Excel's Three Tables

Presented By

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Excel has three very powerful table features. Each one is unique and is used in different ways to save accountants and other business professionals significant amounts of time. This session will cover Data Tables, PivotTables, and Excel Tables to an intermediate level. Armed with these three tables, you will seldom encounter a data analysis problem that cannot be solved in a reasonable amount of time.

Contents

Introducing Excel's Three Tables

Excel now contains three tables that can be of great benefit to accountants. 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 suit, enhanced both, and added them to Excel 5.0 in 1993. The third Excel table is known as a **Table** and was added to Excel with the 2007 release.

Each table has its own distinct set of features and is used for different purposes. Do not let the phrase, "tables" fool you; the three tables are not similar in any fashion.

The primary function of each table is as follows:

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

Despite being part of Lotus 1-2-3 and the early versions of Excel, Data Tables and PivotTables have been misunderstood for years. PivotTables are now becoming popular while Data Tables rarely are used correctly. Tables – the newest of the three – is new enough that most users have not yet explored them in detail and think that they offer little more than formatting; as you will see, Tables are much more than that and may revolutionize how you work with data in Excel. By the end of this session, you will understand how to use each of these three tables in an appropriate fashion.

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 when calculating a result. In a two-variable data table, two variables are manipulated when calculating a result.

Many users only use Data Tables to replicate formulas. This type of use is not very beneficial. Accountants who understand Data Tables know they can use them to analyze 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.

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**.
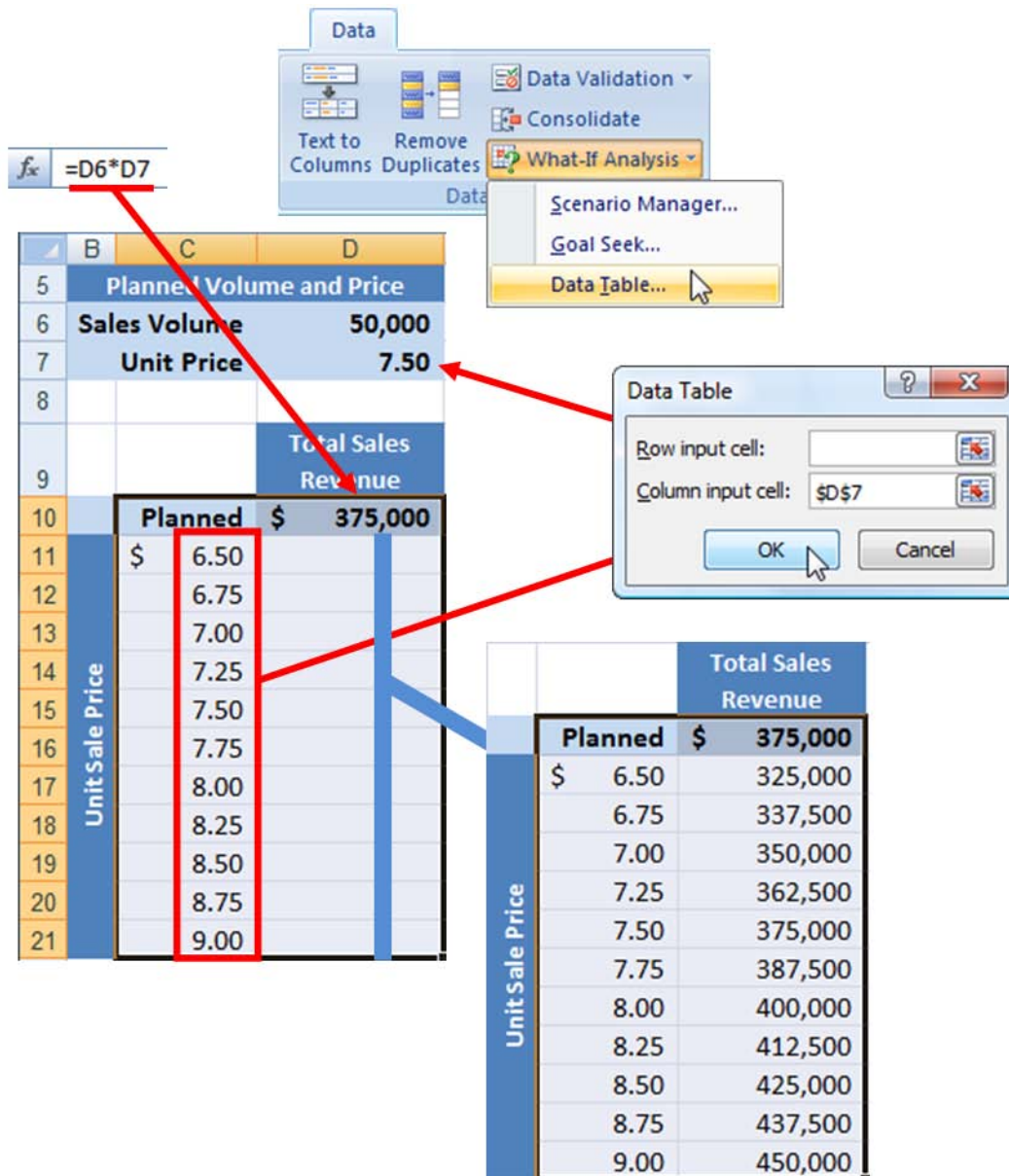

Figure 1 - Creating a One-Way Data Table to Calculate Sales Revenue from Multiple Prices

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, as shown in **Figure 2**.

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

Figure 2 - Excel Capacities

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: **=PMT(rate,nper,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; that analysis requires the body of the amortization in the worksheet that calculates this answer. Hence, the more complex the answer, the more valuable the Data Table analysis is. 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 3**. Note that in the outline shown, cell Q3 contains the formula **=PAYMENT**.

Figure 3 - 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 4**. 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.
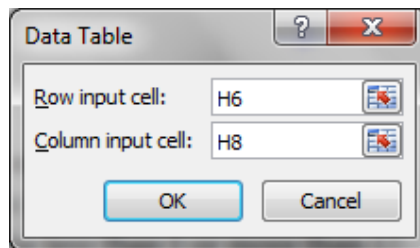
Figure 4 - Data Table Dialog Box

	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	Initital Annual Interest Rate			5.00%
9	Initial Payment			$ 377.42

6

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.
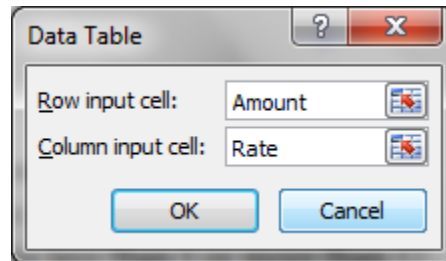
Off-worksheet Data Table

Three variables can be done, sort of. If you think about it for a moment, you will realize we have not touched the idea of an array. In other words, let's go back through multiple sheets using each sheet with a different variable. While the feature to handle this type of Data Table is NOT directly built into Excel, users can build a few workarounds that will provide the ability to get an off-worksheet Data Table. The third variable capability is one of the "promised but forgotten" features of Excel.

Drivers

To accomplish three variables, users must setup extra sheets with all the variables in place. Then they must setup cells to "drive" the variables on the base calculation worksheet. These "drivers" will satisfy Microsoft's requirement that the Data Table input cells must be on the same worksheet.

Formula Needed

So that the base worksheet calculation does not become a one-sided calculation using the current sheet variable, we must put an If statement in the base input cells. One IF statement for each variable. You can also setup a third variable but this workaround only works for one off-worksheet Data Table.

20 PivotTable Tips

1. Before pivoting data, you should make sure you have data that is clean and can be pivoted with no blanks or different characters in the data. Handling blanks or different characters in the data requires advanced tricks.

2. "Save As" often. Always save versions as you work because sooner or later you will have an errant drop. Most errant drops can easily be fixed with an Undo command, but many will not undo.

3. When selecting the data range for the PivotTable, you must include the column (field) headings (names) in the first row which will become the data titles for the PivotTable.

