

Excel's Three Tables & Power Tools

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Three Tables

Excel now contains three tables that can be of great benefit to accountants. Two tables were added to Excel 5.0 in 1993. The third table was added to Excel in Office 2007. The first two, Data Tables and PivotTables, were actually part of Lotus 1-2-3. Microsoft followed, enhanced both, and added the third Excel Tables to Office 2007.

Excel's three tables:

1. Data Tables
2. PivotTables
3. Excel Tables

Each table has its own distinct value. Don't let the title, "Tables", fool you; they are not similar in any fashion.

Despite being part of Lotus 1-2-3 and the early versions of Excel, Data Tables and PivotTables were very unique and very misunderstood for years. PivotTables are now becoming popular while Data Tables are still hardly ever used correctly. The third table, Excel Tables, is new enough that users do not think that they are anything more than formatting, but they are wrong. By the end of this session, you will understand how to use each of these three tables in an appropriate fashion.

The primary function of each table is as follows:

- | | |
|----------------|-------------------------------|
| • Data Tables | One or two variable analysis |
| • PivotTables | Summarize and categorize data |
| • Excel Tables | Control a block of data |

Using Data Tables for Sensitivity Analysis

One-variable and two-variable data tables have been a major spreadsheet analytical tool since Lotus 1-2-3, but for many accountants, data tables have become a lost art. Data tables are an excellent method of conducting sensitivity or what-if analysis. In a simple one-variable data table, one variable is manipulated in calculating a result. In a two-variable data table, two variables are manipulated in calculating a result.

Many users only use Data Tables to replicate formulas. This type of use is not all that beneficial. Accountants who understand Data Tables know they can use them in analyzing large models to provide summaries of complex calculations based on one or two variable changes. The value of the Data Table analysis is directly related to the size or complexity of the calculations used in the tables.

For example, changing COGS based on a lookup function of values that is driven by activity. There is no way to simply create a formula for all the possible effects of activity without a Data Table summary.

Simple Formulas

In our first example, Debbie Nelson, the CFO of a small manufacturing company, is trying to understand the impact of a change in unit sales price on the total sales revenue expected from a new product to be introduced in the coming year. Her analysis can be done quickly and easily with a simple one-way data table. In the example table, the planned sales volume and unit sales price are known. However, Nelson would like to calculate the sales revenue generated by unit prices ranging from \$6.50 to \$9.00 per unit in twenty-five cent increments. First, create a workbook with a layout similar to the one displayed at the left in **Figure 1**. Put the alternative prices in a single column, in this case in cells **C11** through **C21**. Build a formula in cell **D7** to calculate the estimated sales revenue from the planned sales volume and unit price. In a one-way data table, the formula at the top of each column of the data table area is recalculated for each of the values in a single variable, in this case unit sales price. Multiple columns can be recalculated but only on one variable.

To create the data table, highlight the range **C10:D21** and select **What-If Analysis, Data Table** from the **Data** tab of the Ribbon. In the **Data Table** dialog box, click in the box for the **Column input cell** and then click on cell **D7**. This process indicates to Excel where it is to substitute the values \$6.50 through \$9.00 in recalculating the total sales revenue. Click **OK** to produce the data table shown in the lower right of **Figure 1**.

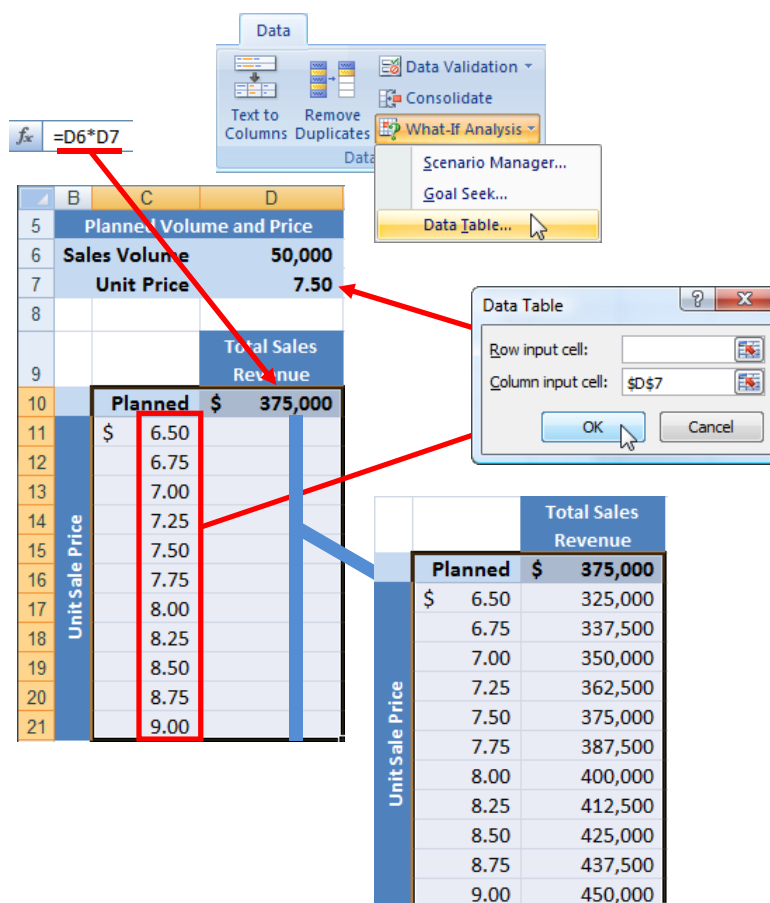


Figure 1 - Creating a One-Way Data Table to Calculate Sales Revenue from Multiple Prices

Multiple Answers in a Column (Row) Data Table

You can use as many available rows as you have in your worksheet for changes in the variable and as many available columns as answers. If you create a Data Table with a row of variables, then the above rules flip and you can use as many available columns for the variable and as many rows for the answer. This option becomes very powerful. We can change the interest rate and find out three answers: Payment, total loan interest, and total payments on loan.

Given Excel 2007 or Excel 2010, Data Tables can become a very powerful tool because you now have over sixteen thousand columns and over one million rows. See table of features below:

Feature	Excel 2003 & Prior	Excel 2007
Rows	65,536	1,048,576
Columns	256	16,384
Cells per Worksheet	16,777,216	17,179,869,184
Worksheets in Workbook	2 GB	All RAM
Characters in Cell	1,024	32,768
Multi-level Undo	16	256
Sort Keys	3	64
Conditional Formats Per Cell	3	Unlimited
Colors in Workbook	56	4.3 Billion

A Greater Value

A greater value can be found by using Data Tables in combination with complex calculations that cannot be done in a single cell. For example, you can easily create a simple formula to calculate a loan payment. $\text{=PMT}(\text{rate}, \text{nper}, \text{pv})$. Using at Data Table when you can easily create a partially absolute formula is not all that helpful.

Using the loan amortization analogy, you would need a Data Table to compare total loan interest with different rates as the variable. Without the Data Table, you cannot easily compare a column of rates and the total loan interest which requires the body of the amortization in the worksheet which calculates this answer. Hence, the more complex the answer, the more valuable the Data Table analysis. Companies with large financial models can reap great insight from using Data Tables with key variables on large calculations.

Analysis of Interest

To create the two-variable data table, begin by creating the outline of the data table as shown in **Figure 2**. Note that in the outline shown, cell Q3 contains the formula **=PAYMENT**.

	Q	R	S	T	U	V	W	X
1	Data Table (Row & Column) Analysis Total Loan Interest							
2	Interest Rate			Years (Periods)				
3	=pay	5	7	10	15	20	25	30
4	PAYMENT							
5	2.75%							
6	3.00%							
7	3.25%							
8	3.50%							
9	3.75%							
10	4.00%							
11	4.25%							
12	4.50%							
13	4.75%							

Figure 2 - Outline of Two-Variable Data Table

Once the outline of the two-variable data table is complete, select the range from cell Q3 through cell X13. Then, from the Data tab of the Ribbon, select **What-If Analysis** and **Data Table** to open the **Data Table** dialog box shown in **Figure 3**. In the Data Table dialog box, enter cell **H7** as the **Row input cell** and cell **H8** as the **Column input cell** and click **OK**.

This instructs the data table to substitute the contents of the first row of the data table into cell H6 and the contents of the left-most column of the data table into cell H8 and to recalculate the formula in the cells.

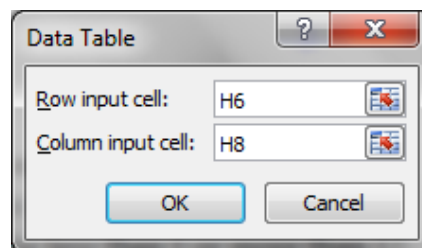
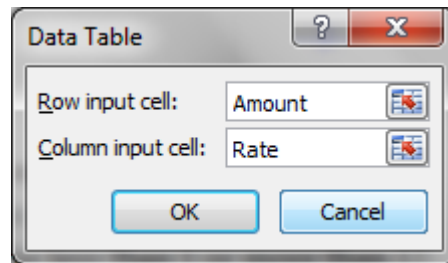


Figure 3 - Data Table Dialog Box

	E	F	G	H
2	K2 Enterprises			
3	VS VER.(4/10/11)			
4				
5	Payment Date		10/15/10	
6	Loan Amount		\$ 20,000.00	
7	Term Of Loan (Years)		5	
8	Initial Annual Interest Rate		5.00%	
9	Initial Payment		\$ 377.42	

Named Cells

A more useful approach when creating Data Tables is to name the cells of key variables so that during Data Table construction you can reference the named cell and not worry about specific cell addresses.



Excel Tables

The **table** features in Excel 2007 and Excel 2010 are designed to ease and enhance the way users sort, filter, format, and analyze information in tables. Here are some of the built-in features for managing and manipulating tables.

- **Auto Expansion** – Tables expand automatically to include new data entered in adjacent rows or columns. All styles, calculations, data validation, and conditional formats are applied to extensions.
- **Sorting** – Users can sort on unlimited columns and on font or fill colors. Sorts can be made case-sensitive.
- **Filtering** – Users can filter on single or multiple criteria, icon sets, and on dynamic dates, such as last week or last month.
- **Formula Replication** – Any formula created in an adjacent column to make calculations on table data is automatically replicated across all rows.
- **Duplicate Data** – Users can highlight or remove duplicate rows with a few simple commands.

- **Table Styles** – A large gallery of table styles is available for automatically formatting tables. Styles with banded rows auto-adjust the color bands for record additions, deletions, sorting, and filtering. Styles interact with Themes to provide greater flexibility in formatting tables.
- **Structured Referencing** – Formulas that reference elements of a table can use row and column tags rather than cell references in the formula for clarity and ease of use.

Think of a table as a two-dimensional Excel database with special functionality. The data should be properly laid out with columns as fields and rows as records. The first row should contain the names of each field. If the first row does not contain field names, Excel will create generic field names automatically.

Creating a Table

To create a table in Excel using the default style, place the cursor inside of the data range and press **CTRL + T**. In the **Create Table** dialog box, confirm the table range and check **My table has headers** as shown in **Figure 4**.

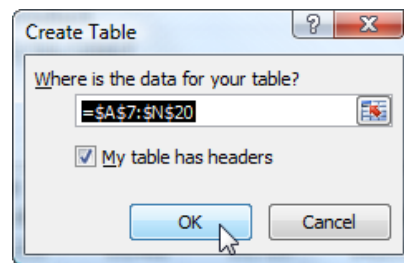


Figure 4 - Create Table Dialog Box

Click **OK** to create the table as shown in **Figure 5**. Instantly, the table is created with the default style. In this case, the default style bands adjacent rows with different colors for readability. Drop-down filter arrows are visible at the top of each column. The arrows are for setting filters and sorting and are not visible on printouts. Any fields that do not have a name at the top of the column will be named **Column1**, **Column2**, etc. These fields can be renamed by typing over the labels.

Item	Description	Jan	Feb	Mar	Apr	May	Jun
1	Creme, Aloe Vera Hand, 9 oz	8,388	9,087	8,039	8,388	10,485	12,582
2	Creme, Extra Moisturizing Hand, 9 oz	8,988	9,737	8,614	8,988	11,235	13,482
3	Creme, Hand and Body, 16 oz	15,588	16,887	14,939	15,588	19,485	23,382
4	Lotion, Organic Body, 9 oz	9,588	10,387	9,189	9,588	11,985	14,382
5	Lotion, Organic Body, 16 oz	17,988	19,487	17,239	17,988	22,485	26,982
6	Lotion, Organic Body, 24 oz	26,388	28,587	25,289	26,388	32,985	39,582
7	Lotion, Extra Moisturizing Body, 9 oz	8,388	9,087	8,039	8,388	10,485	12,582
Item	Description	Jan	Feb	Mar	Apr	May	Jun
9	Creme, Aloe Vera Hand, 9 oz	8,388	9,087	8,039	8,388	10,485	12,582
10	Mask, Organic	8,988	9,737	8,614	8,988	11,235	13,482
11	Mask, Wrinkl	15,588	16,887	14,939	15,588	19,485	23,382
12	Mask, Wrinkl	9,588	10,387	9,189	9,588	11,985	14,382
13	Mask, Wrinkl	17,988	19,487	17,239	17,988	22,485	26,982
	6 Lotion, Organic Body, 24 oz	26,388	28,587	25,289	26,388	32,985	39,582
	7 Lotion, Extra Moisturizing Body, 9 oz	8,388	9,087	8,039	8,388	10,485	12,582
	8 Lotion, Organic Hand and Body, 9 oz	10,188	11,037	9,764	10,188	12,735	15,282
	9 Lotion, Organic Hand and Body, 16 oz	19,188	20,787	18,389	19,188	23,985	28,782
	10 Mask, Organic Facial, 9 oz	16,788	18,187	16,089	16,788	20,985	25,182
	11 Mask, Wrinkle Reducing Facial, 9 oz	22,788	24,687	21,839	22,788	28,485	34,182
	12 Mask, Wrinkle Reducing Facial, 16 oz	5,399	4,679	4,139	4,319	5,399	6,478
	13 Mask, Wrinkle Reducing Facial, 24 oz	8,099	7,019	6,209	6,479	8,099	9,718

Figure 5 - Creating a Table Instantly with CTRL+T

Alternatively, the table could have been created from the Ribbon. Again, position the cursor inside the data range. From the Ribbon, select **Format as Table** from the **Home** tab of the Ribbon. Select a style from the gallery and then confirm the table range in the **Create Table** dialog box. Click **OK** to create the table.

