

K2's Eight Awesome PivotTable Features...And More!

Are you looking to take your PivotTables to the next level? Many experts consider PivotTables to be Excel's most powerful feature. Yet, most who create and work with them barely scratch the surface of all that PivotTables can do. In this session, you'll learn eight powerful features you may have missed. From user-defined calculations to consolidating reports and adding KPIs, we'll show you how to get the most out of your PivotTables. These are just some examples of the great things you can do with PivotTables, and in this session, you will learn these and other techniques to make your PivotTables even more powerful.



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Introduction

Are you looking to take your PivotTables to the next level? Many experts consider PivotTables to be Excel's most powerful feature. Yet, most who create and work with them barely scratch the surface of all that PivotTables can do. In this session, you'll learn eight powerful features you may have missed. From user-defined calculations to consolidating reports and adding KPIs, we'll show you how to get the most out of your PivotTables. These are just some examples of the great things you can do with PivotTables, and in this session, you will learn these and other techniques to make your PivotTables even more powerful.

Learning Objectives

Upon completing this session, you should be able to:

1. Identify three types of user-defined calculations in PivotTables;
2. List the steps necessary to add Key Performance Indicators to PivotTables;
3. Name at least two benefits of using PivotTables for data consolidation needs;
4. Differentiate between Slicer and Timeline filters; and
5. Cite potential benefits of linking data into PivotTable reports.

Understanding PivotTables In Detail

What is a PivotTable?

A PivotTable report is a cross-tabular, interactive report that extracts, organizes, and summarizes data. You can use a PivotTable to analyze data, such as making comparisons, detecting patterns and relationships, or uncovering trends. PivotTables are extremely useful for efficiently and effectively summarizing and analyzing substantial amounts of data. For example, an accountant might need to condense an Excel-based check register into a report of cash disbursements by month to prepare a financial statement. Alternatively, a public practitioner evaluating audit risk may need to summarize all bill payment checks by vendor and quarter. In both examples, users would like to drill into the summarized totals in the report to see the detailed transactions that underlie the calculations. PivotTables can provide this functionality – and much more! – quickly and with computational accuracy.

Primary Benefits Associated with PivotTables

PivotTables provide numerous benefits for those who choose to use them. Among these are:

- Automatic summarization of data, using eleven summarization options, reducing dependency on formulas;
- Drill-through capabilities to underlying details;
- The ability to summarize data across multiple dimensions;
- Automatic recognition of dates in PivotTables, with related automatic summarization by different date levels;
- The availability of predefined formatting options;
- The ability to add a user-defined calculation to PivotTables;
- Creating PivotCharts to express the data summarized in a PivotTable in a graphical environment; and
- Sorting and filtering data quickly and easily.

Although each of the benefits outlined above is beyond the scope of this session, it should become abundantly clear to all that PivotTables are Excel's best feature and, equally important, one of its easiest-to-use features.

The Six Main Elements of a PivotTable

Excel uses specific terms to identify the elements of a PivotTable report. The six primary components, shown in **Figure 1**, are filters, values fields, columns, items, rows, and the data area.

	A	B	C	D	E
1	Vendor	(All)			
2					
3	Sum of Amount	Quarter			
4	Account	Qtr1	Qtr2	Qtr3	Qtr4
5	Beverages	14,620.76	14,630.86	16,476.61	14,706.65
6	Food	72,545.64	70,502.27	69,699.27	75,644.18
7	Insurance	1,281.99	1,281.99	1,521.07	1,640.61
8	Payroll Expense	75,715.47	83,907.75	90,288.01	97,520.26
9	Rent	7,200.00	7,200.00	7,200.00	7,200.00
10	Supplies	4,778.96	6,032.00	5,235.41	5,689.92
11	Utility Expense	5,130.76	7,217.52	7,949.89	5,207.34

Figure 1 – The Six Primary Elements of a PivotTable

1. **Filters** are fields from the source data that act as filters in a PivotTable report. In the example presented in Figure 1, *Vendor* is a filter. You can use the Vendor field to display data from a single vendor or multiple vendors. Filters are optional, and you can use numerous filters if desired.
2. **Values Fields** are fields from the source data that contain the values you will summarize in your PivotTable. For example, *Amount* is a values field in Figure 1. You can choose how to compile the numerical data based on eleven options: sum, count, and average. You can count the times a specific text entry appears in a field for text data.
3. **Columns** are fields from the source data you assign to a vertical layout. For example, *Quarter* is a column field in Figure 1.

4. **Items** are the subcategories of a row, column, or report filter. In this example, the *Quarter* field contains four elements: *Qtr1*, *Qtr2*, *Qtr3*, and *Qtr4*. Further, the *Account* field includes seven items: *Beverages*, *Food*, *Insurance*, *Payroll Expense*, *Rent*, *Supplies*, and *Utility Expense*.
5. **Rows** are fields from the source data that make up the row layout in a PivotTable. As an example, *Account* is a row field in Figure 1.
6. The **Data Area** is the range of cells in a PivotTable report containing summarized data. In Figure 1, cells B5 through E5 represent the *Data Area*. For example, the value in cell B5 totals sales for *Beverages* and *Qtr1*. In other words, cell B5 summarizes the cash disbursements for every row in the source data that contains disbursement data in the first quarter and beverage expenditures.

Now that we understand what a PivotTable is and are familiar with Microsoft's terminology to describe a PivotTable's various elements, let us turn our attention to creating PivotTables.

Creating Simple PivotTables

Even the simplest PivotTables provide a substantial portion of the tool's productivity and information analysis benefits. In other words, you need not be a PivotTable expert or know how to apply the advanced features of PivotTables to take advantage of their power and functionality. As our PivotTables become more complex, the learning required to use their more sophisticated features diminishes. For most analyses, a simple PivotTable that auto-summarizes or auto-tabulates our data will benefit and provide all the power we need.

The table in **Figure 2** contains a restaurant owner's Excel-based check register. Each row includes the details of checks written during the year. The spreadsheet contains five data columns: *Date*, *Check Number*, *Amount*, *Vendor*, and *Account*. This data serves as the data source for our first PivotTable examples.

The sample data set includes details for 430 checks, whereas other data sets may have thousands, tens of thousands, hundreds of thousands, or even millions of rows. Further, the data that underlies PivotTables need not reside in Excel. Practically, there are no limits on the amount of data you can summarize in a PivotTable, but the more information there is, the greater the power of PivotTables. However, arranging your data in a tabular fashion – with column headers and, preferably, no blank rows – is imperative to facilitate quick-and-easy PivotTables.

	A	B	C	D	E
1	Date	Check Number	Amount	Vendor	Account
2	1/1/2021	2154	\$ 1,395.29	Fresh Meats, Inc.	Food
3	1/2/2021	2155	\$ 998.13	Wholesale Beverage	Beverages
4	1/2/2021	2156	\$ 1,221.47	Fresh Meats, Inc.	Food
5	1/2/2021	2157	\$ 6,234.56	Adams & Jefferson, CPAs	Payroll Expense
6	1/3/2021	2158	\$ 1,341.25	Farmer's Produce	Food
7	1/3/2021	2159	\$ 2,400.00	Washington Properties, LLC	Rent
426	12/27/2021	2578	\$ 1,245.76	Fresh Meats, Inc.	Food
427	12/27/2021	2579	\$ 439.59	RSI, Inc.	Supplies
428	12/28/2021	2580	\$ 1,584.08	Farmer's Produce	Food
429	12/28/2021	2581	\$ 7,039.73	Adams & Jefferson, CPAs	Payroll Expense
430	12/30/2021	2582	\$ 1,223.16	Fresh Meats, Inc.	Food
431	12/31/2021	2583	\$ 802.33	Fresh Meats, Inc.	Food

Figure 2 - Data for Simple PivotTable Examples

In our first example, we would like to tabulate cash disbursement figures by account and by expenditure date to produce a set of financial statements. Our completed PivotTable will have rows for Account and Date, and columns for the other fields.

One easy way to create the desired PivotTable is to use Excel's **Recommended PivotTable** feature. With Recommended PivotTables, you can click anywhere in your data range and choose **Recommended PivotTables** from the **Ribbon's Insert tab**. Upon doing so, Excel will automatically create your PivotTable for you, even offering several arrangements for your report from which you can choose. This process can be highly effective when you're in a hurry to build a simple PivotTable.

Alternatively, you can create a PivotTable using a more traditional method by following these steps.

1. Place the cursor in the data and choose **PivotTable** from the **Insert** tab, as shown in **Figure 3**.

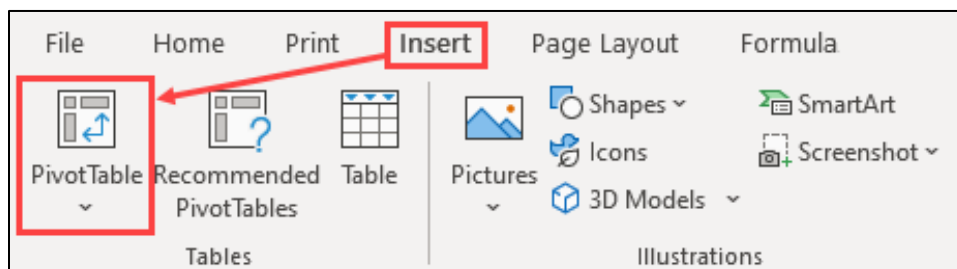


Figure 3 - Select PivotTable from the Insert Tab

2. In the resulting **Create PivotTable** dialog box, shown in

- Figure 4, the data range should already reside in the dialog box. If not, click the **Collapse Dialog** button and select the data range. Ensure your entire data range is selected, including the field names at the top of the columns. Next, select **New Worksheet** and then click **OK**. Note that a Table can serve as a dynamic data range for a PivotTable.

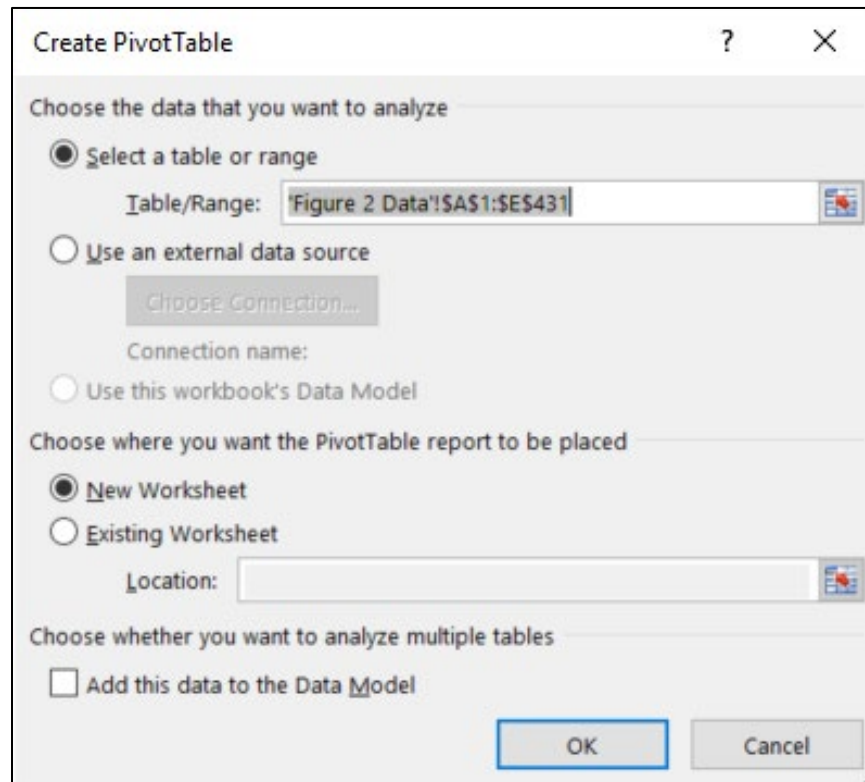


Figure 4 - Highlighting the Data Range and Selecting New Worksheet

- A new worksheet like the one shown in **Figure 5** appears in the workbook. On the left side of the worksheet is a placeholder for the PivotTable. On the right side is the **PivotTable Task Pane**. You can customize the task pane layout to meet your needs. To do so, click the drop-down button in the top right corner of the task pane just below the title bar.
- The task pane contains the **PivotTable Field List** at the top and a quadrant of boxes into which fields are dragged from the list to create the PivotTable. The quadrants correspond to the four areas of a PivotTable report: *Filters*, *Columns*, *Rows*, and *Values*.

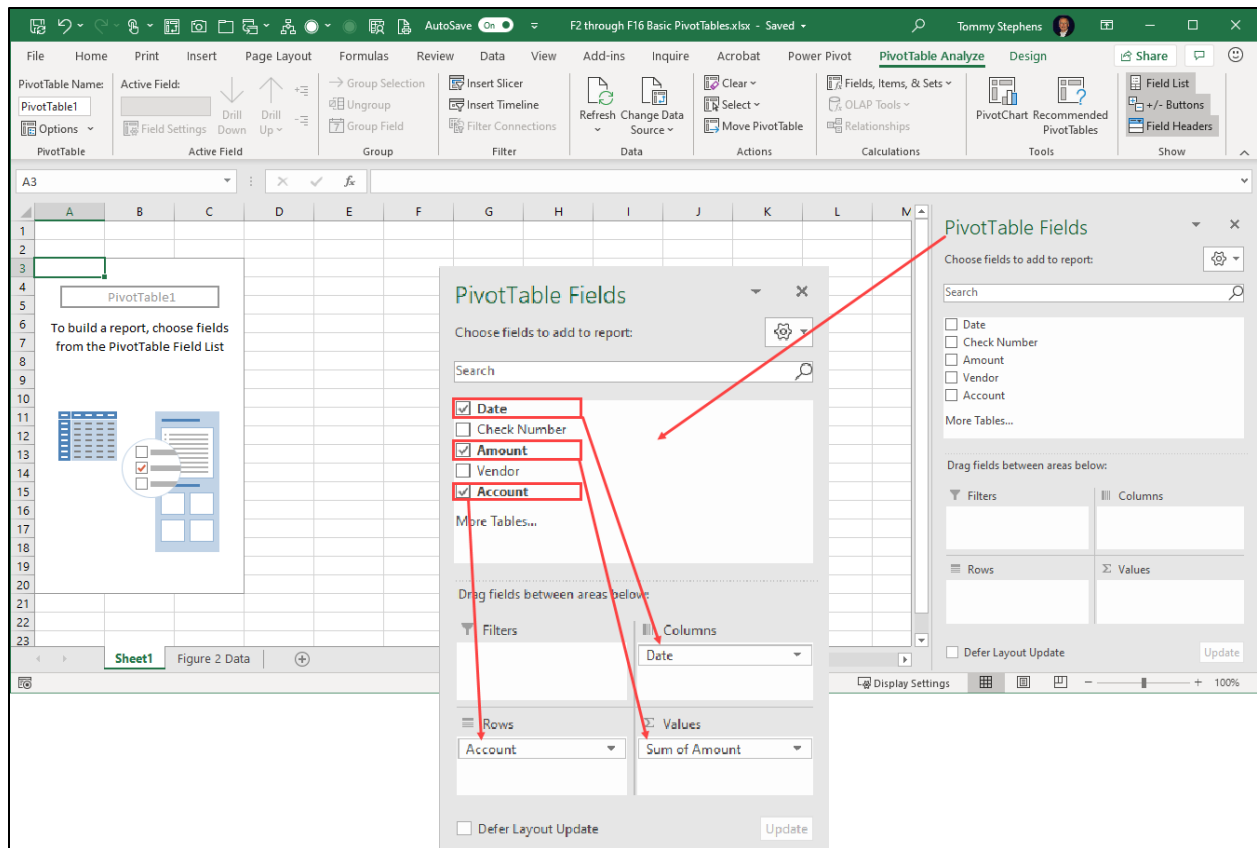


Figure 5 - Creating a PivotTable by Dragging Fields to the Quadrants

6. Drag each desired field from the list to the report quadrants, as shown in Figure 5.
7. Click on the **Date** field, hold down your left mouse button, drag and point to the **Columns** quadrant, and release your left mouse button.
8. Click on the **Account** field, hold down your left mouse button, drag and point to the **Rows** quadrant, and release your left mouse button.
9. Click on the **Amount** field, hold down your left mouse button, drag and point to the **Values** quadrant, and release your left mouse button.

We have just created our first PivotTable. **Figure 6** shows the results of our efforts. The table summarizes the raw data into a two-dimensional table with *Date* across the top and *Account* down the left margin. Also, note that Excel automatically totals each row and column. Further, once we add grouping options to the PivotTable to group the individual dates into months and quarters, the PivotTable will become more valuable.

	A	B	C	IS	IT	IU
1						
2						
3	Sum of Amount	Column Labels ▾				
4	Row Labels ▾	1-Jan	2-Jan	30-Dec	31-Dec	Grand Total
5	Beverages		998.13			60434.88
6	Food	1395.29	1221.47	1223.16	802.33	288391.36
7	Insurance					5725.66
8	Payroll Expense		6234.56			347431.49
9	Rent					28800
10	Supplies					21736.29
11	Utility Expense					25505.51
12	Grand Total	1395.29	8454.16	1223.16	802.33	778025.19

Figure 6 - Simple PivotTable Report Created with a Few Clicks

Grouping and Ungrouping Data

Now, let us examine some of the power of PivotTables. Let us group the dates by month and quarter to calculate and display monthly and quarterly totals for each account. Position the cursor in a cell containing one of the date column headings, such as **1-Jan**. Right-click and choose **Group** to open the **Grouping** dialog box. In the **By** box, click **Months** and **Quarters**, as shown in **Figure 7**. Click **OK** to complete the task.