4. If you happen to include any empty cells, text, or mixed data, in your data range, the PivotTable command will automatically default back to count as the field setting instead of sum. To fix, change the field setting back to sum.

5. To re-activate the field list box and PivotTable toolbar, you need to click back in the PivotTable range or, right-click and select show field list box then issue a View, PivotTable Toolbar command.

6. Excel 2007/2010 has a vastly improved PivotTable interface, filters, and data handling, but a poor choice of icon on the Ribbon found in Insert, PivotTable.

7. If you want the classic blue grid layout from Excel 2003, in Excel 2007/2010 select PivotTable options, display, and Classic PivotTable Layout.

8. All the functionality of Excel 2003 is included, just hiding behind the icon "PivotTable and PivotChart Wizard", in which Excel 2007/2010 users must add to the Quick Access toolbar manually. Otherwise, there is no way to get to the Multiple Consolidation Ranges command.

9. 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 PivotTable.

10. You cannot limit or use the pull down filter box on a data item while it is in the page field area in Excel 2003 (and prior). You can easily filter the page field in Excel 2007/2010. With Excel 2003 (and prior), you can either double-click on the item or move it down to a row or column field first, then edit and put it back in the page field area.

11. Spaces, blanks, or text in the data range may create problems with the PivotTable, especially grouping.

12. To group 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. An easy way to test for this is apply any number format to the date field. If you see a number, it is a real date, if not, it is text.

13. Hide annoying item titles, such as, "Sum of Sales", by changing the name to space, space space, etc. Simply click on the item title and change.

14. Never name a calculated item or field with the same title you want to use in the actual PivotTable summary. You cannot duplicate names of any items, fields, or calculations in any one PivotTable.

15. You can have one table (data item) per worksheet but almost unlimited worksheets per workbook. This is also true for Data Tables, Data Queries, Data Imports, etc.

16. 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 settings box.

17. Turn on filters just outside the table by placing any text in the heading line and then activate filters from the cell just below and the table will back-fire filters into the PivotTable.

18. When creating a relative reference formula, do not point at the cells in the pivot table. Instead, use the actual cell addresses and this will avoid the GETPIVOTDATA function.

19. Use the GETPIVOTDATA function when you want to lock down the reference to a calculation so it will not change the source as you move items from row fields to column fields or even into page field area (report filters in 2007/2010).

20. There are four methods of dealing with a variable data range:

    a. Use a named (defined) range to build the PivotTable. Change the definition of the range as the data changes and then use the Data Refresh command in the PivotTable. While this is a manual process, many users find this the easiest way to deal with a variable range.

    b. Use an Excel Table (Excel 2007/2010 only) to build the PivotTable. An Excel Table is dynamic and will adjust as the data changes.

    c. Select the entire column for each element when building the PivotTable. This will add an element called "Blank" to your report which you need to filter out in the Row Fields. There is a chance that this will not group for you later as you have defined a range with mixed data (numbers and blanks). A PivotTable created in Excel 2007 using a real Excel 2007 file (not in compatibility mode) will have no problem grouping data using this trick. Excel 2003 cannot.

    d. Use the OFFSET function combined with the COUNTA function to create a dynamic named range. Use the formula below to actually name the range. For example, a data range that starts at C9 and continues to F2030 would read as follows: =OFFSET(C9,0,0,COUNTA($A:$A),4). If you add more columns, you will need to adjust the 4 to be 5,6… or you could add another COUNTA function for columns which would read as follows: =OFFSET(C9,0,0,COUNTA($A:$A),COUNTA($9:$9)) There are also advanced versions of this function to deal with data gaps, but you have to be precise as to numbers or text.

Fundamentals of PivotTables

To create a PivotTable, first ensure that the underlying data resides in columns with column headers at the top of each column. Though not required, removing blank rows and replacing blank cells with zeroes is recommended. Note that sorting the data prior to creating the PivotTable is not necessary. The data should resemble that shown in **Figure 5**.

	A	B	C	D	E
1	**Region**	**Product Line**	**Model**	**Date**	**Sales Units**
2	Northeast	Drives	5400-150-25	1/31/2009	3,209
3	Southeast	Drives	5400-150-25	1/31/2009	6,786
4	Midwest	Drives	5400-150-25	1/31/2009	5,836
5	West	Drives	5400-150-25	1/31/2009	5,719
6	Northeast	Drives	5400-150-35	1/31/2009	11,917
7	Southeast	Drives	5400-150-35	1/31/2009	25,200
8	Midwest	Drives	5400-150-35	1/31/2009	21,672
9	West	Drives	5400-150-35	1/31/2009	21,239
10	Northeast	Drives	5400-250-25	1/31/2009	5,912

Figure 5 - Sample PivotTable Data

Once the data is in proper order, simply click anywhere inside the data range and choose **Insert** and **PivotTable** from the Ribbon to open the dialog box shown in **Figure 6**. Accept the defaults and click **OK** to create the basic outline of the PivotTable.
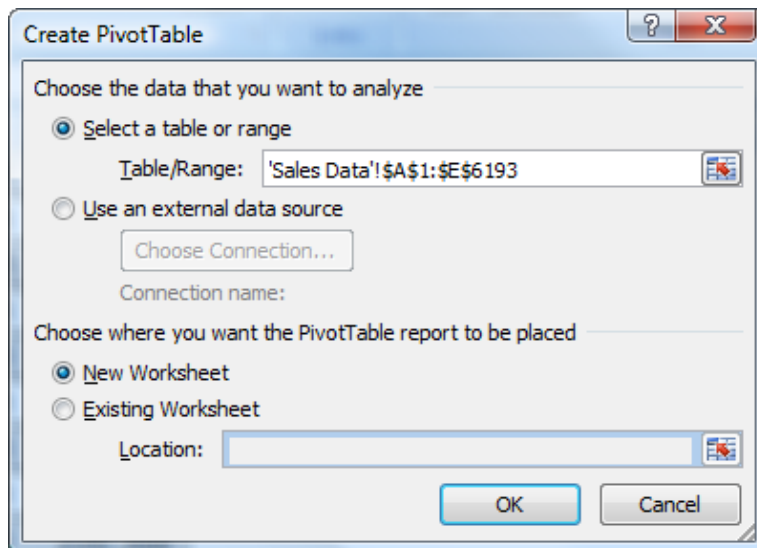
Figure 6 - Create PivotTable Dialog Box

Upon clicking **OK** in the **Create PivotTable** dialog box shown in **Figure 6,** Excel displays the **PivotTable Field List** and an outline of the PivotTable as shown in **Figure 7.**
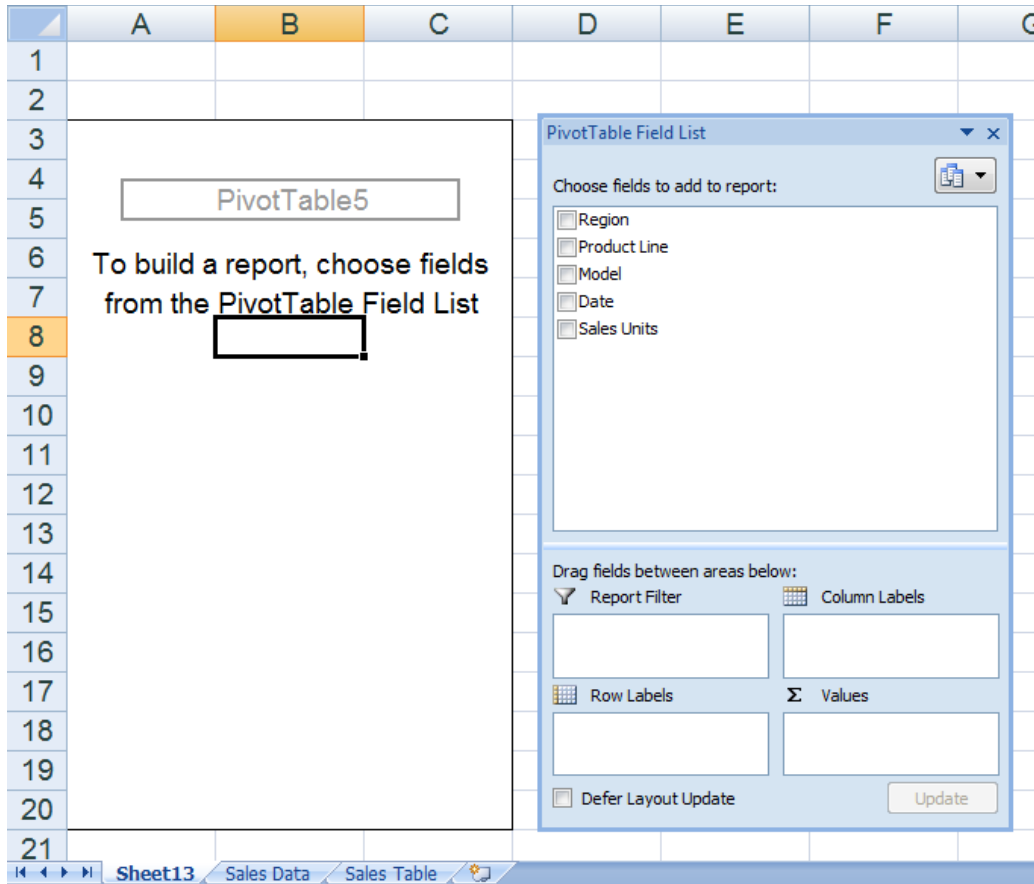
Figure 7 - Creating a PivotTable

