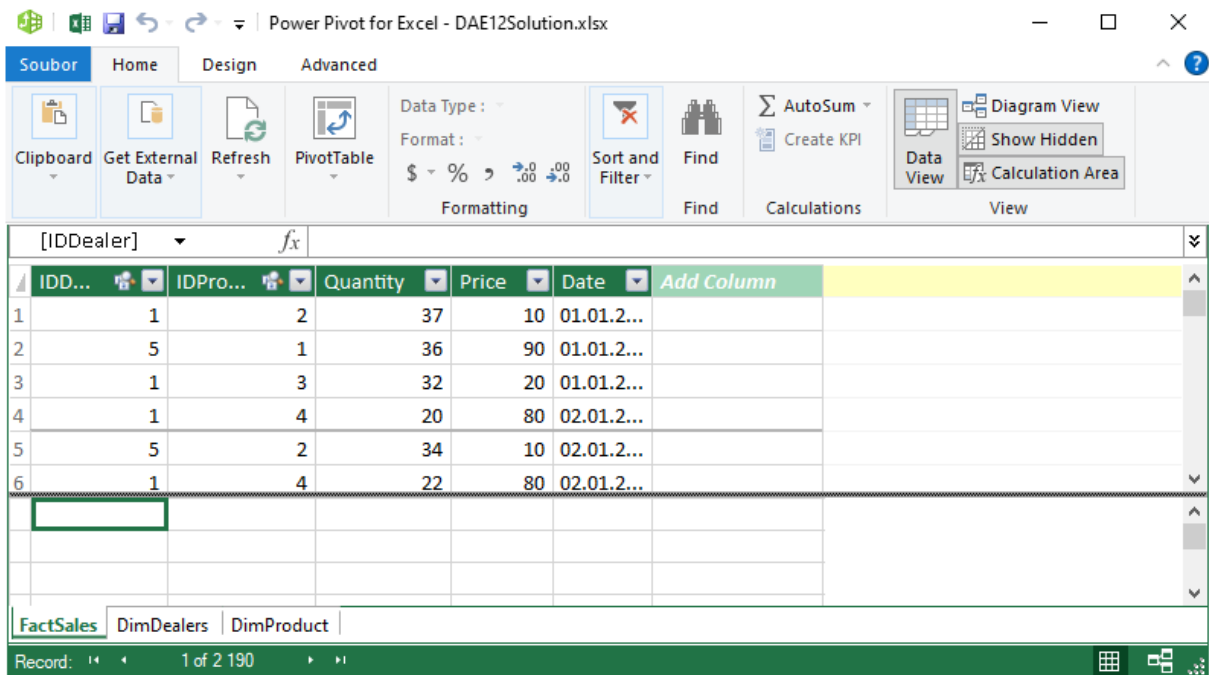


Figure 1 Power Pivot window

Power Pivot actually serves as a data warehouse in which data is collected from other data sources (most often a relational database, but the data source can also be an Excel workbook), so if the data should be changed, it must be done in the data source and the data in Power Pivot then must be just updated.

We will only use Excel workbooks as a data source. So, how to get data from Excel workbook to Power Pivot (or data model)? One of the following methods is possible:

- When creating a pivot table, check **ADD THIS DATA TO THE DATA MODEL** in the **CREATE PIVOT TABLE** dialog box.
- When importing data, check **ADD THIS DATA TO THE DATA MODEL** in the **IMPORT DATA** dialog box.
- When creating a relationship between tables using **RELATIONSHIPS** button on **DATA** tab.

If you are in Power Pivot, you can use the **GET EXTERNAL DATA FROM OTHER DATA SOURCES** button on the **HOME** tab (if the data source is an Excel workbook, it must be closed). We will show most of the methods mentioned above now.



# Data Analysis Using Power Pivot

## Multi-table data models

Creating relationships between several structured tables automatically creates a data model containing those tables. Those of you already familiar with relational database design theory will have a great advantage. In relational databases, it is usual that the database data is not stored in one table, but in several tables, where each table describes one real-world object, e.g. a table of products, dealers or sales. Each row of the table is then one specific object of the real world, i.e. one specific dealer, product or sale. A huge advantage of this approach is the ease adding new objects to the database, their easy modification or deletion. Only one row of the table is always worked with. However, if we want to analyze such a database comprehensively, we must create so-called relationships between the tables that express their relation.

Let's take the exercise workbook tables for this chapter. There are three structured tables in this exercise book:

- **DimDealers** – it describes individual dealers, each dealer has one row in the table.
- **DimProducts** – it describes individual products, each product has one row in the table.
- **FactSales** – it describes individual sales of dealers and products, where one dealers can have more sales and one product can be sold several times.