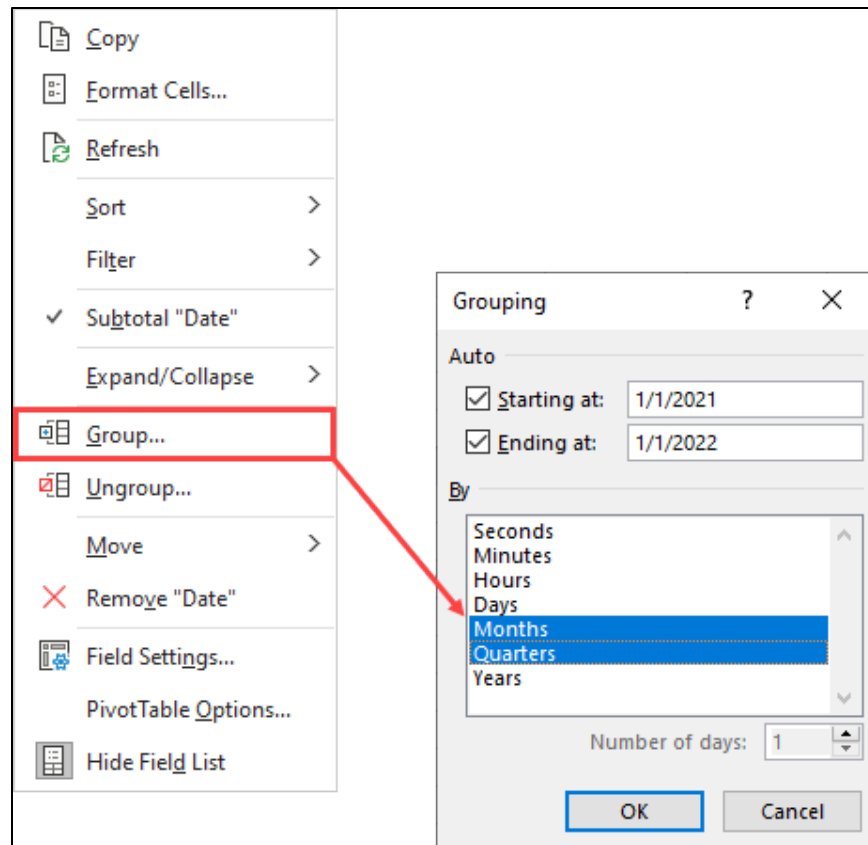


Figure 7 - Grouping Dates into Months and Quarters



In newer versions of Excel, you will notice that Excel offers the option of automatically creating date groupings whenever you add fields containing dates to your PivotTables. This feature can reduce or eliminate the need to manually group data, as described above.

Next, position the cursor in a cell containing one of the quarterly column headings, such as **Qtr1**. Then, right-click on the cell and select **Subtotal "Quarters"** from the context-sensitive menu to add a quarterly subtotal following each calendar year quarter. **Figure 8** shows the initial results, with only the first two quarters presented.

	A	B	C	D	E	F	G	H	I
1									
2									
3	Sum of Amount	Column Labels ▾							
4		⊖ Qtr1			Qtr1 Total	⊖ Qtr2			Qtr2 Total
5	Row Labels ▾	Jan	Feb	Mar		Apr	May	Jun	
6	Beverages	5098.91	4448.02	5073.83	14620.76	4966.58	4902.95	4761.33	14630.86
7	Food	25562.79	23221.12	23761.73	72545.64	24076.4	22816.73	23609.14	70502.27
8	Insurance	427.33	427.33	427.33	1281.99	427.33	427.33	427.33	1281.99
9	Payroll Expense	13658.24	32601.41	29455.82	75715.47	27649.05	27833.66	28425.04	83907.75
10	Rent	2400	2400	2400	7200	2400	2400	2400	7200
11	Supplies	1510.8	1632	1636.16	4778.96	2075.89	2218.97	1737.14	6032
12	Utility Expense	1541.68	2156.87	1432.21	5130.76	2794.58	1301.54	3121.4	7217.52
13	Grand Total	50199.75	66886.75	64187.08	181273.58	64389.83	61901.18	64481.38	190772.39

Figure 8 - 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 select **Expand/Collapse, Collapse Entire Field** from the context-sensitive menu. Months collapse into Quarters, and all the totals now reflect quarterly totals, as shown in **Figure 9**. You can control the detail shown in a field from the context-sensitive menu.

	A	B	C	D	E	F
1						
2						
3	Sum of Amount	Column Labels ▾				
4		⊕ Qtr1	⊕ Qtr2	⊕ Qtr3	⊕ Qtr4	Grand Total
5	Row Labels ▾					
6	Beverages	14620.76	14630.86	16476.61	14706.65	60434.88
7	Food	72545.64	70502.27	69699.27	75644.18	288391.36
8	Insurance	1281.99	1281.99	1521.07	1640.61	5725.66
9	Payroll Expense	75715.47	83907.75	90288.01	97520.26	347431.49
10	Rent	7200	7200	7200	7200	28800
11	Supplies	4778.96	6032	5235.41	5689.92	21736.29
12	Utility Expense	5130.76	7217.52	7949.89	5207.34	25505.51
13	Grand Total	181273.58	190772.39	198370.26	207608.96	778025.19

Figure 9 - Monthly Data Grouped into Quarters

Double-click on the cell of interest to see all the records underlying any calculation. Excel will insert a new sheet containing the detailed observations that created the cell contents. For example, if you click on cell D8, which includes an *Insurance* total of \$1,521.07 in our sample PivotTable, Excel will display the underlying detail, as shown in **Figure 10**. Note that Excel presents the data in Table form and format, making it easy to filter and analyze.

	A	B	C	D	E
1	Date ▾	Check Number ▾	Amount ▾	Vendor ▾	Account ▾
2	7/15/2021	2381	427.33	Gamble Insurance	Insurance
3	8/21/2021	2417	546.87	Gamble Insurance	Insurance
4	9/24/2021	2460	546.87	Gamble Insurance	Insurance

Figure 10 - Drilling to Detail from a PivotTable

Custom Groups

In the example, the PivotTable summarized data using built-in groups, such as consolidating months into quarters. However, Excel allows you to create user-defined groups. First, highlight the items you wish to group to accomplish this task. Then, right-click and select **Group** from the context-sensitive menu.

In the example PivotTable, we would like to group the accounts into two classifications for financial statement presentation – *Cost of Goods Sold* and *Operating Expenses*. Food and Beverages comprise the Cost of Goods Sold group, while all other items comprise the Operating Expenses group. Click on **Beverages**, hold down the **CTRL** key, and then click **Food** to create the groups. Next, right-click and choose **Group** from the context-sensitive menu. This action combines the first two accounts into a single group named **Group1**. Rename the **Group1** label to **Cost of Goods Sold** to complete the first group, as shown in **Figure 11**. You can rename by typing over it with the desired text.

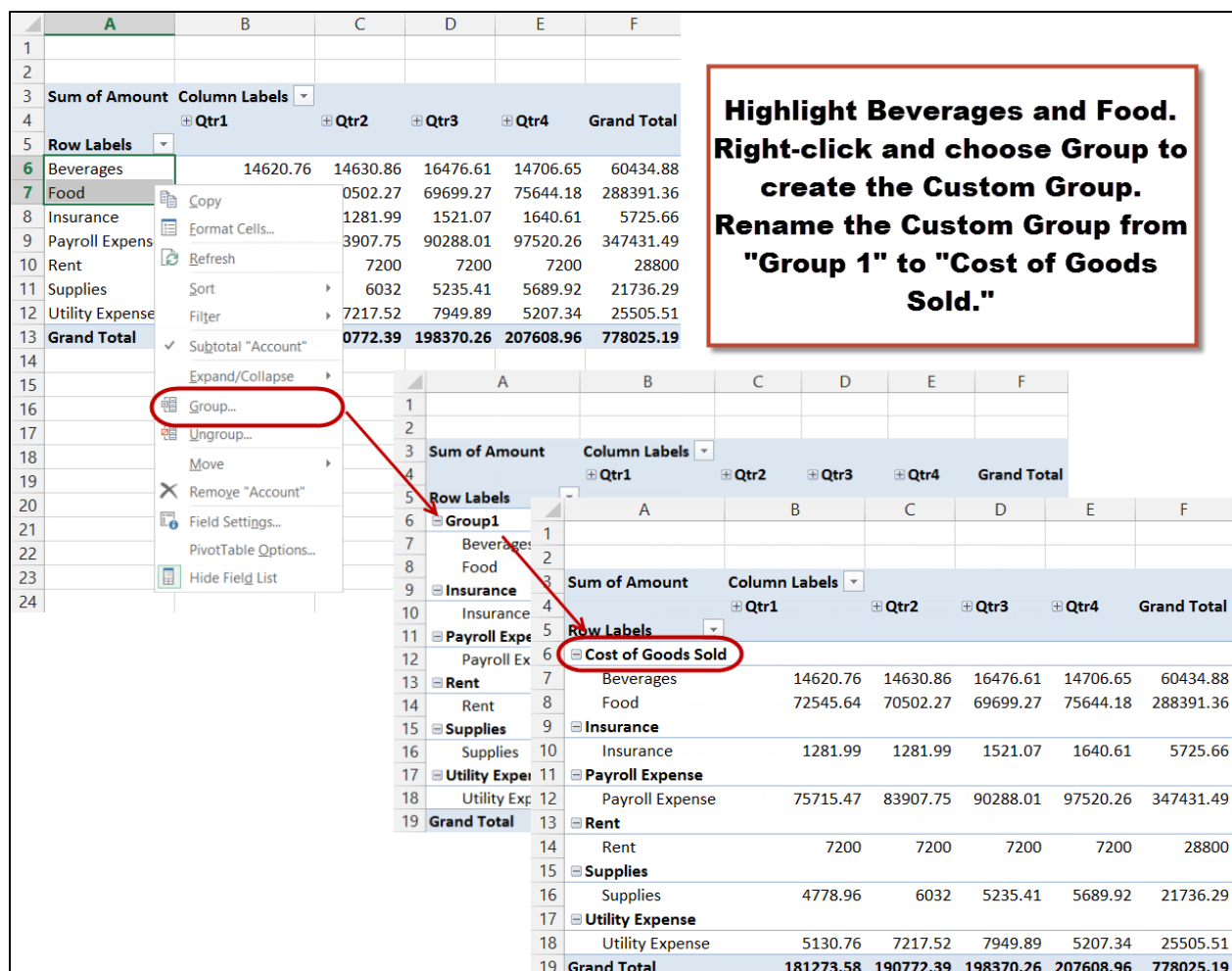


Figure 11 - Grouping Accounts into Account Groups

Repeat the steps for the remaining group, **Operating Expenses**. To complete the PivotTable, add subtotals for both groups. Position the cursor in a cell containing one of the group row headings, such as **Cost of Goods Sold**. Right-click on the cell and select **Subtotal "Account2"** from the context-sensitive menu to add a subtotal for the group. The completed report should resemble the one shown in **Figure 12**.

	A	B	C	D	E	F
1						
2						
3	Sum of Amount	Column Labels ▼				
4		⊕ Qtr1	⊕ Qtr2	⊕ Qtr3	⊕ Qtr4	Grand Total
5	Row Labels ▼					
6	▢ Cost of Goods Sold	87166.4	85133.13	86175.88	90350.83	348826.24
7	Beverages	14620.76	14630.86	16476.61	14706.65	60434.88
8	Food	72545.64	70502.27	69699.27	75644.18	288391.36
9	▢ Operating Expenses	94107.18	105639.26	112194.38	117258.13	429198.95
10	Insurance	1281.99	1281.99	1521.07	1640.61	5725.66
11	Payroll Expense	75715.47	83907.75	90288.01	97520.26	347431.49
12	Rent	7200	7200	7200	7200	28800
13	Supplies	4778.96	6032	5235.41	5689.92	21736.29
14	Utility Expense	5130.76	7217.52	7949.89	5207.34	25505.51
15	Grand Total	181273.58	190772.39	198370.26	207608.96	778025.19

Figure 12 - PivotTable with Account Groups and Subtotals



Note that you can rename the default field name – in this case, **Account2** – given by Excel to the account group in **Field Settings**. Right-click on any group label and select **Field Settings** from the context-sensitive menu. Type the desired field name, such as **Account Group**, in the **Custom Name** box and click **OK** in the **Field Settings** dialog box.

You can create custom groups by selecting and grouping any item within a field. Further, you may need to create custom groups when built-in groups do not align with a company's practices. For example, when grouping months into quarters, the predefined groups use a calendar year to define the quarters. However, a custom grouping based on fiscal periods could be necessary if a company uses a fiscal year instead.

Pivoting Columns and Rows

You can re-arrange – “pivot –” the summarized table to show the data from virtually any perspective. This feature is among the most powerful capabilities of PivotTables. For example, if you wanted to display Accounts as columns and Quarterly Totals as rows, you would re-arrange the rows and columns by dragging and dropping the fields into the quadrant boxes, as detailed below.

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 **Date** and **Account Group** to remove them from the report. Next, click **Quarters**, drag it into the **Rows** quadrant, and drop it below

Account. This action has the effect of reporting Quarters within Accounts, as shown in **Figure 13**.

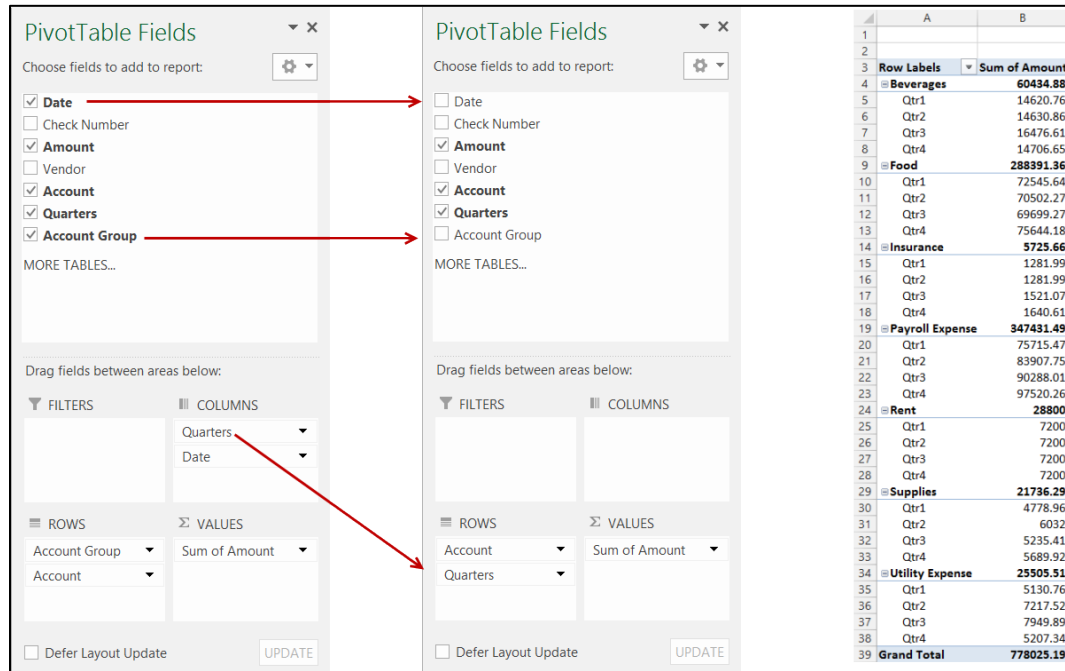


Figure 13 - Dragging Fields in the PivotTable Task Pane to Re-arrange a Report

- Now, click on **Account** and drag and drop it into the **Columns** quadrant. This step re-arranges the report so that Accounts are the columns and Quarters are the rows, as shown in **Figure 14**.

PivotTable Fields

Choose fields to add to report:

- ☐ Date
- ☐ Check Number
- ☒ **Amount**
- ☐ Vendor
- ☒ **Account**
- ☒ **Quarters**
- ☐ Account Group

MORE TABLES...

Drag fields between areas below:

FILTERS **COLUMNS**

ROWS **VALUES**

Account Sum of Amount

Quarters

☐ Defer Layout Update **UPDATE**

PivotTable Fields

Choose fields to add to report:

- ☐ Date
- ☐ Check Number
- ☒ **Amount**
- ☐ Vendor
- ☒ **Account**
- ☒ **Quarters**
- ☐ Account Group

MORE TABLES...