In the PivotTable Field List, click and drag the items to display in the PivotTable into the appropriate quadrants in the bottom half of the PivotTable Field List to finish constructing the basic PivotTable. For example, to construct the PivotTable with Dates as columns, Models as rows, Sales Units summed at the intersection of each unique combination of Date and Model, and Region and Product as top-level filters, drag each of those fields to the quadrants as shown in **Figure 8**.
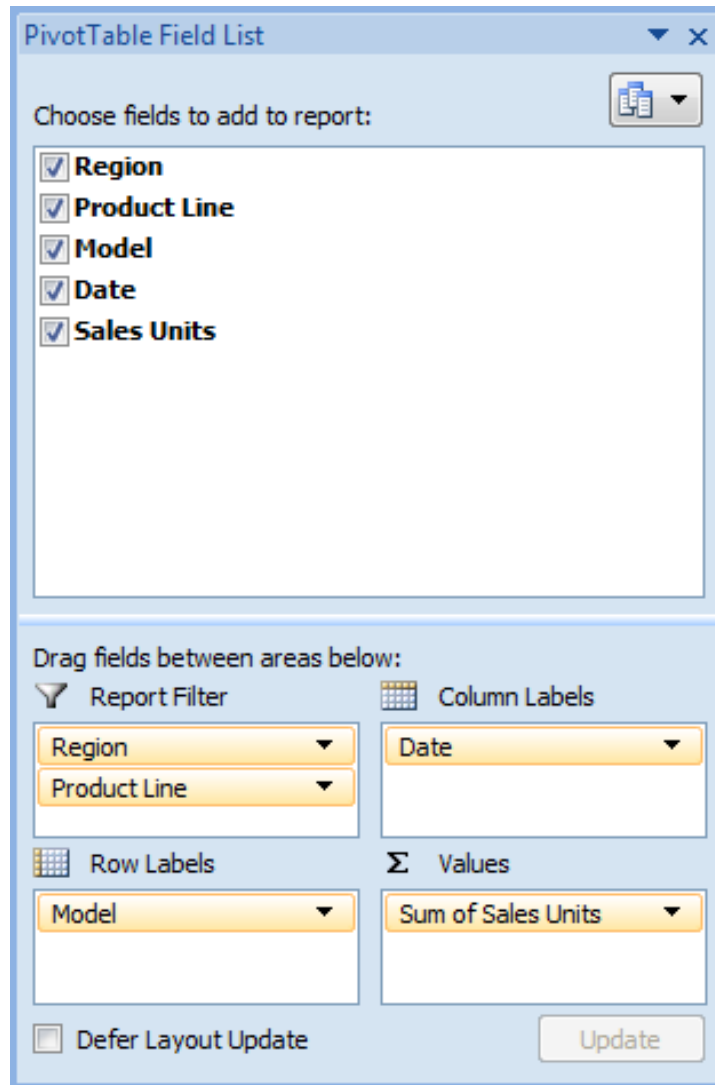
Figure 8 – Arranging Fields in the PivotTable Field List

Grouping Data

PivotTables' **Grouping** features allow users to extend the process of analyzing data in a PivotTable. Grouping can occur automatically – such as with dates – or users can create custom groups to facilitate specific needs. In the example shown in **Figure 9**, automatic grouping organizes the date data by months, quarters, and years. In this example, automatic grouping was accessed by right-clicking on one of the dates.
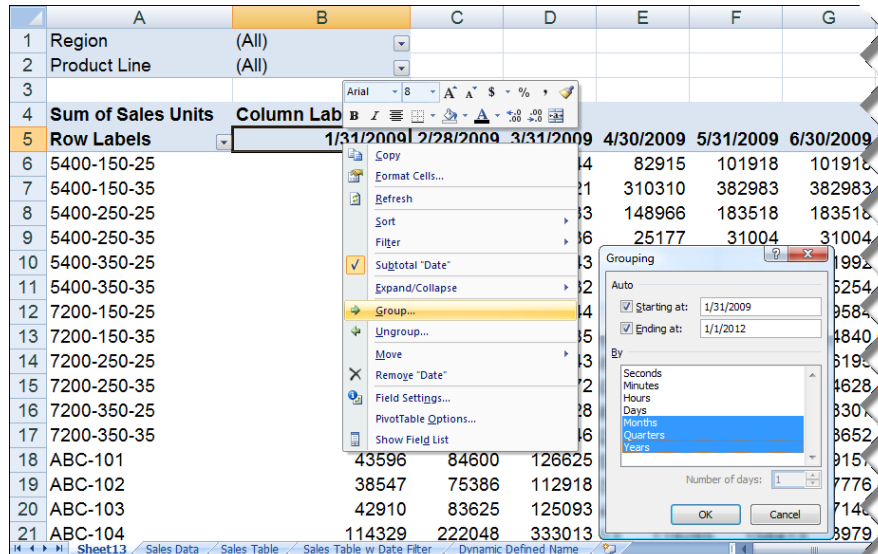

Figure 9 - Using Automatic Grouping in a PivotTable

Custom grouping allows users to group fields in any order desired. For instance, selecting all of the models that begin with "5400" and then right-clicking and choosing **Group** from the pop-up menu allows a user to create a custom grouping of all of the "5400 RPM Hard Disks" as shown in **Figure 10** (formatting applied). Note that custom grouping is also useful when grouping date-oriented data in fiscal years.

Figure 10 - Custom Grouping of Data in a PivotTable

PivotTables Based on Dynamic Defined Names

Prior to Excel 2007, tables were not available. Thus, if faced with a situation where the volume of data feeding into a PivotTable might change, users required a method of building the PivotTable so that it automatically reflected varying volumes of data. **Dynamic Defined Names** solve this, and potentially other problems, associated with building PivotTables.

