DAX for Power BI

Sample manual - first two chapters

Manual 1293 - 126 pages –

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CHAPTER 1 - INTRODUCTION TO DAX IN POWER BI

1.1 DAX in Power BI

In Power BI you can use the *DAX* (*Data Analysis eXpressions*) language to create *calculated columns*, *measures* and *tables*. You can see an example of each below.

How DAX is Used 1 – Calculated Columns

A *calculated column* is like a formula in an Excel table. The results of a calculated column are stored in the data model.

```
1 Sale value = Sales[Price] * Sales[Quantity]
```

SaleDate	ProductId	CentreId	Quantity	Price	Sale value
21 July 2023	10	101	1	£3.99	£3.99
21 July 2023	12	178	2	£6.99	£13.98
21 July 2023	13	207	1	£3.95	£3.95
21 July 2023	13	342	4	£3.95	£15.80

This calculated column gives the value for each row of a sales table by multiplying the price of an item by the quantity sold.

As we will see in this manual, a calculated column is evaluated for each row of a table; DAX uses the *row context* to access the correct values for each separate calculation.

How DAX is Used 2 – Measures

A *measure* is a formula which calculates a value when you place it in a visual. The visual provides a *filter context* which tells the measure which values it can use in the calculation.

```
1 Sum of sale value = SUMX(
2     Sales,
3     Sales[Price] * Sales[Quantity]
4 )
```

This measure multiplies the price of an item by the quantity sold for each row of a sales table, then sums the results.

RegionName	Air	Land	Water	**Total**
East Anglia	1,268.71	13,640.28	2,050.91	**16,959.90**
East Midlands	2,609.87	26,289.48	5,033.67	**33,933.02**
London	4,899.45	54,018.62	9,136.50	**68,054.57**
North	2,874.62	25,980.55	4,334.49	**33,189.66**
North West	7,950.17	69,751.18	12,614.71	**90,316.06**
South East	10,697.97	102,171.04	17,507.12	**130,376.13**
South West	2,616.48	23,769.80	4,506.69	**30,892.97**
West Midlands	4,702.33	49,116.82	8,878.73	**62,697.88**
Yorkshire & Humberside	6,231.78	47,396.27	8,509.78	**62,137.83**
Total	**43,851.38**	**412,134.04**	**72,572.60**	**528,558.02**

When we place the measure in a visual (a matrix in this case) the measure is calculated for each data point in the visual.

The filter context controls which values the measure can access. This cell gives the total sales value for products in the **Water** environment sold in the **South West** region.

How DAX is Used 3 – Calculated Tables

Although most of the tables in your Power BI data model will be created by importing data, you can also use DAX to calculate tables. It's common to use this technique to create custom calendars.

```
Sales Calendar = ADDCOLUMNS(
    CALENDAR(
        DATE(YEAR(MIN(Sales[SaleDate])), 1, 1),
        DATE(YEAR(MAX(Sales[SaleDate])), 12, 31)
    ),
    "Year", YEAR([Date]),
    "Month", MONTH([Date]),
    "Month Name", FORMAT([Date], "MMMM"),
    "Day", DAY([Date])
)
```

Date	Year	Month	Month Name	Day
01/01/2020 00:00:00	2020	1	January	1
02/01/2020 00:00:00	2020	1	January	2
03/01/2020 00:00:00	2020	1	January	3

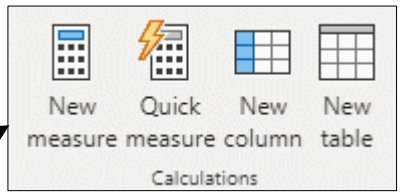
This DAX expression creates a calculated table which contains a range of dates related to the sales in our database.

Choosing the Type of Calculation

Power BI provides several ways to create calculated columns, measures and tables. One way is to click the relevant tool on the **Home** tab of the ribbon while in the **Data** view.

Select the **Data view** tool on the left of the Power BI window.