Drag fields between areas below:

FILTERS **COLUMNS**

ROWS **VALUES**

Quarters Sum of Amount

☐ Defer Layout Update **UPDATE**

	A	B	C	D	E	F	G	H	I
1									
2									
3	Sum of Amount	Column Labels							
4	Row Labels	Beverages	Food	Insurance	Payroll Expense	Rent	Supplies	Utility Expense	Grand Total
5	Qtr1	14620.76	72545.64	1281.99	75715.47	7200	4778.96	5130.76	181273.58
6	Qtr2	14630.86	70502.27	1281.99	83907.75	7200	6032	7217.52	190772.39
7	Qtr3	16476.61	69699.27	1521.07	90288.01	7200	5235.41	7949.89	198370.26
8	Qtr4	14706.65	75644.18	1640.61	97520.26	7200	5689.92	5207.34	207608.96
9	Grand Total	60434.88	288391.36	5725.66	347431.49	28800	21736.29	25505.51	778025.19

Figure 14 - Completing the Drag-and-Drop Rearrangement of a Report

To review, we merely dragged the field buttons to different quadrants in the PivotTable Task Pane to re-arrange the report. The number of ways we can view a PivotTable is limited only by the number of fields 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. With these relationships exposed, we can exploit them on behalf of the organizations we serve. Now, that's analytical power!

Sorting and Filtering Fields

Excel provides enhanced context-sensitive sorting and filtering of PivotTable fields. You can access all the sorting and filtering capabilities from the **Field List** in the **PivotTable Task Pane**. To take advantage of this feature, click the drop-down arrow in any field button and select the appropriate sort or filter options. **Figure 15** illustrates this process.

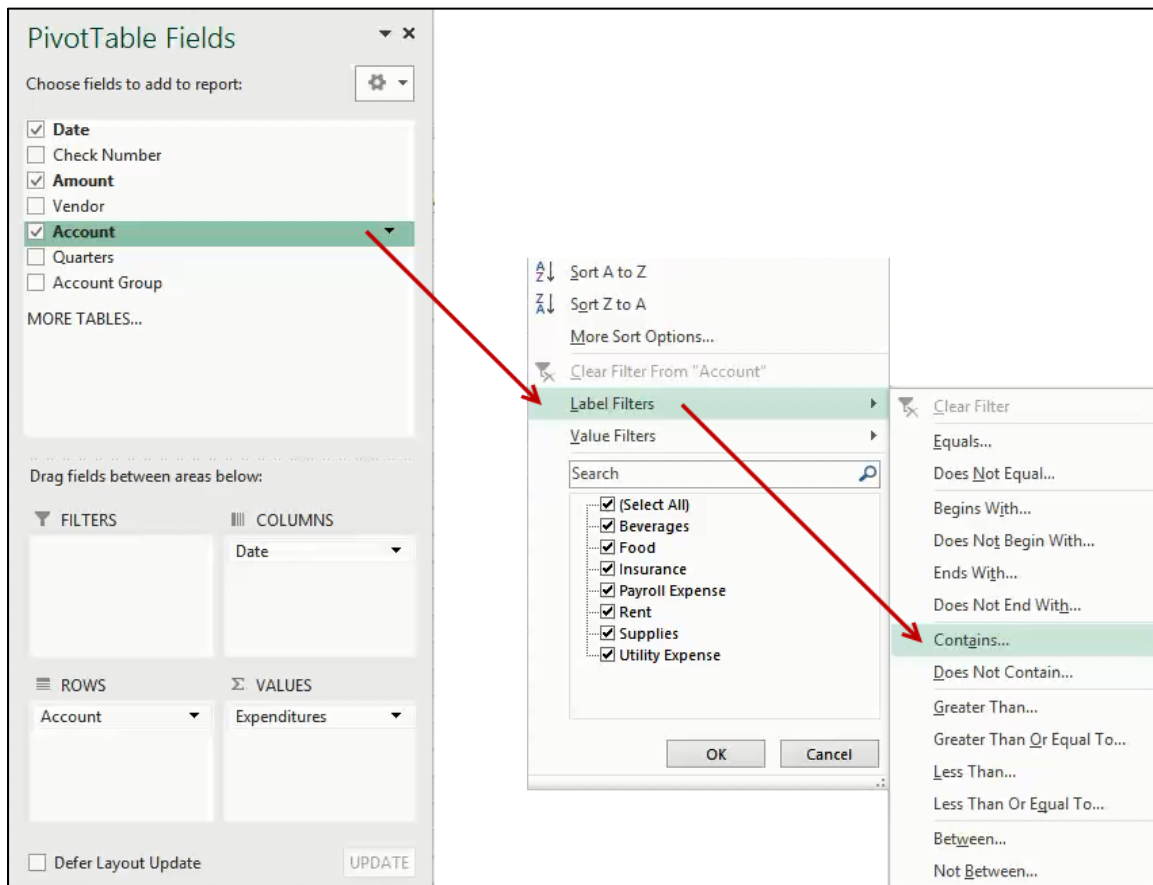


Figure 15 - Sorting or Filtering PivotTable Fields

Updating the Underlying Data

Whenever data is changed, updated, or added to the underlying data table, you must refresh the PivotTable to see the changes reflected in the report. Position the cursor anywhere in the table, right-click, and choose **Refresh** from the context-sensitive menu. Alternatively, click the **Refresh** button on the **PivotTable Tools, Analyze** tab. It is best practice to refresh a PivotTable after re-arranging a sophisticated report.

If data is added or removed from the data range and the range's size changes, you may need to modify the data range. If the data range is an Excel *table*, no action is necessary other than clicking Refresh on the Ribbon's **PivotTable Tools, Analyze tab**. A table is a dynamic range that automatically adjusts its dimensions as the volume of data changes. However, if the data range is specified using cell references, you must re-define it. To do so, position the cursor in the PivotTable report. Next, click **Change Data Source** on the **PivotTable Tools, Analyze tab**. Then, specify the new data range in the **Change PivotTable Data Source** dialog box and click **OK**. The existing PivotTable will update to reflect the latest data.



Describe the fundamental purpose of a PivotTable and provide examples of how you currently use or potentially will use this powerful Excel feature.

Creating Calculated Fields

A *calculated field* is one form of a user-defined calculation you can add to a PivotTable. The other option for creating a user-defined measure is a *calculated item* (discussed beginning on page 6.) You will employ a calculated field to use data from different *fields* in your user-defined calculation. On the other hand, you will use a calculated item when you want your formula to use data from *one or more specific items within a given field*.

This example will create a simple PivotTable from a single table in Sage 100, the customer master file, **AR_Customers**. First, we will connect to the external data source using Open Database Connectivity (ODBC), an open standard for connecting applications to a database. With the connection in place, Excel presents a list of tables. You can expand this list to display the fields contained in each table. First, expand the field list by clicking the plus (+) sign to the left of the table name in the left-hand pane. Then, choose the fields to display in the report and click the (>) button. This action will move them to the right-hand pane, as shown in **Figure 16**. Next, select the following fields: **CustomerNo**, **State**, **SalespersonNo**, **CurrentBalance**, **AgingCategory1**, **AgingCategory2**, **AgingCategory3**, and **Aging Category4**.

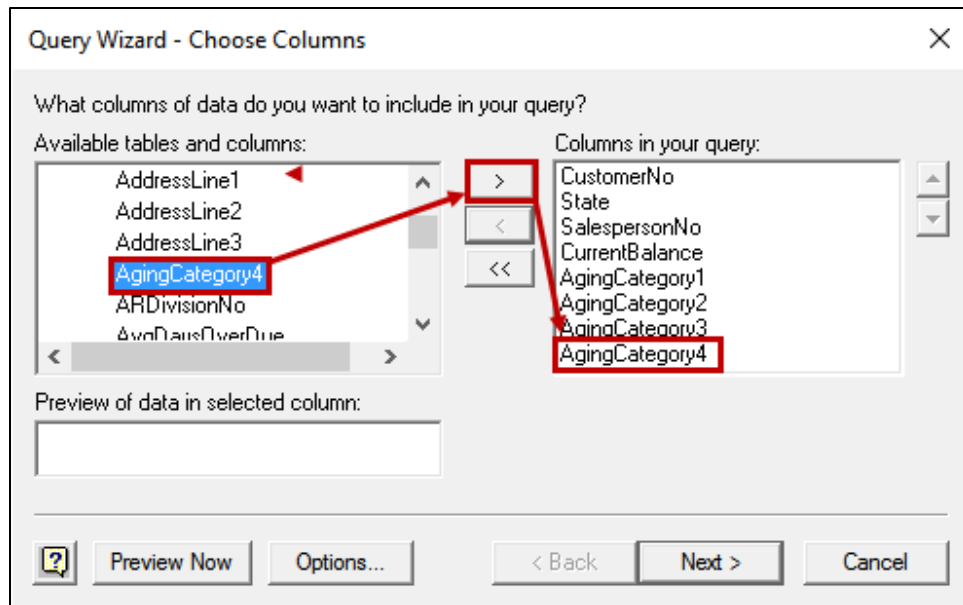


Figure 16 – Selecting the Fields for the Report

After all the required fields are selected, click **Next** several times. Select **Return Data to Microsoft Office Excel** and click **Finish** in the Query Wizard- Finish pane. In the **Import Data** dialog box, select the **PivotTable Report**. Then specify the report location and click **OK**. Next, drag and drop the fields into the appropriate report quadrants in the **PivotTable Task Pane**, rename and format the column labels, choose a number format for the data, and complete the PivotTable as with any other. The primary difference is that this PivotTable dynamically links to the underlying database data. If you need the same report next week or next month, all you need to do is retrieve the workbook, refresh the PivotTable, and print the updated version, a process that takes seconds to complete. **Figure 17** illustrates creating the initial PivotTable.

Import Data

Select how you want to view this data in your workbook.

☐ Table

☒ PivotTable Report

☐ PivotChart

☐ Only Create Connection

Where do you want to put the data?

☒ Existing worksheet:

= \$A\$1

☐ New worksheet

☐ Add this data to the Data Model

Properties... OK Cancel

PivotTable Fields

Choose fields to add to report:

Search

☒ AgingCategory1

☒ AgingCategory2

☒ AgingCategory3

☒ AgingCategory4

☒ Balance

☒ CurrentBalance

☒ CustomerName

☒ SalespersonNo

☒ State

Drag fields between areas below:

Filters

State

SalespersonNo

Columns

Σ Values

Rows

CustomerName

Current

Over 30

Over 60

Over 90

Over 120

Sum of Balance

Defer Layout Update Update

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

Figure 17 – Creating a PivotTable Connected to an External Data Source

Our initial PivotTable contains an accounts receivable aging report but does not have a column for the total outstanding balances owed by our customers. To create a column for the outstanding balances, we must create a calculated field to include the values from other fields in the formula.

To insert a calculated field, follow the procedure described below.

1. Position the cursor anywhere in the **Over 120** column.
2. In Excel, click **Fields, Items, & Sets** on the **PivotTable Tools, Analyze** contextual tab. Then click **Calculated Field**.
3. In the **Insert Calculated Field** dialog box, enter a name for the added field. Enter **Balance** into the field.
4. Then, build the formula. Position the cursor in the **Formula** box, click and highlight **CurrentBalance** in the **Fields** box, and click **Insert Field**. Next, type in the plus sign (+) and click and highlight **AgingCategory1** in the **Fields** box. Again, click on **Insert Field**. Repeat this process until all fields through **AgingCategory4** are summed in the **Formula** box. Click **OK** to complete the process, as shown in **Figure 18**.

Insert Calculated Field

Name: Modify

Formula: Delete

Fields:

- AgingCategory1
- AgingCategory2
- AgingCategory3
- AgingCategory4
- CurrentBalance
- CustomerName
- State
- SalespersonNo

Insert Field OK Close

Figure 18 – Entering a Formula for a Calculated Field

- Excel adds the new field in a separate column to the right of the **Over 120** column.

To complete the table, drag **SalespersonNo** to the **Rows** quadrant and **CustomerName** to the **Filters** quadrant. The reconfigured PivotTable helps users examine and understand their sales staff's sales and collection performance. Similarly, we could have replaced **SalespersonNo** in the **Rows** quadrant with **State** to produce an accounts receivable aging of accounts by state, which could help users manage the risk of non-collection in specific locations. **Figure 19** displays the completed PivotTable.

	A	B	C	D	E	F	G
1	State	(All)					
2	CustomerName	(All)					
3							
4		Current	Over 30	Over 60	Over 90	Over 120	Balance
5	0100	\$ 16,303.22	\$ 1,257.40	\$ -	\$ -	\$ -	\$ 17,560.62
6	0200	\$ 521,120.18	\$ 7,251.31	\$ 2,335.43	\$ -	\$ -	\$ 530,706.92
7	0300	\$ 30,719.81	\$ 4,476.31	\$ 9,741.93	\$ 4,607.18	\$ -	\$ 49,545.23
8	0400	\$ 88,671.32	\$ 4,162.57	\$ 3,089.34	\$ 12.75	\$ -	\$ 95,935.98
9	Grand Total	\$ 656,814.53	\$ 17,147.59	\$ 15,166.70	\$ 4,619.93	\$ -	\$ 693,748.75

Figure 19 – Aging of Accounts Receivable by Salesperson

Remember, our PivotTable links dynamically to the underlying data in Sage 100. So, to use this report in the future, retrieve the workbook and click **Refresh** to produce an updated summary based on the transactions and postings as they exist in the underlying database at the time of refresh.

Creating Calculated Items

Now, let us turn our attention to the task of creating a calculated item. Remember, we will use calculated items to incorporate the values associated with other items into our formulas. In our first example, we will create a calculated item to compute the gross margin from the PivotTable pictured data in **Figure 20**.

	A	B	C	D	M	N
1	Page1	(All)				
2						
3	Sum of Value	Column Labels				
4	Row Labels	1/1/2021	2/1/2021	3/1/2021	12/1/2021	Grand Total
5	Revenue	344,000	377,000	414,000	1,032,000	7,481,000
6	Cost of Sales	173,000	183,000	193,000	285,000	2,748,000
7	Distribution	35,000	45,000	55,000	148,000	1,095,000
8	Facilities	17,000	17,000	17,000	17,000	204,000
9	SG&A	35,000	45,000	55,000	148,000	1,095,000
10	Total Expense	87,000	107,000	127,000	313,000	2,394,000
11	Net Income	84,000	87,000	94,000	434,000	2,339,000
12	Grand Total	775,000	861,000	955,000	2,377,000	17,356,000

Figure 20 – Simple Consolidation PivotTable

To insert a calculated item, use the following procedure.

1. Select any one of the row items, such as *Revenue*, *Cost of Sales*, or *Distribution*.
2. In Excel, on the **PivotTable Tools, Analyze** tab of the Ribbon, click **Fields, Items, & Sets** followed by **Calculated Item**, as shown in **Figure 21**.

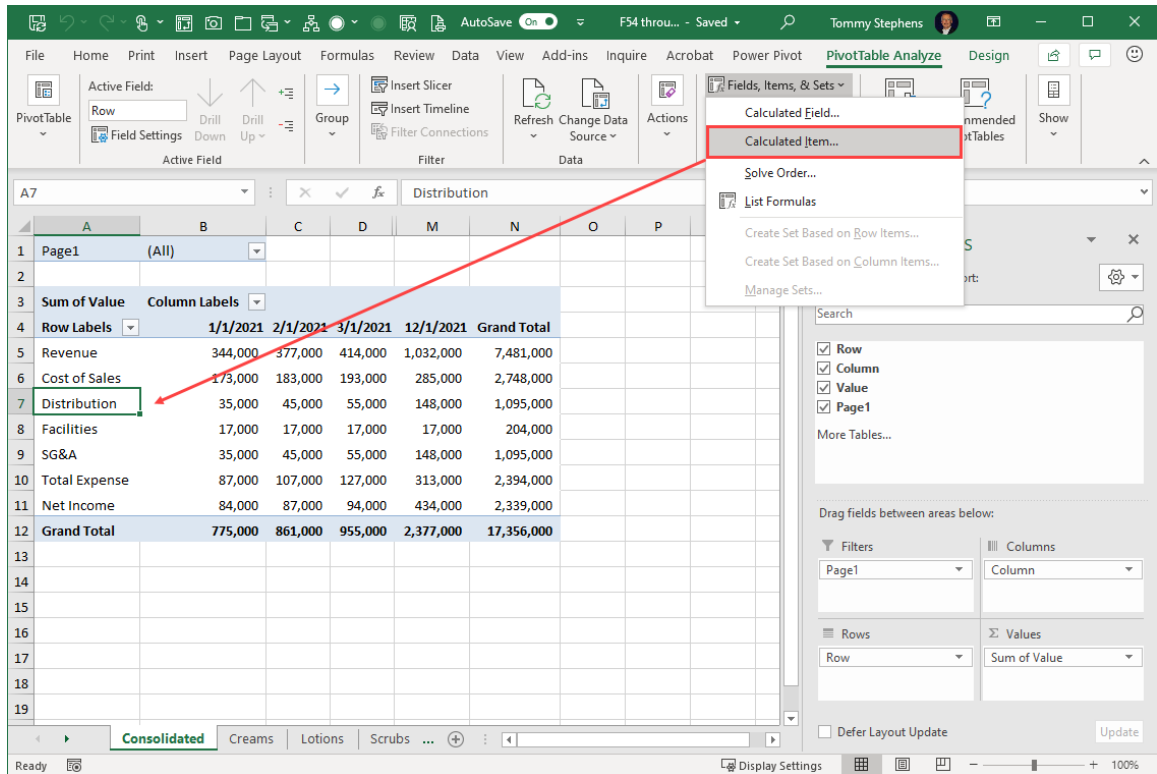


Figure 21 - Creating Formulas from the PivotTable Analyze Tab of the Ribbon

3. In the **Insert Calculated Item** dialog box, enter a name for the added item. Type **Gross Margin** into the dialog box.
4. Now, build the formula. First, position your cursor in the **Formula** box, click and highlight **Revenue** in the **Items** box in the lower right-hand corner, and click **Insert Item**. Next, type in the minus sign (-) and click and highlight **Cost of Sales** in the **Items** box. Finally, click on **Insert Item** and then **OK** to complete the process, as shown in **Figure 22**.