Using CTRL + T is a faster and easier process to create a table, but it always creates a table in the default table style. To change the default table style, click on **Format as Table** on the **Home** tab of the Ribbon, right-click on a style, and choose **Set As Default**.



Styles interact with Themes. Themes contain attributes for fonts, line and fill effects, and the color palette. By changing the Theme, the colors and formats of a Table Style will be affected. To see the impact, select **Themes** from the **Page Layout** tab. Then, roll your mouse over the various themes and watch the table formats change. Themes give users even greater flexibility in formatting their tables.

Using Table Names

Excel names each table with a generic name and displays it in the **Properties** group of **Table Tools, Design**. The table name is part of structured referencing, which will be discussed later. Naming tables with a representative name, such as Sales or Invoices, will make building formulas with structured referencing easier and more intuitive, especially if multiple tables are present in a single workbook.

Turning a Table into a Range

Some accounting professionals will just want to format their lists with a few clicks. They don't need filtering, sorting, or any of the other advanced features, and they certainly don't want the filter arrows at the top of each column. Here's the trick. Create a table from the data selecting the desired style in the process. Then, change the table back into an ordinary range from the Ribbon by selecting **Convert to Range** on the **Table Tools, Design** tab. Click **OK** in the confirmation dialog box, and the table will become a range again. Note that the table formatting remains! To turn off the filter arrows in a working table, position the cursor inside the table and click **Filter** on the **Data** tab or click **Sort & Filter, Filter** on the **Home** tab of the Ribbon. The same process can be used to turn on filtering again whenever it's needed.



When a table is turned into a range, the style formatting becomes cell formatting which may cause unexpected results if the range is later turned back into a table. If the table formatting is inconsistent, it may be repaired. Click inside the table. From the Ribbon, select **Home, Format as Table**. Right-click on the desired style in the gallery and choose **Apply and Clear Formatting**.

Working with Tables

Let's review the sample table. It consists of monthly sales data for thirteen products over the past six months. First, use the check boxes in **Table Style Options** to explore how styles can be adjusted to meet specific needs. **Figure 6** shows the results of our efforts.

☒ Header Row
 ☐ First Column
 ☐ Total Row
 ☐ Last Column
 ☐ Banded Rows
 ☒ Banded Columns

Table Style Options

	Jan	Feb	Mar
Lotion, Organic Body, 9 oz	8,388	9,087	8,039
Lotion, Organic Body, 16 oz	8,988	9,737	8,614
Lotion, Organic Body, 24 oz	15,588	16,887	14,939
Lotion, Extra Moisturizing Body, 9 oz	9,588	10,387	9,189
Lotion, Organic Hand and Body, 9 oz	17,988	19,487	17,239
Lotion, Organic Hand and Body, 16 oz	26,388	28,587	25,289
Lotion, Organic Hand and Body, 24 oz	8,388	9,087	8,039
Lotion, Organic Hand and Body, 9 oz	10,188	11,037	9,764
Lotion, Organic Hand and Body, 16 oz	19,188	20,787	18,389

Figure 6 - Using Table Style Options to Adjust Table Formatting



Altering the options in **Table Style Options** changes the styles presented in the Style Gallery. Formatting tables with styles may be more effective if options are set before styles are applied.

☒ Header Row	☐ First Column
☒ Total Row	☐ Last Column
☒ Banded Rows	☐ Banded Columns

Table Style Options

8,099	9,718	45,623
19,680	23,616	106,928
12,105	14,526	65,770
		1,364,393

f_x =SUBTOTAL(109,[Total])

- None
- Average
- Count
- Count Numbers
- Max
- Min
- Sum
- StdDev
- Var
- More Functions...

Figure 7 - Adding Totals to a Table

Each column in the table can be totaled independently of every other column. In other words, one column can be summed while another can be averaged or counted. Copy the total formula to the bottom of all sales columns by grabbing the auto-fill box in the lower right-hand corner of the cell containing the grand total and dragging the fill box across the row to the January sales column.

Quick-Add Column, Row

Excel Tables will also help with the mundane work, such as, adding columns and rows, including formulas. The trick to this is inserting the column or row within the table range. If you create a formula in the new column or row, the table will automatically copy the formula to the rest of the column or row. When dealing with a substantial amount of data, this can be a huge time saver.

Nov-201	Dec-201	New Caclulation	Dec-201	New Caclulation
289,000	305,000	=sum(Table2[@[Sep-2012]:[	305,000	1,128,000
135,000	140,000	1R x 4C	140,000	530,000
154,000	165,000		165,000	598,000
68,000	73,000		73,000	261,000
68,000	73,000		73,000	261,000
8,000	8,000		8,000	32,000
144,000	154,000		154,000	554,000
10,000	11,000		11,000	44,000

Figure 8 – Quick-Add

Freeze Column and Row

Column and row titles will freeze in place, automatically, as long as you are working in the table. When you click off the table, the column and row headings go back to their original state.

B25		fx Northeast		
	Date	Region	Product Line	Amount
19	7/14/2007	South	Lotions	679.35
20	7/14/2007	South	Cremes	529.89
21	7/14/2007	South	Masks	237.77
22	7/14/2007	Midwest	Lotions	698.76
23	7/14/2007	Midwest	Cremes	545.03
24	7/14/2007	Midwest	Masks	244.57
25	7/21/2007	Northeast	Lotions	782.30
26	7/21/2007	Northeast	Cremes	610.19

Figure 9 – Freeze Column and Row within a Table

Filtering and Sorting

The sales manager for Nature's Softness would like to have monthly sales totals for one of the product groups. Click the drop-down filter button at the top of the **Description** column. Clear the **Select All** button in the record list at the bottom of the filter dialog. Next, select all of the **Cream** products. Click **OK** to apply the filter. The table should resemble the one in **Figure 10**. Note that the total row calculates the total sales

for only the records displayed. Also, note the icon on the filter button of the Description column indicating that a filter is active.

Item	Description	Jan	Feb	Mar	Apr	May	Jun	Total
1	Creme, Aloe Vera Hand, 9 oz	8,388	9,087	8,039	8,388	10,485	12,582	56,969
2	Creme, Extra Moisturizing Hand, 9 oz	8,988	9,737	8,614	8,988	11,235	13,482	61,044
3	Creme, Hand and Body, 16 oz	15,588	16,067	14,559	15,588	19,485	23,582	105,869
Total		32,964	35,711	31,592	32,964	41,205	49,446	223,882

Figure 10 - Table with Simple Filter Applied

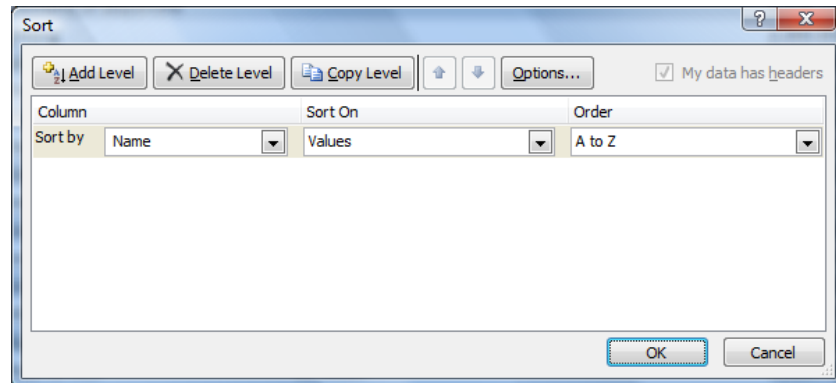


Figure 11 - The Custom Sort Dialog Box

Structured Referencing

Scrolling up to set filters and then down to see totals in a large table is not effective practice. Let's put our totals at the top of the table, so that as we set filters, the results will be plainly visible. In the process, we will investigate another innovation called structured referencing. Position the cursor in cell E4. Type in the label **Total** and format the label with boldface, right justification, and accounting format. Move right to cell F4 and type in the following formula:

=SUBTOTAL(109,Checks[Amount])

The formula sums all checks displayed in the **Amount** column of the **Checks** table. As the filters are reset, the total displayed will change to reflect the sum of just those records displayed. If filters are cleared, then the formula will reflect the sum of all checks written.



As a table is filtered, Excel hides from the user the rows that are not of interest. The **SUBTOTAL** function uses function numbers to determine whether the summary calculation includes hidden rows. Hidden rows are normally included in summary totals when using function numbers 1-11 except when the rows are hidden by active filters, in which case the hidden rows are not included in the totals. Hence, it is not necessary to use SUBTOTAL function 109 to sum filtered tables so that only displayed rows are included in the totals.

Copy cells E4 and F4 to cells E3 and F3. Change the label in cell E3 to read **Mean** and change the formula in cell F3 to read as shown below.

=SUBTOTAL(101,Checks[Amount])

Manipulate the filters, by any means, so that the number of displayed rows varies in length. Note that the mean and total formulas displayed at the top of the table change accordingly as shown in **Figure 12**.

	A	B	C	D	E	F
1	Hesson Flooring Company					
2	Check Payments Data					
3	For the Years 2009 and 2010				Mean	2,756.05
4					Total	135,046.69
5						
6	Type	Date	Num	Name	Memo	Amount
31	Bill Pmt -Check	01/03/2010	126	Sergeant Insurance	786-35	4,050.00
40	Bill Pmt -Check	02/14/2010	136	Timberloft Lumber	1890-76	1,358.00
48	Bill Pmt -Check	03/28/2010	144	East Bayshore Tool & Supply		1,476.23
53	Bill Pmt -Check	04/04/2010	150	Timberloft Lumber	1890-76	1,610.00

Figure 12 - Creating Totals at the Top of a Table

Structured references are a means of working with table data, both inside the table and outside the table. Formulas built on structured referencing are self-documenting because they specify data elements within a table rather than cell references. There are a number of reserved item specifiers. For example, **[#Totals]** refers to the total row, and **@** refers to data elements in other columns but on the same row. A total row exists in the sample table shown in Figure 12. To create a formula in the worksheet to refer to the total displayed at the bottom of the **Amount** column as its value and position changes, use this formula.

=Checks[[#Totals]**, **[Amount]**]**

As the formula is entered from the keyboard, **Formula AutoComplete** will display the tables and fields for selection, just as with functions and range names. To learn more about this innovation, search for "structured references" in the Excel help system.

Removing Duplicate Records

One of the best features of the two latest versions of Excel is their ability to easily identify or remove duplicate values in a range or table.



Using the **Remove Duplicates** command is destructive. The rows in a range or table identified as duplicates will be deleted from the data. Make sure that you save a copy of the workbook with a different file name before executing the command.

Continuing with our example, Rod Hesson would like to have a sorted list of all payees who received a check in 2009 or 2010. To produce the list he needs, simply remove all duplicate records in the Name column.

First, keeping in mind that removing duplicate records is a destructive process, save the workbook with a different file name. Then, clear all of the filters and sorts in the sample table. To remove the duplicate payees, position the cursor in the table and select **Data, Remove Duplicates**. Uncheck all columns except **Name** in the **Remove Duplicates** dialog box as shown in **Figure 13**. Click **OK** and then **OK** again to confirm the removal. Sort the **Name** column in ascending order to complete the task.

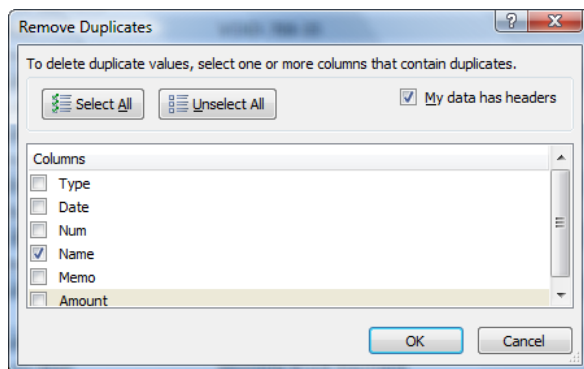


Figure 13 - Selecting Columns from Which to Remove Duplicates

Alternatively, an advanced filter could have been applied to the **Name** field. Using an advanced filter is *not* destructive, and the filtered list can be copied to another range in the worksheet as part of the filter command. Before discussing advanced filters, let's take a few minutes to discuss the process of selecting a range in a table.

Selecting Table Rows or Columns

A table is a single unitary object within a worksheet. Think of a table as a *worksheet within a worksheet*. In other words, users can insert, delete, or move rows and columns within a table without disturbing the surrounding worksheet. Moreover, users can select rows and columns in a table without selecting entire rows and columns in the surrounding worksheet. To select a row, position the cursor just inside the left-hand margin of the row. The cursor will change to a small dark arrow pointing to the right or inside of the table. Click to select the row. Right-click and select **Insert, Table Rows Above** to insert a row in the table but *not* in the surrounding worksheet. If the cursor is positioned too far to the left, in the worksheet row reference, the entire row in the worksheet will be selected. The correct and incorrect cursor positions are shown in **Figure 14**.