The **Calculations** group on the **Home** tab of the ribbon has a button for each type of DAX calculation.



Where Else is DAX Used?

In addition to Power BI, you can write DAX in the following applications:

Application	Description
Power Pivot	Power Pivot is an add-in for Excel which allows you to combine data from multiple sources and present this in a pivot table or chart.
SQL Server Analysis Services (SSAS) Tabular	SSAS Tabular Model allows you to combine data from lots of different data sources, apply security to it to control who sees what and then allow employees of your organisation to share the resulting data model.

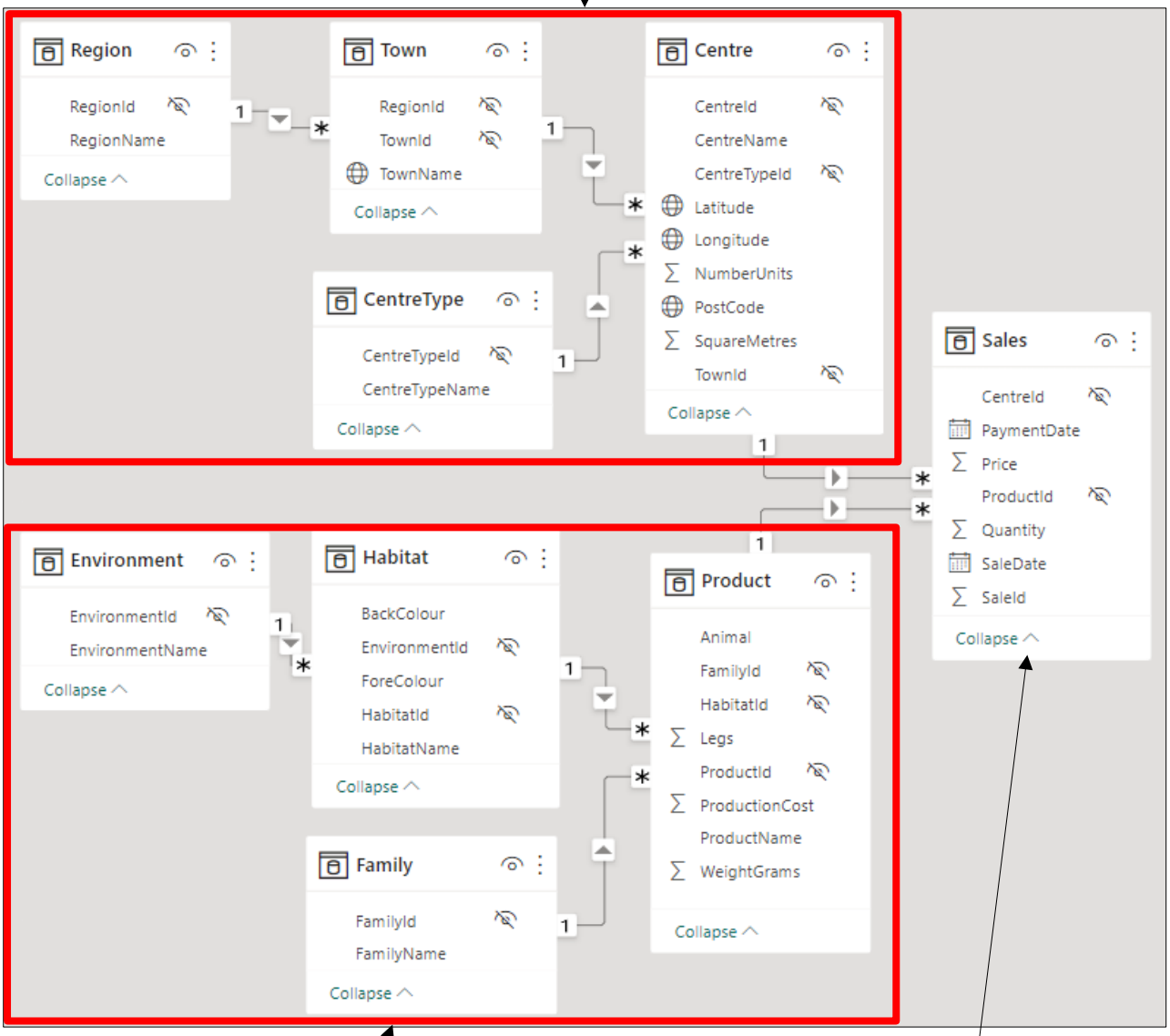
1.2 The Construct-a-Creature Database

This courseware uses data from the (fictitious) Wise Owl subsidiary **Construct-a-Creature** (a retail chain loosely modelled on Build-a-Bear, but with a wider range of animals available for purchase).

The Tables and Relationships

You can see the tables and relationships of the database in the diagram below:

There are four tables representing a geographical dimension to do with where sales took place. These tables give the shopping centre, type of centre, town and region.



There are also four tables representing a product dimension. These give details of the product sold (for example, a frog is an amphibian which lives in a fresh water habitat in a watery environment).

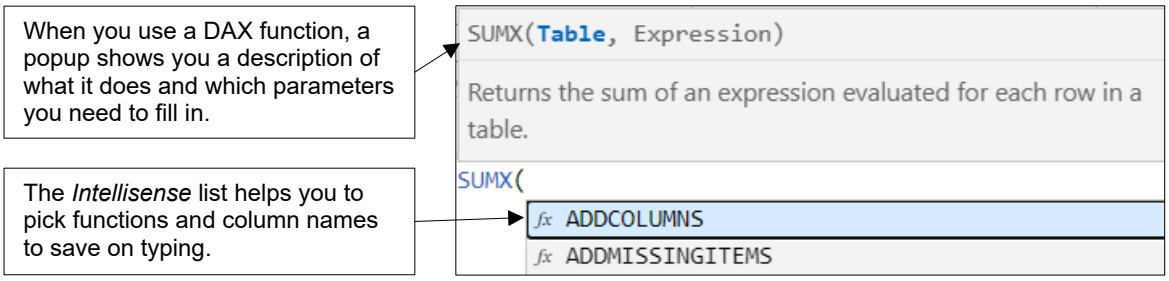
The **Sales** table stores how many of each product were sold in each transaction.

1.3 Getting Help with DAX

