Microsoft

Microsoft Excel 2013

Data Analysis and Business Modeling

Wayne L. Winston

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Microsoft Excel 2013
Data Analysis and Business Modeling

Master business modeling and analysis techniques with Microsoft Excel 2013, and transform data into bottom-line results. Written by award-winning educator Wayne Winston, this hands-on, scenario-focused guide shows you how to use the latest Excel tools to integrate data from multiple tables—and how to effectively build a relational data source inside an Excel workbook.

Solve real business problems with Excel—and sharpen your edge

- Summarize data with PivotTables and Descriptive Statistics
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- Master advanced Excel functions such as OFFSET and INDIRECT
- Delve into key financial, statistical, and time functions
- Make your charts more effective with the Power View tool
- Tame complex optimization problems with Excel Solver
- Run Monte Carlo simulations on stock prices and bidding models
- Apply important modeling tools such as the Inquire add-in

For intermediate to advanced users of Microsoft Excel

About the Author

For the past 15 years, **Wayne Winston**, Ph.D., has been teaching Fortune 500 companies and MBA students the most effective ways to use Excel to solve problems and make better decisions. He has written several books on marketing analytics and mathematics, including *Practical Management Science*, *Mathletics*, and *Marketing Analytics*.

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*For details and **system requirements**, see the Introduction.*

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Wayne L. Winston

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Introduction

Whether you work for a Fortune 500 corporation, a small company, a government agency, or a not-for-profit organization, if you're reading this introduction the chances are you use Microsoft Excel in your daily work. Your job probably involves summarizing, reporting, and analyzing data. It might also involve building analytic models to help your employer increase profits, reduce costs, or manage operations more efficiently.

Since 1999, I've taught thousands of analysts at organizations such as 3M, Booz Allen Hamilton consulting, Bristol-Myers Squibb, Broadcom Cisco Systems, Deloitte Consulting, Drugstore.com, eBay, Eli Lilly, Ford, General Electric, General Motors, Intel, Microsoft, Morgan Stanley, NCR, Owens Corning, Pfizer, Proctor & Gamble, PWC, Schlumberger, Tellabs, the U.S. Army, the U.S. Department of Defense, and Verizon how to use Excel more efficiently and productively in their jobs. Students have often told me that the tools and methods I teach in my classes have saved them hours of time each week and provided them with new and improved approaches for analyzing important business problems.

I've used the techniques described in this book in my own consulting practice to solve many business problems. For example, I have used Excel to help the Dallas Mavericks and New York Knickers NBA basketball teams evaluate referees, players, and lineups. During the last 15 years I have also taught Excel business modeling and data analysis classes to MBA students at Indiana University's Kelley School of Business. (As proof of my teaching excellence, I have won over 45 teaching awards, and have won the school's overall MBA teaching award six times.) I would like to also note that 95 percent of MBA students at Indiana University take my spreadsheet modeling class even though it is an elective.

The book you have in your hands is an attempt to make these successful classes available to everyone. Here is why I think the book will help you learn how to use Excel more effectively:

- The materials have been tested while teaching thousands of analysts working for Fortune 500 corporations and government agencies, including the U.S. Army.
- I've written the book as though I am talking to the reader. I hope this approach transfers the spirit of a successful classroom environment to the written page.

- I teach by example, which makes concepts easier to master. These examples are constructed to have a real-world feel. Many of the examples are based on questions sent to me by employees of Fortune 500 corporations.
- For the most part, I lead you through the approaches I take in Excel to set up and answer a wide range of data analysis and business questions. You can follow along with my explanations by referring to the sample worksheets that accompany each example. However, I have also included template files for the book's examples on the companion website. If you want to, you can use these templates to work directly with Excel and complete each example on your own.
- For the most part, the chapters are short and organized around a single concept. You should be able to master the content of most chapters with at most two hours of study. By looking at the questions that begin each chapter, you'll gain an idea about the types of problems you'll be able to solve after mastering a chapter's topics.
- In addition to learning about Excel formulas, you will learn some important math in a fairly painless fashion. For example, you'll learn about statistics, forecasting, optimization models, Monte Carlo simulation, inventory modeling, and the mathematics of waiting in line. You will also learn about some recent developments in business thinking, such as real options, customer value, and mathematical pricing models.
- At the end of each chapter, I've provided a group of practice problems (over 600 in total) that you can work through on your own. These problems will help you master the information in each chapter. Answers to all problems are included in files on the book's companion website. Many of these problems are based on actual problems faced by business analysts at Fortune 500 companies.
- Most of all, learning should be fun. If you read this book, you will learn how to predict U.S. presidential elections, how to set football point spreads, how to determine the probability of winning at craps, and how to determine the probability of a specific team winning an NCAA tournament. These examples are interesting and fun, and they also teach you a lot about solving business problems with Excel.