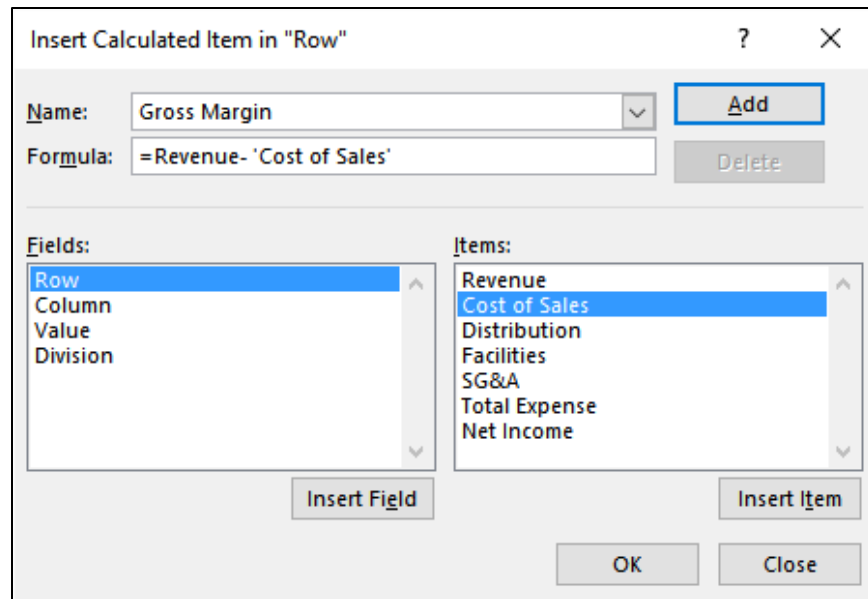


Figure 22 – Entering the Formula for a Calculated Item

5. Excel will create an item at the bottom of the column. Use your mouse to drag the item to the correct position in the report.



Suppose you attempt to group months into quarters in the PivotTable report. Excel will display an error message because the built-in date and number groupings are not allowed across calculated items in PivotTables.

Return to the Insert Calculated Item dialog box to delete a calculated item. Then, use the drop-down list to select the appropriate item in the **Name** box and click **Delete**.

Calculated Items can contain relative references to their underlying data in a PivotTable. For instance, suppose one wants to use the data from the prior months in a PivotTable to estimate future results. More specifically, someone preparing a forecast believes that sales for the current month can be estimated by averaging sales for the prior two months and multiplying that result by 150%. You can use a Calculated Item to perform this calculation. To do so, click in the Months field of the PivotTable and then click **Formulas** from the **PivotTable Tools, Analyze** tab of the Ribbon to open the **Insert Calculated Item** dialog box. Enter the Calculated Item's name and the appropriate formula, as shown in **Figure 23**.

Insert Calculated Item in "Month" ? X

Name: Projection Modify

Formula: $=(((\text{Month}[-1] + \text{Month}[-2]) / 2) * 1.5)$ Delete

Fields: Month Product Sales

Items: Jun-2021 Jul-2021 Aug-2021 Sep-2021 Oct-2021 Nov-2021 Dec-2021 Projection

Insert Field Insert Item

OK Close

Figure 23 - Creating a Calculated Item

It is unnecessary to return to the Calculated Item dialog box to edit the Calculated Item. Instead, you can edit it directly in the Formula Bar or PivotTable after creating a Calculated Item. To do so, double-click in the PivotTable on the Calculated Item of interest, and it will open for editing, as shown in **Figure 24**.

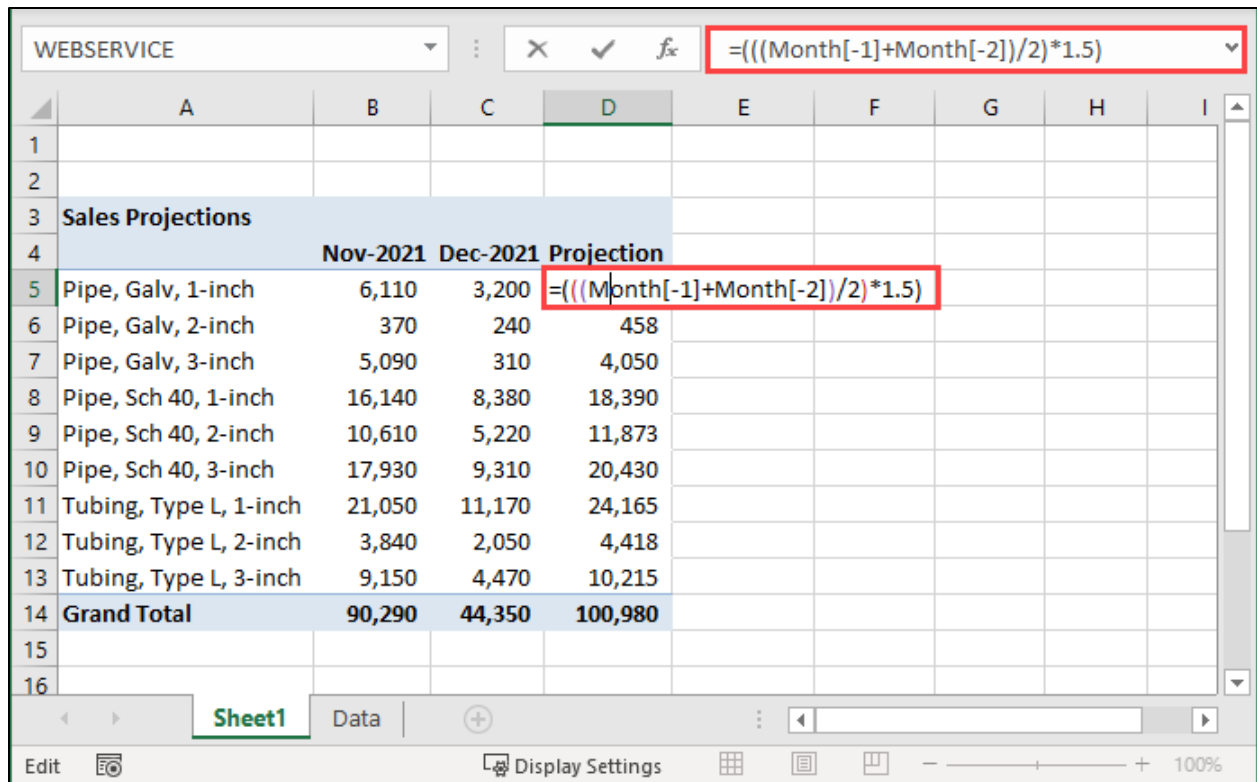


Figure 24 - Editing a Calculated Item in a PivotTable

Adding Slicer and Timeline Filters

Slicers are a relatively new form of filtering. They are visual filters that allow even inexperienced end-users to filter a PivotTable to meet specific needs. Further, you can add multiple Slicers to the same PivotTable, extending their functionality and usefulness.

To add a Slicer to a PivotTable, choose **Insert Slicer** from the **PivotTable Tools, Analyze** tab to open the Insert Slicer dialog box shown in **Figure 25**.

Note that you can customize the physical appearance of a Slicer by clicking on it and selecting the Slicer Tools, Options contextual tab on the Ribbon. You can access color, size, and alignment options from this tab. Additionally, by choosing **Report Connections** on the **Slicer Tools, Options** contextual tab, you can link one Slicer to control multiple PivotTables.

Timeline Filters

Like Slicers, **Timeline** filters are visual filters. Therefore, you can use Timelines only with fields that contain dates. Timelines allow you to quickly filter your PivotTables and PivotCharts by *Day*, *Month*, *Quarter*, or *Year*. You apply filters by clicking and dragging on the Timeline's edges.

To add a Timeline filter, select **Timeline** from the **PivotTable Analyze** tab of the Ribbon. Then, select the date fields you want to filter using a Timeline. The process is complete at that point, and you can use the newly created Timeline to assist in analyzing your data.



What are the relative merits of using Slicers and Timelines to filter your PivotTables?

Filtering Multiple PivotTables Simultaneously

A powerful feature of Slicers and Timelines is their ability to connect to multiple PivotTables constructed from the same data source. When you link numerous PivotTables to the same Slicer or Timeline filter, you can filter each connected PivotTables from the Slicer or Timeline. The advantages of this technique are 1) each connected PivotTable filters to the same criteria, and 2) you spend less time filtering your PivotTables.

To link multiple PivotTables to a Slicer or Timeline, add the Slicer or the Timeline to one of the PivotTables. Once added, right-click the Slicer or Timeline, then choose **Report Connections**. Then check the box next to each additional PivotTables you want to link to that filter. Next, click **OK** to complete the process. Upon doing so, you will control multiple PivotTables from the same Slicer or Timeline.

Using Power Query to Link Data into PivotTables

Microsoft added **Power Query** to Excel 2010 as an add-in. Subsequently, Microsoft fully incorporated Power Query into Excel, beginning with the 2016 release. Power Query provides exceptional functionality in two areas: 1) the option to link data from external data sources into Excel, and 2) the ability to create and apply transformations to data and have those transformations automatically apply each time you refresh a query. We will use Power Query in this session to link external data into our PivotTables.

Power Query allows Excel users to link data into Excel from virtually any common external source, including those named below.

- Other Excel workbooks

- Text files
- Access databases
- SQL Server databases
- Webpages
- PDF documents
- ODBC-compliant databases, including those used by most accounting applications

Importantly, when using Power Query, you establish persistent, refreshable links between your data source(s) and Excel. Therefore, you can refresh your queries quickly, eliminating outdated export/import processes and enabling your PivotTables to report on real-time or near-real-time data.

Linking Data from an Accounting Application

Suppose you need to create a PivotTable report using data from your accounting application. Further, suppose you want the summary to contain a refreshable link to avoid manually exporting/importing the data from the accounting application whenever you need to update the report. This scenario represents a great example of using Power Query to create a refreshable, persistent link between the source data and the PivotTable.

This example uses Power Query to link data from a QuickBooks data file via an ODBC driver supplied by [CData](#). First, assuming you have acquired and installed the appropriate driver, open the QuickBooks data file from which you would like to query data. Then, in Excel, perform the following steps.

1. On the **Data** tab of the Ribbon, click **Get Data, From Other Sources, From ODBC**.
2. In the **Data Source Name** box, choose **CData QuickBooks Source** and click **OK**.
3. Expand the CData entry and then the QuickBooks entry in the Navigator.
4. Choose the table(s) you wish to link into Excel. In this example, choose **Bills**.
5. Click the drop-down arrow next to **Load** (near the bottom of the window) and choose **Load To**, followed by **PivotTable Report**.
6. Click **OK** to complete the process of creating the query.

At this juncture, you can create your PivotTable by dragging and dropping the fields into their desired locations on the report. For example, the PivotTable shown in **Figure 27** illustrates how a completed PivotTable might appear using data linked through Power Query.

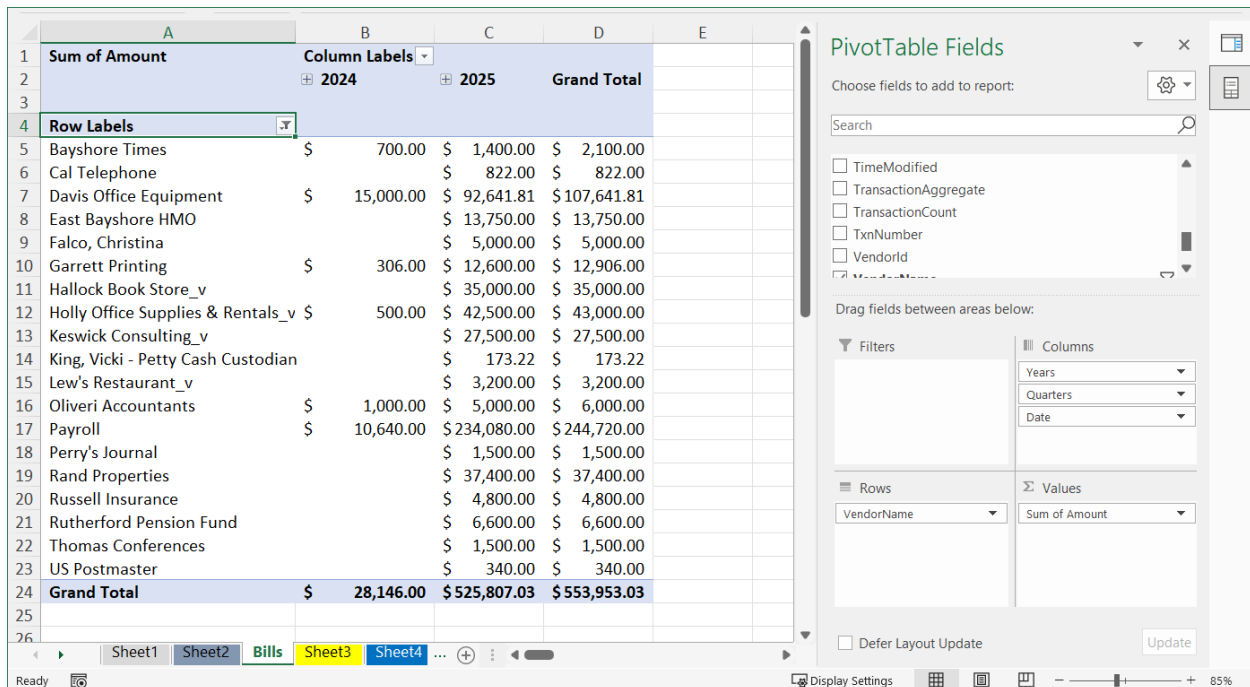


Figure 27 - Sample PivotTable Created from Data Linked Using Power Query

Consolidating Data Using PivotTables

You can use **Consolidation PivotTables** to report data that has already been summarized. For example, suppose you need to combine divisional or departmental income statements, product line, or channel profitability reports. You can use Consolidation PivotTables to produce the merged summary quickly without entering formulas. However, to use this technique, the layout of the individual worksheets you wish to consolidate must be similar, although they need not be identical.

Preparing to Consolidate

An icon for Consolidation PivotTables is not available natively from the Ribbon. To access this functionality, you must add the **PivotTable and PivotChart Wizard** icon to the Quick Access Toolbar (QAT) or Ribbon.

The following example combines product line income statements into a single report with all PivotTable reporting flexibility. **Figure 28** illustrates a sample of the data with identical tables for the three product lines.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	DNM Distribution Company												
2	Comparative Budgeted Monthly Income Statements												
3													
4	Creams												
5		Jan-2021	Feb-2021	Mar-2021	Apr-2021	May-2021	Jun-2021	Jul-2021	Aug-2021	Sep-2021	Oct-2021	Nov-2021	Dec-2021
6	Revenue	100,000	115,000	132,000	152,000	175,000	201,000	231,000	266,000	306,000	352,000	405,000	466,000
7	Cost of Sales	50,000	53,000	56,000	59,000	62,000	65,000	68,000	71,000	74,000	77,000	80,000	83,000
8	Gross Margin	50,000	62,000	76,000	93,000	113,000	136,000	163,000	195,000	232,000	275,000	325,000	383,000
9	Distribution	10,000	13,000	16,000	19,000	22,000	25,000	28,000	31,000	34,000	37,000	40,000	43,000
10	SG&A	10,000	13,000	16,000	19,000	22,000	25,000	28,000	31,000	34,000	37,000	40,000	43,000
11	Facilities	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
12	Total Expense	25,000	31,000	37,000	43,000	49,000	55,000	61,000	67,000	73,000	79,000	85,000	91,000
13	Net Income	25,000	31,000	39,000	50,000	64,000	81,000	102,000	128,000	159,000	196,000	240,000	292,000

Figure 28 - Data to be Summarized Using a Consolidation PivotTable

Simple Consolidating PivotTables

In the first dialog box of the PivotTable Wizard, choose **Multiple consolidation ranges**. Click **Next**. Then, select how you wish to create the Page fields. To ensure maximum reporting flexibility, select **"I will create the page fields,"** then click **Next**. The dialog box for the next step in the wizard appears, as shown in **Figure 29**. Next, define each data range in the page field, one for each of the three product lines – *Creams*, *Lotions*, and *Scrubs*.

In our example, each range to consolidate is on a separate worksheet in a single workbook. However, all the data does not have to reside in the same workbook. You can consolidate data from multiple workbooks. To summarize, ranges from other workbooks can be opened and pointed to during the PivotTable creation process. Alternatively, type in the range addresses using the following format.