The amount of help available for DAX both within Power BI and from third parties has increased dramatically since the product was first released.

Getting Help within Power BI

You'll see various popups appear to help you as you write DAX in Power BI.



Other Sources of Help

You can find more descriptive help for DAX on a range of websites, as shown in the table below:

Website	Description	URL
Microsoft DAX Reference	Microsoft's official documentation for DAX functions. It's somewhat dry but a useful technical reference.	https://learn.microsoft.com/en-us/dax/
Power BI Community	A Microsoft forum in which you can post questions about any aspect of Power BI and rely on other members to provide answers.	https://community.fabric.microsoft.com/t5/Microsoft-Power-BI-Community/ct-p/powerbi
SQLBI	A third-party site maintained by Marco Russo and Alberto Ferrari. The site contains lots of free resources to help you with DAX.	https://www.sqlbi.com/
DAX Guide	A third-party alternative to Microsoft's DAX Reference created by the Italians. This site fleshes out the detail of DAX functions and provides links to helpful articles which describe in more detail how the functions work.	https://dax.guide/
Wise Owl	The Wise Owl website contains lots of free resources including videos, blogs and exercises to help you with learning DAX.	https://www.wiseowl.co.uk/resources/

CHAPTER 2 - BASIC CALCULATED COLUMNS

2.1 Calculated Columns

A *calculated column* is a type of calculation you can create using DAX in Power BI. This chapter shows you the basics of writing DAX using calculated columns.