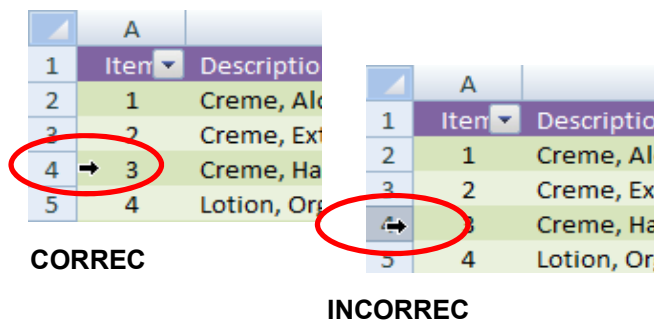
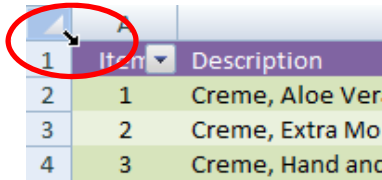


Figure 14 - Positioning Cursor Properly to Insert Row in Table

The data in a table or an entire table can be selected by positioning the cursor just at the upper left-hand corner of the table. The cursor will change to a small dark arrow pointing down and to the right inside the table. Click once to select the data and twice to select the entire table, including the headings and total row. The correct cursor position for selecting an entire table is shown in **Figure 15**.



1	Item	Description
2	1	Creme, Aloe Vera
3	2	Creme, Extra Moi
4	3	Creme, Hand and

Figure 15 - Positioning Cursor to Select Entire Table

Note the similarity of working with rows and columns in Word tables. If you have ever worked with tables in Word, then you will recognize the process immediately.

Filtering Duplicate Records

The last example of working with duplicate records involves using conditional formatting to highlight duplicate records and then filtering by color to find the duplicates. For example, users may want to identify checks issued with duplicate check numbers.

Using the QuickBooks check data, clear all active sorts and filters. Sort the **Date** column in ascending date order. Select the data in the **Num** column by any means. Then, select **Conditional Formatting, Highlight Cells Rules, Duplicate Values** from the **Home** tab of the Ribbon. In the **Duplicate Values** dialog box, select **Duplicates** and accept the default color scheme as shown in **Figure 16**. Click **OK** to apply the conditional formatting.

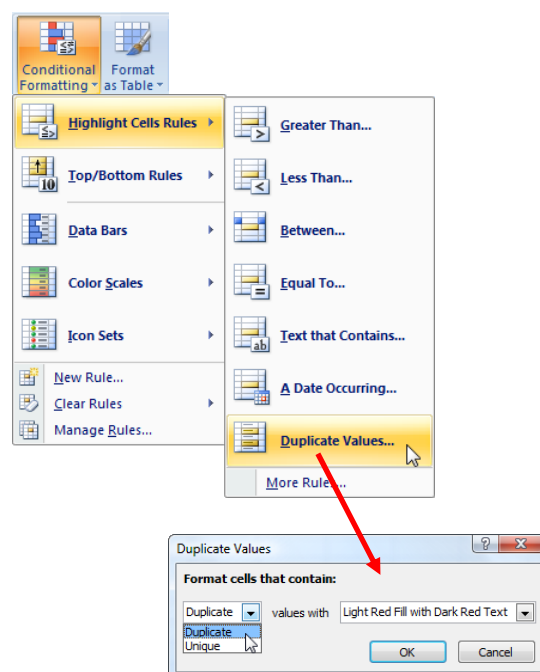


Figure 16 - Formatting Duplicate Values

Slicers for Tables

Think of Slicers as end-user filters. Slicers have been available to filter PivotTables and PivotCharts since Excel 2010. Now they are available for filtering Excel Tables, and can even be used to filter Tables connected to external data sources. To apply a Slicer to a Table, place the cursor in the data and then select **Insert, Slicer** on the ribbon. In the **Insert Slicers** dialog box, check the fields that you desire to filter in the Table and click **OK** to create the Slicers, as shown in **Figure 17**. Arrange, format, and apply styles to Slicers on the **Slicer Tools, Options** contextual tab.

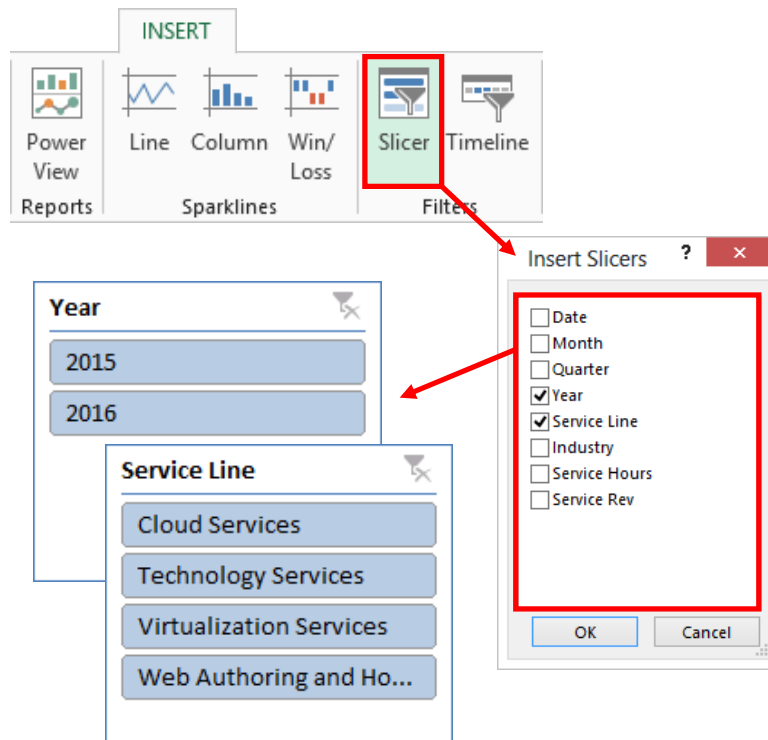


Figure 17 – Applying Slicers to a Table

Introduction to PivotTables

PivotTables are the most powerful feature of Excel, yet few accountants use them in their day-to-day activities. For some, PivotTables are too intimidating; for others, PivotTables are unknown. PivotTables may be challenging at first, but with a little instruction and guidance, they will become part of your regular repertoire for analysis and reporting. Our coverage will begin with basic PivotTables and progress to advanced PivotTable topics. Topics covered in this session will include creating simple PivotTable reports, rearranging reports in the PivotTable task pane, grouping and custom grouping, ungrouping, drill down to underlying details, custom data summaries, creating calculated items and using advanced summarization techniques.

What is a PivotTable?

A PivotTable report is an interactive table that automatically extracts, organizes, and summarizes data. In just a few clicks, users can go from raw data to a completed report, as shown in **Figure 18**. A PivotTable report can be used to analyze data — for example, to make comparisons, to detect patterns and relationships, or to uncover trends. PivotTables are extremely useful for summarizing and analyzing large amounts of data efficiently and effectively. For example, a CFO may need to summarize fifty thousand sales transactions to produce quarterly totals by product line within sales region. Alternatively, a public practitioner evaluating audit risk may need to summarize all of a client's bill payment checks by vendor and by quarter. In both examples, users would like to be able to drill on the summarized totals in the report to see the detailed transactions that underlie the totals. PivotTables can provide all of this functionality and more, quickly and with computational accuracy.

Month	Region	Product	Amount			
1/31/2013	New England	Astringent, Organic, 16 oz	8,376			
1/31/2013	Southeast	Astringent, Organic, 16 oz	10,615			
1/31/2013	Midwest	Astringent, Organic, 16 oz	9,532			
1/31/2013	West	Astringent, Organic, 16 oz	8,284			
1/31/2013	New England	Astringent, Organic, 24 oz	16,185			
1/31/2013	Southeast	Astringent, Organic, 24 oz	19,962			
1/31/2013	Annual Comparative Product Sales					
1/31/2013		2013	2014	2015	Grand Total	
1/31/2013	☐ Lotion, Organic Body, 9 oz		663,216	703,012	633,845	2,000,073
1/31/2013	New England		155,568	164,619	147,417	467,604
	Southeast		191,601	203,277	183,760	578,638
	Midwest		167,694	177,921	160,685	506,300
	West		148,353	157,195	141,983	447,531
	☐ Lotion, Organic Body, 16 oz		1,266,688	1,342,084	1,207,893	3,816,665
	New England		288,344	305,247	276,567	870,158
	Southeast		362,758	384,803	344,832	1,092,393
	Midwest		332,305	351,728	318,052	1,002,085
	West		283,281	300,306	268,442	852,029

Figure 18 – From Raw Data to PivotTable Report in a Few Clicks

Excel uses specific terms to identify the elements of a PivotTable report. The main elements, shown in **Figure 19**, are row fields, column fields, report filters, values fields, items, and the data area.

	A	B	C	D	E
1	Years	(All)			
2					
3	Sum of Sales		Quarter		
4	Region	Product	Qtr1	Qtr2	Qtr3
5	East	Pipe, 1/2-inch, Galv	13,950	9,220	4,470
6		Pipe, 1/2-inch, Sch 40	48,070	44,280	40,490
7		Pipe, 1-inch, Galv	15,400	17,300	19,190
8		Pipe, 3/4-inch, Galv	35,940	31,860	36,960
9		Pipe, 3/4-inch, Sch 40	50,520	54,310	58,100
10		Tubing, 1/2-inch, Type L	7,570	9,460	11,370
11		Tubing, 1-inch, Type L	44,150	53,620	63,110
12		Tubing, 3/4-inch, Type L	43,020	39,220	35,430
13	East Total		258,620	259,270	269,120
14	West	Pipe, 1/2-inch, Galv	18,420	10,730	5,930
15		Pipe, 1/2-inch, Sch 40	63,350	51,480	53,350

Figure 19 - Parts of a PivotTable

- | | | | |
|---|----------------|---|------------|
| 1 | Report Filters | 4 | Items |
| 2 | Values Fields | 5 | Row Fields |
| 3 | Column Fields | 6 | Data Area |

Row Fields are fields from the source data that are assigned to a row layout in a PivotTable. Region and Product are row fields in Figure 19.

Column Fields are fields from the source data that are assigned to a column layout. Quarter is a column field in Figure 19.

Report Filters are fields from the source data that act as filters in a PivotTable report. Years is a report field in Figure 19. The Years field could be used to display data from a single year, such as 2014, or multiple years, such as 2013 and 2014, etc.

Items are the elements within a row, column, or report filter. In this example, the Region field contains these items: East and West. The Product field contains these items: Pipe, 1/2-inch, Galv; and Pipe, 1/2-inch, Sch 40, etc.

Values Fields are fields from the source data that contain values to be summarized. Sales is a values field in Figure 1. For numeric data, users can choose how to summarize the data (sum, average, count, etc.). For text data, users can count the number of times a specific text entry, such as Yes or No, appears in a field.

The **Data Area** is the range of cells in a PivotTable report that contains summarized data. For example, the value in cell C5 summarizes sales for the product Pipe, 1/2-inch, Galv, for the East region in the first quarter of 2012. In other words, cell C5 provides a summary of the sales figures for every row in the source data that contains the items Pipe, 1/2-inch, Galv, East, Qtr1, and 2012.

Simple PivotTables

A large portion of the productivity and information analysis benefits of using PivotTables is gained with the simplest of PivotTables. In other words, you need not be a PivotTable expert or know how to apply the advanced features of PivotTables in order to take advantage of their power and functionality. The Law of Diminishing Returns applies! As our PivotTables become more complex, the amount of learning required to take advantage of their more complex functionality increases. For most analyses, a simple PivotTable that auto-summarizes or auto-tabulates our data will be very effective and will provide all of the power that we need.

The table of data in **Figure 20** contains sales data extracted from a general ledger. It will serve as the data source for our initial PivotTable examples. Each record represents the total sales by month for a specific product. There are three columns of data – Month, Product, and Sales. The sales figures could be in units, thousands of units, dollars, or thousands of dollars, etc. In this case, we will assume that sales are reported in dollars.

In our sample data set, there are nearly one hundred rows of data, although many data sets may have thousands of rows. The latest version of Excel supports over one million rows in the worksheet grid. PowerPivot in Excel 2013 supports data sets up to ninety-nine billion records. As you can see, PivotTables can be used to summarize very large data sets. While there are no practical limits on the amount of data that can be used in a PivotTable, the more data there is to summarize or analyze, the greater the power of PivotTables.

	A	B	C
1	Month	Product	Sales
2	Jan-2015	Pipe, Galv, 1-inch	4,040
3	Jan-2015	Pipe, Galv, 2-inch	4,230
4	Jan-2015	Pipe, Galv, 3-inch	13,460
5	Jan-2015	Pipe, Sch 40, 1-inch	12,110
6	Jan-2015	Pipe, Sch 40, 2-inch	12,350
7	Jan-2015	Pipe, Sch 40, 3-inch	13,460
8	Jan-2015	Tubing, Type L, 1-inch	11,210
9	Jan-2015	Tubing, Type L, 2-inch	1,900
10	Jan-2015	Tubing, Type L, 3-inch	12,080
11	Feb-2015	Pipe, Galv, 1-inch	2,920
12	Feb-2015	Pipe, Galv, 2-inch	2,640
13	Feb-2015	Pipe, Galv, 3-inch	7,170
14	Feb-2015	Pipe, Sch 40, 1-inch	8,600
15	Feb-2015	Pipe, Sch 40, 2-inch	9,090
16	Feb-2015	Pipe, Sch 40, 3-inch	9,560

Figure 20 - Data for Simple PivotTable Examples

In our first example, we would like to tabulate the sales figures by Product and by Month of sale. Our completed PivotTable will have rows for the Product and Months for the columns.

To create a simple PivotTable from our data, do the following.

1. Place the cursor in the data and click **PivotTable** on the **Insert** tab, as shown in **Figure 21**, to open the **Create PivotTable** dialog box.

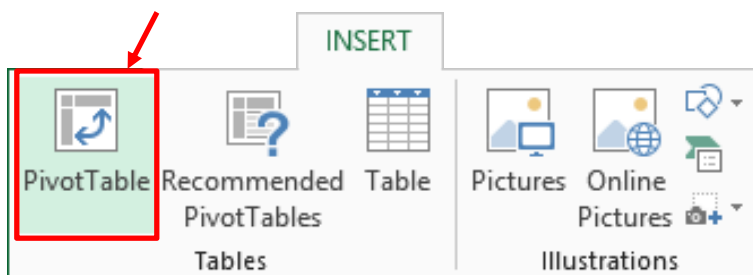


Figure 21 - Select PivotTable from the Insert Tab

2. In the **Create PivotTable** dialog box, shown in **Figure 22**, the data range should already be defined. If not, click the **Collapse Dialog** button and highlight the data range. Make sure that the entire data range is selected, including the field names at the top of the data columns. Select **New Worksheet** and then click **OK**. Note that a Table can serve as a dynamic data range for a PivotTable in Excel 2007/2010/2013.

