A Complete Guide to PivotTables
A Visual Approach

Learn how to use PivotTables in Excel to analyze your data and make better decisions.

Paul Cornell

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Tables are powerful data analysis tools, yet most Excel users don't use them to their fullest potential. This guide shows why Pivot Tables are versatile for data analysis and how you can leverage them to spot trends and make fast business decisions.

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PivotTables are powerful data analysis tools, yet most Excel users don’t use them to their fullest potential. A Complete Guide to PivotTables: A Visual Approach shows you why PivotTables are so versatile for data analysis and how you can leverage PivotTables to rapidly spot trends and make fast business decisions on mountains of data.

A series of step-by-step tutorials and plenty of sample business data will help you get productive with PivotTables quickly and easily. Whereas most books only devote a small section to PivotTables, this book covers everything about this important Excel feature. With his tremendous experience writing about Office and Excel for Power Users, Paul Cornell will teach you plenty about PivotTables.

About the Author

Paul Cornell works at Microsoft on the documentation team for Microsoft Visual Studio Tools for the Microsoft Office system. He worked as an editor, writer, and columnist on the MSDN Office Developer Center and edited the Microsoft Office Visual Basic Language Reference. Cornell also founded the Power User Corner, on Microsoft Office Online, where he was a frequent contributor.

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Preface

I have been interested in writing a book on PivotTables for several years. Most folks don't know what PivotTables are. Those that do use PivotTables don't always use them to their full potential. When I tell people what PivotTables are, and demonstrate PivotTables to their fullest, it is truly a rewarding experience.

If you're wondering what qualifies me to write a book on PivotTables, perhaps I can share a portion of my work experience with you. I started my career in Microsoft Office when I joined the Microsoft Office User Assistance team more than four years ago. Microsoft had recently shipped Office 2000 and we were setting our sights on creating Microsoft Office XP. My first job was to go through all of the Office 2000 Visual Basic Language Reference documentation, including the documentation for Microsoft Excel, and prepare it for the next version of Office. During that time I learned the ins and outs of the Excel programmatic object model, along with the other Office applications.

After Office XP shipped, I moved over to become the editor for the Office Developer Center on the Microsoft Developer Network Web site. Around that time, I began teaching developers how to extend their customized Excel solutions and other Office solutions with Visual Basic for Applications and later Microsoft Visual Basic .NET and Microsoft Visual C# .NET.

At the same time, I saw a big gap between Office end users (we sometimes referred to them in Office as information workers) and Office solution developers. To help information workers who wanted to go deeper in their understanding of Excel and the other Office applications without becoming professional programmers, I founded the Office Power User Corner column on the Microsoft Office Online Web site.

As others and I began publishing monthly installments for the Office Power User Corner, we were overwhelmed by the positive customer response. We discovered that tens of thousands of folks each month visited the Office Power User Corner, and dozens of folks e-mailed us daily with kind words of appreciation and encouragement to continue.

Of the various subjects we wrote about, what really stood out for me in our e-mail feedback was the general lack of readers' understanding of what PivotTables were and how they could be used. A little over a year-and-a-half ago, I met with Apress founder Gary Cornell to discuss the opportunity of writing a book that shares my PivotTable skills with you to help you become a more productive Excel user.

I hope you enjoy reading this book as much as I enjoyed writing it. I hope you will find this book to be a great training resource and an indispensable ongoing technical reference.

Warmest regards,
Paul Cornell
Introduction—PivotTables Are Powerful!

This book is designed to help you understand what PivotTables are. You'll learn how to get the most out of PivotTables to make your work tasks easier, which will make you more valuable to your organization. It doesn't matter whether you're a corporate data analyst, an information worker for a large or medium-sized company, a small business owner, a student researcher, or anyone else who works with numbers. PivotTables will help reduce the time you spend analyzing data to spot trends, patterns, and problems. PivotTables will also help you make data-based decisions faster and more confidently.