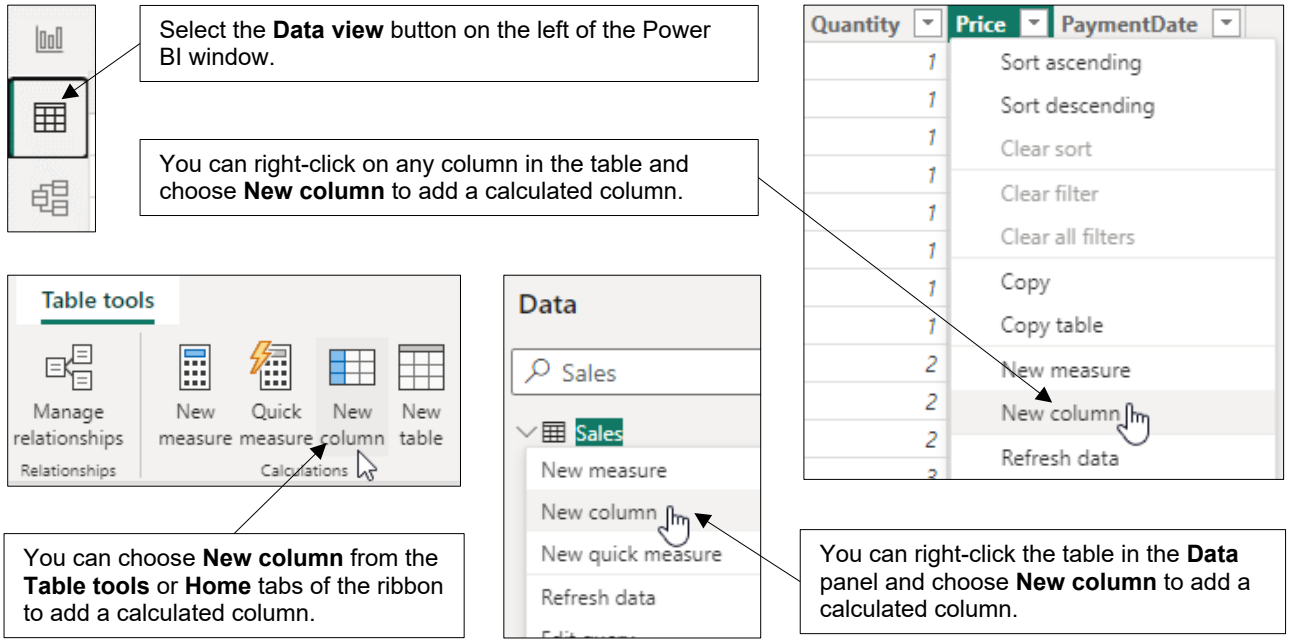
Key Features of Calculated Columns

You can see some of the key features of calculated columns in the table below:

Feature	Description
Created in data tables	You create a calculated column in a table in the data model. The calculated column can refer directly to any column in the same table.
Calculated immediately	A calculated column produces its results as soon as you enter it. The values are updated whenever the data model is refreshed.
Stores data in the model	A calculated column stores its results in the data model. Each calculated column you create increases the storage space required by the model.
Uses row context	The expression in a calculated column is evaluated for each row in the table. The row context provides the expression with access to values on the same row in the table.

Creating a Calculated Column

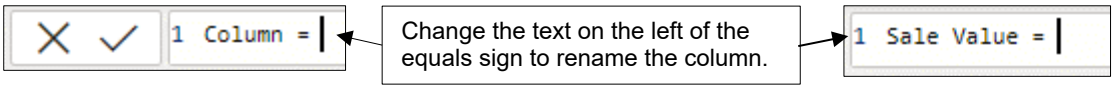
You can create a calculated column in any of the three Power BI views but, if you want to see the results of your calculation, it's best to select the **Data** view.