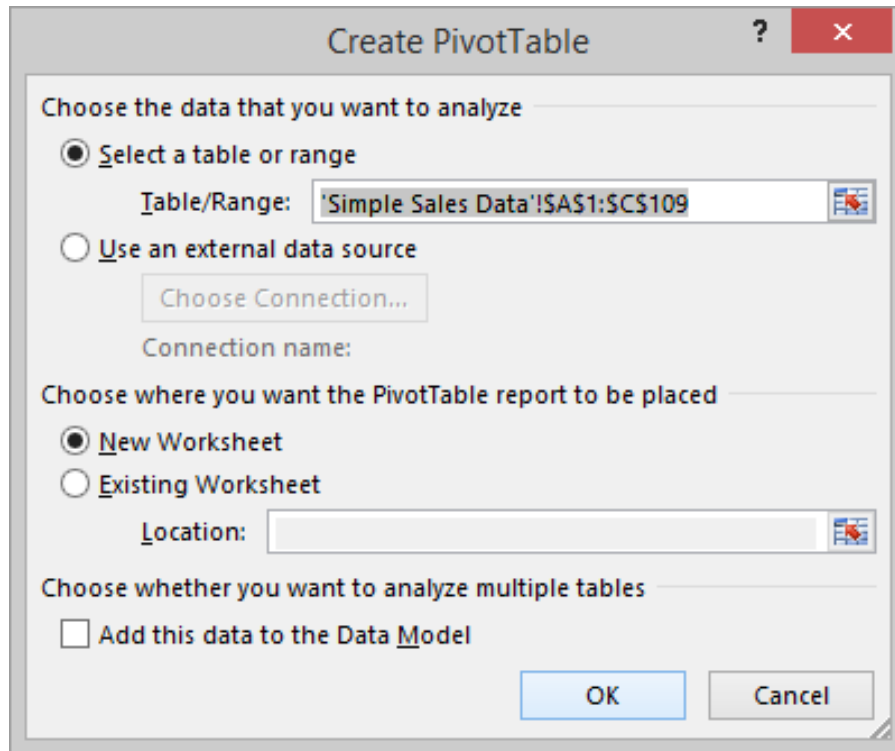


Figure 22 - Highlight the Data Range and Select New Worksheet

3. A new worksheet, like the one shown in **Figure 23**, will be inserted in the workbook. On the left side of the worksheet is a placeholder for the PivotTable report to be created. On the right side is the **PivotTable Task Pane**. The layout of the task pane can be customized to a user's needs by clicking the drop-down button in the top right corner of the task pane just below the title bar.
4. The task pane contains the **PivotTable Field List** at the top and four drop areas into which fields can be dragged from the list to create the PivotTable. The drop areas correspond to the four areas of a PivotTable report: Report Filters, Column Labels (column fields), Row Labels (row fields), and Values (data area).



Experienced PivotTable users will recognize Report Filters as Page Fields in earlier versions of Excel. Report Filters are just a new, more descriptive, name for existing functionality. Report Filters serve the same function and work exactly as Page Fields.

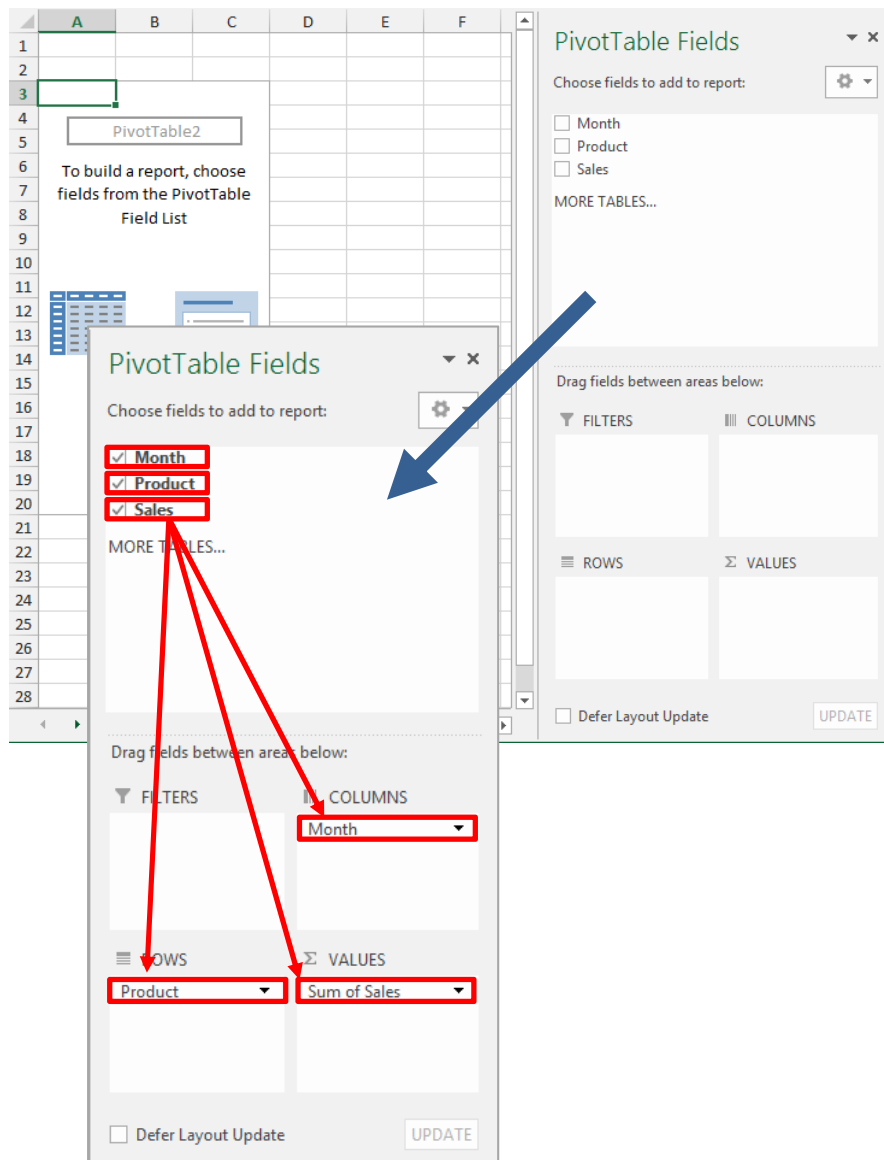


Figure 23 - Creating a PivotTable by Dragging Fields to the Drop Areas

5. Now, drag each of the fields, in turn, from the field list at the top of the **PivotTable Task Pane** to the drop areas at the bottom, as shown in **Figure 23**.
6. Click on the **Month** field, hold down your left mouse button and drag and point to the **Column Labels** drop area, and then release your left mouse button.
7. Click on the **Product** field, hold down your left mouse button and drag and point to the **Row Labels** drop area, and again release your left mouse button.
8. Click on the **Sales** field, hold down your left mouse button and drag and point to the **Values** drop area, and then release your left mouse button.

Turn off the field headers in the report for presentation. Click **Field Headers** on the **PivotTable Tools, Analyze** tab, to turn off the headers, as shown in **Figure 24**. Next, rename the Sum of Sales label by typing the desired label into the cell. Simply click in the cell containing the label **Sum of Sales** and enter **Monthly Sales by Product**.

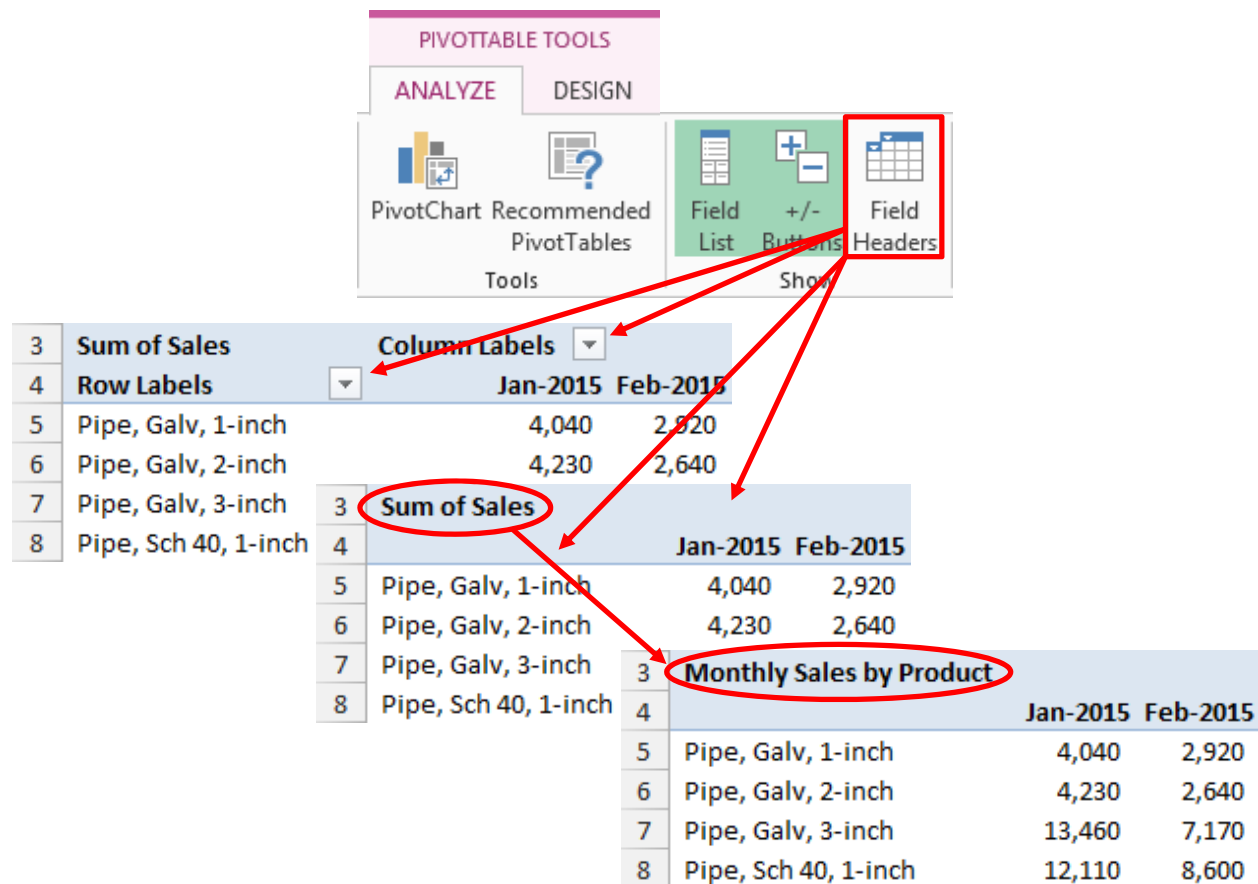


Figure 24 - Hiding the Field Headers and Entering a Descriptive Label for Presentation

Cells in a PivotTable can be formatted for printing and display just as with any other cell or range of cells. In our example PivotTable, the sales values in the report need to be formatted in the Accounting format with zero decimals and without dollar signs. The first and total rows of the sales values need to be formatted with dollar signs for presentation.

Excel also has a large number of built-in visual styles with which to format PivotTables automatically. These styles, available in the **PivotTables Styles** gallery on the **PivotTable Tools, Design** contextual tab, contain a wide variety of colors and formatting for the table, table headers, and total and subtotal rows. **Figure 25** shows our PivotTable report with the values formatted as dollars and one of the built-in styles applied.

Figure 25 - PivotTable with Accounting Format and Style Applied

Grouping and Ungrouping Data

Now, let's examine some of the power of PivotTables. To calculate and display quarterly sales totals for each of the products, simply group the months into quarters. Position the cursor in a cell containing one of the monthly column headings, such as **Jan-2015**. Right-click, and choose **Group** to open the **Grouping** dialog box. In the **By** box, click **Quarters**, so that Months and Quarters are highlighted, as shown in **Figure 26**. Click **OK** to complete the task.

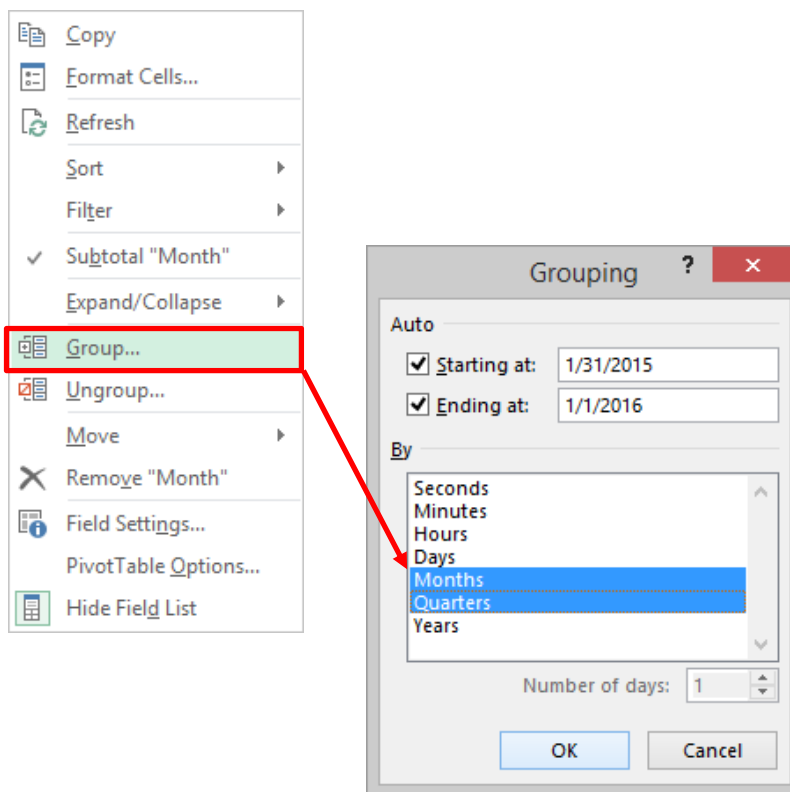


Figure 26 - Grouping Months into Quarters

Turn off the field headers for presentation. On the **PivotTable Tools, Analyze** contextual tab, click on **Field Headers**. Next, position the cursor in a cell containing one of the quarterly column headings, such as **Qtr1**. Right-click on the cell and from the context-sensitive menu, select **Subtotal "Quarters"** to add a quarterly subtotal for each quarter. The initial results are shown in **Figure 27**. Some of the columns have been removed for presentation.

