

# business solutions

# Formulas and Functions with Microsoft® Office Excel 2007

Paul McFedries



800 E. 96th Street  
Indianapolis, Indiana 46240

## Contents at a Glance

### I Mastering Excel Ranges and Formulas

1 Getting the Most Out of Ranges .....	7
2 Using Range Names .....	37
3 Building Basic Formulas .....	55
4 Creating Advanced Formulas .....	89
5 Troubleshooting Formulas .....	113

### II Harnessing the Power of Functions

6 Understanding Functions .....	133
7 Working with Text Functions .....	143
8 Working with Logical and Information Functions .....	167
9 Working with Lookup Functions .....	195
10 Working with Date and Time Functions .....	213
11 Working with Math Functions .....	243
12 Working with Statistical Functions .....	263

### III Building Business Models

13 Analyzing Data with Tables .....	297
14 Business Modeling with PivotTables .....	331
15 Using Excel's Business-Modeling Tools .....	361
16 Using Regression to Track Trends and Make Forecasts .....	385
17 Solving Complex Problems with Solver .....	427

### IV Building Financial Formulas

18 Building Loan Formulas .....	449
19 Building Investment Formulas .....	469
20 Building Discount Formulas .....	483

Index ..... 505

---

# Contents

<b>Introduction</b>	<b>1</b>
What's in the Book	2
This Book's Special Features	2
 I MASTERING EXCEL RANGES AND FORMULAS	
<b>1 Getting the Most Out of Ranges</b>	<b>7</b>
Advanced Range-Selection Techniques	7
Mouse Range-Selection Tricks	8
Keyboard Range-Selection Tricks	9
Working with 3D Ranges	9
Selecting a Range Using Go To	10
Using the Go To Special Dialog Box	11
Data Entry in a Range	15
Filling a Range	16
Using the Fill Handle	16
Using AutoFill to Create Text and Numeric Series	16
Creating a Custom AutoFill List	18
Filling a Range	19
Creating a Series	19
Advanced Range Copying	20
Copying Selected Cell Attributes	20
Combining the Source and Destination Arithmetically	22
Transposing Rows and Columns	23
Clearing a Range	23
Applying Conditional Formatting to a Range	24
Creating Highlight Cells Rules	24
Creating Top/Bottom Rules	26
Adding Data Bars	28
Adding Color Scales	31
Adding Icon Sets	33
From Here	35
<b>2 Using Range Names</b>	<b>37</b>
Defining a Range Name	38
Working with the Name Box	38
Using the New Name Dialog Box	39
Changing the Scope to Define Sheet-Level Names	41
Using Worksheet Text to Define Names	41
Naming Constants	44

Working with Range Names .....	.45
Referring to a Range Name .....	.46
Working with Name AutoComplete .....	.47
Navigating Using Range Names .....	.48
Pasting a List of Range Names in a Worksheet .....	.48
Displaying the Name Manager .....	.48
Filtering Names .....	.49
Editing a Range Name's Coordinates .....	.49
Adjusting Range Name Coordinates Automatically .....	.50
Changing a Range Name .....	.51
Deleting a Range Name .....	.52
Using Names with the Intersection Operator .....	.52
From Here .....	.53
<b>3 Building Basic Formulas .....</b>	<b>.55</b>
Understanding Formula Basics .....	.55
Formula Limits in Excel 2007 .....	.56
Entering and Editing Formulas .....	.56
Using Arithmetic Formulas .....	.57
Using Comparison Formulas .....	.58
Using Text Formulas .....	.59
Using Reference Formulas .....	.59
Understanding Operator Precedence .....	.59
The Order of Precedence .....	.60
Controlling the Order of Precedence .....	.60
Controlling Worksheet Calculation .....	.62
Copying and Moving Formulas .....	.64
Understanding Relative Reference Format .....	.65
Understanding Absolute Reference Format .....	.66
Copying a Formula Without Adjusting Relative References .....	.66
Displaying Worksheet Formulas .....	.67
Converting a Formula to a Value .....	.67
Working with Range Names in Formulas .....	.68
Pasting a Name into a Formula .....	.68
Applying Names to Formulas .....	.69
Naming Formulas .....	.72
Working with Links in Formulas .....	.72
Understanding External References .....	.73
Updating Links .....	.74
Changing the Link Source .....	.75
Formatting Numbers, Dates, and Times .....	.75
Numeric Display Formats .....	.76
Date and Time Display Formats .....	.83
Deleting Custom Formats .....	.86
From Here .....	.87