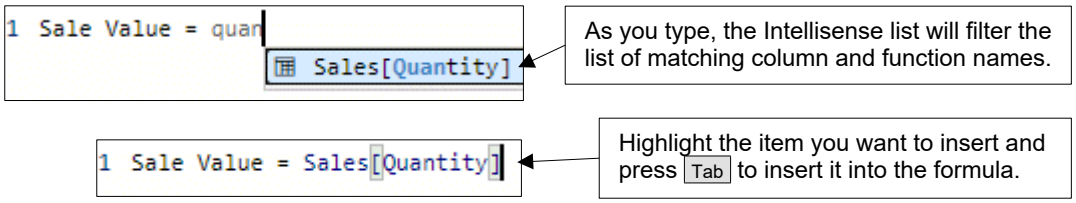
Entering a Formula

After choosing to create a calculated column you can enter your DAX code in the formula bar below the ribbon. The example below multiplies one column by another to create a new value:

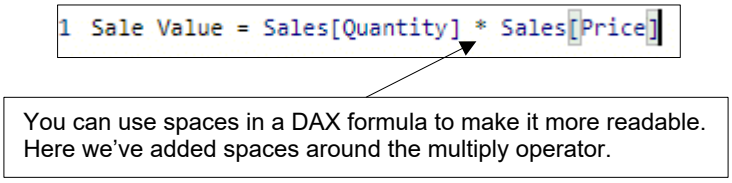
1) Start by giving the column a sensible name.



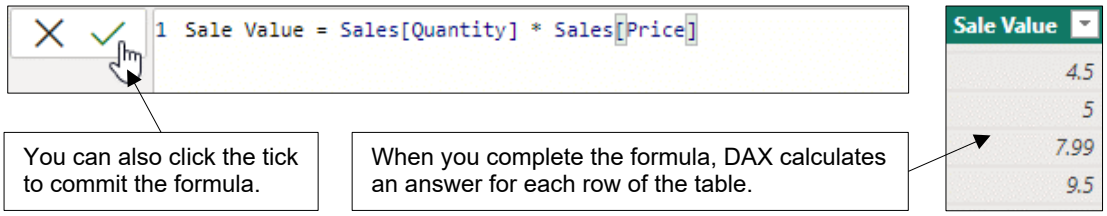
2) To reference a column in the same table, simply begin typing the column name.



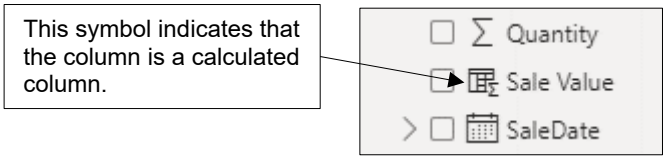
3) Type in an operator then reference the next column.



4) Press Enter to commit the formula.

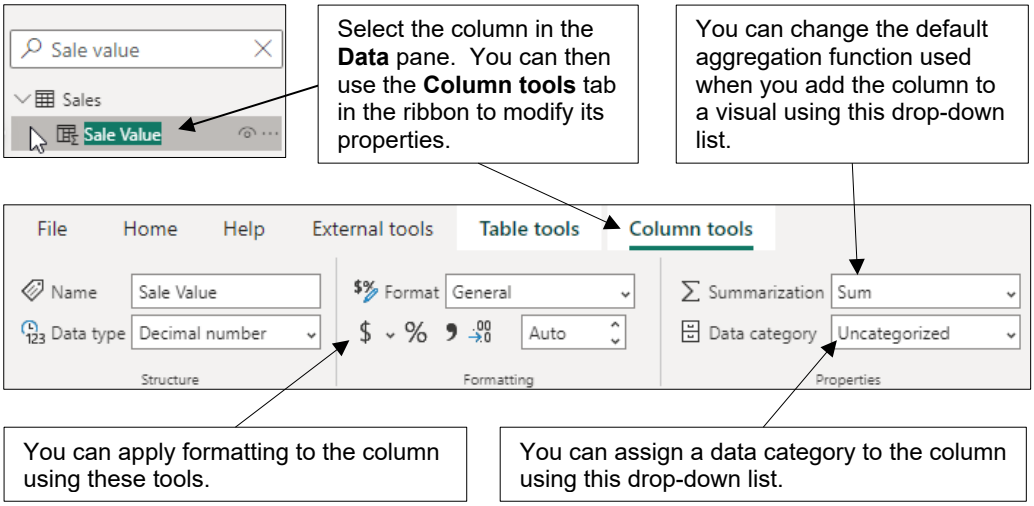


Your calculated column will appear in the table in the **Data** pane with a special symbol to indicate its status.