Monthly Sales by Product				
	Qtr1			Qtr1 Total
	Jan	Feb	Mar	
Pipe, Galv, 1-inch	\$ 4,040	\$ 2,920	\$ 3,620	\$ 10,580
Pipe, Galv, 2-inch	4,230	2,640	2,780	9,650
Pipe, Galv, 3-inch	13,460	7,170	4,280	24,910
Pipe, Sch 40, 1-inch	12,110	8,600	10,520	31,230
Pipe, Sch 40, 2-inch	12,350	9,090	10,550	31,990
Pipe, Sch 40, 3-inch	13,460	9,560	11,690	34,710
Tubing, Type L, 1-inch	11,210	8,370	10,690	30,270
Tubing, Type L, 2-inch	1,900	1,440	1,850	5,190
Tubing, Type L, 3-inch	12,080	8,130	9,410	29,620
Grand Total	\$84,840	\$57,920	\$65,390	\$ 208,150

Figure 27 - Results of Grouping Months into Quarters

Again, position the cursor in a cell containing one of the quarterly column headings, such as **Qtr1**. Right-click on the cell and from the context-sensitive menu, select **Expand/Collapse, Collapse Entire Field**. Months are collapsed into Quarters, and all of the totals now reflect quarterly totals as shown in **Figure 28**. Detail can be shown or hidden for a single group or an entire field from the context-sensitive menu.

Monthly Sales by Product					
	Qtr1	Qtr2	Qtr3	Qtr4	Grand Total
Pipe, Galv, 1-inch	\$ 10,580	\$ 10,630	\$ 13,180	\$ 12,970	\$ 47,360
Pipe, Galv, 2-inch	9,650	5,700	3,130	840	19,320
Pipe, Galv, 3-inch	24,910	18,420	24,450	9,290	77,070
Pipe, Sch 40, 1-inch	31,230	30,050	35,940	34,260	131,480
Pipe, Sch 40, 2-inch	31,990	27,260	27,880	22,590	109,720
Pipe, Sch 40, 3-inch	34,710	33,390	39,930	38,060	146,090
Tubing, Type L, 1-inch	30,270	32,960	43,310	44,620	151,160
Tubing, Type L, 2-inch	5,190	5,820	7,790	8,140	26,940
Tubing, Type L, 3-inch	29,620	24,150	24,410	19,490	97,670
Grand Total	\$ 208,150	\$ 188,380	\$ 220,020	\$ 190,260	\$ 806,810

Figure 28 - Monthly Data Grouped into Quarters

To see the detail observations that underlie any of the cells, just double-click on the cell of interest. Excel will insert a new sheet containing the detail observations that created the cell contents. For example, if a user double-clicked on 34,260 (Qtr4 sales for 1-inch Sch 40 Pipe) in our sample PivotTable, Excel would display the underlying detail as shown in **Figure 29**. Note that the data is presented in Table form and

format, which makes it easy to filter and analyze. In this case, a Total Row was added to the table, thereby providing a supporting schedule for the summarized value.

Month ▼	Product ▼	Sales ▼
10/31/2015	Pipe, Sch 40, 1-inch	9,740
11/30/2015	Pipe, Sch 40, 1-inch	16,140
12/31/2015	Pipe, Sch 40, 1-inch	8,380
Total		34,260

Figure 29 - Drilling to Detail from a PivotTable

Custom Groups

In the example PivotTable, data items were summarized using built-in groups, such as when months were grouped into quarters. However, Excel allows data to be grouped with user-defined groups. To accomplish this task, first highlight the items to be grouped together. Then, right-click and select **Group** from the context-sensitive menu.

In the example PivotTable, we would like to group the products into one of three product lines – Iron, Plastic, and Copper. The galvanized pipe products make up the Iron group, the schedule 40 products make up the Plastic group, and the tubing products make up the Copper group. Click on product **Pipe, Galv, 1-inch**, hold down the **CTRL** key and then select **Pipe, Galv, 2-inch** and **Pipe, Galv, 3-inch**. Next, right-click and choose **Group** from the context sensitive menu. This combines the first three products into a single group. Rename the **Group1** label to **Iron** to complete the first group, as shown in **Figure 30**.

Highlight the

Rename the group by typing Iron in the cell that

	Qtr1	Qtr2	Qtr3	Qtr4	Grand Total
Pipe, Galv, 1-inch	\$ 10,580	\$ 10,630	\$ 9,740	\$ 47,950	
Pipe, Galv, 2-inch	9,650	5,700	3,130	840	19,320
Pipe, Galv, 3-inch			50	9,250	77,070
Pipe, Sch 40, 1-inch			40	34,260	131,480
Pipe, Sch 40, 2-inch			80	22,590	109,720
Pipe, Sch 40, 3-inch			30	38,060	146,090
Tubing, Type L, 1-in			10	44,620	151,160
Tubing, Type L, 2-in			90	8,140	26,940
Tubing, Type L, 3-in			20	26,160	97,670
Grand Total			20	\$190,260	\$ 806,810

	Qtr1	Qtr2
Group1		
Pipe, Galv, 1-inch	\$ 10,580	\$ 10,630
Pipe, Galv, 2-inch	9,650	5,700
Pipe, Galv, 3-inch	24,910	18,420
Pipe, Sch 40, 1-inch		
Pipe, Sch 40, 1-inch	31,230	30,050
Pipe, Sch 40, 2-inch		
Pipe, Sch 40, 2-inch	31,990	27,260

	Qtr1	Qtr2
Iron		
Pipe, Galv, 1-inch	\$ 10,580	\$ 10,630
Pipe, Galv, 2-inch	9,650	5,700
Pipe, Galv, 3-inch	24,910	18,420
Pipe, Sch 40, 1-inch		
Pipe, Sch 40, 1-inch	31,230	30,050
Pipe, Sch 40, 2-inch		
Pipe, Sch 40, 2-inch	31,990	27,260

Figure 30 - Grouping Products into Product Groups

Repeat the steps for each of the two remaining groups, Plastic and Copper. To complete the PivotTable, add subtotals for each of the product groups. Position the cursor in a cell containing one of the group row headings, such as **Iron**. Right-click on the cell and from the context-sensitive menu, select **Subtotal "Product2"** to add a subtotal for each product group. The completed report should resemble the one shown in **Figure 31**.

Monthly Sales by Product					
	Qtr1	Qtr2	Qtr3	Qtr4	Grand Total
Iron	45,140	34,750	40,760	23,100	143,750
Pipe, Galv, 1-inch	\$ 10,580	\$ 10,630	\$ 13,180	\$ 12,970	\$ 47,360
Pipe, Galv, 2-inch	9,650	5,700	3,130	840	19,320
Pipe, Galv, 3-inch	24,910	18,420	24,450	9,290	77,070
Plastic	97,930	90,700	103,750	94,910	387,290
Pipe, Sch 40, 1-inch	31,230	30,050	35,940	34,260	131,480
Pipe, Sch 40, 2-inch	31,990	27,260	27,880	22,590	109,720
Pipe, Sch 40, 3-inch	34,710	33,390	39,930	38,060	146,090
Copper	65,080	62,930	75,510	72,250	275,770
Tubing, Type L, 1-inch	30,270	32,960	43,310	44,620	151,160
Tubing, Type L, 2-inch	5,190	5,820	7,790	8,140	26,940
Tubing, Type L, 3-inch	29,620	24,150	24,410	19,490	97,670
Grand Total	\$ 208,150	\$ 188,380	\$ 220,020	\$ 190,260	\$ 806,810

Figure 31 - PivotTable with Product Groups and Subtotals



Note that the default field name, **Product2**, given by Excel to the product group can be renamed in **Field Settings**. Right-click on any one of the group labels and select **Field Settings** from the context-sensitive menu. In the **Field Settings** dialog box, type in the desired field name, such as Product Line, in the **Custom Name** box and click **OK**.

Note that the default Compact layout puts group subtotals at the top of the group on the same line with the group name. If subtotals are desired at the bottom of each group, select **Subtotals, Show All Subtotals at Bottom of Group** on the **PivotTable Tools, Design** contextual tab. Alternatively, right-click on any one of the group labels and select **Field Settings**. In the **Field Settings** dialog box, on the **Layout & Print** tab, uncheck **Display subtotals at the top of each group**, and click **OK**.

Any items within a field may be custom grouped to form another field. Custom grouping may also be necessary when built-in groups are not consistent with a company's practices. For example, when months are grouped into quarters, the built-in groups use a calendar year to define the quarters.

Pivoting Columns and Rows

The summarized table can be rearranged, or pivoted, to show the data from any perspective. Along with the ability to group or ungroup data, being able to immediately rearrange the table is among the most powerful features of PivotTables. For example, if users wanted to display Products as the columns and Quarterly Totals as the rows, they would simply rearrange the rows and columns by dragging and dropping the fields in the drop areas. Continuing with our example PivotTable, follow along with your instructor as we demonstrate the ease of rearranging a PivotTable report.

1. Position the cursor in the PivotTable report to display the **PivotTable Task Pane**. In the field list at the top of the task pane, uncheck **Month** and **Product Line** to remove them from the report. Click-and-drag **Quarters** to the **Row Labels** drop area below **Product**. This has the effect of reporting Quarters within Products, as shown in **Figure 32**.

The figure illustrates the process of rearranging a PivotTable report by dragging fields in the PivotTable Task Pane. It shows two states of the task pane and the resulting PivotTable report.

Initial State (Left):

- Field List:** Month, Product, Sales, Quarters, Product Line (all checked).
- ROWS:** Product Line, Product.
- COLUMNS:** Quarters, Month.
- VALUES:** Monthly Sales ...

Final State (Right):

- Field List:** Month, Product, Sales, Quarters (checked); Product Line (unchecked).
- ROWS:** Product, Quarters.
- COLUMNS:** (Empty).
- VALUES:** Monthly Sales ...

PivotTable Report (Right):

	Sales
Pipe, Galv, 1-inch	\$ 47,360
Qtr1	10,580
Qtr2	10,630
Qtr3	13,180
Qtr4	12,970
Pipe, Galv, 2-inch	19,320
Qtr1	9,650
Qtr2	5,700
Qtr3	3,130
Qtr4	840
Pipe, Galv, 3-inch	77,070
Qtr1	24,910
Qtr2	18,420
Qtr3	24,450
Qtr4	9,290

Figure 32 - Dragging Fields in the PivotTable Task Pane to Rearrange a Report

2. Now, click-and-drag **Quarters** to the **Column Labels** drop area. This rearranges the report so that Products are the columns and Quarters are the rows.

To review, we are simply dragging the field buttons to different drop areas in the PivotTable Task Pane in order to rearrange the report. We can view a report with Month and/or Quarters across the columns and Products as the rows, or Products as the columns and Months and/or Quarters as the rows, Months within Products, or Products within Months, etc. The number of ways that we can view a PivotTable is limited only by the number of fields that we have to display and our imagination.

At first glance, the power of PivotTables to reduce the time and tedium of preparing routine reports is significant. However, the real power of PivotTables is not clerical; it is the added ability they provide to view data from different perspectives. By viewing data from different perspectives, PivotTables increase the probability of uncovering relationships in the data that were previously unknown and of exploiting these relationships on behalf of our company or our clients. Now, that's analytical power!

Using Field Settings

In our PivotTable examples above, the individual data elements were summed to produce the report. By changing field settings, we can display the average sales in each cell, or the minimum or maximum sales, or the variance or standard deviation of the sales distribution, etc. Field Settings are accessible in any of several ways: 1) Right-click on a field label and select **Field Settings** or **Value Field Settings** from the context-sensitive menu, 2) Position the cursor in a cell containing a field label or value and select **Field Settings** from the **PivotTable Tools, Analyze** contextual tab, or 3) Click the drop-down arrow of any field button in a drop area in the PivotTable Task Pane and select **Field Settings** or **Value Field Settings** from the menu.

To change the summary function for any value field, open the **Value Field Settings** dialog box using any of the described methods. In the **Summarize value field by** box, select the function to use in summarizing the field's values. To summarize the selected field by calculating averages, select **Average**, as shown in **Figure 33**.

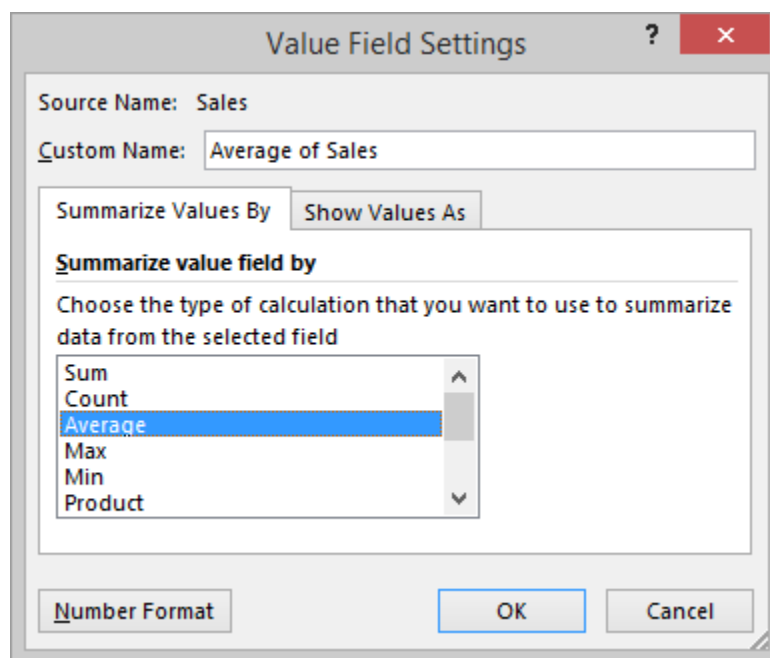


Figure 33 - Changing the Summary Function for a Value Field

In the next example, a PivotTable report that displays four columns, one each for the total annual sales by product, the average sales by product, and the minimum and maximum sales by product will be created. Since the statistics are calculated on sales data, the sales field must be dragged to the **Values**

drop area four times, once for each summary column to be displayed. The Field Settings (field name and summary function) for each field are then modified, in turn, to reflect the appropriate calculation. **Figure 34** illustrates this process and the finished report. Follow along with your instructor as we explore multi-column reports and field settings.

