**Data Analysis & Business Intelligence Made Easy with Excel Power Tools**

**Excel Data Analysis Basics = E-DAB**

**Notes for Video:**

**E-DAB 07: Excel Data Analysis & BI Basics: Data Modeling: Excel Formulas, Power Query, Power Pivot?**

**Outcomes for Video:**

[1. Data Modeling 2](#_Toc3632019)

[2. VLOOKUP Function 6](#_Toc3632020)

[3. Multiple Tables: Fact Tables and Dimension Tables (Lookup Tables) 10](#_Toc3632021)

[4. Power Pivot is just one of Many Tools in Excel 11](#_Toc3632022)

[5. Excel Power Pivot and Data Model PivotTables 12](#_Toc3632023)

[2) Show Power Pivot Ribbon Tab in Excel 12](#_Toc3632024)

[4) Excel Power Pivot provides 3 Data Tools 13](#_Toc3632025)

[5) Why the name Power Pivot? 13](#_Toc3632026)

[8) Basic Advantages of Excel Power Pivot 14](#_Toc3632027)

[9) Relationship feature works in versions of Excel 2013 or later 14](#_Toc3632028)

[10) DAX Formulas 14](#_Toc3632029)

[6. Implicit vs. Explicit DAX Measures : 15](#_Toc3632030)

[7. Power Query Merge feature 17](#_Toc3632031)

[8. Data Types in Power Query. 18](#_Toc3632032)

[9. Overview of Three Examples in Video 19](#_Toc3632033)

[10. VLOOKUP Video Example 20](#_Toc3632034)

[11. Power Query Video Example 21](#_Toc3632035)

[12. Power Pivot Relationships feature & Implicit Measure feature 22](#_Toc3632036)

# Data Modeling

* 1. Define Data Modeling:
     1. Configuring Raw Data into Proper Data Sets that can be used for creating information easily with tools like PivotTables, Power Pivot, Power BI Desktop and other tools.
  2. Tools we use for Data Modeling:
     1. Data Modeling can be accomplished with many different tools such as Excel Spreadsheet Formulas, Excel features such as Text To Columns, Flash Fill, DAX Formulas and more, but the main tool we use in Excel and in Power BI is Power Query.
  3. So far in this class, we have performed Data Modeling to convert Raw Data into a single Proper Data Set, such as:  
     1. In Video #6, we used Power Query to Split by Delimiter to create a single Proper Data Set that we used as the source data for a PivotTable Report, as seen here:

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* + 1. In Video #6, we used Power Query to append multiple Text Files into a single Proper Data Set:
    2. A screenshot of a cell phone

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    3. In example #1 this video, Video #7, we will use Spreadsheet Functions to gather the raw data from three different tables and converge it into a single Proper Data Set that we can use to build a requested report, as seen on the next page:

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* + 1. In example #2 this video, Video #7, we will use Power Query to gather the raw data from two different tables in an Access database abd one table from an Excel Sheet and converge it into a single Proper Data Set that we can use to build a requested report, as seen below:

A close up of a map

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* + 1. In example #3 this video, Video #7, we will use Power Pivot’s Relationship feature and Implicit Measure feature to show three tables (from an Excel Sheet) in the PivotTable Field List and create our desired report, as seen here:

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# VLOOKUP Function

1. Looking things up in Lookup Tables is a common task in business, accounting and other professions.
2. Almost all Lookup Tables are Vertical because the first column contains the item that we try to match, and items are listed vertically.
   1. Examples of Looking up items in a Vertical Lookup Table:
      1. This is a Price Lookup Table:  
         A screenshot of a cell phone

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      2. This is a Commission Bonus % Lookup Table:  
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         Description automatically generated
      3. This is an Employee Lookup Table:  
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         Description automatically generated
      4. This is a Tax Lookup Table:  
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      5. This is a Region Lookup Table:  
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      6. This is a Commission Bonus $ Lookup Table:  
         A screenshot of a cell phone

         Description automatically generated
      7. This is a Sales Category Table:  
         A screenshot of a cell phone