A dynamic defined name is a defined name built based on a formula that causes the definition of the dynamic defined name to vary based on the volume of data present. The formula that creates the dynamic defined name typically depends on an **OFFSET** function and one or more **COUNTA** functions to create the named range based on a variable number of rows, columns, or both. To create a dynamic defined name, click **Define Name** in the **Formulas** tab of the Ribbon to open the **New Name** dialog box. There, enter the desired name to assign to the range and a formula that defines the range. For example, the formula shown **Figure 11** creates a dynamic defined name that:

- Is "anchored" in cell A1,
- Does not "jump over" any rows away from the "anchor" when defining the first row in the range,
- Does not "jump over" any columns away from the "anchor" when defining the first column in the range,
- Is as many rows long as is returned by the COUNTA function, and
- Is five columns wide.
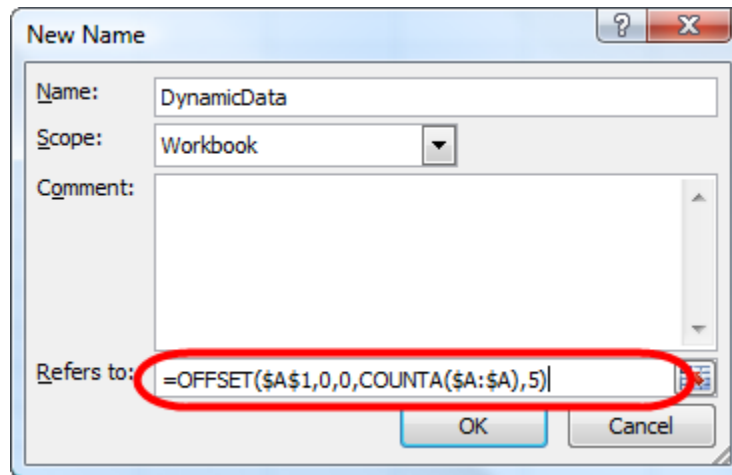
Figure 11 - Creating a Dynamic Defined Name

Whereas the dynamic defined name in **Figure 11** is dynamic with respect to the number of *rows*, the formula can be dynamic with respect to the number of *columns* by changing the location of the COUNTA function as shown in **Figure 12**. Likewise, users could modify the formula to include two COUNTA functions – one for the number of rows and one for the number of columns – so that the dynamic defined name was dynamic with respect to *both*.
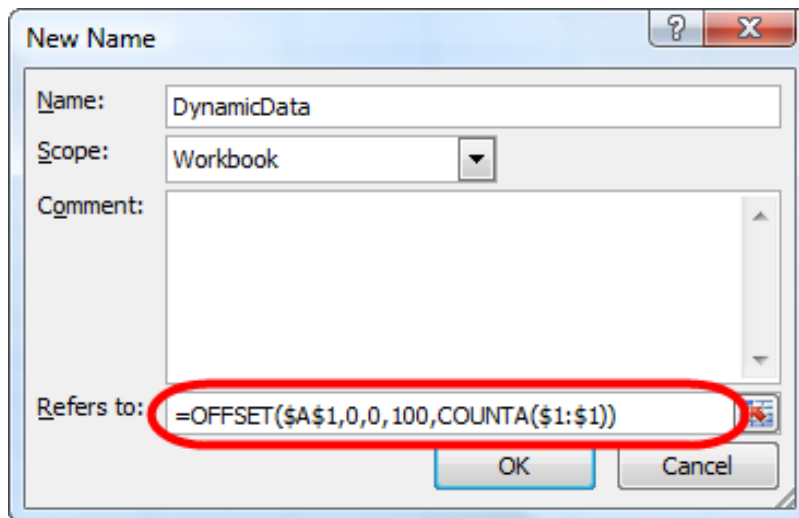
Figure 12 - Dynamic Defined Name Modified to be Dynamic with Respect to the Number of Columns

To build a PivotTable based on a dynamic defined name, click **Insert** and **PivotTable** from the Ribbon to open the **Create PivotTable** dialog box. In the Create PivotTable dialog box, enter the dynamic defined name as the data source for the PivotTable as shown in **Figure 13**. Thereafter, the process for completing the PivotTable is the same as for any other PivotTable.

Figure 13 - Creating a PivotTable Based on a Dynamic Defined Name

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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.
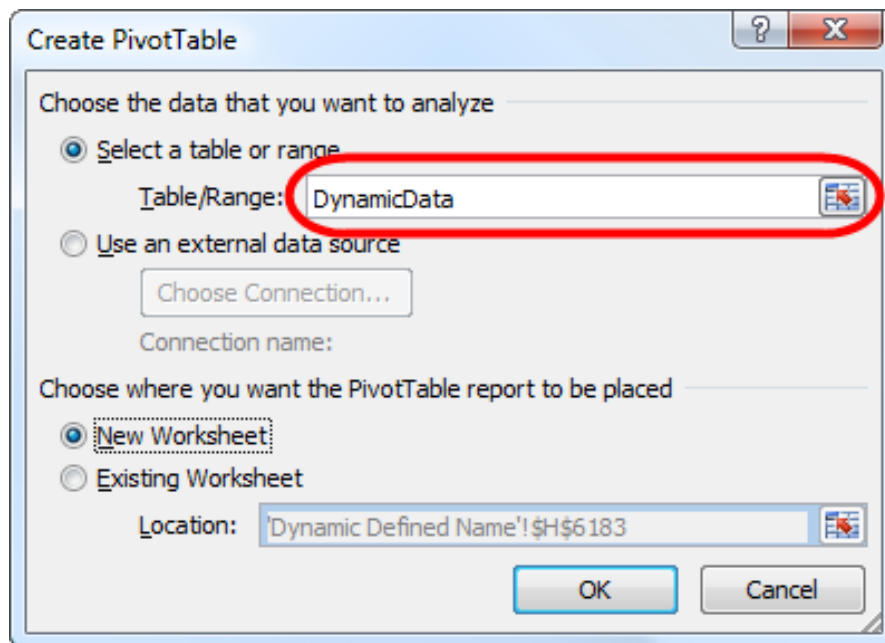
- **Auto Expansion** – Tables expand automatically to include new data entered in adjacent rows or columns. All styles, calculations, data validation, and conditional formats are applied to extensions.
- **Sorting** – Users can sort on unlimited columns and on font or fill colors. Sorts can be made case-sensitive.
- **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 14**.
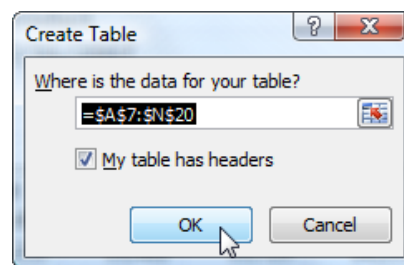

Figure 14 - Create Table Dialog Box

Click **OK** to create the table as shown in **Figure 15**. 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	988	9,737	8,614	8,988	11,235	13,482
3	Creme, Hand and Body, 16 oz	15, 88	16,887	14,939	15,588	19,485	23,382
4	Lotion, Organic Body, 9 oz	9,58	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	087	8,388	10,485	12,582	

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	588	16,887	14,939	15,588	19,485	23,382
4	Lotion, Organic Body, 9 oz	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
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 15 - 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.

PivotTables Based on Tables

Tables provide users with dynamic definitions of data – that is, as the volume of data in the Table changes, so, too, does the definition of the table and, by extension, any object (such as a PivotTable) that uses the table as its data source. This means that as users add or delete rows or columns to or from a table, any PivotTable based on the Table automatically reflects the new volume of data upon its next refresh.

As shown in **Figure 16**, to construct a PivotTable from a table, simply click inside the Table and choose **Summarize with PivotTable** from the **Table Tools Design** contextual tab on the Ribbon.
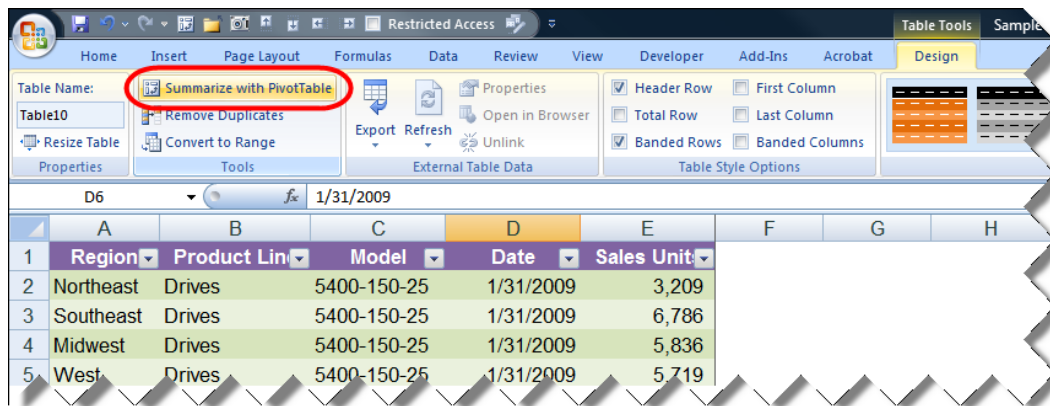

Figure 16 - Building a PivotTable from a Table

Upon clicking **Summarize with PivotTable**, the dialog box shown in **Figure 16** opens, and the remainder of the process for creating a PivotTable is unchanged from that described previously.