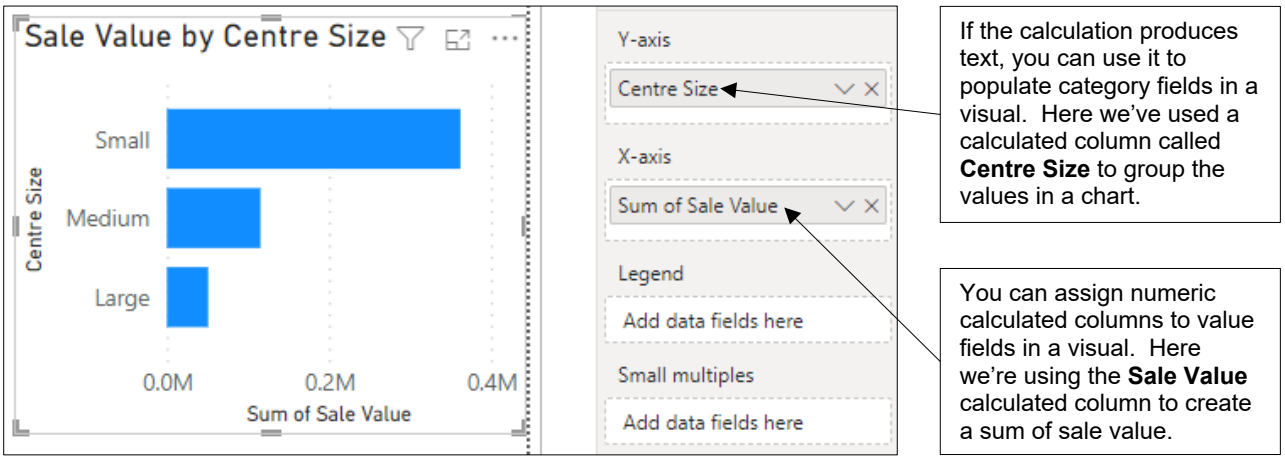
Calculated Column Properties

Once you've created a calculated column, you can modify it in the same way as any other column in your data model, as shown in the diagram below.



Using Calculated Columns in Visuals

You can use a calculated column to populate visuals in your report, just as for any other column in your data model.



2.2 Referencing Columns and Tables

This section shows you various ways to refer to columns and tables in your DAX formulae.

Qualifying Column Names

When you select a column name from the Intellisense list, it will be automatically qualified with the name of the table to which it belongs. You don't have to include the table name, however.

```
Average Unit Size = Centre[SquareMetres] / Centre[NumberUnits]
```

```
Average Unit Size = [SquareMetres] / [NumberUnits]
```

These two formulae give the same result.

Although you don't always have to include the table name when referencing a column, it makes sense to do so for the following reasons:

- If you always include the table name you don't have to remember when it is or isn't required.
- It allows you to spot when you're referring to a column as opposed to, say, a measure.
- When a column name exists in multiple tables it makes the reference unambiguous.