For instance, by now you've probably used Excel to

- Work with the Insert Function dialog box to specify functions to report the sum of a column of numbers, find the lowest value in a column, and compute the average of a row of numbers.

- Subtotal a series of facts and figures by geographical region, date, or a person's name.

- Create a graph or chart to provide a visual representation of facts and figures.

These tasks aren't terribly difficult, but they aren't trivial either. Also, moving from one of these tasks to another means you have to use a different set of data analysis skills.

With PivotTables, you'll be able to perform these tasks easier:

- PivotTables provide standard functions such as Sum, Min, and Max that can be quickly calculated across a wide range of summarized data with just a few mouse clicks.

- PivotTables calculate subtotals automatically, based on logical categorizations of facts and figures, with no additional effort on your part.

- You can create a chart based on a PivotTable with as little as one mouse click.

Let's face it; data is everywhere. You already know that as you skim through your morning paper, you are confronted with numerical data, trends, and patterns. As you page through weather forecasts, the business section, and even the sports reports, there is a mountain of numbers. Your checkbook register, your monthly credit statements, and your taxes all resound with numerical figure after figure. The working world thrives on making wise decisions based on data to serve customers, sell more goods and services, and maximize profits. PivotTables organize, categorize, and present data in a summarized manner to help you make sense of the vast quantities of data that come your way.

What You Will Learn

Before you get started, here's a brief outline of what you'll be learning in this book. To demonstrate how much better PivotTables are for analyzing data, we'll first review Excel's basic data analysis techniques. You'll then begin creating simple PivotTables. From there, you'll practice using more advanced PivotTable features. You'll put your new skills to use right away by using PivotTables in real-world scenarios. You'll move from PivotTables to PivotCharts, and then into more advanced data-analysis scenarios by using PivotTables and PivotCharts to analyze multidimensional data. Finally, you'll use Visual Basic for Applications (VBA) code to programmatically automate PivotTables and PivotCharts. This book's chapters are organized to follow this outline, starting with basic data-analysis techniques and then moving to more advanced data-analysis techniques.

In Chapter 1, What Are PivotTables?, you are introduced to PivotTables. You learn why PivotTables are so valuable after you first try analyzing data using less sophisticated and less integrated Excel data analysis techniques, including visual inspection of long data lists, the use of summary functions, and concluding with the use of crosstab tables. By the end of this chapter, you'll begin to see how PivotTables bring together all these other data-analysis techniques into one cohesive tool. A PivotTable is like a Swiss Army knife for robust data analysis!

In Chapter 2, Creating PivotTables, you learn how to quickly create simple PivotTables with the PivotTable and PivotChart Wizard, which you later extend using other tools and techniques. You discover how to work with data sources other than data in Excel workbooks. You learn how to create data in external data sources. You also discover how to format PivotTables for more professional presentation. You finish the chapter by creating a PivotTable on your own using the wizard.

In Chapter 3, Working with PivotTable Components, you begin pivoting data quickly using row, column, data, and page fields. Pivoting allows you to look at your data from different perspectives, which enables you to quickly spot trends and anomalies, and helps provide
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You also begin using the PivotTable Field List to customize PivotTables. You round out the chapter by working with the PivotTable toolbar and PivotTable menu to further extend PivotTables.

In Chapter 4, Using PivotTables in the Real World, you see how three fictional companies could use PivotTables to help increase their employees' data-analysis productivity, which allows their employees to make better business decisions faster. You are introduced to three companies: Fabrikam Interiors, Tailspin Toys, and Contoso Publishing Ltd. Each of these companies use PivotTables in a slightly different scenario. You can use these real-world scenarios to give you ideas and leverage best practices as you begin to use PivotTables in your organization.

In Chapter 5, Working with PivotCharts, you learn why PivotCharts are a powerful companion to PivotTables. As its name suggests, PivotCharts allow you to present data in a more graphically and visually friendly way. This makes data even more meaningful and also allows for even better and quicker decisions based on data than with PivotTables alone.