<b>4 Creating Advanced Formulas</b>	<b>89</b>
Working with Arrays .....	89
Using Array Formulas .....	90
Using Array Constants .....	93
Functions That Use or Return Arrays .....	94
Using Iteration and Circular References .....	95
Consolidating Multisheet Data .....	97
Consolidating by Position .....	97
Consolidating by Category .....	101
Applying Data-Validation Rules to Cells .....	102
Using Dialog Box Controls on a Worksheet .....	105
Using the Form Controls .....	105
Adding a Control to a Worksheet .....	106
Linking a Control to a Cell Value .....	106
Understanding the Worksheet Controls .....	107
From Here .....	111
<b>5 Troubleshooting Formulas</b>	<b>113</b>
Understanding Excel's Error Values .....	114
#DIV/0! .....	114
#N/A .....	115
#NAME? .....	115
Avoiding #NAME? Errors When Deleting Range Names .....	116
#NULL! .....	117
#NUM! .....	117
#REF! .....	117
#VALUE! .....	118
Fixing Other Formula Errors .....	118
Missing or Mismatched Parentheses .....	118
Erroneous Formula Results .....	119
Fixing Circular References .....	120
Handling Formula Errors with IFERROR() .....	121
Using the Formula Error Checker .....	122
Choosing an Error Action .....	123
Setting Error Checker Options .....	123
Auditing a Worksheet .....	126
Understanding Auditing .....	126
Tracing Cell Precedents .....	127
Tracing Cell Dependents .....	127
Tracing Cell Errors .....	127
Removing Tracer Arrows .....	128
Evaluating Formulas .....	128
Watching Cell Values .....	129
From Here .....	129

---

## II HARNESSING THE POWER OF FUNCTIONS

<b>6 Understanding Functions .....</b>	<b>133</b>
About Excel's Functions .....	134
The Structure of a Function .....	134
Typing a Function into a Formula .....	136
Using the Insert Function Feature .....	138
Loading the Analysis ToolPak .....	140
From Here .....	141
<b>7 Working with Text Functions .....</b>	<b>143</b>
Excel's Text Functions .....	144
Working with Characters and Codes .....	145
The CHAR() Function .....	145
The CODE() Function .....	148
Converting Text .....	149
The LOWER() Function .....	149
The UPPER() Function .....	149
The PROPER() Function .....	149
Formatting Text .....	150
The DOLLAR() Function .....	150
The FIXED() Function .....	151
The TEXT() Function .....	151
Displaying When a Workbook Was Last Updated .....	151
Manipulating Text .....	152
Removing Unwanted Characters from a String .....	152
The TRIM() Function .....	152
The CLEAN() Function .....	153
The REPT() Function: Repeating a Character .....	153
Padding a Cell .....	154
Building Text Charts .....	154
Extracting a Substring .....	155
The LEFT() Function .....	156
The RIGHT() Function .....	156
The MID() Function .....	156
Converting Text to Sentence Case .....	156
A Date-Conversion Formula .....	157
Generating Account Numbers .....	158
Searching for Substrings .....	158
The FIND() and SEARCH() Functions .....	158
Extracting a First Name or Last Name .....	159