[workbook name] sheet name! range

Include the brackets around the workbook name and the exclamation point between the sheet name and the range specification. Using tables or defined names to define the data ranges in the individual workbooks will make the task easier and less prone to error.

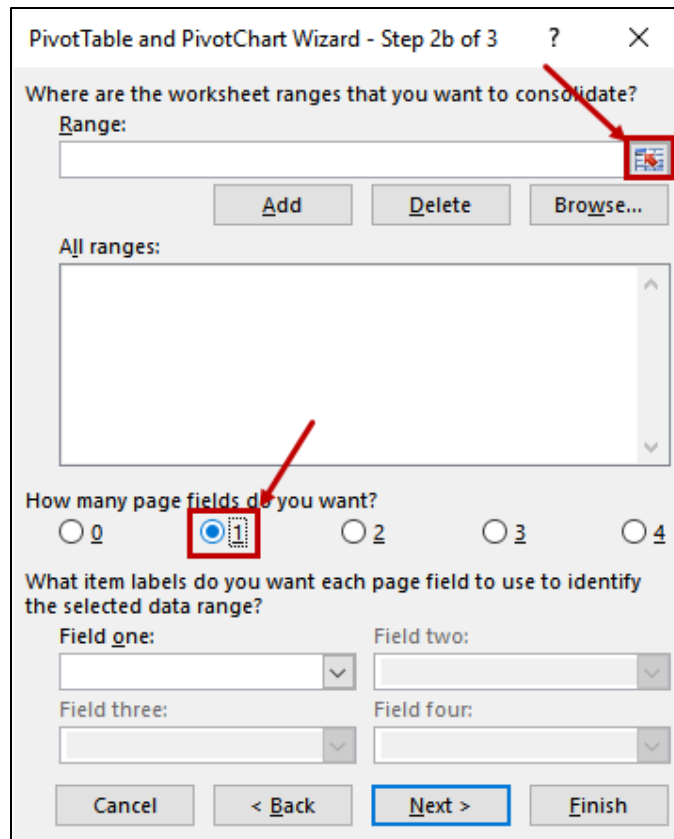


Figure 29 - Using the Collapse Dialog Button When Highlighting Ranges

Next, click the **Collapse Dialog** button, shown in Figure 29, at the right end of the range box to temporarily hide the dialog box. Using the mouse, highlight a range to include in the report, and click the **Collapse Dialog** button to redisplay the dialog box. Click **Add** to add the content to the consolidation. In the **Field**, enter the item name in one box. Each range added in the dialog box will have an item name; in this example, *Creams*, *Lotions*, and *Scrubs* are the names. The completed dialog appears in **Figure 30**.

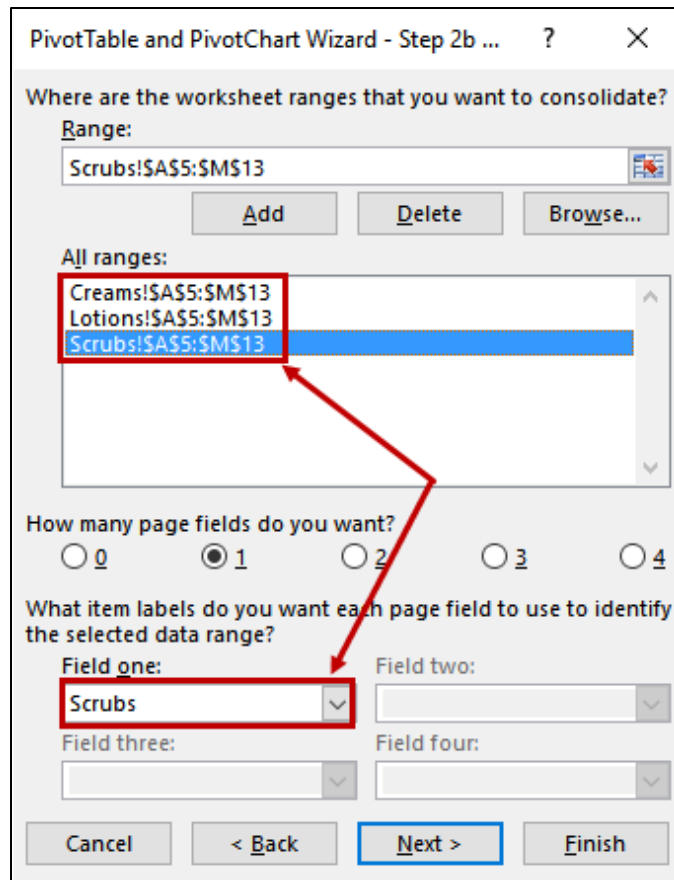


Figure 30 - Naming Each Field when Adding the Field Range

Click **Next**. Choose to create the PivotTable on a new worksheet and then click **Finish**. After grouping Months into Quarters and making minor formatting changes, the initial PivotTable should resemble the one shown in **Figure 31**.

	A	B	C	D	E	F
1	Page1	(All) ▼				
2						
3	Sum of Value	Column Labels ▼				
4	Row Labels ▼	Qtr1	Qtr2	Qtr3	Qtr4	Grand Total
5	Cost of Sales	549,000	641,000	733,000	825,000	2,748,000
6	Distribution	135,000	227,000	319,000	414,000	1,095,000
7	Facilities	51,000	51,000	51,000	51,000	204,000
8	Gross Margin	586,000	870,000	1,309,000	1,968,000	4,733,000
9	Net Income	265,000	365,000	620,000	1,089,000	2,339,000
10	Revenue	1,135,000	1,511,000	2,042,000	2,793,000	7,481,000
11	SG&A	135,000	227,000	319,000	414,000	1,095,000
12	Total Expense	321,000	505,000	689,000	879,000	2,394,000
13	Grand Total	3,177,000	4,397,000	6,082,000	8,433,000	22,089,000

Figure 31 - Initial Consolidation PivotTable Created from Product Data

The only task remaining is to complete the PivotTable for presentation. Hide the field headings, center the column headings, rename the Filter to **Product Line**, and give the values field a descriptive name, such as **Budgeted Income Statement**. The completed PivotTable should resemble the one shown in **Figure 32**. Remember that all the drag-and-drop PivotTable functionality is available in the consolidated report.

	A	B	C	D	E	F
1	Product Line	(All) ▼				
2						
3	Budgeted Income Statement					
4		Qtr1	Qtr2	Qtr3	Qtr4	Grand Total
5	Revenue	1,135,000	1,511,000	2,042,000	2,793,000	7,481,000
6	Cost of Sales	549,000	641,000	733,000	825,000	2,748,000
7	Gross Margin	586,000	870,000	1,309,000	1,968,000	4,733,000
8	Distribution	135,000	227,000	319,000	414,000	1,095,000
9	Facilities	51,000	51,000	51,000	51,000	204,000
10	SG&A	135,000	227,000	319,000	414,000	1,095,000
11	Total Expense	321,000	505,000	689,000	879,000	2,394,000
12	Net Income	265,000	365,000	620,000	1,089,000	2,339,000

Figure 32 - Completed PivotTable

Creating PivotTables from Data Models

A data model is a collection of two or more tables that you *relate* or link together based on the presence of one or more common fields. Once you create a data model, Excel interprets it as a single data source, and you can use it as the source data for a PivotTable.

Conceptually, a data model might appear similar to the image in **Figure 33**. In this illustration, three tables link together to create a data model, and you can use the data model as the source data for a PivotTable.

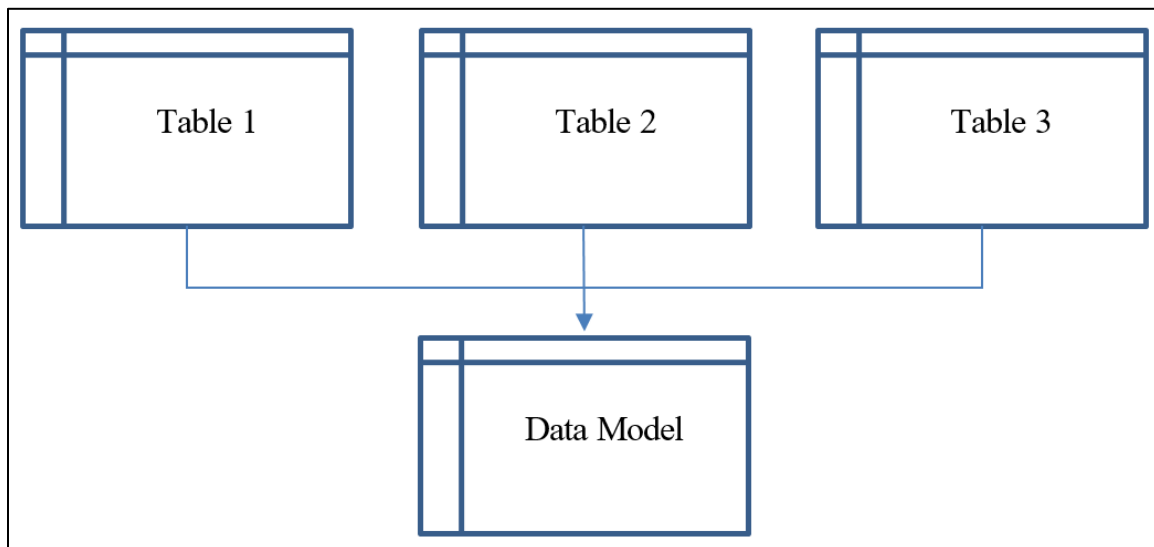


Figure 33 - Schematic of an Excel Data Model

Creating Simple Data Models from Excel Tables

Creating data models in Excel can be easy; you can do so with a single click mouse click. However, before attempting to relate multiple Excel tables, you should verify that each table has a field that is common to the other table(s) in the data model. For example, suppose you are attempting to relate two tables containing inventory data; in this case, you would probably look for a part number or SKU code common to each table. Likewise, if you desire to relate multiple employee-related tables, you would probably do so based on a common field of employee identification numbers or a similar field.

Our first example of relating tables together to create a data model will be in the context of creating a PivotTable. In this example, we have an Excel workbook that contains two tables – *Transactions* and *Product*. We want to build a PivotTable that uses data from both tables, but we do not want to use an XLOOKUP or VLOOKUP approach to consolidate the data from the two tables. Fortunately, we can use data models to solve the problem.

Begin by clicking on either of the tables. Then, click **Summarize with PivotTable** from the **Table Tools Design** tab of the Ribbon to open the **Create PivotTable** dialog box pictured in **Figure 34**. Check the box next to **Add this data to the Data Model** in this dialog box. Note that checking this box adds *all* tables in the workbook – not just the currently selected table – to the workbook's data model.

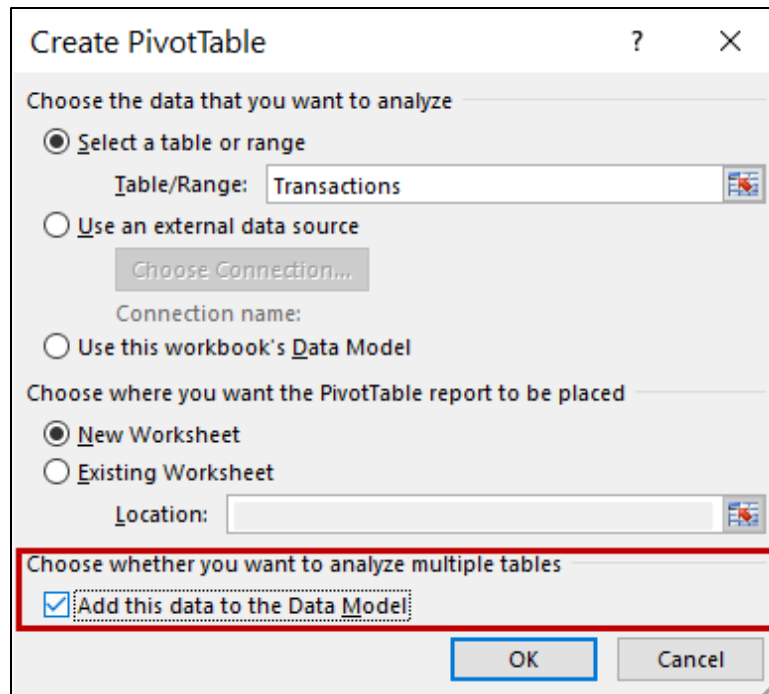


Figure 34 - Adding Tables to a Workbook's Data Model

Click **OK** to complete the process, and Excel opens a new workbook with the **PivotTable Field List** available, as shown in **Figure 35**. As indicated in the figure, click **All** to see all the tables available in the PivotTable. Further, notice the faint line that separates the *Product* table from the *Transactions* table. This line indicates that the two tables are not yet related. You should never build a PivotTable (or any other analytical tool) from unrelated tables in the data model! If you do, Excel will display a warning message indicating that you should relate your tables. Further, if you build a PivotTable from unrelated tables, you will probably notice that the calculations in your PivotTable do not seem to make sense. In short, ensure proper relationships exist before continuing with your PivotTable.

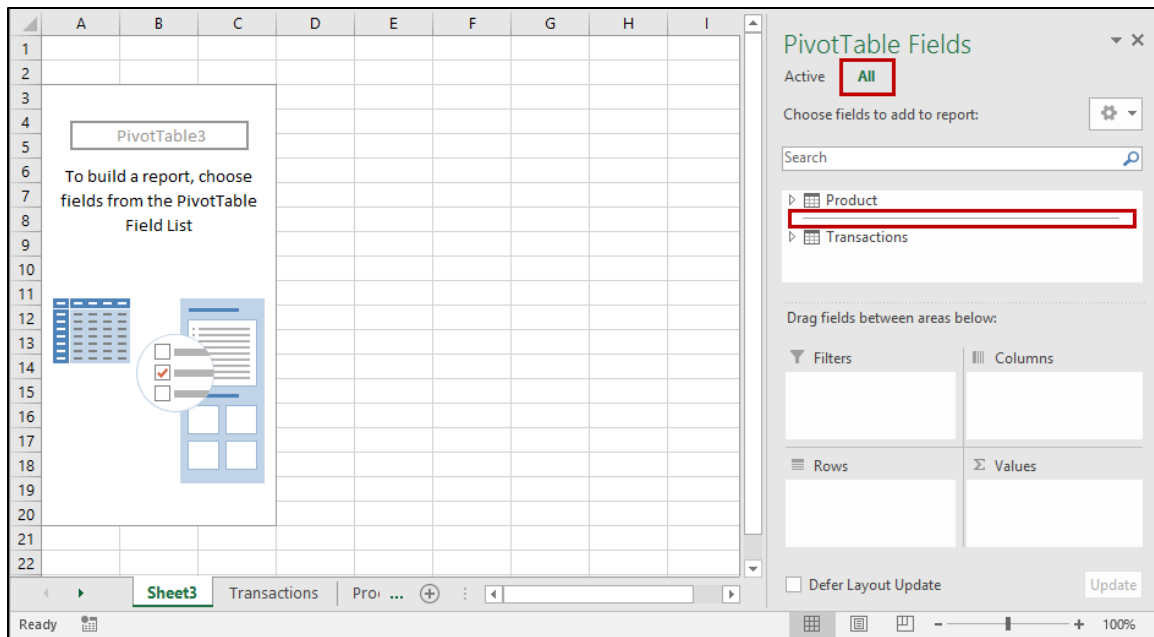


Figure 35 - Unrelated Tables in PivotTable Field List

You can establish relationships between the tables in the data model using multiple approaches. First, suppose Excel provides an **Auto-Detect** option similar to that pictured in **Figure 23**. In that case, you can click the **Auto-Detect** button, and Excel will attempt to identify and relate the tables together automatically. There is a high probability that this process will be successful in relatively simple data models. However, if it does not, you must establish the relationships manually. To do so, click the **Create** button pictured in **Figure 36** or click **Relationships** from the **PivotTable Tools Analyze** tab of the Ribbon. Both approaches will open the **Manage Relationships** dialog box illustrated in **Figure 37**. You can also access the Manage Relationships dialog box by clicking the **Relationships** button on the **Ribbon's Data** tab.