Note To follow along with this book, you must have Excel 2013. Previous versions of this book can be used with Excel 2003, Excel 2007, or Excel 2010.

What's new in this edition

This edition of the book contains the following changes:

- An explanation of Excel's 2013 exciting Flash Fill feature
- An explanation of how to delete invisible characters which often mess up calculations.
- An explanation of the following new Excel 2013 functions: SHEET, SHEETS, FORMULATEXT, and ISFORMULA.
- A simple method for listing all of a workbook's worksheet names.
- A chapter describing the exciting new field of analytics.
- How to create PivotTables from data in disparate locations or based on another PivotTable.
- How to use Excel 2013's new Timeline feature to filter PivotTables based on dates.
- A description of Excel 2013's Data Model.
- A description of Excel 2013's PowerPivot add-in.
- How to use Power View to create mind blowing charts and graphics.
- A new chapter on charting tricks and a general description of charting in Excel 2013.
- Over 30 new problems have been added.

What you should know before reading this book

To follow the examples in this book you do not need to be an Excel guru. Basically, the two key actions you should know how to do are the following:

- **Enter a formula** You should know that formulas must begin with an equals sign (=). You should also know the basic mathematical operators. For example, you should know that an asterisk (*) is used for multiplication, a forward slash (/) is used for division, and the caret key (^) is used to raise a quantity to a power.
- **Work with cell references** You should know that when you copy a formula that contains a cell reference such as A4 (an absolute cell reference, which is created by including the dollar signs), the formula still refers to cell A4 in the

cells you copy it to. When you copy a formula that contains a cell reference such as $A4 (a mixed cell address), the column remains fixed, but the row changes. Finally, when you copy a formula that contains a cell reference such as A4 (a relative cell reference), both the row and the column of the cells referenced in the formula change.

How to use this book

As you read along with the examples in this book, you can take one of two approaches:

- You can open the template file that corresponds to the example you are studying and complete each step of the example as you read the book. You will be surprised how easy this process is and amazed with how much you learn and retain. This is the approach I use in my corporate classes.
- Instead of working in the template, you can follow my explanations as you look at the final version of each sample file.

Using the companion content

This book features a companion website that makes available to you all the sample files you use in the book's examples (both the final Excel workbooks and starting templates you can work with on your own). The workbooks and templates are organized in folders named for each chapter. The answers to all chapter-ending problems in the book are also included with the sample files. Each answer file is named so that you can identify it easily. For example, the file containing the answer to Problem 2 in Chapter 10 is named s10_2.xlsx.

To work through the examples in this book, you need to copy the book's sample files to your computer. These practice files, and other information, can be downloaded from the book's detail page, located at:

http://aka.ms/Excel2013Data/files

Display the detail page in your Web browser, and follow the instructions for downloading the files.

Your companion eBook

The eBook edition of this book allows you to:

- Search the full text
- Print
- Copy and paste

To download your eBook, please see the instruction page at the back of this book.

Acknowledgments

I am eternally grateful to Jennifer Skoog and Norm Tonina, who had faith in me and first hired me to teach Excel classes for Microsoft finance. Jennifer in particular was instrumental in helping design the content and style of the classes on which the book is based. Keith Lange of Eli Lilly, Pat Keating and Doug Hoppe of Cisco Systems, and Dennis Fuller of the U.S. Army also helped me refine my thoughts on teaching data analysis and modeling with Excel.

Editors Kenyon Brown and Rachel Roumeliotis did a great job of keeping me (and the book) on schedule. Peter Myers did a great job with the technical editing. Thanks also to Production Editors Kara Ebrahim and Chris Norton for managing the book's production. I am grateful to my many students at the organizations where I've taught and at the Indiana University Kelley School of Business. Many of them have taught me things I did not know about Excel.

Alex Blanton, formerly of Microsoft Press, championed this project at the start and shared my vision of developing a user-friendly text designed for use by business analysts.

Finally, my lovely and talented wife, Vivian, and my wonderful children, Jennifer and Gregory, put up with my long weekend hours at the keyboard.

Support & feedback

The following sections provide information on errata, book support, feedback, and contact information.

Errata

We've made every effort to ensure the accuracy of this book and its companion content. If you do find an error, please report it on our Microsoft Press site:

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CHAPTER 3

INDEX function

Questions answered in this chapter:

- I have a list of distances between US cities. How can I write a function that returns the distance between, for example, Seattle and Miami?
- Can I write a formula that references the entire column containing the distances between each city and Seattle?