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 17** shows the results of our efforts.

Figure 17 - 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.

Let's continue with our example. First, name the table. Click inside the table and select **Table Tools, Design**. Enter **Sales** in the **Table Name** box.

Now, add some new records to the table. The easiest method is to position the cursor in the first blank row immediately below the table and to begin typing. Press **TAB** to advance the cursor to the next field. The table will automatically be expanded to include the new row. A new row can also be added by pressing **TAB** while in the last row of the most right-hand column of the table or by dragging the resize handle in the lower right-hand corner of the table to expand its size. Enter the following records in the sample table.

| 14 | Astringent, Facial, 9 oz | 15,744 | 17,056 | 15,088 | 15,744 | 19,680 | 23,616 |
| 15 | Astringent, Facial, 16 oz | 9,684 | 10,491 | 9,281 | 9,684 | 12,105 | 14,526 |

Next, let's add a column. The column will contain a formula to total sales by product for the last six months. Position the cursor in cell **I7**, type in the column label **Total**, and press **ENTER**. The table immediately expands to include the new column. Now, position the cursor in cell **I8**. To create the formula, perform the following steps:

1. Type in **=SUM(** and move left one cell to cell **H8**. (Do *not* press **ENTER**.)

2. Hold down the **SHIFT** key while using the **LEFT-ARROW** to expand the range to include cells **H8** through **H3**. (Do *not* press **ENTER**.)

3. Type in **)** to complete the formula and press **ENTER**.

Immediately, the formula will be copied down the full length of the column. Note the contents and format of the formula.

=SUM(Sales[@,[Jan]:[Jun]])

Note that the above formula represents how Excel 2010 creates structured referencing formulas. In Excel 2007, the formula would present as shown below.

=SUM(Sales[[#ThisRow],[Jan]:[Jun]])

In Excel 2010, think of the "@" sign in the formula as "shorthand" for "#ThisRow."

The format of this formula is known as **Structured Referencing**, which allows users to refer to columns, rows, or specific ranges within a table using tags. Try this: position your cursor in any cell *outside* of the table and then enter the formula below.

=SUM(Sales[Apr])

The formula totals sales for April – and it doesn't matter if the table contains 100 records or 500,000! Add another record, and the total will be updated to include whatever sales amount was entered for April.

At first glance, auto-expansion of tables may appear to be just another ho-hum feature, but beneath this facade lurks great power because any formula, chart, or PivotTable that references the table will automatically incorporate any new data added to the table. Have you heard of named dynamic ranges? Tables in Excel can perform the same function but without the need for creating defined names based on complex formulas that average users have little chance of understanding or applying.

Let's add a totals row to the sample table. Position the cursor inside the table. Select the **Table Tools, Design** tab. Now, check **Total Row** in the **Table Style Options** group. A grand total is appended to the bottom of the table in the Total column. Click on the cell containing the total and then click the drop-down arrow to select the desired summarizing function. Let's use **SUM**, which is the default. Notice the formula in the Formula Bar. Excel entered the **SUBTOTAL** function instead of SUM, so that the total will not include hidden rows when the table is filtered. The process described is shown in **Figure 18**.
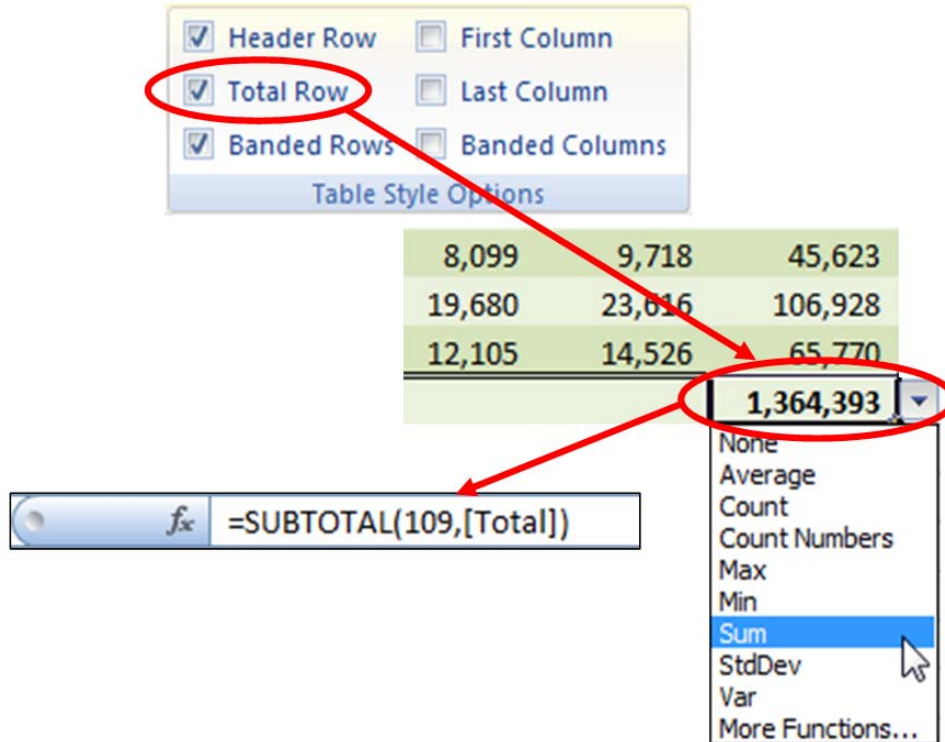
Figure 18 - Adding Totals to a Table

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.

Our sample table should now resemble the one shown in **Figure 19**.

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	16,887	14,939	15,588	19,485	23,382	105,869
4	Lotion, Organic Body, 9 oz	9,588	10,387	9,189	9,588	11,985	14,382	65,119
5	Lotion, Organic Body, 16 oz	17,988	19,487	17,239	17,988	22,485	26,982	122,169
6	Lotion, Organic Body, 24 oz	26,388	28,587	25,289	26,388	32,985	39,582	179,219
7	Lotion, Extra Moisturizing Body, 9 oz	8,388	9,087	8,039	8,388	10,485	12,582	56,969
8	Lotion, Organic Hand and Body, 9 oz	10,188	11,037	9,764	10,188	12,735	15,282	69,194
9	Lotion, Organic Hand and Body, 16 oz	19,188	20,787	18,389	19,188	23,985	28,782	130,319
10	Mask, Organic Facial, 9 oz	16,788	18,187	16,089	16,788	20,985	25,182	114,019
11	Mask, Wrinkle Reducing Facial, 9 oz	22,788	24,687	21,839	22,788	28,485	34,182	154,769
12	Mask, Wrinkle Reducing Facial, 16 oz	5,399	4,679	4,139	4,319	5,399	6,478	30,413
13	Mask, Wrinkle Reducing Facial, 24 oz	8,099	7,019	6,209	6,479	8,099	9,718	45,623
14	Astringent, Facial, 9 oz	15,744	17,056	15,088	15,744	19,680	23,616	106,928
15	Astringent, Facial, 16 oz	9,684	10,491	9,281	9,684	12,105	14,526	65,770
Total		203,194	217,202	192,146	200,494	250,618	300,740	1,364,393

Figure 19 - Sample Table with Added Rows and a Total Column

The total row can be turned on or off in **Table Style Options**. The row remembers its content and layout so that the next time it is turned on, it will display just as it did before it was turned off.

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 20 – 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			f_x	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 21 – 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 22**. 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.

Figure 22 - Table with Simple Filter Applied

Our next example uses check data exported from QuickBooks. Rod Hesson, the owner of Hesson Flooring, hired us to help him analyze his check payment history. In preparation for the engagement, he exported a list of check data for the past two years from QuickBooks. First, place the cursor in the data and convert it to a table by any means with a style of your choice. Name the table **Checks**. After those tasks are complete, the table should resemble the one shown in **Figure 23**.