In Chapter 6, Analyzing Multidimensional Data with PivotTables, you are introduced to the concept of multidimensional data. This type of data basically deals with exponentially huge amounts of data that are interrelated in many complex ways. You discover how PivotTables can chew through these huge warehouses of information, summarizing the data for you in a more approachable and understandable manner.

In Chapter 7, Programming PivotTables, you learn how to extend PivotTables even further through Visual Basic for Applications (VBA) code. This allows you to build more sophisticated PivotTable solutions than using the PivotTable wizard, toolbar, and menu alone.

Because this book discusses PivotTables and PivotCharts from an Excel 2003 perspective, it's important for you to understand how to adapt the descriptions and exercises if you're using an earlier Excel version. Therefore, an appendix is also included, which lists the primary differences between Excel 2000, Excel 2002, and Excel 2003 for features described throughout this book.
Outcome

By the time you finish this book, you should be able to

- Understand PivotTables, what they're used for, and the best scenarios in which to use them.
- Be very comfortable using the PivotTable and PivotChart Wizard with Excel data and other types of data to create and customize your own PivotTables.
- Feel confident using row, column, page, and data fields; the PivotTable toolbar and menus; and the PivotTable Field List to quickly rearrange PivotTables and bring new perspectives to data.
- Leverage best practices and case studies in real-world scenarios to help you apply PivotTables to your current data and business problems.
- Be at ease using PivotCharts to add visual perspective and depth to data in PivotTables.
- Have a good understanding of multidimensional data.
- Use PivotTables to analyze enormous collections of complex interrelated data, including online analytical processing (OLAP) data.
- Begin to build customized PivotTable solutions using VBA code.
- Understand the key differences between PivotTable features in different Excel versions.
Using the Try It! Exercises

Throughout this book, beginning in Chapter 1, several sections begin with the phrase Try It!. These sections provide opportunities for you to use PivotTables and PivotCharts to help you more easily understand the concepts throughout this book. To access the business data used in these Try It sections, visit the Apress Web site Downloads section at http://www.apress.com. This book uses Microsoft Office Excel 2003 as the basis of the Try It sections. For information on the features that work on earlier Excel versions, see the appendix at the end of this book. The appendix lists some of the differences between Excel 2000, Excel 2002, and Excel 2003 that apply to concepts and exercises shared in this book.
What You Should Already Know

Before you begin using this book, you should have a good general understanding of Excel already. You should know about Excel terms such as workbooks, worksheets, cells, formulas, and the like. If you haven't guessed by now, this book only covers how to use PivotTables, not how to use the rest of Excel. You should already know how to use Excel's core user interface, including navigating the Excel menu bars, using and customizing Excel toolbars, and other Excel user interface components such as wizards. More specifically, you should know how to

- Add and delete worksheets in Excel workbooks.
- Import and export data to and from Excel.
- Format data such as currency and dates in worksheet rows and columns.
- Work with worksheet formulas.
- Format charts.

If you want to learn how to use Excel or brush up on your existing Excel skills, see the Microsoft Office Online Web site at http://www.microsoft.com/office, as well as the documentation included with Excel.

As you begin to master Excel, you might want to consider becoming certified as a Microsoft Office Specialist. When compared with those that aren't Office-certified, being a Microsoft Office Specialist can set you apart in the job market, increase your employment opportunities, give you the opportunity to increase your earning potential, and enhance career advancement. Not only that, you can also potentially increase your credibility with fellow coworkers, students, and customers. As an added benefit, you'll learn more about Excel, obviously increasing your satisfaction and skill level with the product. For more information about the Microsoft Office Specialist Certification, visit the Microsoft Office Specialist Web site at http://www.microsoft.com/learning/mcp/officespecialist.