Syntax of the *INDEX* function

The *INDEX* function enables you to return the entry in any row and column within an array of numbers. The most commonly used syntax for the *INDEX* function is the following:

```
INDEX(Array,Row Number,Column Number)
```

To illustrate, the INDEX(A1:D12,2,3) formula returns the entry in the second row and third column of the A1:D12 array. This entry is the one in cell C2.

Answers to this chapter's questions

This section provides the answers to the questions that are listed at the beginning of the chapter.

I have a list of distances between US cities. How can I write a function that returns the distance between, for example, Seattle and Miami?

The Index.xlsx file (see Figure 3-1) contains the distances between eight US cities. The C10:J17 range, which contains the distances, is named *Distances*.

	A	B	C	D	E	F	G	H	I	J
4		Boston-Denver	1991			T Dist to Seattle	15221			
5		Seattle- Miami	3389							
6										
7										
8										
9			Boston	Chicago	Dallas	Denver	LA	Miami	Phoenix	Seattle
10	1	Boston	0	983	1815	1991	3036	1539	2664	2612
11	2	Chicago	983	0	1205	1050	2112	1390	1729	2052
12	3	Dallas	1815	1205	0	801	1425	1332	1027	2404
13	4	Denver	1991	1050	801	0	1174	2100	836	1373
14	5	LA	3036	2112	1425	1174	0	2757	398	1909
15	6	Miami	1539	1390	1332	2100	2757	0	2359	3389
16	7	Phoenix	2664	1729	1027	836	398	2359	0	1482
17	8	Seattle	2612	2052	2404	1373	1909	3389	1482	0

FIGURE 3-1 You can use the *INDEX* function to calculate the distance between cities.

Suppose that you want to enter the distance between Boston and Denver in a cell. Because distances from Boston are listed in the first row of the array named *Distances*, and distances to Denver are listed in the fourth column of the array, the appropriate formula is INDEX(distances,1,4). The results show that Boston and Denver are 1,991 miles apart. Similarly, to find the (much longer) distance between Seattle and Miami, you would use the INDEX(distances,6,8) formula. Seattle and Miami are 3,389 miles apart.

Imagine that a resident of Seattle, Kurt Sovain is embarking on a road trip to visit relatives in Phoenix, Los Angeles (USC!), Denver, Dallas, and Chicago. At the conclusion of the road trip, Kurt returns to Seattle. Can you easily compute how many miles Kurt travels on the trip? As you can see in Figure 3-2, you simply list the cities Kurt visited (*8-7-5-4-3-2-8*) in the order he visited them, starting and ending in Seattle, and copy the INDEX(distances,C21,C22) formula from D21 to D26. The formula in D21 computes the distance between Seattle and Phoenix (city number 7), the formula in D22 computes the distance between Phoenix and Los Angeles, and so on. Kurt will travel a total of 7,112 miles on his road trip. Just for fun, use the *INDEX* function to show that the Miami Heat travel more miles during the NBA season than any other team.

	C	D	E
19	**Road Trip!!**		
20	City	Distance	
21	8	1482	
22	7	398	
23	5	1174	
24	4	801	
25	3	1205	
26	2	2052	
27	8		
28	Total	7112	

FIGURE 3-2 These are the distances for Kurt's road trip.

Can I write a formula that references the entire column containing the distances between each city and Seattle?

The *INDEX* function makes it easy to reference an entire row or column of an array. If you set the row number to 0, the *INDEX* function references the listed column. If you set the column number to 0, the *INDEX* function references the listed row. To illustrate, suppose you want to total the distances from each listed city to Seattle. You could enter either of the following formulas:

```
SUM(INDEX(distances,8,0))

SUM(INDEX(distances,0,8))
```

The first formula totals the numbers in the eighth row (row 17) of the Distances array; the second formula totals the numbers in the eighth column (column J) of the Distances array. In either case, you find that the total distance from Seattle, to the other cities, and back to Seattle is 15,221 miles, as you can see in Figure 3-1.

Problems

1. Use the *INDEX* function to compute the distance between Los Angeles and Phoenix and the distance between Denver and Miami.
2. Use the *INDEX* function to compute the total distance from Dallas to the other cities.
3. A resident of Dallas, Texas, is embarking on a road trip that takes her to Chicago, Denver, Los Angeles, Phoenix, and Seattle. How many miles will she travel on this trip?
4. The Product.xlsx file contains monthly sales for six products. Use the *INDEX* function to compute the sales of Product 2 in March. Use the *INDEX* function to compute total sales during April.
5. The Nbadistances.xlsx file shows the distance between any pair of NBA arenas. Suppose you begin in Atlanta, visit the arenas in the order listed, and then return to Atlanta. How far would you travel?
6. Use the *INDEX* function to solve problem 10 of Chapter 2, "Lookup functions."

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