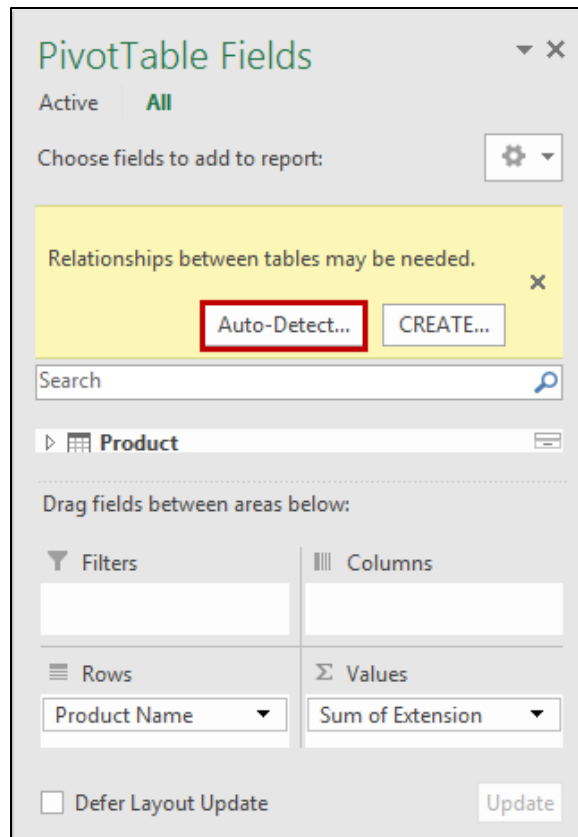


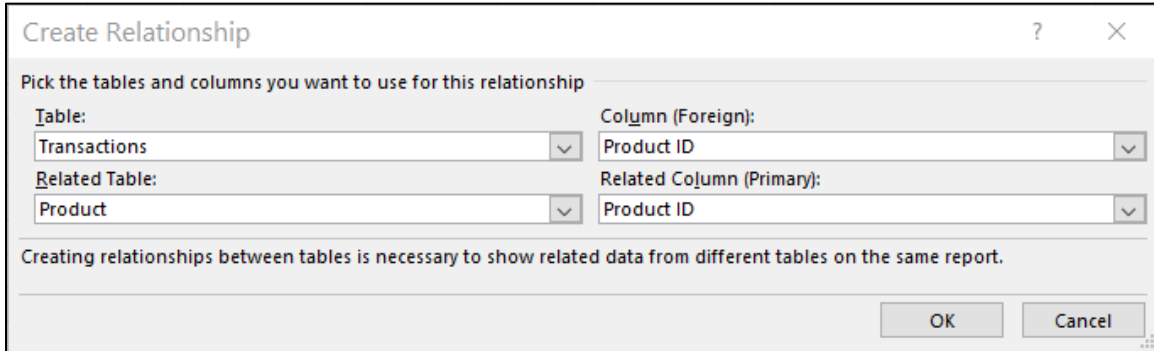
Figure 36 - Using Excel's Auto-detect Feature to Establish Relationships in Data Models



Figure 37 - Excel's Manage Relationships Dialog Box

In the Manage Relationships dialog box, click the **New** button to open the **Create Relationship** dialog box shown in **Figure 38**. On the left side of this dialog box, choose the tables you wish to relate. Next, choose the field common to both tables on the right side of the dialog box. Click **OK**

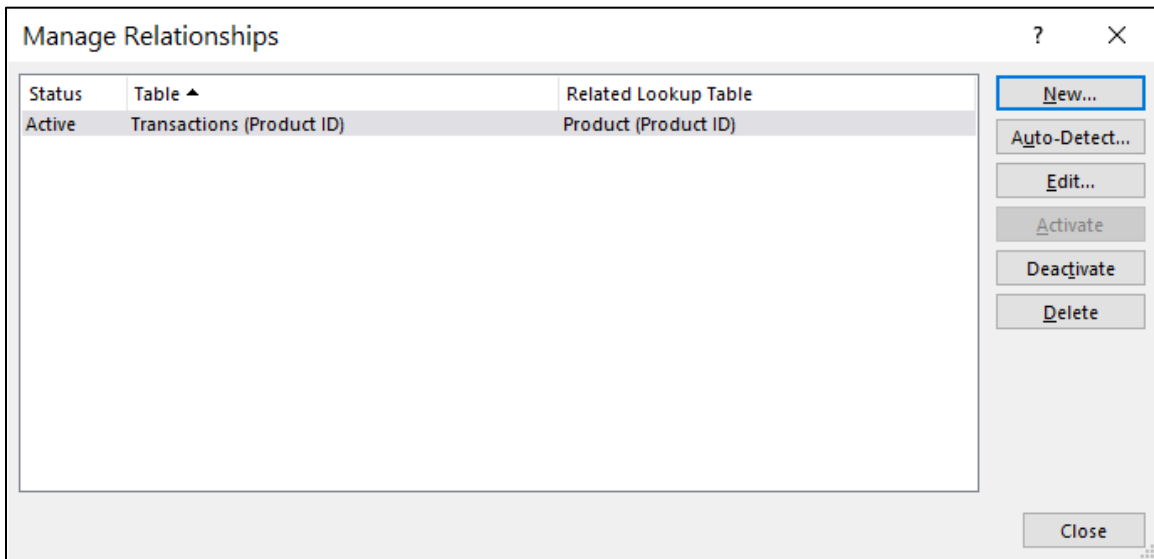
to complete the process of relating these two tables. Repeat this process for as many tables as you need to link in the data model.



The 'Create Relationship' dialog box is shown. It has a title bar with a question mark and a close button. The main area is titled 'Pick the tables and columns you want to use for this relationship'. It contains four dropdown menus: 'Table:' (set to 'Transactions'), 'Column (Foreign):' (set to 'Product ID'), 'Related Table:' (set to 'Product'), and 'Related Column (Primary):' (set to 'Product ID'). Below these is a text box with the message: 'Creating relationships between tables is necessary to show related data from different tables on the same report.' At the bottom right are 'OK' and 'Cancel' buttons.

Figure 38 - Manually Establishing Relationships between Tables in a Data Model

After successfully establishing the relationship, the Manage Relationships dialog box will change to reflect the relationship and its current status, as shown in **Figure 39**.



The 'Manage Relationships' dialog box is shown. It has a title bar with a question mark and a close button. The main area is a table with three columns: 'Status', 'Table', and 'Related Lookup Table'. The table contains one row: 'Active', 'Transactions (Product ID)', and 'Product (Product ID)'. To the right of the table are buttons: 'New...' (highlighted with a blue border), 'Auto-Detect...', 'Edit...', 'Activate', 'Deactivate', and 'Delete'. At the bottom right is a 'Close' button.

Status	Table	Related Lookup Table
Active	Transactions (Product ID)	Product (Product ID)

Figure 39 - Displaying All Relationships in the Manage Relationship Dialog Box

With the relationship between the two tables in place, we can construct a PivotTable that utilizes data from both tables in the data model. **Figure 40** presents an excerpt of that PivotTable.

	A	B	C	D	E	F
3	Summary of Sales by Product/Year					
4		2016	2017	2018	Grand Total	
5	Active Outdoors Crochet Glove	516.20	3,563.44	775.03	4,854.67	
6	Active Outdoors Lycra Glove	674.85	4,922.01	1,560.09	7,156.95	
7	Descent	77,759.06	1,312,790.24	495,070.87	1,885,620.17	
8	Endorphin	12,192.99	204,626.02	60,020.01	276,839.02	
9	Guardian "U" Lock	35.00	763.90	105.00	903.90	
10	Guardian ATB Lock	39.42	782.93	306.60	1,128.95	
11	Guardian Chain Lock	27.00	250.68	39.38	317.06	
12	Guardian Mini Lock	325.23	825.63	434.73	1,585.59	
13	Guardian XL "U" Lock	19.90	1,104.46	179.10	1,303.46	
14	InFlux Crochet Glove	54.00	1,732.13	693.23	2,479.36	
15	InFlux Lycra Glove	369.69	1,948.37	593.67	2,911.73	
16	Micro Nicros	4,307.31	24,568.02	8,436.25	37,311.58	
17	Mini Nicros	5,524.28	27,128.10	6,426.19	39,078.57	
18	Mozzie	57,154.08	452,709.11	122,659.45	632,522.64	
19	Nicros	13,556.88	147,789.54	42,435.27	203,781.69	
20	Rapel	18,450.26	161,853.64	52,759.56	233,063.46	

Figure 40 - Sample PivotTable Created from a Data Model

Adding Calculations Using Power Pivot

Power Pivot is a tool for significantly modifying your data models. One such change could be adding user-defined calculations. You can add two forms of user-defined calculations to your data models: *calculated columns* (a/k/a *calculated fields*) and *measures*. Both calculations use **Data Analysis Expressions (DAX)** instead of the traditional Excel function library. Some DAX functions resemble standard Excel functions, but most are substantially different. You can learn more about the DAX function library at <https://docs.microsoft.com/en-us/dax/>.

Creating Simple Calculated Columns with DAX

Calculated columns are columns that you add to an existing data model. Instead of pasting or importing values into the column, you create a DAX formula that defines its values. Once you create a calculated column, you can use its values like data from any other column.

To illustrate the power of calculated columns built using DAX expressions, consider the data shown in **Figure 41**. The extraction pulls 10 records from a population of 34,169 time-and-billing records for a consulting firm. The firm operates on a fiscal year that starts on July 1 and ends on June 30. PivotTables – including those built from data models – have the inherent capability to group date data automatically only on calendar years/quarters/months; you can also create fiscal year groupings, but those involve manual workarounds.

	Trans Date	Region	Account Category	Service Line	Sector	Hours	Net Revenue	Add Column	
34162	5/26/2021	South A...	Regional	HR Manageme...	Transpor...	160.67	24960.12		
34163	5/27/2021	South A...	Regional	IT Consulting	Transpor...	2.79	4645.97		
34164	6/2/2021	South A...	Regional	HR Manageme...	Transpor...	173.36	70883.16		
34165	6/10/2021	South A...	Strategic Account	IT Consulting	Transpor...	28.35	4199.76		
34166	6/11/2021	South A...	Regional	IT Consulting	Transpor...	37.56	9594.96		
34167	6/14/2021	South A...	Regional	IT Consulting	Transpor...	5.49	1329.28		
34168	6/24/2021	South A...	Regional	IT Consulting	Transpor...	98.54	10235.11		
34169	6/27/2021	South A...	Regional	IT Consulting	Transpor...	5.38	2748.79		

Record: 1 of 34,169

Figure 41 - Extraction of Time and Billing Data Used in Creating Calculated Columns with DAX

In this example, a relatively easy-to-implement workaround is to use three DAX functions – MONTH, YEAR, and IF – to create calculated columns in the data model that identify the appropriate fiscal quarter and fiscal year for the time and billing records. Note that these three functions operate as DAX functions almost exactly as they do in a traditional Excel environment.¹

Begin by double-clicking the top of a blank column in the data model, then enter *Month* as the column header. Repeat that process two times, adding *Fiscal Quarter* and *Fiscal Year*. Then, enter the following formula on the first row of the Month column.

=Month([Trans Date])

This formula returns the month number (1-12) based on the data in the current row of the *Trans Date* column in the data model. Notice that it uses a **MONTH** DAX function that operates identically to the MONTH function in traditional Excel spreadsheets.

Next, enter the following formula in the first row of the *Fiscal Quarter* column.

=IF([Month]<4,3,IF([Month]<7,4,IF([Month]<10,1,2)))

This formula checks whether the month is January, February, or March (month numbers 1 through 3) and, if so, assigns the value 3 to the corresponding row in the Quarters column, indicating that the month falls in the third fiscal quarter. If the month is April, May, or June (month numbers 4 through 6), the formula assigns 4 to that row of the *Quarters* column, indicating that the month falls into the fourth fiscal quarter. If the month is July, August, or September (month numbers 7 through 9), the formula assigns a value of 1 to that row of the *Quarters* column, indicating that the month falls into the first fiscal quarter. Finally, if the month is October, November, or December (month numbers 10 through 12), the formula assigns a value

¹ Those well versed in Power Pivot may already realize that Date Tables (also known as Calendar Tables) represent a viable option to the use of DAX-based formulas to identify fiscal reporting periods in data models.

of 2 to that row of the *Quarters* column. Of course, this assignment indicates that the month falls into the second fiscal quarter.

Finally, enter the following formula into the *Fiscal Year* column.

=If([Month]<7,Year([Trans Date]),Year([Trans Date])+1)

This formula identifies the appropriate fiscal year for the transaction. It does so by checking to see if the month is January through June and, if it is, assigns the transaction to the year found in the *Trans Date* field. Otherwise, if Excel identified the month as July through December, Excel deems the transaction to occur in the following fiscal year. **Figure 42** displays the modified data model, with three newly added calculated columns based on **MONTH**, **YEAR**, and **IF**, three DAX functions.

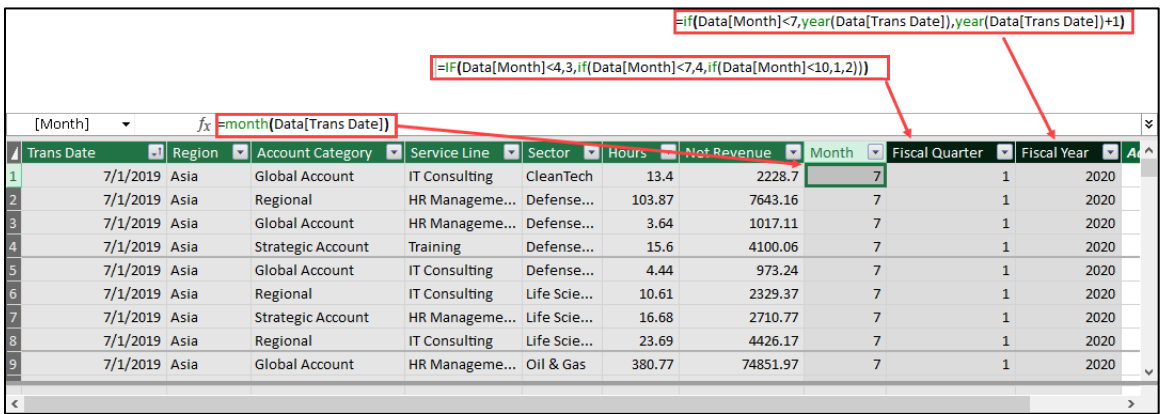


Figure 42 – Creating Calculated Columns in the Data Model with DAX Expressions

The only remaining action is to complete the PivotTable with the calculated columns in place. From Power Pivot’s **Home** tab, click **PivotTable**. Then, in the PivotTable field list, drag *Region* and *Service Line* to the *Rows* quadrant, *Fiscal Year* and *Fiscal Quarter* to the *Columns* quadrant, and *Net Revenue* to the *Values* quadrant. With formatting added, the completed report might resemble that pictured in **Figure 43**.

	B	C	D	E	F	G	H
3	Summary of Revenue by Region by Service Line						
4		2020				2021	Grand Total
5		Q1	Q2	Q3	Q4		
6	Asia						
7	Advisory Services	1,658,032.94	1,576,453.77	1,301,879.93	1,892,261.05	12,360,427.55	18,789,055.24
8	HR Management	4,520,169.49	5,137,624.93	3,906,747.95	3,284,249.64	25,869,617.77	42,718,409.78
9	IT Consulting	4,121,422.18	4,625,545.13	4,924,517.10	5,449,134.85	25,900,438.80	45,021,058.06
10	Training	675,998.37	727,372.56	653,771.06	411,210.91	4,524,464.40	6,992,817.30
11	Europe						
12	Advisory Services					32,556,283.45	32,556,283.45
13	HR Management					83,009,493.19	83,009,493.19
14	IT Consulting					62,567,734.62	62,567,734.62
15	Training					11,730,023.94	11,730,023.94
16	North America						
17	Advisory Services	12,306,107.21	11,758,282.30	9,985,846.06	14,550,079.51	93,790,984.33	142,391,299.41
18	HR Management	43,044,885.85	44,382,045.00	37,769,699.45	31,831,110.70	238,928,484.35	395,956,225.35
19	IT Consulting	30,640,819.14	34,164,260.01	36,674,269.90	42,187,684.74	198,726,768.70	342,393,802.49
20	Training	5,327,027.03	4,860,874.83	4,669,726.12	2,949,590.75	34,129,956.82	51,937,175.55
21	South America						
22	Advisory Services	6,529,300.05	5,802,681.90	3,151,025.60	7,354,537.67	31,050,687.45	53,888,232.67
23	HR Management	24,838,193.69	24,784,377.11	19,747,035.21	15,501,797.02	80,532,819.96	165,404,222.99
24	IT Consulting	13,908,957.85	16,457,588.23	15,400,544.65	22,633,945.64	60,822,949.84	129,223,986.21
25	Training	2,601,007.04	2,835,299.61	2,698,274.45	1,440,770.40	11,443,707.04	21,019,058.54
26	Grand Total	150,171,920.84	157,112,405.38	140,883,337.48	149,486,372.88	1,007,944,842.21	1,605,598,878.79

Figure 43 - PivotTable Using Calculated Columns for Fiscal Period Groupings

Creating Measures in a PivotTable Using DAX

Consider the need for advanced data analysis capabilities in a PivotTable built from data models. For instance, the PivotTable pictured in **Figure 44** presents data by region, year, and service line; however, it paints an incomplete picture relative to revenue because it does not show the number of revenue-producing sectors in each region. In other words, a simple revenue comparison between regions does not provide the depth of analysis necessary if the South American region does not operate in all the industry sectors that the North American region does.

	A	B	C	D
1	Total Revenue			
2		Asia	North America	South America
3	2020			
4	Advisory Services	6,428,627.69	48,600,315.08	22,837,545.22
5	HR Management	16,848,792.01	157,027,741.00	84,871,403.03
6	IT Consulting	19,120,619.26	143,667,033.79	68,401,036.37
7	Training	2,468,352.90	17,807,218.73	9,575,351.50
8	2021			
9	Advisory Services	12,360,427.55	93,790,984.33	31,050,687.45
10	HR Management	25,869,617.77	238,928,484.35	80,532,819.96
11	IT Consulting	25,900,438.80	198,726,768.70	60,822,949.84
12	Training	4,524,464.40	34,129,956.82	11,443,707.04
13	Grand Total	113,521,340.38	932,678,502.80	369,535,500.41

Figure 44 – Sample PivotTable Analyzing Revenue by Region, Year, and Service Line

You can add a measure to the PivotTable built from the data model to paint a complete picture. *Measures* are formulas explicitly created in PivotTables (or PivotCharts) that use data from data models. You can create measures based on standard DAX aggregation functions, such as **COUNT** or **SUM**. You can also generate them using DAX expressions. You always use measures in the *Values* area of a PivotTable. If you need to place calculated results elsewhere in a PivotTable – such as a row or column – you should use a calculated column instead of a measure.