Figure 23 - Table Created from QuickBooks Check Data

The table has nearly 200 records. To begin the analysis, filter the data on the **Date** field so that only checks for the current year are displayed. Click on the filter drop-down in the **Date** column. Click on **Date Filters,** and then on **This Year,** to set the filter as shown in **Figure 24**. Only checks dated during the current calendar year are now visible in the table.
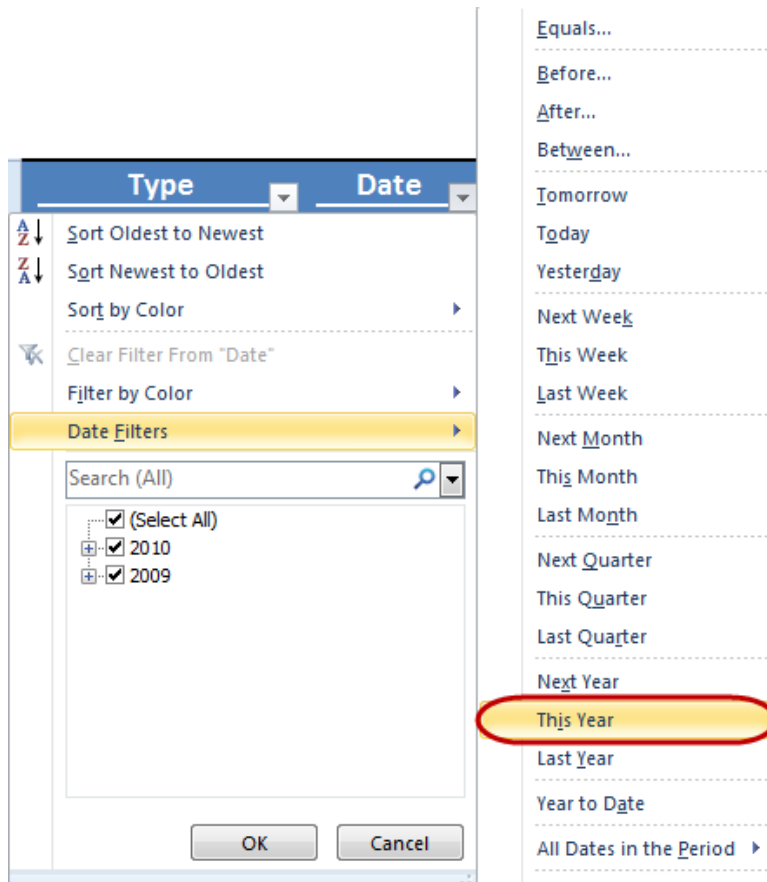
Figure 24 - Setting a Predefined Date Filter

Our attention is focused on those checks that were written for amounts of at least $1,000. Using a similar process, set a filter on the **Amount** field so that only checks with amounts of $1,000 or more are displayed. Click on the filter drop-down in the **Amount** column. Click on **Number Filters** and then on **Greater Than Or Equal To**. In the **Custom AutoFilter** dialog box, enter **1000** as the amount. Click **OK** to set the filter as shown in **Figure 25**. Only checks with amounts of $1,000 or more are now visible in the table.

Now, let's sort the data. Click on the filter drop-down in the **Amount** field. Select **Sort Largest to Smallest** so that the largest check amounts are at the top of the list. Next, do another simple sort so that the name of the payee is in alphabetical order. Click on the filter drop-down in the **Name** field. Select **Sort A to Z** so that the list is in ascending order. Note that when a sort is active, the filter drop-down has a small arrow pointing up or down to indicate the direction of sort in the field.

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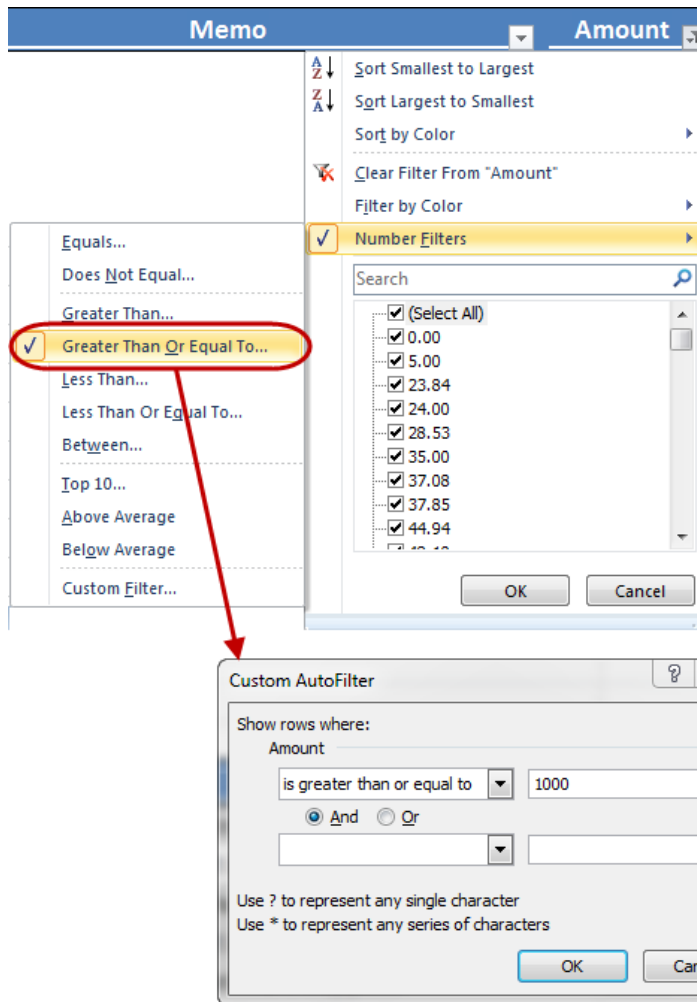
Figure 25 - Setting a Filter on Numerical Data

The two latest versions of Excel allow sorting on up to 64 fields simultaneously – more of a theoretical limit than a practical one for most users. Click on the filter drop-down in the **Name** field. Select **Sort by Color, Custom Sort** to display the **Sort** dialog box shown in **Figure 26**.
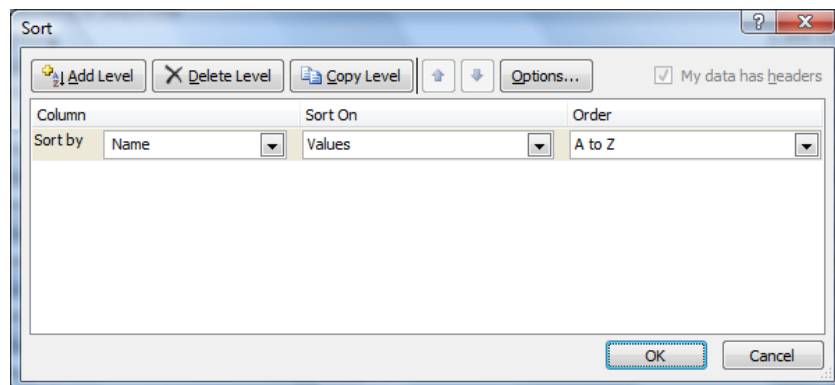

Figure 26 - The Custom Sort Dialog Box

Click **Add Level** to add another sort criterion. In the **Then by** box, select **Type**. In the **Sort On** box, choose **Values**. Note that a column can be sorted on values, cell color, font color, or cell icon (from an icon set). In the **Order** box, select **Z to A**. Again, click **Add Level** to add yet another sort criterion. In the **Then by** box, select **Amount**. In the **Sort On** box, choose **Values**. In the **Order** box, select **Largest to Smallest**.