PivotTable Fields

Choose fields to add to report:

- ☐ Month
- ☒ Product
- ☒ Sales
- ☐ Quarters
- ☐ Product Line

MORE TABLES...

Drag fields between areas below:

FILTERS

COLUMNS

ROWS

VALUES

Product

Total

Mean

Min

Sum of Sales3

Defer Layout Update

Value Field Settings...

Value Field Settings

Source Name: Sales

Custom Name: Max

Summarize Values By: Show Values As

Summarize value field by

Choose the type of calculation that you want to use to summarize data from the selected field

Sum

Count

Average

Max

Min

Product

Number Format

OK

Cancel

	Total	Mean	Min	Max
Pipe, Galv, 1-inch	\$ 47,360	\$3,947	\$2,640	\$ 6,110
Pipe, Galv, 2-inch	19,320	1,610	230	4,230
Pipe, Galv, 3-inch	77,070	6,423	310	13,460
Pipe, Sch 40, 1-inch	131,480	10,957	7,370	16,140
Pipe, Sch 40, 2-inch	109,720	9,143	5,220	12,810
Pipe, Sch 40, 3-inch	146,090	12,174	8,190	17,930
Tubing, Type L, 1-inch	151,160	12,597	8,370	21,050
Tubing, Type L, 2-inch	26,940	2,245	1,440	3,840
Tubing, Type L, 3-inch	97,670	8,139	4,470	12,080
Grand Total	\$ 806,810	\$ 7,470	\$ 230	\$ 21,050

Figure 34 - Creating a Multi-Column PivotTable to Display Sales Statistics

Let's add another column to our report. In this final example, the CFO would like to have a column that displays the sales of each product as a percentage of total sales. Since the column will summarize sales data, the **Sales** field must be dragged to the **Values** drop area once again. Right-click on its column heading and select **Value Field Settings**. Click on the **Show values as** tab and in the **Show values as** drop-down list, select **% of column** and click **OK**. Type in **Percent** as the new column heading, drag the new Percent column

just to the left and adjacent to the Totals column, and then adjust the column widths to complete the PivotTable report, as shown in **Figure 35**.

The figure illustrates the steps to format a PivotTable to show sales as a percentage of total sales. It includes a PivotTable, the PivotTable Fields task pane, and the Value Field Settings dialog box.

	Total	Percent	Mean	Min	Max
Pipe, Galv, 1-inch	\$ 47,360	5.87%	\$3,947	\$2,640	\$ 6,110
Pipe, Galv, 2-inch	19,320	2.39%	1,610	230	4,230
Pipe, Galv, 3-inch	77,070	9.55%			
Pipe, Sch 40, 1-inch	131,480	16.30%			
Pipe, Sch 40, 2-inch	109,720	13.60%			
Pipe, Sch 40, 3-inch	146,090	18.11%			
Tubing, Type L, 1-inch	151,160	18.74%			
Tubing, Type L, 2-inch	26,940	3.34%			
Tubing, Type L, 3-inch	97,670	12.11%			
Grand Total	\$ 806,810	100.00%			

PivotTable Fields

Choose fields to add to report:

- ☐ Month
- ☒ Product
- ☒ Sales
- ☐ Quarters
- ☐ Product Line

MORE TABLES...

Drag fields between areas below:

FILTERS

COLUMNS

ROWS

Product

VALUES

Total

Percent

Mean

Min

Max

☐ Defer Layout Update **UPDATE**

Value Field Settings

Source Name: Sales

Custom Name: Percent

Summarize Values By: Show Values As

Show values as

- % of Column Total
- No Calculation
- % of Grand Total
- % of Column Total
- % of Row Total
- % Of
- % of Parent Row Total

Number Format

OK Cancel

Figure 35 - Using Percentage of Column to Display Sales as a Percentage of Total Sales

Sorting and Filtering Fields

The latest versions of Excel provides enhanced context-sensitive sorting and filtering of PivotTable fields. All of the sorting and filtering capabilities are easily accessible in the **Field List** at the top of the **PivotTable Task Pane**. Click the drop-down arrow of any field button and select the appropriate sort or filter options, as shown in **Figure 36**.

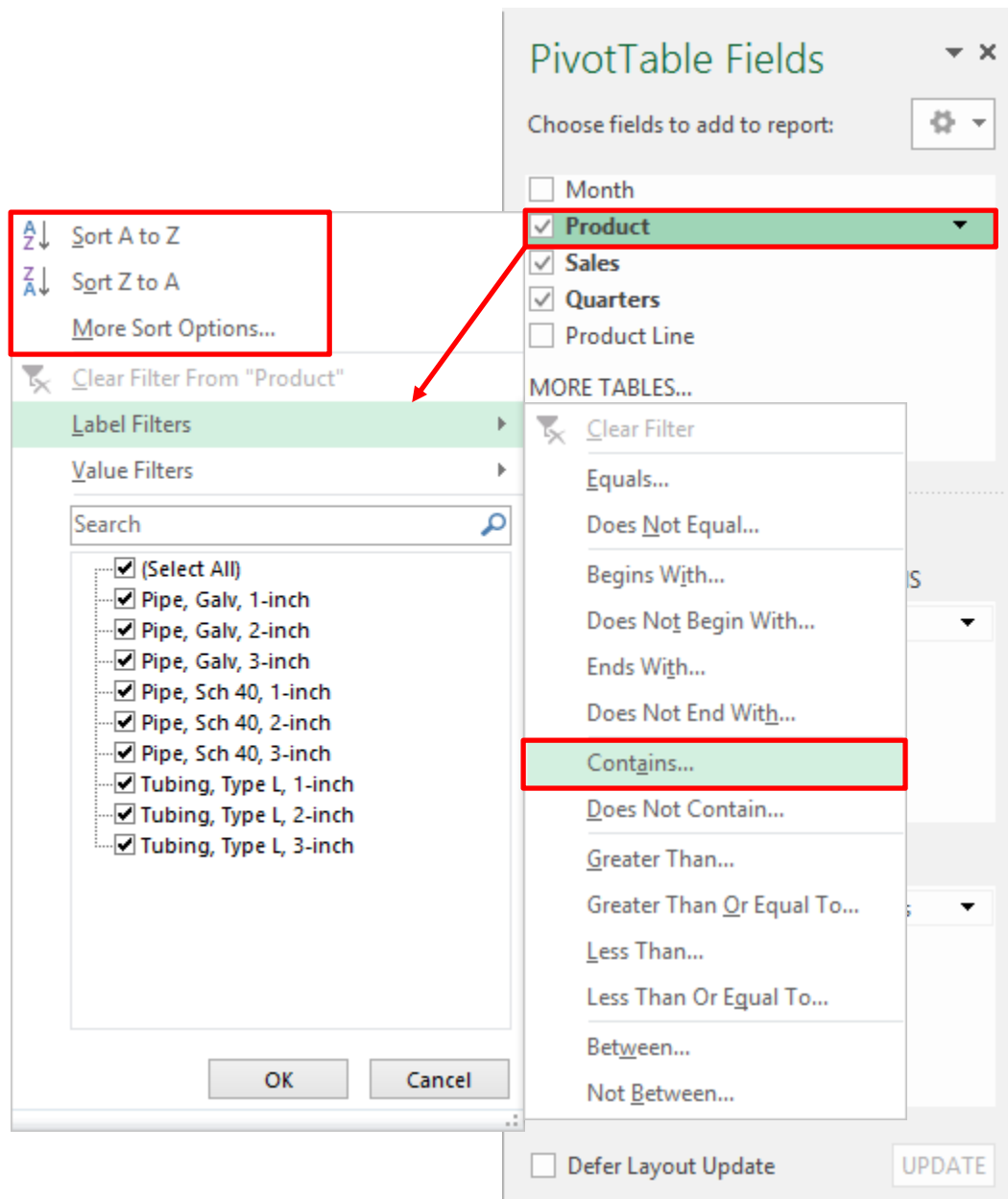


Figure 36 - Sorting or Filtering PivotTable Fields

Updating the Underlying Data

Whenever data is changed, updated, or added to the underlying data set, a user must refresh the PivotTable to see the changes reflected in the report. Position the cursor anywhere in the PivotTable report, and then right-click and choose **Refresh** from the context-sensitive menu. Alternatively, click the **Refresh** button on the **PivotTable Tools, Analyze** contextual tab. Note that it is best practice to refresh a PivotTable after re-arranging a complex report.

If data is added or removed from the data range and the size of the range changes, then users may have to modify the data range. If the data range is an Excel table, no action is necessary. A table is a dynamic range that re-adjusts its dimensions automatically as data is added or removed. Similarly, if the data range is a named dynamic range, no action is necessary. However, if the data range is an ordinary range specified using cell references, the data range must be adjusted. To adjust the data range, position the cursor in the PivotTable report. On the **PivotTable Tools, Analyze** contextual tab, click **Change Data Source**. In the **Change PivotTable Data Source** dialog box, re-specify the data range and click **OK**. The existing PivotTable will be updated to reflect the new data.

Recommended PivotTables in Excel 2013

Excel 2013 attempts to ease the burden of learning how to use PivotTables with Recommended PivotTables. Excel produces a gallery or pre-configured PivotTables, from which a user need only make a selection.

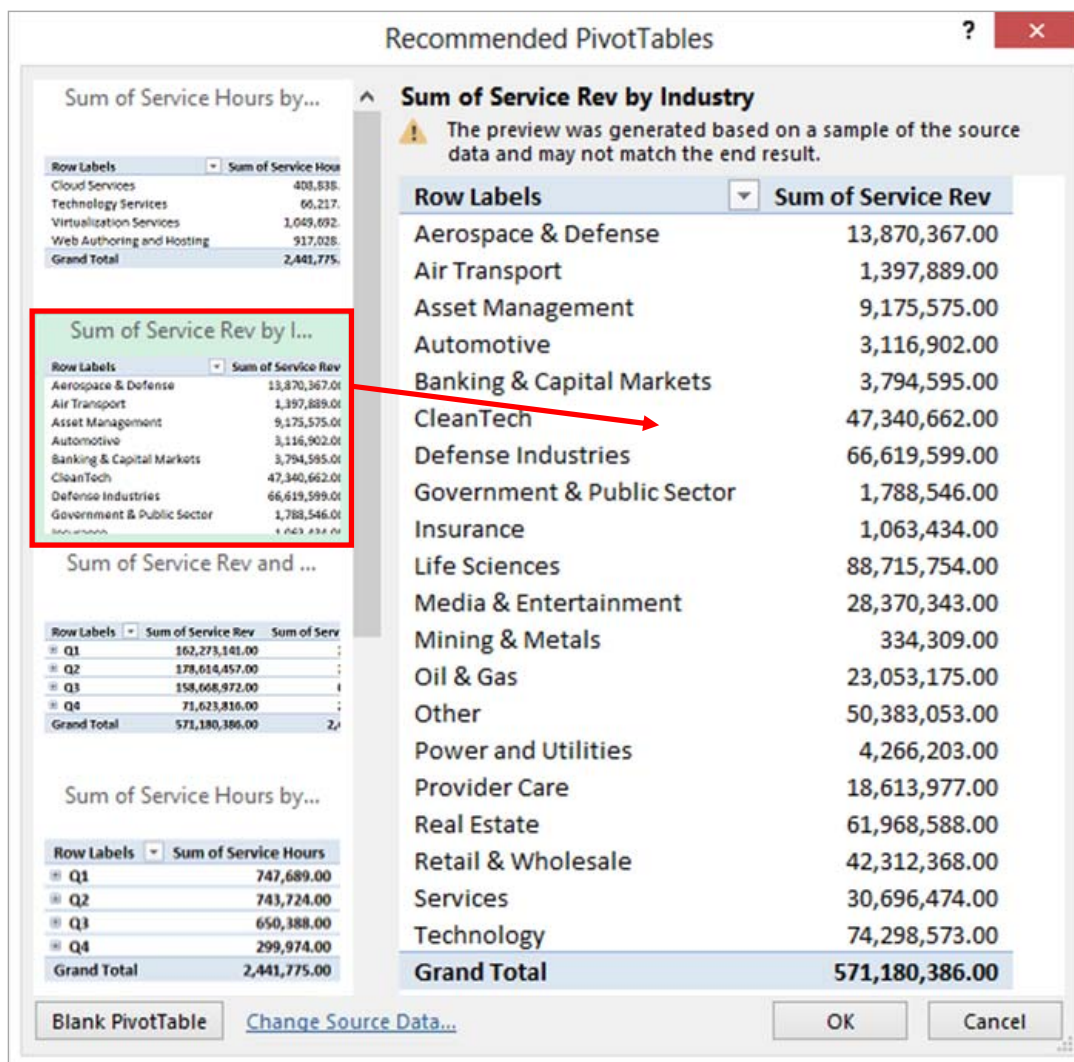


Figure 37 - Creating a PivotTable with Recommended PivotTables

While the PivotTables produced by this functionality are the simplest of reports, they can serve as the foundation for more sophisticated analysis. In this context, Recommended PivotTables can save many steps in the report creation process, thereby saving time and delivering greater staff productivity.