While this book does contain a chapter about programming PivotTables, this is not a book on programming the rest of Excel. Before you read Chapter 7, you should already have an introductory understanding of Excel VBA. For more information on Excel programming, see the following Apress books:


If you're interested in other Office books by Apress, see **Office 2003 XML for Power Users** by Matthew MacDonald (Apress, 2004).
Overview

PivotTables are a feature of Excel that allows you to see patterns and trends of large amounts of data in a short amount of time. You can take lots of pieces of information and get insights about how the data is related. If you want to look at the same data insights from additional perspectives, you simply rearrange, or pivot, the data in the PivotTable accordingly so that additional insights swing into view.

As you use PivotTables to help you analyze and compare information, you begin to make sense of what at first seems like unrelated information, turning data into the fuel that helps you make key decisions in faster time.

For example, using PivotTables, you can take thousands of individual sales transactions and present them in a table that provides a summary view of sales by calendar month that fits nicely within your computer screen without scrolling. You could then quickly transform the summary view into sales by geographical store location for comparison. Lastly, you could quickly compare sales by both calendar month and store location at the same time with just a few mouse clicks.

You could get answers to questions such as

- What are my sales totals for each geographic region? Which product line sold the best and at which time of the year?
- When is the best day of the week for customers to visit my Web site? Which portion of the Web site attracts the most visitors during that day?
- In which academic quarter, and in which subjects during the quarter, did students score the best on their exams?

These somewhat involved data analysis questions are easy to figure out with a PivotTable. For instance, to get sales totals for each geographic region, you could simply drag a few items around in an Excel workbook. The resulting PivotTable could calculate all of the sales totals automatically. Likewise, with a few mouse clicks, you could quickly and easily determine which product sold the best based on a certain date.

Other Ways to Analyze Data in Excel

There are certainly other ways of analyzing Excel information. However, none of them have the benefits of PivotTables previously mentioned. To begin your PivotTable journey, you'll look at a few of these data analysis tools individually and then compare them to PivotTables. By the end of this chapter, you'll see that PivotTables provide a more integrated and powerful way to analyze data than each of the following data analysis approaches by themselves. Now you'll look at some of Excel's data analysis techniques individually.

Subtotals

You could use subtotals to analyze your data. Subtotaling is a fast and easy method of grouping similar data and summarizing it. Subtotaling data by time, location, person, subject, and so on are common data analysis tasks. To use subtotals, you simply select a cell in the column that you want to subtotal, choose Data ➤ Subtotals, and follow the directions in the Subtotal dialog box. An example of some data to be subtotaled is shown in Figure 1-1.
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![Table Image]

**Figure 1-1:** Example data to be subtotaled

An example of the Subtotal dialog box is shown in **Figure 1-2**.

![Subtotal Dialog Box Image]

**Figure 1-2:** The Subtotal dialog box
Chapter 1: What Are PivotTables?

At each change in music genre in the data as shown in Figure 1-1, a subtotal will be calculated for all albums in stock for that genre across all music stores.

Figure 1-3 shows the result of applying the subtotals.

However, this approach alone is insufficient as a robust data analysis solution. Unless your data is presented in a way that allows for easy subtotaling, for example listing time-based numbers by geographical region instead, using subtotals can yield odd results, which might force you to spend a lot of time reorganizing your data to get the subtotaling just the way you want. Also, every time you want to change the way your subtotals are calculated, you might have to remove the existing subtotals and go through the subtotaling process from the beginning all over again.

In contrast, PivotTables allow you to quickly rearrange numbers so that subtotals can be quickly recalculated, without having to rearrange the source data on which the PivotTables are based. Figure 1-4 shows a PivotTable based on the data in Figure 1-1.
If you're unfamiliar with Excel's subtotaling feature, you can practice using it in the "Analyze Data Using Subtotals" section later in this chapter.

### Worksheet Formulas

You could also use worksheet formulas to summarize data. Excel has hundreds of worksheet formula types covering simple calculations such as addition and averages all the way up to advanced statistical analysis. However, worksheet formulas can be unstable and error-prone.