         Description automatically generated
3. What does VLOOKUP Function do?
   1. VLOOKUP tries to find a match of an item in the first column of the Lookup Table and then retrieves (goes and gets) something from one of the other columns in the table and bring it back to the cell or formula.
   2. In VLOOKUP the V means Vertical.
   3. Example: VLOOKUP can find a match for the Sales Number 17,382 in the sorted first column of the Lookup Table and retrieve the correct Bonus Commission %, 1.00%, from the 2nd column and bring it back to the cell C30, like in this picture:  
      A screenshot of a cell phone

      Description automatically generated
   4. Example: VLOOKUP can find a match for the Product “Quad” in the first column of the Lookup Table and retrieve the Quad’s Price, 43.95, from the 3rd column and bring it back to the cell F23.  
      A screenshot of a cell phone

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4. VLOOKUP Function arguments:   
     
   =VLOOKUP( lookup\_value , table\_array , col\_index\_num , [range\_lookup] )  
   1. **lookup\_value** = Item that you are trying to find in first column of lookup table.
   2. **table\_array** = Vertical table = Lookup table. First Column contains items you want to “match” with the lookup\_value.
   3. **col\_index\_num** = Which column in the lookup table has the items that you want to go and get and bring back to the cell? You have to count to determine which columns contains the items you want to retrieve: is it column 2, or column 3, or column 4, and so on.
   4. **[range\_lookup]** = Because there are two different types of lookup, we must tell VLOOKUP which of the two lookups we want it to do: either: Approximate Match Lookup or Exact Match Lookup. This argument tells VLOOKUP how to find a match in the first column of the Lookup Table.
      1. **Approximate Match:**
         * For “**Approximate Match**” we must put = TRUE or 1 or omitted.  
           A screenshot of a cell phone

           Description automatically generated
         * How **Approximate Match** works:
           1. For Approximate Match the VLOOKUP table MUST be sorted on the first column: Ascending, A to Z (Small to Big).
           2. This is how Approximate Match Lookup works:

It will look through the first column:

If the first value in the table is smaller than the lookup\_value, VLOOKUP returns a Not Available Error: #N/A!

Then it looks through the first column until it bumps into the first value bigger than it and then jump back one row. When it finds a match, it knows what row it should look in.

It actually does a “binary search”, which is a technical computer term for “Approximate Match”. “Binary Search” calculates quickly compared to “Exact Match”.

If the lookup\_value is bigger than the last value, it stops at the last row.

* + 1. **Exact Match:**
       - For “**Exact Match**” we must put = FALSE or 0.  
         A screenshot of a cell phone

         Description automatically generated
       - How **Exact Match** works:
         1. VLOOKUP will look though each item in the first column of the VLOOKUP table and try to find a match. When it finds a match, it knows what row it should look in.
         2. If VLOOKUP cannot find a match it will it will give an #N/A! error that tells you it did not find a match “it is not available”.
       - ***Note about Exact Match***: If you have very large data sets, Exact Match Lookup may cause formula to calculate slowly because “Exact Match” Lookup must look through every item, one-by-one, until it finds a match.

# Multiple Tables: Fact Tables and Dimension Tables (Lookup Tables)

* 1. In much of Data Analysis, Business Intelligence and Data Warehousing, we usually refer to our Proper Data Sets as either a Fact Table or a Dimension Table, as defined here:
     1. Fact Table (Also known as Transaction Table or Sales Table)
        1. A Fact Table is a table that has numbers we need to summarize (like Sales or Units or dates or times). The word "Fact" equals a measurement of business activities (like amount of sales, or how many units sold, or clicks on web links)
        2. A Fact Table has Foreign Key columns that we will use in relationships (like Date, SalesRepKey, ProductKey)
     2. Dimension Table (also known as Lookup Table or Entity Table)
        1. A Dimension Table is a table that has the first column as a Primary Key (Unique Identifier) for the Entity (Product, Sales Rep and so on) used in relationship with Fact Table.
        2. Remaining columns are attributes that we can use as:
           1. Criteria / Filters / Categories / Report Labels for our Reports & Dashboards. These columsn are often referred to as “Filtering Column”.
           2. Values we can lookup (like Price).
           3. Helper Columns (like Sort Helper Columns or Intermediate calculations).
        3. Synonyms for Filtering columns: Attribute, Criteria, Filters, Category, Categorical attributes, Constraints, Groupings, Report labels for the reports and analytics.
  2. Fact Tables are usually large. Dimension Tables are comparatively small.
  3. Example:

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# Power Pivot is just one of Many Tools in Excel

* 1. Excel is a program with many tools
  2. Power Pivot is just one of the tools in Excel
  3. The tool Power Pivot has two main parts:
     1. Data Model
     2. Data Model PivotTables
  4. The Data Model is made up of three main parts:
     1. Columnar Database
     2. Relationships
     3. DAX Formulas
  5. From the Data Model, we make Data Model PivotTables.
  6. Picture:

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# Excel Power Pivot and Data Model PivotTables

* 1. Excel Power Pivot comes in Office 365.
  2. Show Power Pivot Ribbon Tab in Excel
     1. Click on the File Tab, then click on Options, then on the left, click on Add-ins, then in the Manage textbox dropdown, select “Com Add-ins”, then check the check Box for Power Pivot.
     2. In Excel, the Power Ribbon Tab looks like this:

Click the “Manage Data Model” button to open Power Pivot Window to look at the Data Model

A screenshot of a cell phone

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Use this button to add Excel Tables from an Excel Worksheet to the Data Model

* + 1. When you open the Power Pivot Window, and click on Design View, you can see the Data Model that you created with the Relationships feature, as seen here:

Power Pivot Window

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Diagram View to see tables and Relationships

* 1. Excel Power Pivot allows us to build “Data Model” PivotTables, as opposed to “Standard PivotTables”
     1. Reminder from E-DAB video #4:

Standard PivotTables:

* + - * + Use when you have about 50,000 rows of data or less.
        + Use when you have one Proper Data Set with all your Data.
        + You don’t mind applying Number Formatting every time you make a PivotTable Calculation.
        + PivotTable Calculations are sufficient.

Data Model PivotTables:

* + - * + Big Data. Good for two reasons when you have large data sets:

File size is reduced when your Data is in the Data Model.

You can easily build reports from millions of rows of data (Excel Spreadsheet only allows 1 million rows)

* + - * + Relationships for Multiple Tables. Great when you have more than one Proper Data Set as the source Data. Allows you to use the Relationship feature rather than the VLOOKUP function when you need to connect tables.
        + DAX Formulas.

Has more options for calculations than a Standard PivotTable.

Allows you to add Number Formatting to Formulas.

Can use the same formula over and over.

* 1. Excel Power Pivot provides 3 Data Tools
     1. Columnar Database = Behind the scenes in RAM Memory Efficient Big Data Analytics Database
     2. Relationships Between Tables = replace VLOOKUP and allow criteria and filters to affect reports and visualizations from one table to another.
     3. DAX Formulas:
        1. Efficiently Calculate Over Big Data.
        2. Many More Calculations than in Standard PivotTable
        3. Build One Formula that can work in many reports
        4. Add Number Formatting to Formulas
  2. Why the name Power Pivot?
     1. Because Microsoft wanted to use the same amazing PivotTable user interface to drag and drop fields to make reports but with more Power.
     2. The “Power” part of the name means:
        1. We can make PivotTables from “Big Data”
        2. We can make PivotTables from multiple Tables
        3. We can use DAX Formulas, which can process over big data efficiently and which allows us more varied calculations than in a Standard PivotTable.
     3. The “Pivot” part of the name means we can use a PivotTable user interface, that we all know and love!
  3. Data Model = Name for Power Pivot’s 3 Data Tools :
     1. The Columnar Database, Relationships and DAX Formulas together are called the “Data Model”.
  4. From the Data Model we make Data Model PivotTables.
     1. Synonyms for Data Model PivotTable:
        1. Power Pivot Report
        2. Power Pivot PivotTable
     2. Data Model PivotTables create summary reports with one or more calculations based on conditions / criteria / filters