Hesson would like to see his data sorted first on check Type, then Name, and then Amount. Click on the row identified as **Then by Type**. With the row highlighted, click the small blue arrow at the top of the dialog box to move **Type** to the top of the sort order as shown in **Figure 27**.
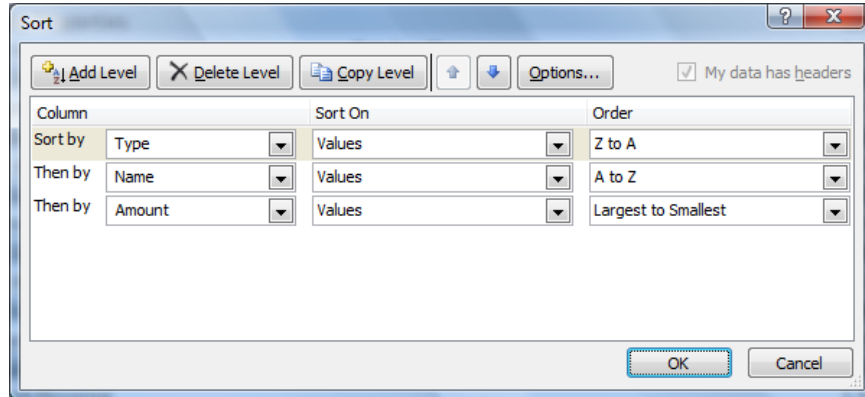

Figure 27 - Specifying a Custom Sort Order

The results of the sorting exercise are shown in **Figure 28**.

Type	Date	Num	Name	Memo	Amount
Sales Tax Payment	11/03/2010	230	State Board of Equalization	ABCD 11-234567	1,911.91
Sales Tax Payment	12/10/2010	285	State Board of Equalization	ABCD 11-234567	1,469.30
Check	12/15/2010	196	Daigle Lighting		2,000.00
Check	06/01/2010	301	Davis Business Associates		2,100.00
Check	11/30/2010	264	Great Statewide Bank		1,304.45
Check	10/30/2010	220	Great Statewide Bank		1,294.52
Check	12/01/2010	265	Reyes Properties		1,200.00
Check	10/15/2010	210	Rod Hesson	October Draw	3,000.00
Check	11/15/2010	247	Rod Hesson	November Draw	3,000.00
Check	06/28/2010	300	Sergeant Insurance		1,786.00
Check	04/08/2010	151	Timberloft Lumber		1,080.73
Bill Pmt -Check	12/05/2010	271	C.U. Electric		1,500.00
Bill Pmt -Check	05/23/2010	162	Custom Kitchens of Bayshore		3,076.32
Bill Pmt -Check	06/27/2010	169	Custom Kitchens of Bayshore		3,076.32

Figure 28 - Table Sorted on Type, Name, and Amount

Hesson would like to re-sort the data by check Type, Amount, and then payee Name. To do so, re-visit the **Sort** dialog box to rearrange the sort order.

> ⓘ To perform a _case-sensitive_ sort or to sort _across columns,_ click on the **Options** button in the **Sort** dialog box. To clear all active sorts and filters, position the cursor in the table and select **Home, Sort & Filter, Clear**. This will reposition the data to its original order.

For the next example, clear the active sorts and filters. Position the cursor in the table and select **Sort & Filter, Clear** on the **Home** tab of the Ribbon. Re-filter the table by any means so that only checks written in 2010 and with amounts of $1,000 or more are displayed. Add a total row to the table by checking **Total Row** on the **Table Tools, Design** tab. Note that the total row is off the screen at the bottom of the table. Position the cursor inside the table. Use the scroll bar on the right to _slowly_ scroll down to see the total row. Watch as the table header row approaches the top edge of the worksheet grid and then becomes embedded in the columnar headings as shown in **Figure 29**. In other words, the column headings A, B, C, etc., become Type, Date, Num, etc. This innovation insures that table headings never scroll off of the screen, reducing the need to use Excel's **Freeze Panes** tool.

Figure 29 - Table Headings Embedded in Worksheet Columnar Headings

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 30**.

	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 30 - 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 30. 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.

> (i) 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 a 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 31**. Click **OK** and then **OK** again to confirm the removal. Sort the **Name** column in ascending order to complete the task.
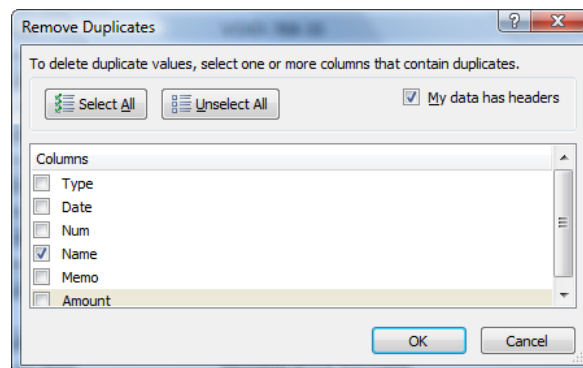

Figure 31 - Selecting Columns from Which to Remove Duplicates

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 32**.
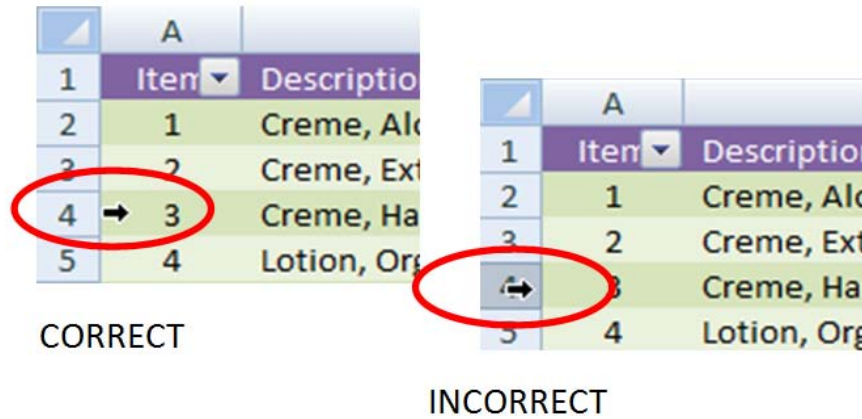

Figure 32 - Positioning Cursor Properly to Insert Row in Table

Similarly, to select a column, position the cursor just at the top margin of the table above the column label. The cursor will change to a small dark arrow pointing down to the inside of the table. Click once to select the data and click twice to select the entire column, including the heading and total row. Right-click and select **Insert, Table Columns to the Left** to insert a column in the table but _not_ in the surrounding worksheet. If the cursor is positioned too far to the top, in the worksheet column reference, the entire column in the worksheet will be selected. Rows and columns can be selected and _deleted_ without affecting the surrounding worksheet using a similar process. Selected rows or columns can be dragged to new positions within a 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 33**.
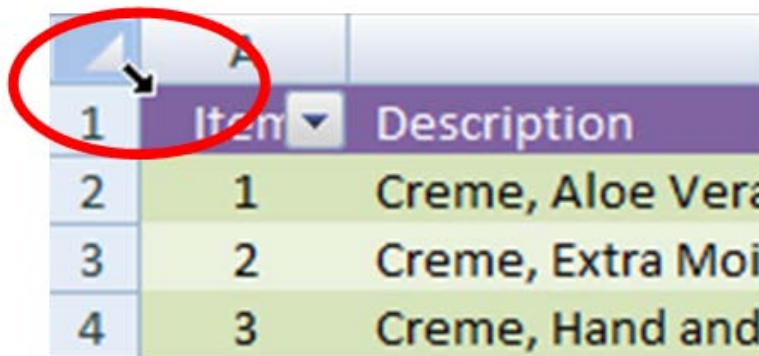

Figure 33 - Positioning Cursor to Select Entire Table

30

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.