Extracting First Name, Last Name, and Middle Initial .....	160
Determining the Column Letter .....	161
Substituting One Substring for Another .....	162
The REPLACE() Function .....	162
The SUBSTITUTE() Function .....	163
Removing a Character from a String .....	163
Removing Two Different Characters from a String .....	164
Removing Line Feeds .....	164
Generating Account Numbers, Part 2 .....	165
From Here .....	165
<b>8 Working with Logical and Information Functions .....</b>	<b>167</b>
Adding Intelligence with Logical Functions .....	167
Using the IF() Function .....	168
Performing Multiple Logical Tests .....	171
Combining Logical Functions with Arrays .....	176
Building an Accounts Receivable Aging Worksheet .....	182
Calculating a Smarter Due Date .....	182
Aging Overdue Invoices .....	183
Getting Data with Information Functions .....	184
The CELL() Function .....	186
The ERROR.TYPE() Function .....	188
The INFO() Function .....	189
The IS Functions .....	191
From Here .....	193
<b>9 Working with Lookup Functions .....</b>	<b>195</b>
Understanding Lookup Tables .....	196
The CHOOSE() Function .....	197
Determining the Name of the Day of the Week .....	198
Determining the Month of the Fiscal Year .....	198
Calculating Weighted Questionnaire Results .....	199
Integrating CHOOSE() and Worksheet Option Buttons .....	200
Looking Up Values in Tables .....	200
The VLOOKUP() Function .....	201
The HLOOKUP() Function .....	202
Returning a Customer Discount Rate with a Range Lookup .....	202
Returning a Tax Rate with a Range Lookup .....	203
Finding Exact Matches .....	204
Advanced Lookup Operations .....	206
From Here .....	211

<b>10 Working with Date and Time Functions .....</b>	<b>213</b>
How Excel Deals with Dates and Times .....	213
Entering Dates and Times .....	214
Excel and Two-Digit Years .....	215
Using Excel's Date Functions .....	216
Returning a Date .....	218
Returning Parts of a Date .....	219
Calculating the Difference Between Two Dates .....	229
Using Excel's Time Functions .....	233
Returning a Time .....	234
Returning Parts of a Time .....	235
Calculating the Difference Between Two Times .....	237
Building an Employee Time Sheet .....	238
From Here .....	241
<b>11 Working with Math Functions .....</b>	<b>243</b>
Understanding Excel's Rounding Functions .....	247
The ROUND() Function .....	247
The MROUND() Function .....	248
The ROUNDDOWN() and ROUNDUP() Functions .....	248
The CEILING() and FLOOR() Functions .....	249
Determining the Fiscal Quarter in Which a Date Falls .....	249
Calculating Easter Dates .....	250
The EVEN() and ODD() Functions .....	250
The INT() and TRUNC() Functions .....	251
Using Rounding to Prevent Calculation Errors .....	251
Setting Price Points .....	252
Rounding Billable Time .....	253
Summing Values .....	253
The SUM() Function .....	253
Calculating Cumulative Totals .....	254
Summing Only the Positive or Negative Values in a Range .....	255
The MOD() Function .....	255
A Better Formula for Time Differences .....	256
Summing Every nth Row .....	256
Determining Whether a Year Is a Leap Year .....	257
Creating Ledger Shading .....	257
Generating Random Numbers .....	259
The RAND() Function .....	259
The RANDBETWEEN() Function .....	261
From Here .....	262

<b>12 Working with Statistical Functions</b>	<b>263</b>
Understanding Descriptive Statistics .....	265
Counting Items with the COUNT() Function .....	266
Calculating Averages .....	267
The AVERAGE() Function .....	267
The MEDIAN() Function .....	267
The MODE() Function .....	268
Calculating the Weighted Mean .....	268
Calculating Extreme Values .....	269
The MAX() and MIN() Functions .....	269
The LARGE() and SMALL() Functions .....	270
Performing Calculations on the Top <i>k</i> Values .....	271
Performing Calculations on the Bottom <i>k</i> Values .....	271
Calculating Measures of Variation .....	272
Calculating the Range .....	272
Calculating the Variance with the VAR() Function .....	272
Calculating the Standard Deviation with the STDEVP() and STDEV() Functions .....	273
Working with Frequency Distributions .....	275
The FREQUENCY() Function .....	275
Understanding the Normal Distribution and the NORMDIST() Function .....	276
The Shape of the Curve I: The SKEW() Function .....	278
The Shape of the Curve II: The KURT() Function .....	279
Using the Analysis ToolPak Statistical Tools .....	280
Using the Descriptive Statistics Tool .....	283
Determining the Correlation Between Data .....	285
Working with Histograms .....	287
Using the Random Number Generation Tool .....	289
Working with Rank and Percentile .....	292
From Here .....	294

---

### III BUILDING BUSINESS MODELS

<b>13 Analyzing Data with Tables</b>	<b>297</b>
Converting a Range to a Table .....	299
Basic Table Operations .....	300
Sorting a Table .....	301
Sorting a Table in Natural Order .....	303
Sorting on Part of a Field .....	304
Sorting Without Articles .....	305
Filtering Table Data .....	306
Using Filter Lists to Filter a Table .....	306
Using Complex Criteria to Filter a Table .....	310