* 1. Basic Advantages of Excel Power Pivot
     1. Can work on Millions of rows of data
     2. Can Reduce file size on data sets with less than a million rows
     3. Can use Relationships and Multiple Tables rather than VLOOKUP and a single Flat Table.
     4. DAX formulas provide more variety that in a Standard PivotTable and can work efficiently on Big Data that is stored in the Columnar Database.
  2. Relationship feature works in versions of Excel 2013 or later
     1. This means that if you have Excel 2013 or 2016, but you do not have the correct version with the Power Pivot Com Add-in, you can still use the Relationships feature to add two or more tables to a PivotTable field list and then make a PivotTable based on multiple tables. However, if you do not have the correct version with the Com-Add-in, you will not be able to work in the Power Pivot Data Model Window.
  3. DAX Formulas
     1. DAX = **D**ata **A**nalysis **E**xpressions
     2. Types of DAX Formulas:
        1. **Calculated Column** = New Columns add to tables in the Data Model. Video #8 will demonstrate Calculated Columns.
        2. **Measures** = Formulas used in Data Model PivotTables.
           + Two types of Measures:

**Implicit Measures** = formulas automatically created by Power Pivot. Video #7 will demonstrate Implicit Measures.

**Explicit Measures** = formulas that Data Modeler creates. Video #8 will demonstrate Explicit Measures.

* + - * + DAX Measures are different that the built-in calculation sin a Standard PivotTable, like “Summarize Values By” and “Show Values As”.
        + When you create a DAX Measure you create a formula using DAX Functions like SUM, SUMX, AVERAGEX, CALCULATE, REALTED and others.
      1. **Table Formulas** = deliver a table of values. Video #9 will demonstrate Table Formulas.

# Implicit vs. Explicit DAX Measures :

* 1. To show Implicit Measures:
     1. In Excel, go to the Power Pivot Ribbon Tab, then in the Data Model group, click Manage button. This opens up the Power Pivot Window.
     2. Then in the Power Pivot Window, go to the Advanced Ribbon Tab, then click on the Show Implicit Measures Button. This will show the Implicit Measures in the Measure Grid (area below tables in Power Pivot Data Model).

Show Implicit Measure button

* + 1. Here is a picture of the Implicit Measure sin the Measure Grid in the Power Pivot Data Model:

Power Pivot Window

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Implicit Measures

Measure Grid

* 1. In general, it is okay to use Implicit Measures when you have a small data set (about 50,000 rows) and the built-in calculations in a Standard PivotTable are sufficient.
  2. Compare and contrast Implicit and Explicit Measures picture is on next page.

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# Power Query Merge feature

* 1. Power Query Has Six Types of Merges / Joins. This picture summarizes pictorially the six types of merges / joins in Power Query:

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* 1. What is a Merge / Join?
     1. What does a Merge accomplish in Power Query?
        + The Left Outer Merge is a substitute for VLOOKUP. Merge can help us to add a column to a table by pulling matching values from a second table into the first table.
     2. Merge / Join Terminology:
        + Merge is the word that we use in Power Query.
        + Join is the word that is used in the SQL (Structured Query Language) and in other database languages.
        + Merge and Join will be synonyms for us.
  2. Power Query Merges are similar to using VLOOKUP or Relationships.
     1. VLOOKUP in Excel requires that you have two related columns if you want to lookup a value. We will see how to do this Merge using a Left Outer Merge in Power Query.
     2. Relationships in the Excel Power Pivot or Power BI Desktop Data Model require that you have two Related Columns. Relationships in Data Models allow us to accomplish many tasks, one of which is like a Left Outer Merge.
  3. Requirements for a Merge:
     1. To Merge one or more queries, you must have the data imported into Power Query as a query.
     2. The Merge Feature is for Table Objects.
     3. Merges require Related Columns in one or more Table Objects.

# Data Types in Power Query.

* 1. Unlike Excel, we must properly Defined each Field with a Data Type. If we do not define the correct Data Type, for example a dollar amount as Currency, then some of the calculations in Power Query, Excel, Power Pivot and Power BI Desktop will not work correctly.
  2. Here is a list of the Data Types in Power Query:





# Overview of Three Examples in Video

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# VLOOKUP Video Example

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# Power Query Video Example

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# Power Pivot Relationships feature & Implicit Measure feature

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