The most frequent problem occurs when the worksheet locations of the numbers that a worksheet formula depends on change, such as when lists are sorted or grouped. When this happens, worksheet formulas that rely on numbers to be in a specific worksheet location could be rendered invalid or return the wrong results. One example is a simple function that sums three numbers. If one of these numbers is changed or removed from the group, the function will only report the results that include the new changed number or of the remaining two numbers if one of the numbers is missing. To see what this looks like in a worksheet, start with the scenario in Figure 1-5.

#### Figure 1-5: Sample data and formula with numbers in fixed positions on the worksheet. Note that the formula in cell C19 depends on the values in rows C2, C6, C10, and C14.

Now, move the numbers around in the column, as shown in Figure 1-6.

#### Figure 1-6: Sample data with a different result after values are moved from their previous fixed positions. Notice that the result in cell
Chapter 1: What Are PivotTables?

C19 is incorrect because the values in rows C2, C6, C10, and C14 are not the same as in Figure 1-5.

Notice how the result has changed because the numbers changed absolute positions in the column. Refer to Figure 1-4 earlier to see how these numbers would look in a PivotTable. Even if the numbers are moved around in the same column, the PivotTable’s results should not change.

Additionally, more complex worksheet functions require an understanding of the functions’ inputs. If you input the wrong information to a function, the function will, of course, return the wrong results. One of these functions, for example, is the Subtotal function. The first input to this function is a number from 1 to 111 that represents the intersection of a worksheet function such as Average, Min, or Var, along with whether the worksheet function recognizes or ignores hidden values. Obviously, this algorithm is not intuitive for most Excel users.

Worksheet functions in PivotTables are very flexible; because you’re rearranging a copy of the source data and not the data itself, the worksheet functions can better rely on stationary source data. Additionally, PivotTable worksheet functions are self-contained. In other words, you don't have to learn how to craft formulas. You can spend your time doing direct data analysis instead.

The "Analyze Data Using Worksheet Functions" section later in this chapter gives you an opportunity to practice using worksheet functions if you're unfamiliar with this Excel feature.

Filters

Filters are also tools for analyzing data. Filters allow you to exclude numbers that don't meet particular criteria that you choose in advance. For example, you can use a filter to only view students' test results that exceed a given limit, say 85%.

Filters have the same issues as subtotals, however, in that if you want to apply different filters, you need to sometimes experiment with the AutoFilter buttons to get the right combination of filters on the correct rows and/or columns. Also, again, worksheet formulas can break or show the wrong results if they rely on unfiltered data only. For example, say you want to show albums in stock for only store 7847, as shown in Figure 1-7.

![Figure 1-7: Using a filter to show albums in stock for only store 7847](image)

Next, say you want to show rock albums in stock for all stores. So, as shown in Figure 1-8, you attempt to set the filter for only showing rock albums. However, you forgot to turn off the filter for the store number column.

![Figure 1-8: Using a filter to show only rock albums in stock for only store 7847. To show only rock albums in stock for all stores, you must remember to remove the filter from the store number column as well.](image)

Getting all of these filters set correctly can be time consuming. PivotTables make this type of mistake much easier to spot, as shown in Figure 1-9.
Chapter 1: What Are PivotTables?

Data Validation and Conditional Formatting

Validating data and applying conditional formatting to data are good basic indicators of data anomalies and trends.

You can validate data to make sure it falls within a specific numerical range of values, for example, ensuring that only valid calendar dates are entered for a sales transaction date.

You can use conditional formatting to change the visual display of the data, for instance coloring cells red if the number of albums in stock for any cell is 100 or less. An example of this is shown in Figure 1-10.

As with the other methods previously mentioned, validating data and applying conditional formatting works well for single pieces of data. However, when data is filtered or moved around, validation rules and conditional formatting can become inoperable, display incorrect results, or trigger the wrong outcomes. Also, validating data and applying conditional formatting doesn't help filter or group data. So, these methods are not good ways of performing robust data analysis on very large groups of data.
Chapter 1: What Are PivotTables?

When used with PivotTables, data validation and conditional formatting take on greater meaning by providing additional data integrity and insights to already-summarized data, as shown in Figure 1-11.