We want to display the data of the DimDealers and DimProducts tables in the **ROWS** or **COLUMNS** sections of the pivot table, that is why they are called **dimension tables**. We want to display the data of the FactSales table in the **VALUES** section, that is why it is called a **fact table**

To create relationships, it is necessary to know the concepts of primary and foreign keys, which are commonly used in relational databases. The **primary key** is a table column that uniquely identifies each row in the table, i.e. a unique identifier. In exercise



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workbook, there are the **ProductID** column in the **DimProducts** table and the **DealerID** in the **DimDealers** table with unique value for each row in the table – primary keys.

In order to create a relationship between tables, this column must also exist in the related table, where the values usually already contain duplicates. E.g. in order to make it clear which sale was made by which dealer, the **DealerID** must also be in the **FactSales** table. This column, which expresses a relationship with another table, is called the **foreign key**.

If you have data in Excel and you want to create relationships between tables in Excel, it is necessary to format your tables as structured tables (it is already done in our exercise workbook). Relationships in Excel you can create using the **DATA** tab with the **RELATIONSHIPS** button. The **MANAGE FRELATIONSHIPS** dialog box opens.

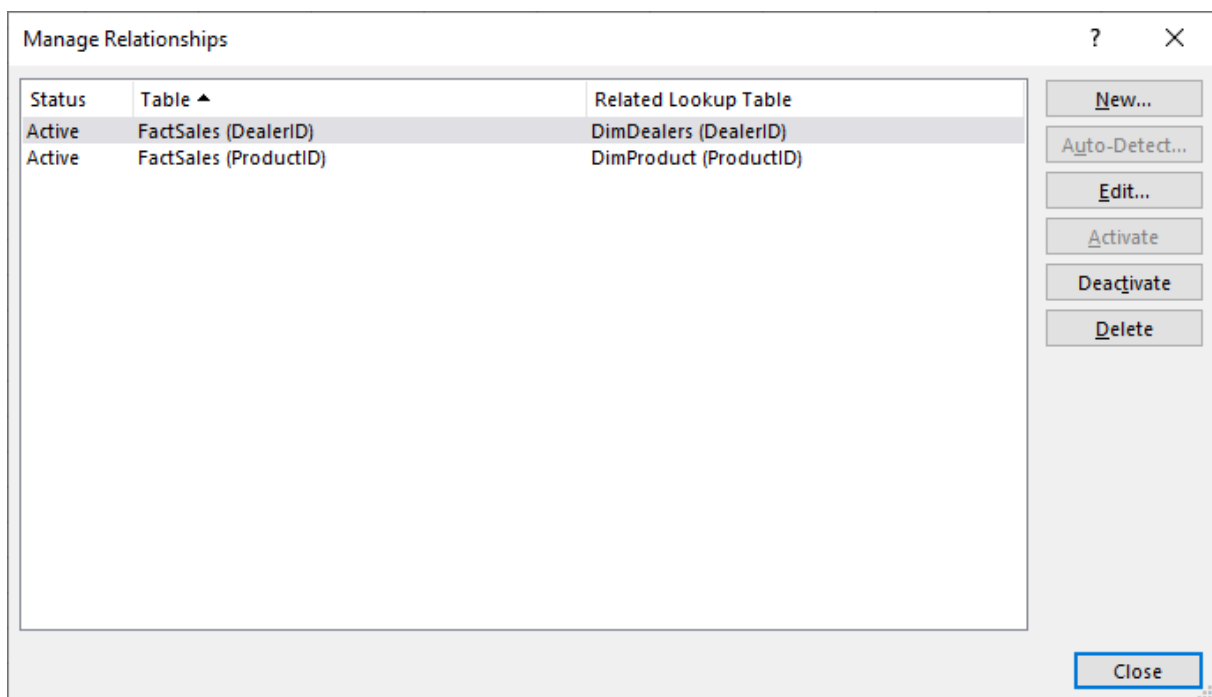


Figure 2 Manage Relationships dialog box

In the **MANAGE FRELATIONSHIPS** dialog box, click **NEW**. In the **CREATE RELATIONSHIP** dialog box, it is necessary to select **TABLE** (table with foreign key) and **RELATED TABLE** (table primary key) and their related columns, i.e. foreign and primary key.