Table Names

If the name of a table contains spaces, or it conflicts with another DAX keyword, you must enclose the table name in single quotes.

```
Sale value = 'Sales Table'[Price] * 'Sales Table'[Quantity]
```

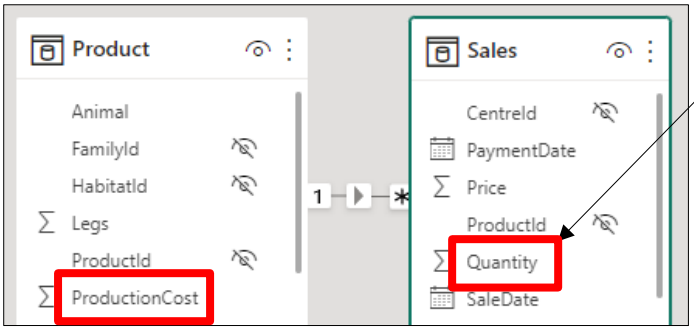
Sales Table must be enclosed in single quotes due to the space in the table name.

Wise Owl's Hint

You can always enclose a table name in single quotes, even when it isn't required.

Referencing Columns in Other Tables

In a calculated column you can only directly reference other columns which belong to the same table. This is a problem when your calculation needs to refer to columns in other tables!



We'd like to create a calculated column in the **Sales** table which multiplies the **Quantity** by the **ProductionCost** in the **Product** table.

```
1  Sale cost = Sales[Quantity] * Product[ProductionCost]
```

A single value for column 'ProductionCost' in table 'Product' cannot be

When we reference the **ProductionCost** column directly, the formula results in an error.

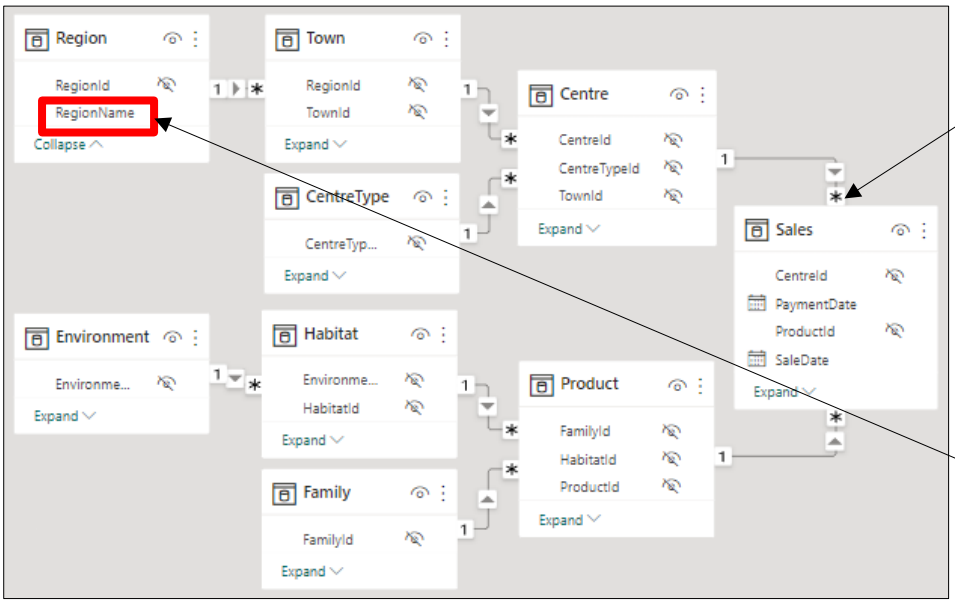
The Related Function

The key to solving the above problem is that the **Product** and **Sales** tables have a relationship. This allows us to use the **RELATED** function to reference a column in a related table.

```
1  Sale cost = Sales[Quantity] * RELATED(Product[ProductionCost])
```

We can successfully reference the **ProductionCost** column by using the **RELATED** function.

You can reference columns from a table at the **1** end of a relationship, regardless of how many steps it takes. In our model, the **Sales** table sits at the many end of every relationship:



A calculated column in the **Sales** table can reference any other column in the data model using the **RELATED** function.