![Figure 1-11: A PivotTable based on the data in Figure 1-11. Dark red cells highlight cells in which albums in stock is 100 or less.](image)

If you're not familiar with how to use Excel's conditional formatting feature, you can practice using it in the "Analyze Data Using Conditional Formatting" section later in this chapter.

**Dynamic Lists**

Beginning in Excel 2003, you can organize data into dynamic lists. These lists support built-in filtering, sorting, and a limited set of worksheet functions, and the data in lists can be moved around as a discrete unit. An example of a dynamic list is shown in Figure 1-12.

![Figure 1-12: An example of a dynamic list based on the data in Figure 1-1](image)

However, dynamic lists don't provide any additional built-in data analysis functionality on their own, such as subtotals and grouping, data validation, and conditional formatting.

PivotTables are superior to dynamic lists in that they add subtotals and grouping, as previously shown in Figure 1-4.

In the "Try It! Analyze Data with a List" exercises later in this chapter, you can practice using dynamic lists if you're not already familiar with how to use them.

**Crosstab Tables**
Lastly, you can create crosstab tables, which are summarized lists of subtotals, averages, or other types of calculations for numbers that are usually grouped in row-and-column format. One specific numerical dimension (such as sales by salespeople’s names) is listed down the table’s rows, and another specific numerical measurement (such as sales by calendar month) is listed across the table’s columns. An example of a crosstab table is shown in Figure 1-13.

![Figure 1-13: An example of a crosstab table](image)

Although powerful, creating crosstab tables can be tedious and prone to error. Tedious because the summarized data in crosstab tables is frequently typed by hand and prone to error because crosstab tables’ results are often based on worksheet formulas referring to highly volatile data or frequently moving cell positions. Additionally, crosstab tables usually address only one type of data analysis scenario at a time. To address additional data analysis scenarios, crosstab tables either need to be substantially modified, consisting of a complicated series of tasks, or the original crosstab tables must be replaced altogether by new sets of crosstab tables.

PivotTables use a unique series of rows, columns, row and column nesting, and pages to quickly present data views in three, four, or even more perspectives as your data analysis needs become more sophisticated, as previously shown in Figure 1-4.

If you're unfamiliar with using crosstab tables, the “Try It! Analyze Data with Crosstab Tables” exercises later in the chapter give you the opportunity to create and use crosstab tables.
Good Uses for PivotTables

To help you understand the scenarios that PivotTables are best used for, assume the facts and numbers in Figure 1-14 consist of hundreds or even thousands of rows of data like sales transactions for a given calendar year spread out over several sales outlets in a large geographical area.

How would you begin to make sense of all of that data?

It would be hard to visually and mentally process thousands of rows of data, not to mention tens of thousands or hundreds of thousands of rows. Summing or averaging the rows is usually not enough. Outlining in Excel is not very flexible either. You will most likely need to organize related data together along several groupings.

When you want to look at the data from a different perspective, you need to start over and organize the data into different groupings. These groupings don't necessarily follow the pattern of the data as it's presented in the worksheet.

The nice thing about PivotTables is that changing the groupings of data is quick. You can quickly rearrange, or pivot, the data to see information from whole new perspectives. You can ask all sorts of questions about your data without affecting the underlying data itself.

Following are good candidates for data that can be measured by PivotTables:

- Data that is presented in rows with the same number of columns per row. For example, the geographical location that applies to each fact and figure is placed in the first column, the date that each fact and figure was collected is placed in the second column, and so on.

- Numerical data or columnar text that is restricted to predictable lists of choice or values; for example, true/false, male/female, only the numbers 1 through 10, north/south/east/west, and so on.

- Data that is separated into, and organized by, logical relationships; for example, time (years, months, weeks, days, hours, minutes, and seconds), geography (continents, countries, regions, zones, states, cities, and communities), and so on.

- Data that is measured consistently; for example, the same currency, date formatting, metric measurement system, and so on.