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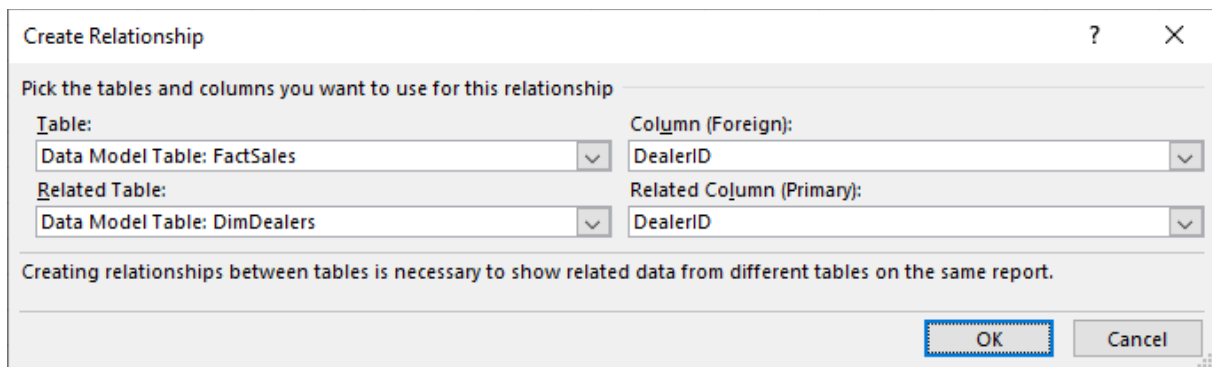


Figure 3 Create Relationship dialog box

In the **MANAGE FRELATIONSHIPS** dialog box, you can also modify created relationships using the **EDIT** button, or delete them using the **DELETE** button. The **ACTIVATE** and **DEACTIVATE** buttons are beyond the scope of this tutorial.

You will use Power Pivot mainly for creating calculated columns and measures. But it is also possible to view your data model graphically in the diagram view. In Power Pivot, choose the **HOME** tab and the **DIAGRAM VIEW** button.

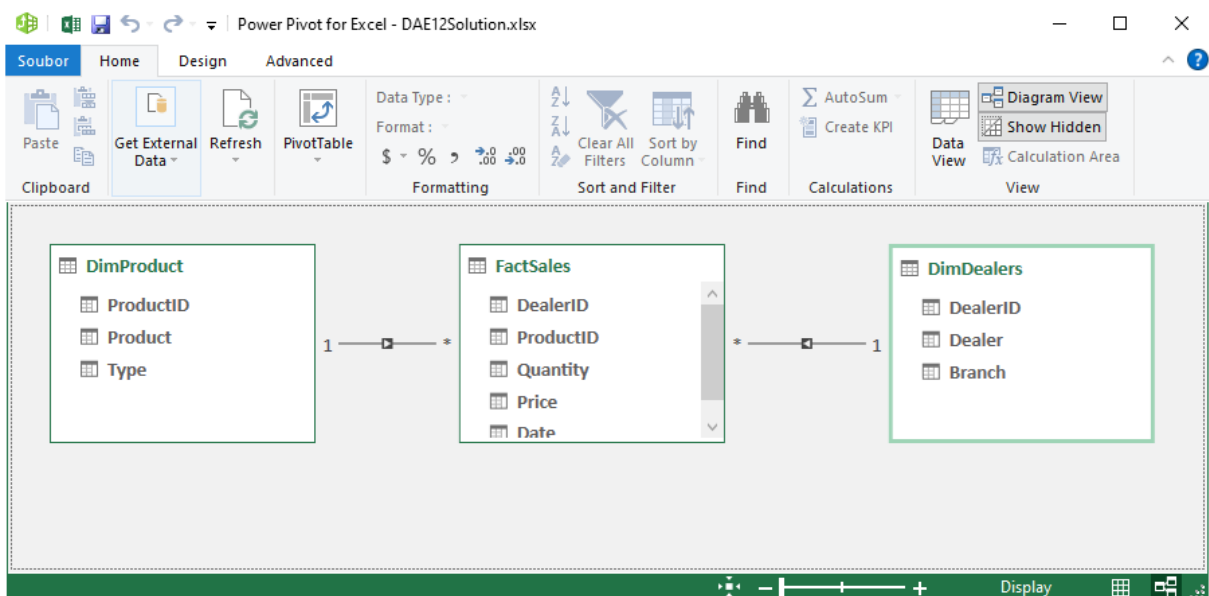


Figure 4 PowerPivot add-in in diagram view

If the Excel workbook contains a data model and you want to use it to create a pivot table, in the **CREATE PIVOT TABLE** dialog box check the checkbox **USE THIS**



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**WORKBOOK'S DATA MODEL.** The only difference is that instead of just fields, you choose fields from several tables for the pivot table.

## Using the Checkbox **ADD THIS DATA TO THE DATA MODEL**

But Power Pivot can also be used for single-table data models. The reason is using additional functions of the Data Analysis Expressions (DAX) language for calculating aggregations in pivot tables or the possibility to store tables with more than one million rows in Excel. The **DISTINCT COUNT** function, which is not available without a data model, is offered directly in the **VALUE FIELD SETTINGS** dialog box of a pivot table in Excel, other DAX functions must be used in the Power Pivot environment.