When you define a formula for a measure, nothing happens until you add the measure to the PivotTable. Upon adding the measure, the formula evaluates for each cell in the PivotTable's Values area. Because Excel creates a result for each combination of row and column headers, a measure's result will likely be different in each cell. Excel saves the definition of the measure you create with its source table. It appears in the PivotTable Fields list and is available to all workbook users.

Returning to the example presented in Figure 44, you can use a DAX function – **DISTINCTCOUNT** – available only in DAX to perform a deeper analysis of the data. **DISTINCTCOUNT** identifies the number of distinct values a PivotTable summarizes at each unique intersection of a column and a row. To add this calculation to the PivotTable shown in Figure 44, click the arrow under **Measures** on the **Power Pivot** Ribbon and then choose **New Measure** to open the **Measure** dialog box pictured in **Figure 45**. In the dialog box, add the formula using the **DISTINCTCOUNT**

function, referring to the table and the column header in the table on which you want to base the calculation.

The screenshot shows the 'Measure' dialog box in Excel. The 'Table name' is set to 'Data'. The 'Measure name' is 'Revenue Producing Sectors'. The 'Description' is 'Counts the number of industry sectors generating revenue for each reporting period'. The 'Formula' is '=DISTINCTCOUNT(Data[Sector])'. The 'Category' is 'General'. The 'OK' button is highlighted.

Figure 45 – Adding a Measure in Power Pivot’s Measure Dialog Box

Once you create the formula and click **OK**, Excel adds the measure to the PivotTable. After you add it, you can use it in any other calculation in the PivotTable. **Figure 46** illustrates the updated PivotTable, complete with the newly appended measures offering greater insight into the revenues than previously available.

	A	B	C	D	E	F	G
1	Asia			North America		South America	
2		Total Revenue	Revenue Producing Sectors	Total Revenue	Revenue Producing Sectors	Total Revenue	Revenue Producing Sectors
3	2020	44,866,391.86	22	367,102,308.60	24	185,685,336.12	21
4	Advisory Services	6,428,627.69	15	48,600,315.08	17	22,837,545.22	14
5	HR Management	16,848,792.01	20	157,027,741.00	22	84,871,403.03	19
6	IT Consulting	19,120,619.26	22	143,667,033.79	24	68,401,036.37	21
7	Training	2,468,352.90	18	17,807,218.73	20	9,575,351.50	17
8	2021	68,654,948.52	22	565,576,194.20	24	183,850,164.29	22
9	Advisory Services	12,360,427.55	16	93,790,984.33	18	31,050,687.45	16
10	HR Management	25,869,617.77	21	238,928,484.35	23	80,532,819.96	21
11	IT Consulting	25,900,438.80	22	198,726,768.70	24	60,822,949.84	22
12	Training	4,524,464.40	18	34,129,956.82	20	11,443,707.04	18
13	Grand Total	113,521,340.38	22	932,678,502.80	24	369,535,500.41	22

Figure 46 – PivotTable with Calculated Field Added by Power Pivot

Creating Key Performance Indicators in Power Pivot

Power Pivot provides the ability to develop **Key Performance Indicators (KPIs)** and measure results against the KPIs you establish. KPIs are visual measures of performance that help users quickly evaluate their progress toward meeting specified goals. For example, an organization’s

sales department could use a KPI to measure monthly sales against sales quotas. Similarly, the accounting department might compare monthly advertising expenses against budgeted amounts, or a human resources department might measure quarterly employee turnover to a target value. Business professionals frequently use KPIs grouped onto a business scorecard to quickly and accurately summarize business activities and identify trends.

Using KPIs can be very useful when you need to show how actual results measure against expectations because KPIs are visual representations of performance. According to Microsoft, a “KPI gauges the performance of the value, defined by a Base measure, against a Target value, also defined by a measure or an absolute value.”

When building KPIs in Power Pivot, understanding three terminology elements is essential.

1. **Base Value.** A base value is a measure that resolves to a numeric value. It could represent sales or net profit for a period or year-to-date revenue through a specified date during the year.
2. **Target Value.** A target value can be a specific numeric target, or you can define it as a measure that resolves to a numeric value. For example, the sales target for the entire organization could be budgeted sales, a constant value. Alternatively, sales targets for each salesperson could be calculated using measures such as last year’s sales revenue plus a percentage increase.
3. **Status Thresholds.** Status thresholds are ranges between the high and low end points. They are displayed graphically (red, yellow, and green light, for example) to help users determine the base value’s progression toward a goal.

To create a KPI using Power Pivot, establish measures to serve as the **Base Value** and **Target Value**. In this case, establish the two measures below to summarize sales and targeted sales for the year using the following DAX formulas.

TotalSales:=SUM(Transactions[SalesAmount])

TotalSalesTarget:=SUM(SalesTargets[2020SalesTarget])

After creating the measures, return to the **Power Pivot** tab of the Ribbon. Click **KPI, New KPI** to open the **Key Performance Indicator (KPI)** dialog box displayed in **Figure 47**. Select the TotalSales measure as the KPI base field in the Key Performance Indicator dialog box. Additionally, set the **TotalSalesTarget** measure as the **Target value**. Finally, adjust the upper and lower **Status thresholds** to **95%** and **90%**, respectively. Click **OK** to complete the process.

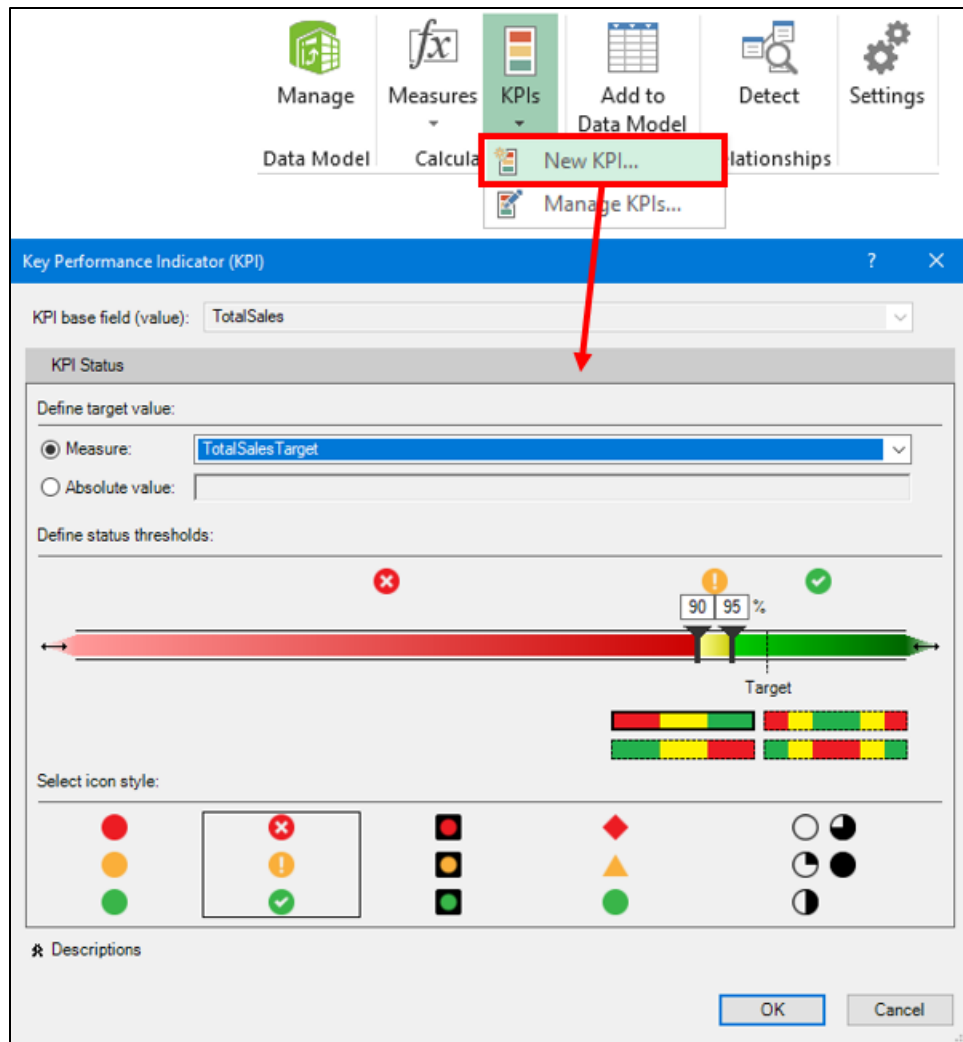


Figure 47 – Defining a New KPI in Power Pivot

As shown in **Figure 48**, each KPI component appears as a new field that you can add to the PivotTable. Note the traffic signal symbol to differentiate a KPI from other fields in the Field List. Next, add the KPI to the PivotTable to complete the report.

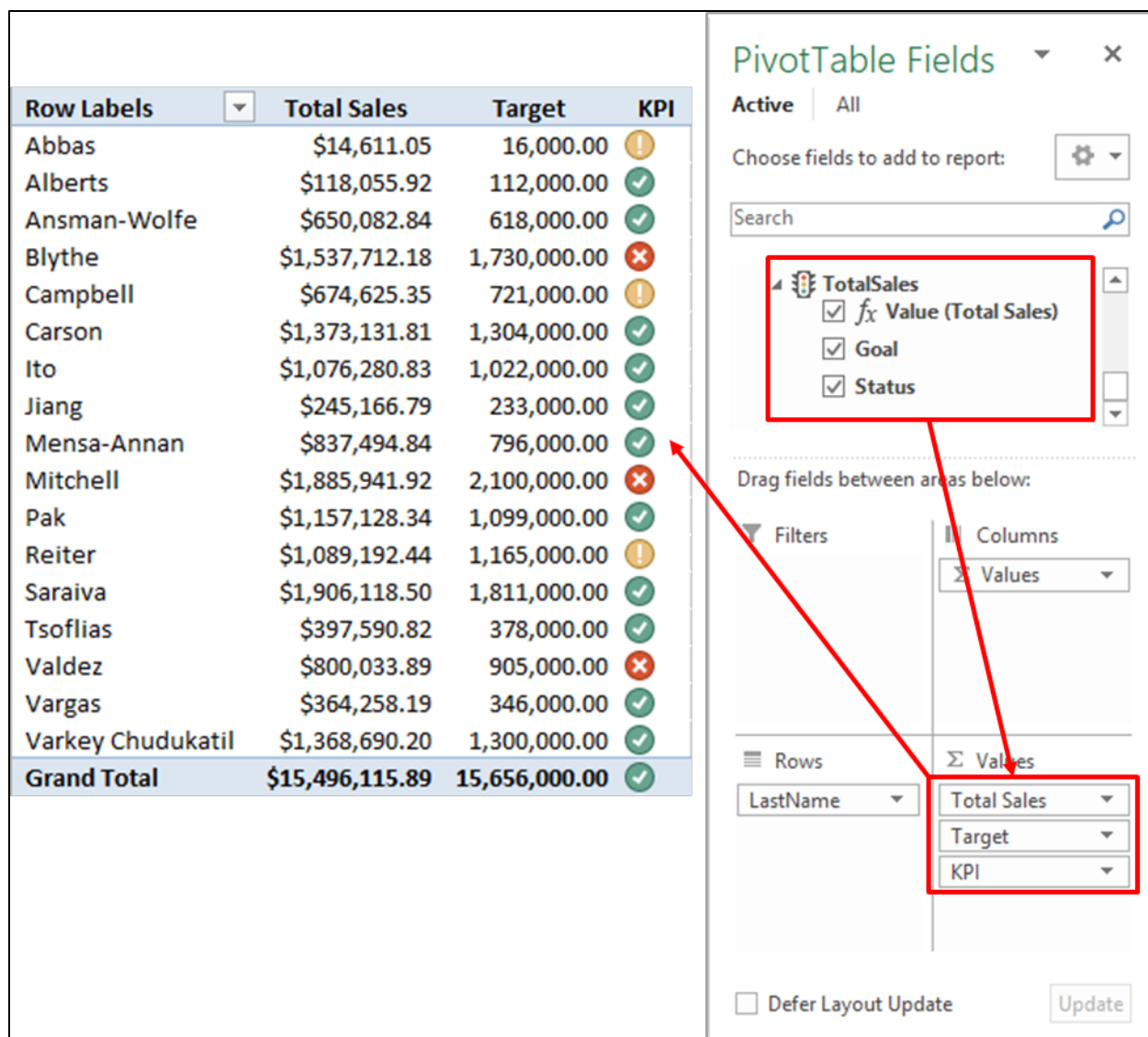


Figure 48 - PivotTable with KPI Added

Excel's GROUPBY And PIVOTBY Functions

Formula-Based Alternatives To PivotTables

In 1994, Microsoft added PivotTables to Excel. Since that time, many business professionals adopted this feature as their *de facto* way of summarizing and analyzing information – and for good reasons! A PivotTable offers powerful data summarization options without using time-consuming and error-prone formulas.

However, PivotTables have limitations. One such limitation is that they are structured somewhat rigidly, with few options for manipulating and presenting their summarized data. To address that issue, Microsoft recently added **GROUPBY** and **PIVOTBY** – two functions in Excel that offer many

of the computational advantages of traditional PivotTables while at the same time providing formula-based flexibility.

Getting Started With GROUPBY

Like Excel's **SUM**, **SUBTOTAL**, and other functions, GROUPBY is an Excel function you can use to summarize information quickly, easily, and accurately. However, GROUPBY differs from other Excel features as it allows you to quickly and easily aggregate data by categories, such as product line, region, customer, etc. In other words, you can use GROUPBY to generate a data summary filtered to specific criteria.

Although up to eight arguments can be present in the formula, only three are necessary when creating a formula based on the GROUPBY function.

1. First, indicate the row(s) in a table or range by which you will summarize your data; in the formula below, the **(FinancialData[Segment])** argument serves that purpose. Note that you can specify multiple rows, and if you do, you will have multiple groupings in your formula results.
2. Second, specify the column(s) that serves as the numeric values you wish to summarize; in the example below, the **(FinancialData[Net Sales])** argument serves that purpose. Like rows, you can specify multiple columns, and if you do, your report will have multiple aggregations.
3. Finally, specify the aggregation function; in the example below, that is the **SUM** argument.

To illustrate, consider the formula shown below.

=GROUPBY(FinancialData[Segment],FinancialData[Net Sales],SUM)

You could use this formula to summarize the amounts in FinancialData's "Net Sales" column by segment. Upon creating the formula, your output might resemble that shown in **Figure 49**.

Channel Partners	\$	1,800,593.64
Enterprise	\$	19,611,694.38
Government	\$	52,504,260.67
Midmarket	\$	2,381,883.08
Small Business	\$	42,427,918.50
Total	\$	118,726,350.26

Figure 49 - Output Generated By Simple GROUPBY Formula

In this simple example, the GROUPBY function creates summaries of the sales data for each of the specified business segments. Note that you need not sort, filter, or otherwise manipulate or rearrange the data to use GROUPBY.

Multiple Grouping Levels

Next, assume you need to summarize your data not only by **Segment** but also by **Country**. In that case, you can modify your formula to include **Country** as a second summarizing criterion. The modified formula appears below.

=GROUPBY(FinancialData[[Country]:[Segment]],FinancialData[Net Sales],SUM)

Upon entering the formula outlined above, the output changes to that pictured in **Figure 50**.

Channel Partners	Canada	\$	491,164.14
Channel Partners	France	\$	372,090.36
Channel Partners	Germany	\$	336,425.88
Channel Partners	Mexico	\$	234,379.08
Channel Partners	United States of America	\$	366,534.18
Enterprise	Canada	\$	3,967,491.25
Enterprise	France	\$	3,890,890.63
Enterprise	Germany	\$	4,086,826.25
Enterprise	Mexico	\$	3,315,881.25
Enterprise	United States of America	\$	4,350,605.00
Government	Canada	\$	10,741,236.52
Government	France	\$	12,127,782.72
Government	Germany	\$	11,452,895.94
Government	Mexico	\$	9,791,599.38
Government	United States of America	\$	8,390,746.11
Midmarket	Canada	\$	510,213.98
Midmarket	France	\$	593,802.08
Midmarket	Germany	\$	301,344.75
Midmarket	Mexico	\$	511,136.40
Midmarket	United States of America	\$	465,385.88
Small Business	Canada	\$	9,177,549.00
Small Business	France	\$	7,369,606.50
Small Business	Germany	\$	7,327,848.00
Small Business	Mexico	\$	7,096,356.00
Small Business	United States of America	\$	11,456,559.00
Total		\$	118,726,350.26

Figure 50 - GROUPBY Formula With Two Summarizing Criteria

As with the example in Figure 49, you can quickly summarize data and arrange it vertically without creating a PivotTable.