In the **Sales** table you could return the **RegionName** with this formula:

=RELATED(Region[RegionName])

2.3 Editing DAX Code

Although you can write a DAX formula as a continuous stream of code, there are several things you can do to make your code more readable.

```
1 Sale Value % of Total = IF(NOT(ISBLANK(SUMX(Sales,Sales[Price]*Sales
  [Quantity]))),DIVIDE(SUMX(Sales,Sales[Price]*Sales[Quantity]),
  CALCULATE(SUMX(Sales,Sales[Price]*Sales[Quantity]),REMOVEFILTERS())))
```

Laying out a formula like this makes it very difficult to work with!

Wise Owl's Hint

It's not important to understand what the code in this section does – instead, focus on the techniques used to make it more readable.

Multiple Lines and Indenting

You can break a formula onto multiple lines and add tab spaces to make it more readable. You can use the following keys to add new lines and indenting to a formula:

Key	What it does
Shift + Enter or Alt + Enter	Adds a new line, and a tab level if appropriate.
Tab	Indents the highlighted lines one tab space.
Shift + Tab	Outdents the highlighted lines one tab space.

You can see an example of a formula with new lines and indenting in the diagram below:

When you use a function (in this case **DIVIDE**), open the round brackets then start a new line and add a tab space.

Close the brackets for a function at the same indent level as the line on which the brackets were opened. Use the vertical grey lines to help you put the brackets in the right place.

```
1  Sale Value % of Total = DIVIDE(
2      SUMX(
3          Sales,
4          Sales[Price]*Sales[Quantity]
5      ),
6      CALCULATE(
7          SUMX(
8              Sales,
9              Sales[Price]*Sales[Quantity]
10         ),
11         REMOVEFILTERS()
12     )
13 )
```

Each new function that you use should have its arguments indented one extra tab level.

All of the arguments for a single function should be at the same tab level.

Use a comma at the end of a line to separate one argument from the next.

Comments

You can use *comments* to annotate your code. You can add a comment at the end of any line after the = sign in a formula.

```
1  Sale Value % of Total = //divide filtered sales by all sales
2  DIVIDE(
3      SUMX(  --calculate filtered sales
4          Sales,
5          Sales[Price]*Sales[Quantity]
6      ),
7      /*
8          remove filters
9          to get unfiltered sales
10     */
11     CALCULATE(
```

You can type **//** to begin adding a comment, followed by the comment text.

You can also begin a comment using -- rather than **//**.

Start a multi-line comment with **/*** and end it with ***/** as shown here.

Keyboard Shortcuts

You can use a range of keyboard shortcuts to help you edit your DAX code. You can see some of these in the table below:

Key	What it does
Ctrl + G	Goto the specified line number.
Alt + ↑ / Alt + ↓	Move the line of code up / down.
Shift + Alt + ↑ / Shift + Alt + ↓	Copy the line of code up / down.
Ctrl + Shift + \	Jump to the paired bracket.
Alt + Left mouse click	Add a text cursor at the clicked position.
Ctrl + L	Select the line of code.
Ctrl + Shift + L	Select all occurrences of the current selection.
Ctrl + F2	Select all occurrences of the current word.
Ctrl + /	Comment/uncomment the line of code.
Ctrl + = / Ctrl + -	Zoom in / zoom out.
Ctrl + Space Bar	Show the Intellisense list.
Ctrl + I	Show and hide tooltips.
Ctrl + J	Expand and collapse the formula bar.

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What we do!

		Basic training	Advanced training	Systems / consultancy
Office	Microsoft Excel	✓	✓	✓
	VBA macros	✓	✓	✓
	Office Scripts	✓		
	Microsoft Access			✓
Power BI, etc	Power BI and DAX	✓	✓	✓
	Power Apps	✓		
	Power Automate (both)	✓	✓	
SQL Server	SQL	✓	✓	✓
	Reporting Services	✓	✓	✓
	Report Builder	✓	✓	✓
	Integration Services	✓	✓	✓
	Analysis Services	✓		
Coding and AI	Visual C#	✓	✓	✓
	VB programming			✓
	AI tools	✓		
	Python	✓	✓	✓

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