Using Advanced Filters to Identify Unique Records

Now, let's return to identifying or creating a list of unique records in our table. Recall that Hesson would like to have a sorted list of all payees who received a check in 2009 or 2010. Click on the heading for the **Name** column. Select **Data** and then **Advanced** in the **Sort and Filter** group.
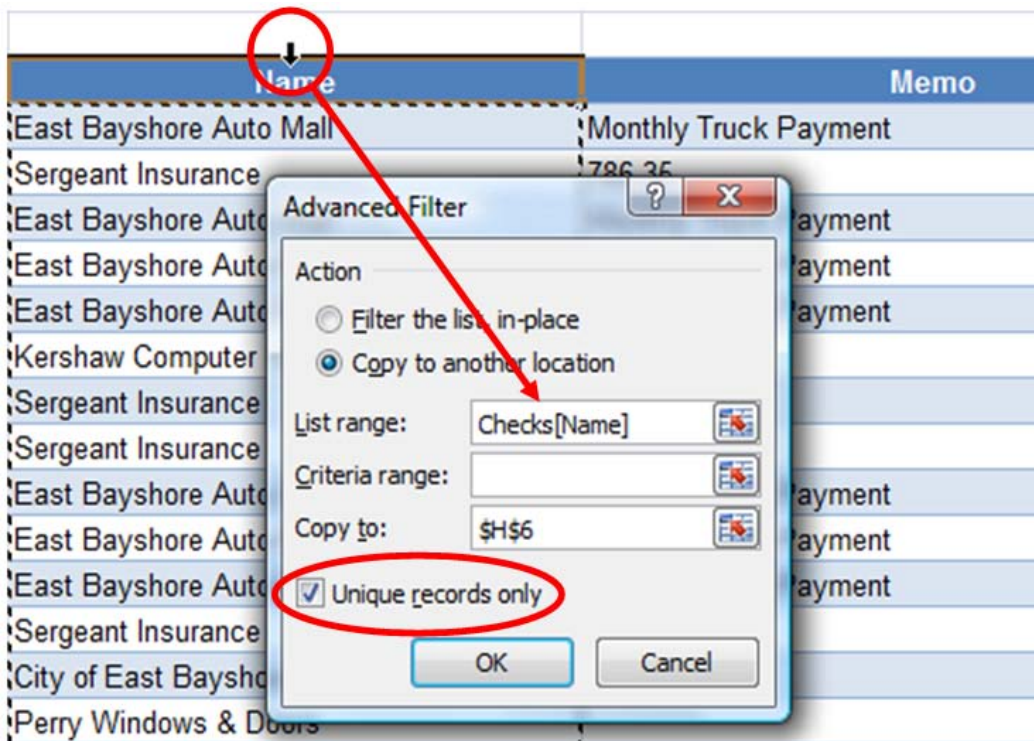
In the **Advanced Filter** dialog box, shown in **Figure 34**, select **Copy to another location**. Click in the **List range** box and then select the data range for the **Name** column. Click the top of the column, as shown in Figure 34, until the range reference reads **Checks[Name]**. Click in the **Copy to** box and enter **H6**. Check **Unique records only** and click **OK** to create the list. Cut and paste the list to another worksheet, sort the list in ascending order, and add formatting, as required, to complete the task. Note that a list _cannot_ be extracted to another worksheet. Also, note that our advanced filter could have been used to filter the list in place. In other words, the table list could have been filtered to display unique records in the table. Subsequently, sorting the **Name** column would have produced similar results.

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 35**. Click **OK** to apply the conditional formatting.
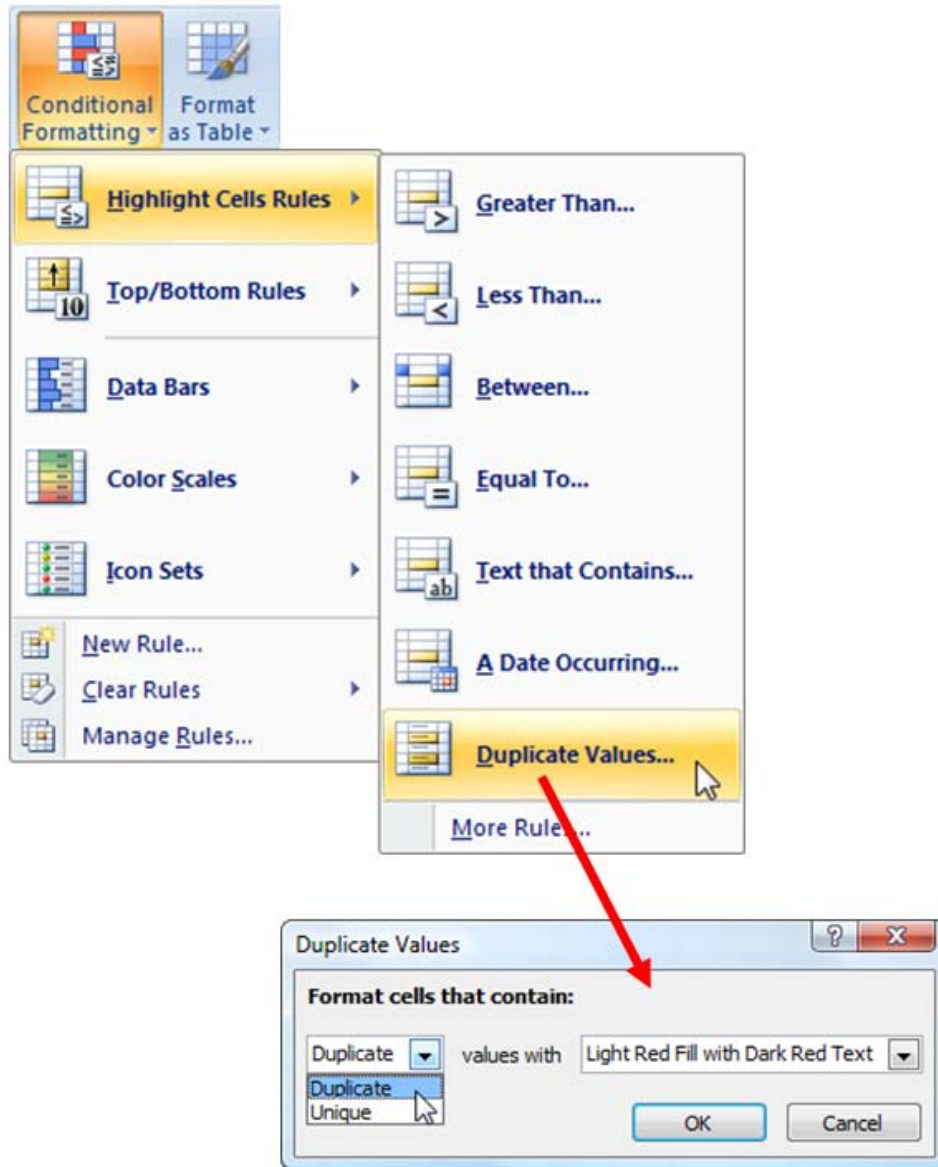
Next, filter the **Num** column to display only the duplicate values. Click the filter drop-down arrow and select **Filter by Color**. Choose **Filter by Font Color** and select the deep red bar as shown in **Figure 36.**
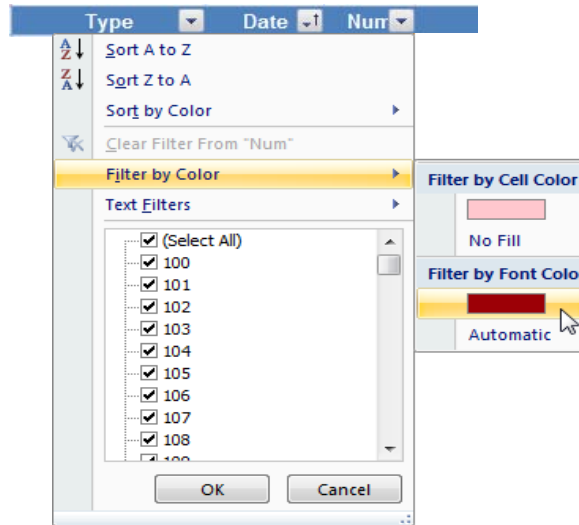
Figure 36 - Filtering a Column by Font Color

The results are shown in **Figure 37**. If you have ever scrolled through a sorted list looking for duplicate check numbers, then you understand the effectiveness of the method demonstrated.

Type	Date	Num	Name	Memo	Amount
Bill Pmt -Check	09/15/2010	196	Thomas Kitchen & Bath	R 55-801	7,719.95
Check	12/15/2010	196	Daigle Lighting		2,000.00
Total					9,719.95

Figure 37 - Filtering by Color to Identify Duplicate Check Numbers