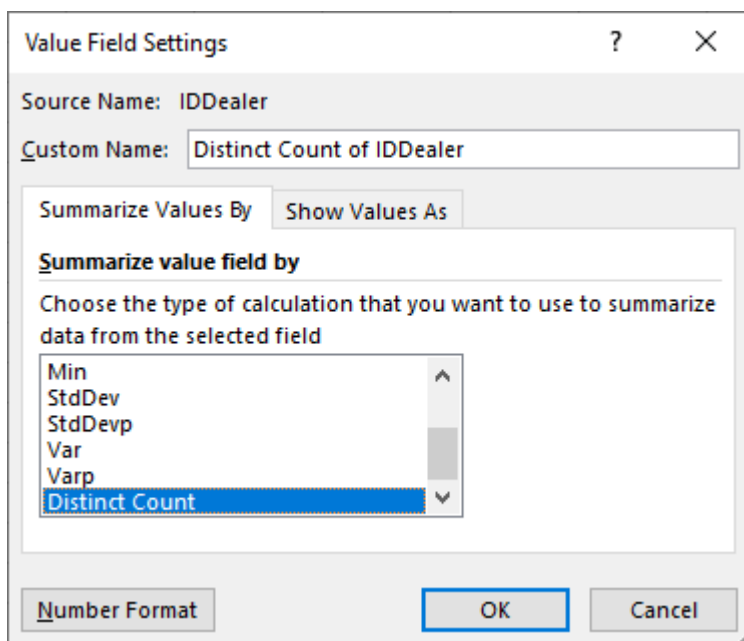


Figure 5 Value Field Settings dialog box with Distinct Count function

If you want to create single-table data model, use the **ADD THIS DATA TO THE DATA MODEL** checkbox in the **CREATE PIVOT TABLE** dialog box.



# Data Analysis Using Power Pivot

## Introduction to Data Analysis

### Expressions (DAX)

For calculations in pivot tables, we have used only those aggregation functions that pivot tables offered in VALUE FIELD SETTINGS so far. Since now, we can already call such calculations implicit measures. Power Pivot and its query language Data Analysis Expressions (DAX), offer us the possibility to calculate other calculations as well, both in the form of calculated columns and explicit measures, i.e. measures whose calculation formula you must specify explicitly.

The functions of DAX are similar to functions of Excel, but there are also many functions that do not exist in Excel at all. We will show the DAX language on a single example, namely the calculation of the total profit, when we only have the **Quantity** and **Price** columns in the **FactSales** table.

If the data were in a structured table in Excel, it would not be possible to calculate the total profit using the SUM function, for example using the formula `=SUM(FactSales[Quantity]*FactSales[Price])`, because the parameter of the SUM function can be only one data column, but not an expression. However, it is possible to use the Power Pivot data model and enter the implicit measure formula in the lower part of the FactSales table:

**Profit:=SUMX(FactSales;FactSales[Quantity]\*FactSales[Price])**



# Data Analysis Using Power Pivot

The screenshot shows the Power Pivot for Excel interface. The ribbon includes 'Soubor', 'Home', 'Design', and 'Advanced'. The 'Advanced' ribbon is active, showing options like 'Clipboard', 'Get External Data', 'Refresh', 'PivotTable', 'Data Type', 'Format: General', 'Formatting', 'Sort and Filter', 'Find', 'Calculations', and 'View'. The formula bar displays the DAX measure: `Profit:=SUMX(FactSales;FactSales[Quantity]*FactSales[Price])`. Below the formula bar is a table with the following data:

	DealerID	ProductID	Quantity	Price	Date	Date (Quarter)
1	1	2	37	10	01.01.2...	Qtr1
2	5	1	36	90	01.01.2...	Qtr1
3	1	3	32	20	01.01.2...	Qtr1
4	1	4	20	80	02.01.2...	Qtr1
5	5	2	34	10	02.01.2...	Qtr1
6	1	4	22	80	02.01.2...	Qtr1

Below the table, the 'Profit: 3237790' is displayed in a cell. The bottom status bar shows 'Record: 1 of 2 190'.

Figure 6 Data model with explicit measure Profit

Functions with X suffix are called iterators and are able to calculate aggregations of expressions above tables or table functions. Such measure is possible to use in Excel pivot table in VALUES section.

Functions with X suffix are not the only difference between DAX and Excel functions. There are hundreds of additional functions in the DAX language that can extend your calculation capabilities in Excel pivot tables.



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