Producing a recommended PivotTable takes just a few clicks. Highlight the data, including the field names, or use a Table for the data, and then click **Recommended PivotTables** on the **Insert** tab. From the gallery of PivotTables, select the one that best summarizes the data and click **OK**, as shown in **Figure 37**. The PivotTable may then be customized and formatted to meet a user's needs. Note that recommended PivotTables can also be created from the **Tables** tab of the **Quick Analysis** lens.

PivotTables on External Data Sources

Most users build PivotTables on data stored in the workbook where the PivotTable is being built. Under these circumstances, the creation and update of a report will require the extraction of data from the application where the data is stored and maintained, which is usually the general ledger or other business application. Alternatively, we could use the Open DataBase Connectivity (ODBC) capabilities of Excel to extract the data from the general ledger. Once we connect a PivotTable to our general ledger using ODBC, Excel becomes an extraordinarily effective *ad hoc* reporting engine.

What is ODBC?

ODBC is a standard database access method developed by the SQL Access group in 1992. With ODBC, it is possible to access data stored in any ODBC-compliant database from within any ODBC-compliant application. ODBC manages this by inserting a middle layer, called an ODBC driver, between the application and the database management system (DBMS) that translates the application's data queries into commands that the DBMS understands. ODBC can be used to provide two-way integration between Excel and the general ledger, although generally ODBC is used only to extract data.

ODBC is an open, vendor-neutral interface for database connectivity that provides access to a variety of PC, RISC, and mainframe database systems. The ODBC programming interface permits a developer to build an application without targeting a specific DBMS. Users can add drivers that link their applications to a database management system and then can access their data using conventional SQL query commands. Most accounting software applications support ODBC. If your accounting software supports ODBC, then Excel can access historical data directly in the general ledger without re-keying any data or going through the typical import-export process used by most management accountants.

All of the Microsoft Office applications are ODBC compliant. Office comes with ODBC drivers for Access, Excel, dBase, and text files. Windows 7 and Windows 8 broaden the ODBC capabilities of Windows applications by adding drivers for SQL Server, Visual FoxPro, Oracle, and Paradox. The Windows ODBC drivers are part of Microsoft Data Access Components (MDAC), the latest version of which can be downloaded from the Microsoft web site.

Extracting Data from an External Database

Using ODBC, Excel can easily connect to an external database and extract any necessary data. **Figure 38** depicts a graphical representation of the data access process. Direct extraction may not solve all of our problems. In earlier versions of Excel, it was not uncommon for a data extraction to exceed the row or column capacity of Excel. Users were forced to use an intermediary database, such as Access, to store the data temporarily. However, if users extract data directly into a PivotTable and thereby summarize the data in a limited number of rows or columns, the row and column limits of Excel are not exceeded even if the data itself exceeds the limitations.

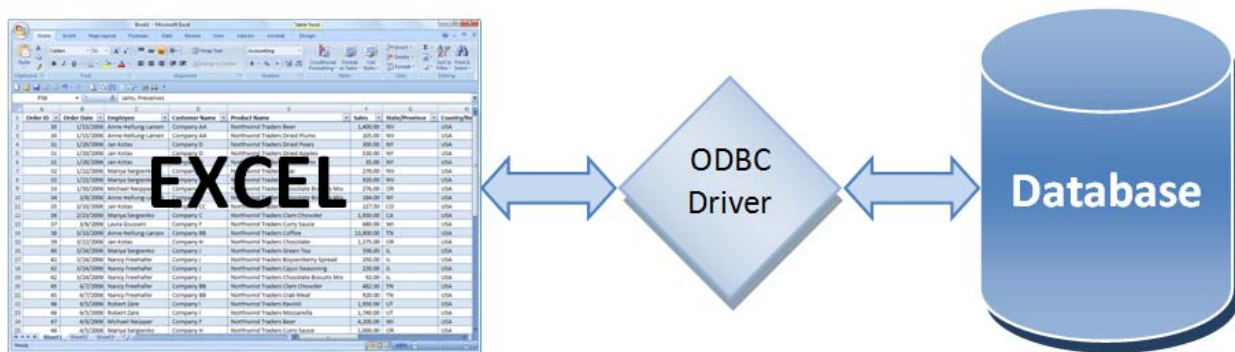


Figure 38 - Accessing Data in Excel Using ODBC

The process of creating a PivotTable from an external database is the same as for any other PivotTable except that users must specify a source database and the database fields that contain the data of interest. If the data source has already been defined in Excel, the PivotTable creation process is simplified. On the **Insert** tab, select **PivotTable, PivotTable**. In the **Create PivotTable** dialog box, select **Use an external data source** and click **Choose Connection**. Select an existing data source in the **Existing Connection** dialog box and click **Open**. Then, continue the process to create the desired PivotTable.

If the data source has not been defined, begin the PivotTable creation process on the **Data** tab. Click **From Other Sources, From Microsoft Query** to open the **Choose Data Source** dialog box. Select the appropriate ODBC data source, and click **OK**, as shown in **Figure 39**. In the resulting dialog box, select the desired tables and/or fields from the table list.

In this example, we will be using MAS 90 data from the ABC sample company file. After selecting the data source in the dialog box shown in Figure 39, choose a company file and authenticate to MAS 90, if necessary, by entering a username and password. The ODBC driver for MAS 90 requires authentication for each use if ODBC security is enabled. ODBC security can be set from within MAS 90 to restrict access to the general ledger data on a user by user basis. When users authenticate themselves to a company file, the users will only have access to the data for which they have been granted specific rights and permissions. Only a MAS 90 administrator can alter the data access rights and permissions of an individual user.

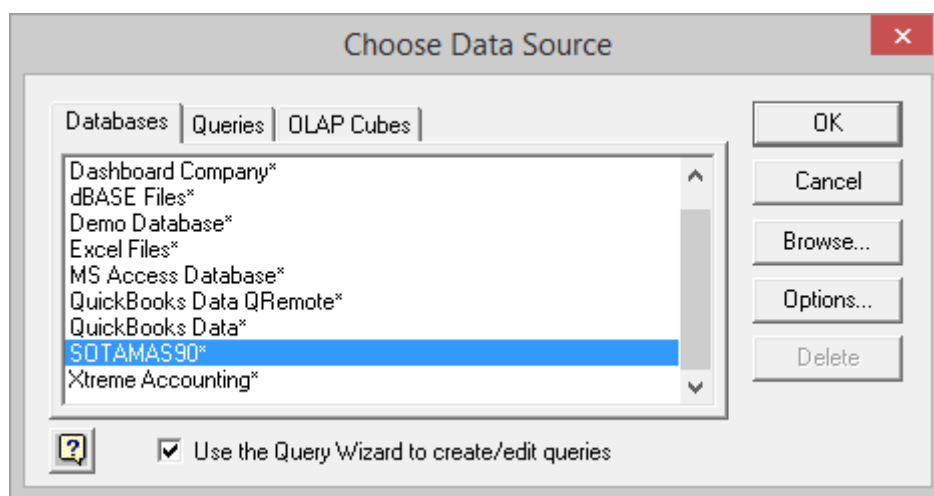


Figure 39 - Selecting the External Data Source

Figure 40 - Creating a PivotTable Connected to an External Data Source

The PivotCache – A Temporary Data Store

Would users be able to send this report by e-mail to their managing partner in another office? After all, the PivotTable gets its data from MAS 90, and the managing partner doesn't have access to the data. The simple answer is "Yes." When Excel retrieves data from a data source, it puts the data into a work area called the PivotCache. The PivotTable is actually built on the data residing in the cache, not directly on the data in the external database. The reason for this is to speed up the data manipulation process – the dragging and dropping, the grouping, the renaming, and the rearranging – that goes on when we use PivotTables. **Figure 41** illustrates the PivotTable data model.

The PivotCache becomes part of the workbook and is always in the background, unseen and inaccessible except through the PivotTable. Whenever a user sends a PivotTable by e-mail or direct file transfer, the PivotCache accompanies the PivotTable as part of the workbook, so that the recipient can view the report and drill down to the underlying details as if she were connected to the MAS 90 database.

Database

PivotCache

	A	B	C	D	E	F	G
1		Current	Over 30	Over 60	Over 90	Over 120	Balance
2	A To Z Carpet Supply	8,732.40	-	-	-	-	8,732.40
3	Allen's Appliance Repair	582.11	18.95	31.70	12.75	-	645.51
4	American Business Futures	4,474.96	1,257.40	-	-	-	5,732.36
5	American Concrete Service	12,657.82	1,085.98	-	-	-	13,743.80
6	Autocraft Accessories	12,940.31	-	6,406.53	4,607.18	-	23,954.02
7	Avnet Processing Corp	7,377.37	-	-	-	-	7,377.37
8	Bay Pyrotronics Corp.	10,529.66	3,057.64	3,057.64	-	-	16,644.94
9	Breslin Parts Supply	11,828.26	-	-	-	-	11,828.26
10	Capri Sailing Ships	56,169.33	-	-	-	-	56,169.33
11	Custom Craft Products	11,634.72	4,476.31	3,335.40	-	-	19,446.43
12	Greater Alarm Company	825.50	-	-	-	-	825.50
13	Hillsboro Service Center	402.86	1,000.00	1,500.00	-	-	2,902.86
14	Jellco Packing	5,055.91	-	-	-	-	5,055.91
15	Orange Door & Window Co.	263.37	-	-	-	-	263.37
16	R & S Supply Corp.	-	6,251.31	835.43	-	-	7,086.74
17	Shepard Motorworks	513,339.95	-	-	-	-	513,339.95
18	Grand Total	656,814.53	17,147.59	15,166.70	4,619.93	-	693,748.75

Figure 41 - PivotTable Data Model

Timeline Filters

Timeline filters in Excel 2013 are similar to slicers, but are used to filter date fields in PivotTables. If you are using PivotTables to analyze transactional data, every record in your data set will have a date associated with it. Usually, dates are grouped into months, quarters, or years for reporting and analysis. Date grouping adds another layer of complexity that makes it more difficult for less knowledgeable users to create and manipulate PivotTables. That's where Timelines come in to play. Simply click in a PivotTable and select **Timeline** from the **Insert** tab to produce a Timeline filter as displayed in **Figure 42**. To change how the data is grouped (months, quarters, or years), click the drop-down in the upper right hand corner of the Timeline control. To filter the PivotTable, click on a period button, such as **Q1**, **Q2**, etc., or drag your mouse across the Timeline to select multiple periods. The selected period is displayed in the upper left hand corner of the control.

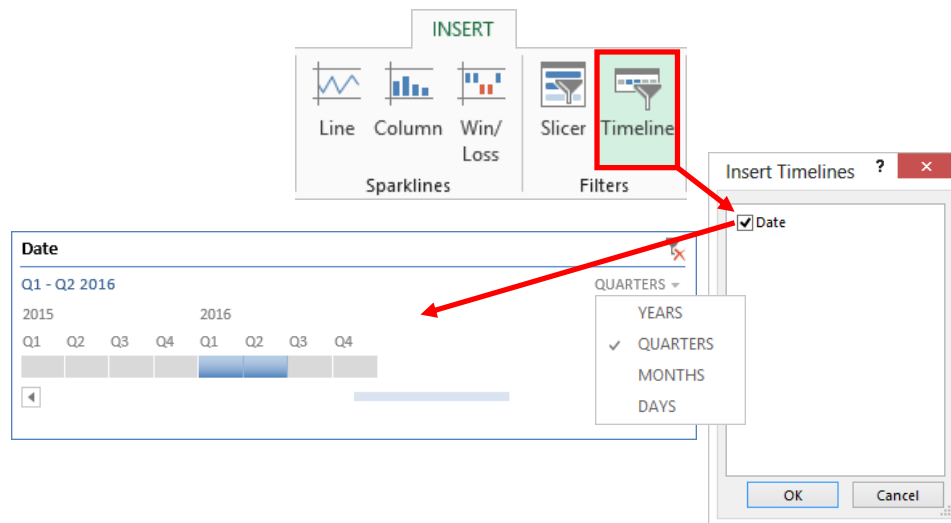


Figure 42 – Using a Timeline to Filter Dates in a PivotTable

Flash Fill

Flash Fill is a new data manipulation feature that allows users to split, combine, or rearrange data quickly and easily without using commands or complicated formulas. Whether it's rearranging customer contact names, inserting parentheses and hyphens in telephone numbers, or separating account numbers and account names in a QuickBooks trial balance, Flash Fill can get the job done, as shown in **Figure 43**.

Contact	Phone
Abercrombie, Kristy	4155556579
Allard, Robert	6505553422

Contact Name	Phone
Baker, Chris	(415) 555-6579
Balak, Mike	(650) 055-3422
Barley, Renee	Robert Allard
Bauman, Mark	Chris Baker
Bolinski, Rafal	Mike Balak
Bristol, Sonya	Renee Barley
Burch, Jason	Mark Bauman
	Rafal Bolinski
	Sonya Bristol
	Jason Burch

Account No and Account
10100 · Checking
10300 · Savings
10400 · Petty Cash
11000 · Accounts Receivable
12000 · Undeposited Funds
12100 · Inventory Asset
12800 · Employee Advances
13100 · Pre-paid Insurance
13400 · Retainage Receivable
15000 · Furniture and Equipment

Account No	Account
10100	Checking
10300	Savings
10400	Petty Cash
11000	Accounts Receivable
12000	Undeposited Funds
12100	Inventory Asset
12800	Undeposited Funds
13100	Inventory Asset
13400	Employee Advances
15000	Pre-paid Insurance
	Retainage Receivable
	Furniture and Equipment

Figure 43 – Use Flash Fill to Manipulate Data

There are multiple ways to apply Flash Fill. In default, Excel displays Flash Fill suggestions as you work. As shown in **Figure 44**, a user has modified the first record and has moved to the second record. As the user begins modifying the second record, Excel automatically displays a suggested flash fill for the column. At that point, the user can press **ENTER** to accept the suggested flash fill or press **ESC** to cancel the suggested fill. Alternatively, select **Data, Flash Fill** from the ribbon or press **CTRL + E** to execute Flash Fill from the keyboard.