Summarizing Multiple Columns Of Data By Multiple Criteria Using GROUPBY

Continuing with the same data, let us now use GROUPBY to summarize multiple columns of data by multiple criteria. In this illustration, we will summarize **Net Sales** and **Gross Profit** by **Segment** and **Country**. In some cases, it may be necessary to rearrange your data when summarizing multiple columns using GROUPBY. Specifically, the summarized columns must be contiguous when using this function. Therefore, if the summarizing columns are not contiguous, rearrange them in that order. Alternatively, you could insert a new “helper” column contiguous to the other columns of interest and use a formula to link the value from the original column into the helper column. We can use the following formula to summarize multiple columns by multiple criteria – specifically, Segment followed by Country, and Net Sales followed by Gross Profit. **Figure 51** illustrates the formula’s results.

**=GROUPBY(FinancialData[[Country]:[Segment]],
FinancialData[[Net Sales]:[Gross Profit]],SUM)**

Channel Partners	Canada	\$ 491,164.14	\$ 358,978.14
Channel Partners	France	\$ 372,090.36	\$ 271,581.36
Channel Partners	Germany	\$ 336,425.88	\$ 247,358.88
Channel Partners	Mexico	\$ 234,379.08	\$ 170,890.08
Channel Partners	United States of America	\$ 366,534.18	\$ 267,994.68
Enterprise	Canada	\$ 3,967,491.25	\$ (121,508.75)
Enterprise	France	\$ 3,890,890.63	\$ (95,749.38)
Enterprise	Germany	\$ 4,086,826.25	\$ (101,473.75)
Enterprise	Mexico	\$ 3,315,881.25	\$ (120,678.75)
Enterprise	United States of America	\$ 4,350,605.00	\$ (175,135.00)
Government	Canada	\$ 10,741,236.52	\$ 2,258,471.52
Government	France	\$ 12,127,782.72	\$ 2,709,915.22
Government	Germany	\$ 11,452,895.94	\$ 2,677,175.94
Government	Mexico	\$ 9,791,599.38	\$ 2,039,159.38
Government	United States of America	\$ 8,390,746.11	\$ 1,703,451.11
Midmarket	Canada	\$ 510,213.98	\$ 132,488.98
Midmarket	France	\$ 593,802.08	\$ 164,542.08
Midmarket	Germany	\$ 301,344.75	\$ 85,354.75
Midmarket	Mexico	\$ 511,136.40	\$ 150,546.40
Midmarket	United States of America	\$ 465,385.88	\$ 127,170.88
Small Business	Canada	\$ 9,177,549.00	\$ 900,799.00
Small Business	France	\$ 7,369,606.50	\$ 730,731.50
Small Business	Germany	\$ 7,327,848.00	\$ 771,973.00
Small Business	Mexico	\$ 7,096,356.00	\$ 667,606.00
Small Business	United States of America	\$ 11,456,559.00	\$ 1,072,059.00
Total		\$ 118,726,350.26	\$ 16,893,702.26

Figure 51 - Summarizing Multiple Columns Of Data Using GROUPBY

Optional Arguments For GROUPBY Summarizations

As indicated earlier, there are only three mandated arguments for using the GROUPBY function: 1) row fields, 2) values, and 3) the summarizing function, such as SUM, COUNT, AVERAGE, etc. However, you can use up to five optional arguments to enhance your formula's results. Each of these is discussed below.

1. The *field_headers* argument allows you to specify whether your *row_fields* and *values* have headers and whether those headers should appear in your formula's results.
2. The *total_depth* argument determines whether row headers should contain totals.
3. You can use the *sort_order* argument to determine how Excel should sort rows in your formula's results.
4. A *filter_array* indicates whether a corresponding row of data should be considered when filtering.

5. The *field_relationship* argument specifies the relationship fields when multiple columns are provided to row fields.

Although a full discussion of each of the five options is beyond the scope of this session, a simple example can help you to understand the power of these options. For instance, suppose you want the output shown in Figure 49 to display sorted in *descending* order based on the summarized values. To achieve that result, you could modify the formula as shown below to indicate that you want the data sorted on the second column (thus, the entry of “2” in the formula) and, because you prefaced your entry of “2” with a minus sign, Excel knows to sort the data in *descending* order.

=GROUPBY(FinancialData[Segment],FinancialData[Net Sales],SUM,,,-2)

You can learn more about GROUPBY’s optional arguments at <https://k2e.fyi/groupby>.

PIVOTBY – An Even More Flexible And Powerful Tool

Excel’s **PIVOTBY** function provides even more flexibility and utility than the GROUPBY function. Specifically, PIVOTBY allows you to create data summaries and reports using *any* Excel function. Fortunately, the process for using PIVOTBY is like that of using GROUPBY, so if you know how to work with GROUPBY, the learning curve to adapt to PIVOTBY is short.

When using PIVOTBY, Excel requires you to specify four arguments:

1. **Row fields**, to describe which column of data will be used as row labels,
2. **Column fields**, to identify which column of data will be used as column headers,
3. **Values**, to indicate which column of data contains the data to summarize, and
4. **Function**, the summarizing function you want to use to analyze the data.

Using the data from the previous example, we could build the following formula to summarize our sales data by channel and country. The formula to accommodate that need is shown in **Figure 119**.

=PIVOTBY(FinancialData[Segment],FinancialData[Country],FinancialData[Net Sales],SUM)

	Canada	France	Germany	Mexico	United States of America	Total
Channel Partners	491,164.14	372,090.36	336,425.88	234,379.08	366,534.18	1,800,593.64
Enterprise	3,967,491.25	3,890,890.63	4,086,826.25	3,315,881.25	4,350,605.00	19,611,694.38
Government	10,741,236.52	12,127,782.72	11,452,895.94	9,791,599.38	8,390,746.11	52,504,260.67
Midmarket	510,213.98	593,802.08	301,344.75	511,136.40	465,385.88	2,381,883.08
Small Business	9,177,549.00	7,369,606.50	7,327,848.00	7,096,356.00	11,456,559.00	42,427,918.50
Total	24,887,654.89	24,354,172.28	23,505,340.82	20,949,352.11	25,029,830.17	118,726,350.26

Figure 52 - Sample Report Generated With Excel's PIVOTBY Function

If necessary, you could use any of the seven available optional arguments to modify your PIVOTBY formula so that the results meet your needs better. Several of these are similar to the optional arguments available with GROUPBY, and you can learn more about PIVOTBY's optional arguments at <https://k2e.fyi/pivotby>.

For example, suppose we modify the original formula to that shown below.

=PIVOTBY(FinancialData[Segment],FinancialData[Country],FinancialData[Net Sales],SUM,,-1)

In this case, we have added two commas and a "-1" to the end of the PIVOTBY formula. That modification causes Excel to display the PivotTable with the Grand Total as the first numerical row of the report instead of the last.



	Canada	France	Germany	Mexico	United States of America	Total
Total	24,887,654.89	24,354,172.28	23,505,340.82	20,949,352.11	25,029,830.17	118,726,350.26
Channel Partners	491,164.14	372,090.36	336,425.88	234,379.08	366,534.18	1,800,593.64
Enterprise	3,967,491.25	3,890,890.63	4,086,826.25	3,315,881.25	4,350,605.00	19,611,694.38
Government	10,741,236.52	12,127,782.72	11,452,895.94	9,791,599.38	8,390,746.11	52,504,260.67
Midmarket	510,213.98	593,802.08	301,344.75	511,136.40	465,385.88	2,381,883.08
Small Business	9,177,549.00	7,369,606.50	7,327,848.00	7,096,356.00	11,456,559.00	42,427,918.50

Figure 53 - Sample PIVOTBY-Based Formula With Optional Argument

Although PivotTables are entrenched firmly into many business professionals' Excel repertoire, GROUPBY and PIVOTBY are welcome additions to the lineup. Notably, because they are both formula-based, these functions update dynamically as your data changes – there is no need to initiate a refresh, such as with a PivotTable.

Building Charts Using GROUPBY And PIVOTBY

One ancillary advantage of using the GROUPBY and PIVOTBY functions is creating dynamic charts linked to the aggregations produced using these functions. Specifically, you can take the values produced by GROUPBY and PIVOTBY and link them directly into an Excel chart. At first glance,

this may not seem significant because of the presence of PivotCharts and the ability to generate PivotCharts from PivotTables. However, there is a significant limitation associated with PivotCharts. Specifically, Excel does not provide access to several chart types if you attempt to create a PivotChart. For example, suppose you had created a PivotTable and wanted to create a corresponding PivotChart in the form of a Treemap. If you attempt to do so, Excel displays the message in **Figure 54**.

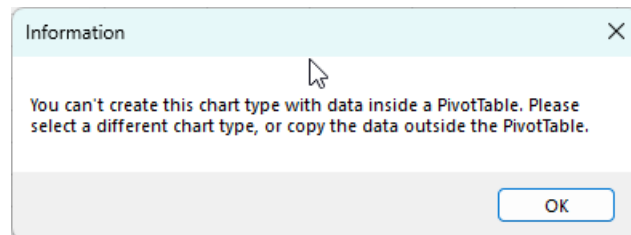


Figure 54 - Error Message Associated With Attempting To Create Certain Types Of Charts As PivotCharts

Specifically, Excel excludes numerous chart types from the PivotChart library, as detailed below.

- Box and Whisker
- Funnel
- Histograms
- Map
- Stock
- Sunburst
- Treemaps

Fortunately, there is a relatively simple solution to this issue. Specifically, you can use GROUPBY or PIVOTBY to create your aggregations and then build your chart from those aggregations. When you use this method, you avoid the limitations imposed by the absence of the seven chart types listed above.

To illustrate, let us return to the **FinancialData** table previously used in this session; the PivotTable pictured in **Figure 55** summarizes the data from that table.

Sum of Net Sales		Column Labels					
Row Labels		Canada	France	Germany	Mexico	United States of America	Grand Total
Government	\$	10,741,236.52	\$ 12,127,782.72	\$ 11,452,895.94	\$ 9,791,599.38	\$ 8,390,746.11	\$ 52,504,260.67
Small Business	\$	9,177,549.00	\$ 7,369,606.50	\$ 7,327,848.00	\$ 7,096,356.00	\$ 11,456,559.00	\$ 42,427,918.50
Enterprise	\$	3,967,491.25	\$ 3,890,890.63	\$ 4,086,826.25	\$ 3,315,881.25	\$ 4,350,605.00	\$ 19,611,694.38
Midmarket	\$	510,213.98	\$ 593,802.08	\$ 301,344.75	\$ 511,136.40	\$ 465,385.88	\$ 2,381,883.08
Channel Partners	\$	491,164.14	\$ 372,090.36	\$ 336,425.88	\$ 234,379.08	\$ 366,534.18	\$ 1,800,593.64
Grand Total	\$	24,887,654.89	\$ 24,354,172.28	\$ 23,505,340.82	\$ 20,949,352.11	\$ 25,029,830.17	\$ 118,726,350.26

Figure 55 - PivotTable Created From "FinancialData" Table

If we wanted the data displayed as a Treemap chart, we would be prohibited from completing that task because, as shown below, Treemaps are not available as PivotCharts.

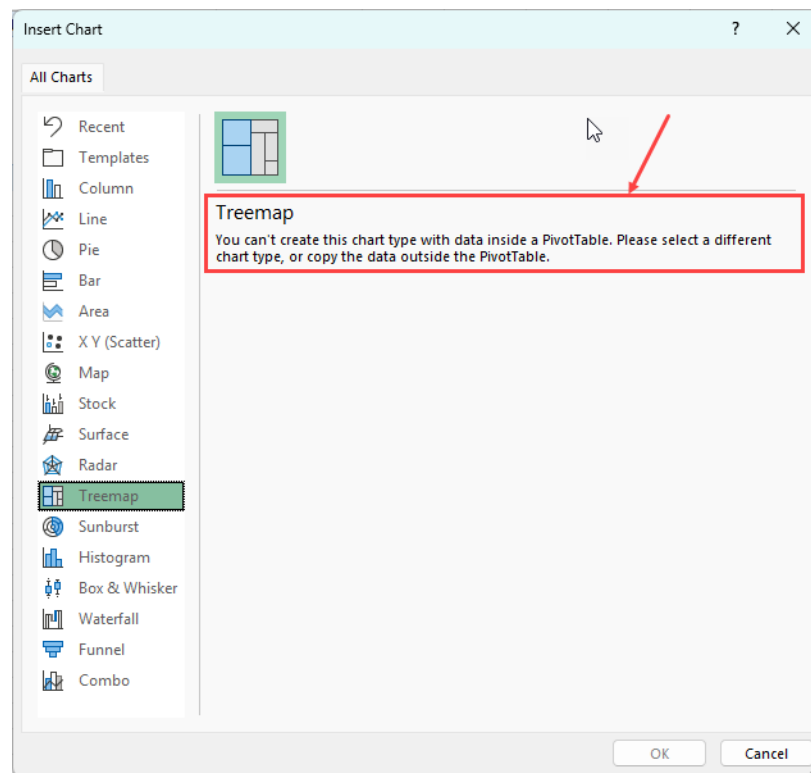


Figure 56 - Sample "Blocked" Treemap Chart

However, we could change our approach and use the results of a GROUPBY-based formula to achieve our desired results. Specifically, we could create the following formula:

GROUPBY(FinancialData[Segment],FinancialData[Net Sales],SUM,,0,-2)

The formula above creates the data summary pictured in **Figure 57**.

Government	52,504,260.67
Small Business	42,427,918.50
Enterprise	19,611,694.38
Midmarket	2,381,883.08
Channel Partners	1,800,593.64

Figure 57 - Data Summary Produced By GROUPBY-based Formula

With the tabulation complete, we could easily generate the treemap chart pictured in Figure 58 that provides a graphical representation of the data. Again, note that this would not be possible with a PivotChart.

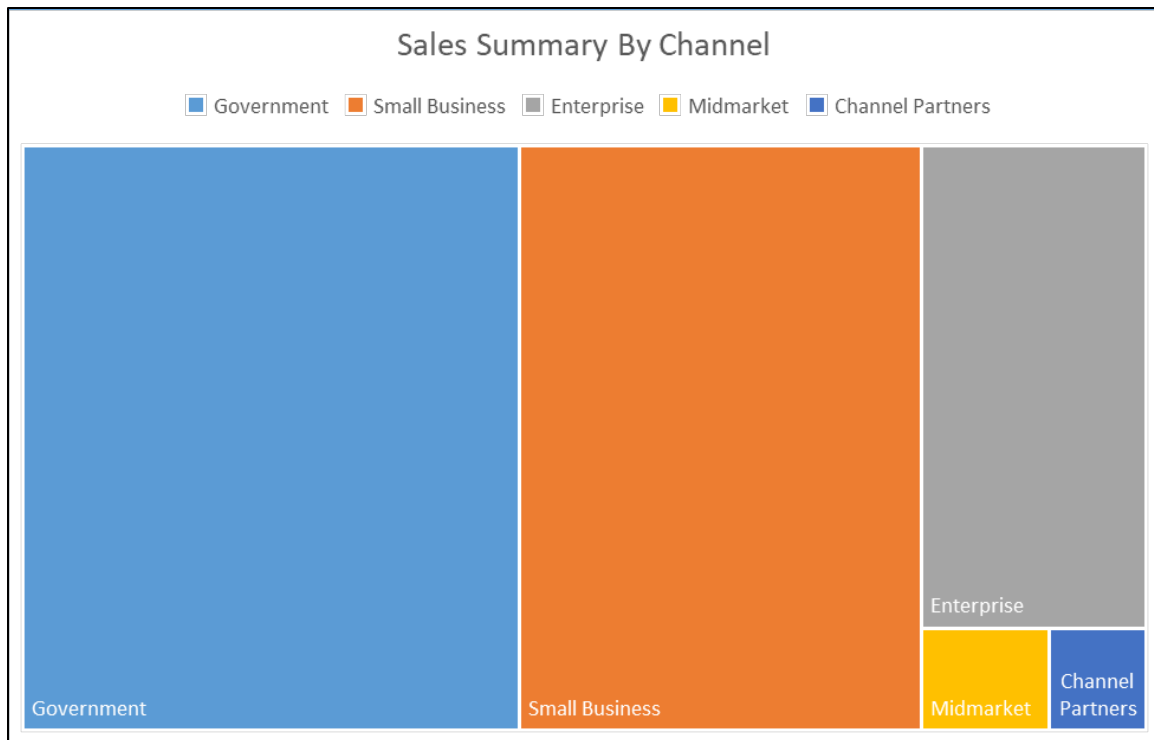


Figure 58 - Using Excel's GROUPBY Function To Bypass PivotChart Limitations

Summary

Basic and intermediate-class PivotTables offer tremendous opportunities to speed up data summarization, with computational accuracy all but guaranteed. However, as you have seen in this introduction to enterprise-class PivotTables, incorporating data models and using Power Query and Power Pivot set the stage for even greater efficiency and analytical power. Fortunately, because these tools are so easy to learn and use, you can take advantage of them immediately to improve your reporting and analytics processes. We encourage you to get started today!