To reformat a list of telephone numbers, type one number as it is to appear with parentheses and a hyphen, press **ENTER**, and then press **CTRL + E**. If Excel is unsure of what is to be done for any record, it

will skip the record. Move the cursor to a skipped record and "correct" it, and then press **CTRL + E** to fill similar records. Continue this process until the entire column has been updated.

Contact	Phone	Contact Name	Phone
Abercrombie, Kristy	4155556579	Kristy Abercrombie	(415) 555-6579
Allard, Robert	6505553422	Robert Allard	(650) 055-3422
Baker, Chris		Chris Baker	(415) 555-2253
Balak, Mike		Mike Balak	(415) 555-6636
Barley, Renee		Renee Barley	(415) 555-7262
Bauman, Mark		Mark Bauman	(415) 555-8669
Bolinski, Rafal	4155553262	Rafal Bolinski	(415) 555-3262
Bristol, Sonya	4155555239	Sonya Bristol	(415) 555-5239
Burch, Jason	4155552351	Jason Burch	(415) 555-2351

Figure 44 – Excel Automatically Displays a Suggested Flash Fill

Here's a few tips for using Flash Fill effectively:

- Flash Fill does not create formulas related to the original records, so the original data column can be deleted without impact on the fill column.
- The fill column need not be adjacent to the column that contains the data to be manipulated, but make sure that there are no blank columns between the original data and the intended fill column.
- Flash Fill cannot be used to transform numbers. For example, Flash Fill cannot be used to divide a column of numbers by five. Use formulas instead.
- A column can be filled from any record in the column. If the first record contains ambiguous data, use another record to demonstrate how the data is to be manipulated and then press **CTRL + E** to force the execution of Flash Fill.
- Flash Fill is a pattern recognition engine, not a logic engine. Flash Fill cannot be used to convert state names to state abbreviations because it does not recognize that UT and LA are the abbreviations for Utah and Louisiana, respectively. Use Custom Lists or a VLOOKUP table instead.

The Excel Data Model

All versions of Excel 2013 include the Excel Data Model, a core in-memory OLAP data engine. The Data Model provides users with additional PivotTable functionality, but it also removes some functionality with which many users are familiar and are accustomed to using. In order to use the newest and most powerful functionality associated with the Data Model, users must give up some tried and true functionality.

The Excel data model provides PivotTables with new and powerful functionality.

- PivotTables can be built from multiple related tables. The ability to establish relationships between tables eliminates the need to build VLOOKUP formulas to cross-reference information stored in different tables. Relationships between tables can be defined before or during the PivotTable building process.

- PivotCharts without an accompanying PivotTable (Standalone Pivot Charts) are available in Excel 2013 when the data is stored in the Excel Data Model.
- Quick Explore, a revolutionary way to drill to detail, allows users to drill up, down, and around a PivotTable to examine and explore a report's underlying data more easily. In order to use Quick Explore, a PivotTable must be built on the Excel Data Model.
- Since the Excel Data Model is an OLAP data engine, this allows users to convert PivotTables to formulas using the OLAP Tools available in Excel 2013. This converts a PivotTable from a single unitary object into individual cells connected to the underlying data, which allows users to insert rows or columns, to create subtotals as required, or to move connected cells to produce entirely different reports. All this can be done without breaking the links to the underlying data or impairing the ability to refresh a report after the data has been updated.

Notwithstanding the powerful advantages of building PivotTables on the Excel Data Model, there are several significant disadvantages.

- Grouping of items is not available in a PivotTable built on the Data Model. Neither built-in date grouping nor custom item grouping is available. Calculated fields can be created in the source data to work around this limitation.
- Calculated fields and items are not supported. Calculated fields can be created in the source data as a workaround. PowerPivot users can create calculated fields in PivotTables built on the Excel Data Model from within PowerPivot.
- In default, drilling to detail only displays the first 1000 records that underlie a summarized cell. With the introduction of Office 2013 SP1, Data Model drill-through can be configured to return as many records as desired, up to the maximum number of rows available in Excel.
- Excel 2013 workbooks that use the Data Model are not backward compatible to earlier versions of Excel. For workbooks that must be shared with users of earlier versions of Excel, ordinary PivotTables – those not based on the Excel Data Model – may be used.

From the outset, users must be keenly aware that the Excel Data Model need not be used when constructing PivotTables in Excel 2013. When the additional features of the Data Model are warranted, users can employ the Data Model. When the features are not needed, or when data sets are small, users still have all of the features of ordinary PivotTables – the ability to create calculated fields and calculated items, group data items, drill through to display all supporting data, and backward compatibility. Those using Excel 2013 Professional Plus or the standalone version of Excel 2013 (acquired not as part of a Microsoft Office license) have yet a third type of PivotTable, those built with PowerPivot. PowerPivot uses the Excel Data Model, but it can connect to multiple external data sources, handle billions of records, and provide users with additional functionality not available to those using just the Excel Data Model.

4-4-5 Reporting with Related Tables

Earlier in this session, we used VLOOKUP to retrieve reporting period information from a table into the transaction summary to build a PivotTable report. With the Excel Data Model, we can simply relate the **Sales** transaction summary table to the **Dates** table, thereby avoiding the complexity of building VLOOKUP formulas to perform this task. The only requirement is that the Dates table contain a record for each date, rather than just the beginning date for each period, as required to use VLOOKUP. Similarly, we could use related tables instead of VLOOKUP in transforming coded data into an understandable format.

Begin the PivotTable creation process by selecting **Insert, PivotTable** to open the **Create PivotTable** dialog box. Enter the name of the first table and make sure to check **Add this data to the Data Model** as shown in **Figure 45**. Click **OK** to display the PivotTable placeholder and Field List.

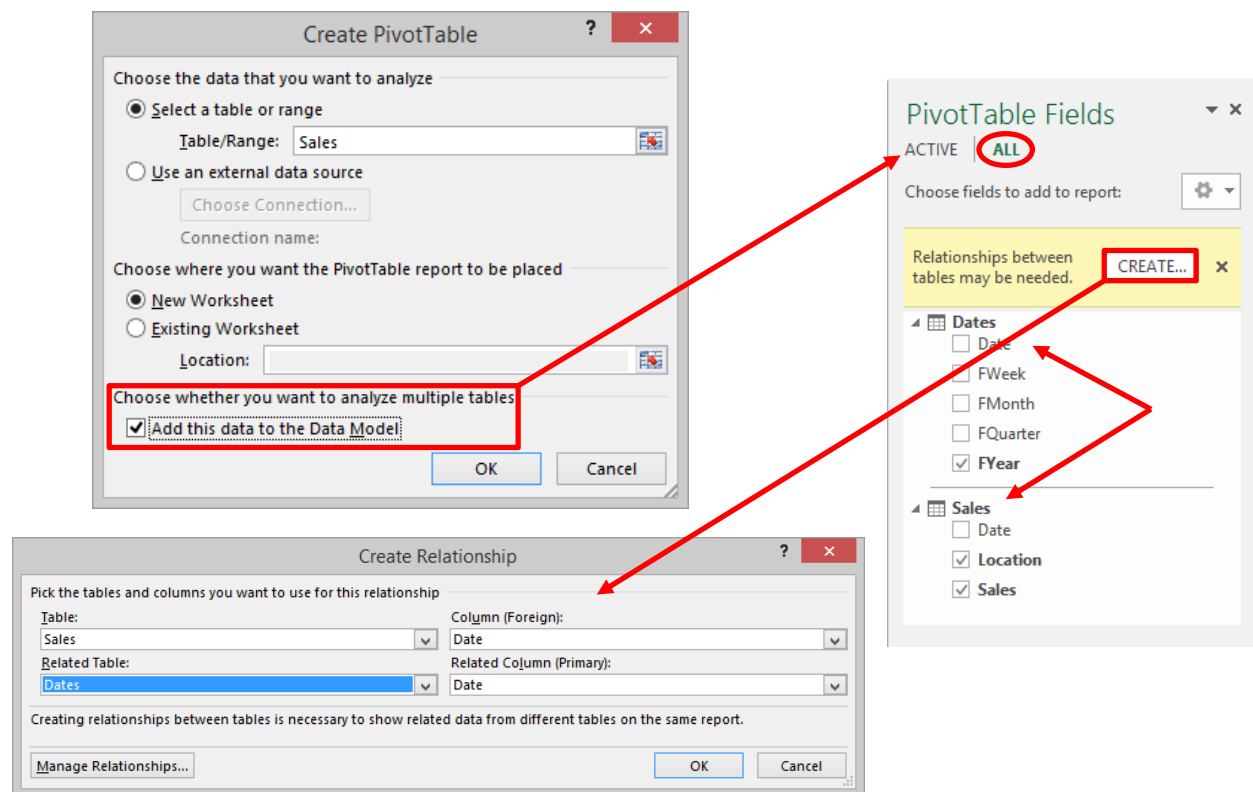


Figure 45 – Creating a PivotTable Using the Excel Data Model

When a table is added to the Data Model, the PivotTable Field List can display all fields from all tables in a workbook. If the tables are not related, relationships can be created on a common field directly from the Field List as shown in Figure 45. With the Excel Data Model, end users can create PivotTables from multiple related tables, even if the tables themselves are from multiple external data sources.

Relationships

In the previous example, establishing relationships between tables was accomplished through a link in the PivotTable Field List. A more sophisticated approach to establishing and maintaining data relationships

between tables is available through the ribbon. Select **Data, Relationships** to access this functionality as shown in **Figure 46**.

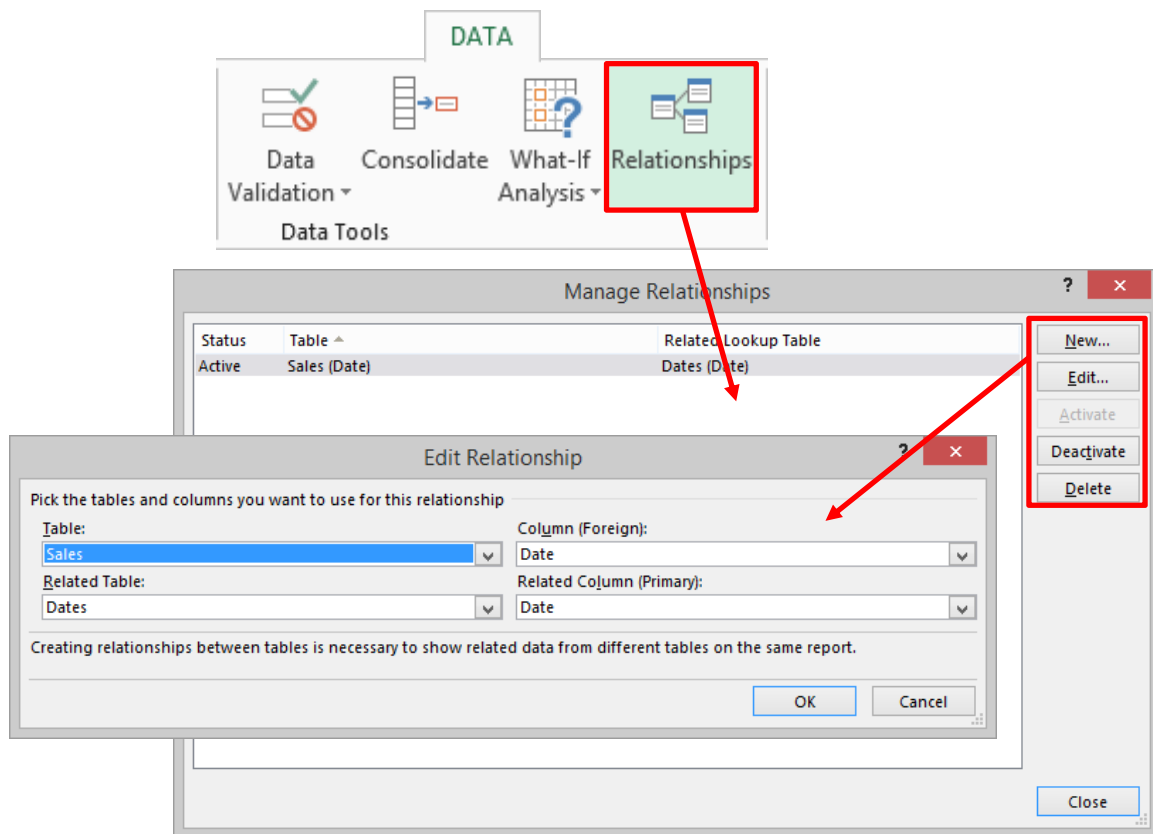


Figure 46 – Creating and Maintaining Data Relationships

10 Rules of Pivot Tables

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1. You must have data that is clean and can be pivoted with no blanks or weird characters in the data.
2. Perform a “Save As” as often as you can. Save versions of your work because sooner or later you will have a mess to recover from.
3. There are five ways to deal with a variable data source:
 - a. Go back into the table settings and change the data range
 - b. Use a Defined Name on the source range
 - c. Use a Dynamic Defined Name on the source Range
 - d. Highlight all in the column
 - e. Use an Excel Table as the source
4. When highlighting the data range you must include the column headings in the first row which will become the data titles for the pivot table.
5. If you happen to include any empty cells or text in your data range the pivot table command will automatically default back to count as the field setting instead of sum. To fix change the field setting back to sum.
6. To re-activate the field list box and pivot table toolbar you need to click back in the pivot table range or right-click and select show field list box then issue a View, Pivot Table Toolbar command.
7. If you want 4 different elements of a data item such as sales in your table, you must drag and drop four instances of that data item into the data range of the pivot table.
8. To group on dates you must have real dates and not text dates. Convert the text dates to real dates using Data, Text to Columns command and then group.
9. Never name a calculated item or field with the same title you want to use in the actual pivot table summary. You cannot duplicate names of items, fields, or calculations. By default, any grouped item will not have a subtotal on that item. You will need to add those manually if desired. Fix this in the field