Entering Computed Criteria .....	313
Copying Filtered Data to a Different Range .....	315
Referencing Tables in Formulas .....	316
Using Table Specifiers .....	316
Entering Table Formulas .....	318
Excel's Table Functions .....	320
About Table Functions .....	320
Table Functions That Don't Require a Criteria Range .....	320
Table Functions That Accept Multiple Criteria .....	323
Table Functions That Require a Criteria Range .....	325
Applying Statistical Table Functions to a Defects Database .....	329
From Here .....	330
<b>14 Analyzing Data with PivotTables .....</b>	<b>331</b>
What Are PivotTables? .....	331
How PivotTables Work .....	332
Some PivotTable Terms .....	334
Building PivotTables .....	335
Building a PivotTable from a Table or Range .....	335
Building a PivotTable from an External Database .....	338
Working with and Customizing a PivotTable .....	339
Working with PivotTable Subtotals .....	340
Hiding PivotTable Grand Totals .....	341
Hiding PivotTable Subtotals .....	341
Customizing the Subtotal Calculation .....	341
Changing the Data Field Summary Calculation .....	341
Using a Difference Summary Calculation .....	342
Using a Percentage Summary Calculation .....	344
Using a Running Total Summary Calculation .....	347
Using an Index Summary Calculation .....	348
Creating Custom PivotTable Calculations .....	350
Creating a Calculated Field .....	352
Creating a Calculated Item .....	353
Budgeting with Calculated Items .....	355
Using PivotTable Results in a Worksheet Formula .....	357
From Here .....	359
<b>15 Using Excel's Business-Modeling Tools .....</b>	<b>361</b>
Using What-If Analysis .....	361
Setting Up a One-Input Data Table .....	362
Adding More Formulas to the Input Table .....	364
Setting Up a Two-Input Table .....	365
Editing a Data Table .....	367

Working with Goal Seek .....	367
How Does Goal Seek Work? .....	367
Running Goal Seek .....	368
Optimizing Product Margin .....	370
A Note About Goal Seek's Approximations .....	371
Performing a Break-Even Analysis .....	372
Solving Algebraic Equations .....	373
Working with Scenarios .....	374
Understanding Scenarios .....	375
Setting Up Your Worksheet for Scenarios .....	376
Adding a Scenario .....	376
Displaying a Scenario .....	378
Editing a Scenario .....	379
Merging Scenarios .....	379
Generating a Summary Report .....	380
Deleting a Scenario .....	382
From Here .....	382
<b>16 Using Regression to Track Trends and Make Forecasts .....</b>	<b>385</b>
Choosing a Regression Method .....	386
Using Simple Regression on Linear Data .....	386
Analyzing Trends Using Best-Fit Lines .....	387
Making Forecasts .....	395
Trend Analysis and Forecasting for a Seasonal Sales Model .....	400
Using Simple Regression on Nonlinear Data .....	409
Working with an Exponential Trend .....	409
Working with a Logarithmic Trend .....	415
Working with a Power Trend .....	417
Using Polynomial Regression Analysis .....	420
Using Multiple Regression Analysis .....	423
From Here .....	426
<b>17 Solving Complex Problems with Solver .....</b>	<b>427</b>
Some Background on Solver .....	427
The Advantages of Solver .....	428
When Do You Use Solver? .....	428
Loading Solver .....	429
Using Solver .....	429
Adding Constraints .....	432
Saving a Solution as a Scenario .....	434

Setting Other Solver Options .....	434
Controlling Solver .....	435
Selecting the Method Solver Uses .....	436
Working with Solver Models .....	437
Making Sense of Solver's Messages .....	438
Solving the Transportation Problem .....	439
Displaying Solver's Reports .....	441
The Answer Report .....	442
The Sensitivity Report .....	443
The Limits Report .....	445
From Here .....	445

---

## IV BUILDING FINANCIAL FORMULAS

<b>18 Building Loan Formulas .....</b>	<b>449</b>
Understanding the Time Value of Money .....	449
Calculating the Loan Payment .....	450
Loan Payment Analysis .....	451
Working with a Balloon Loan .....	452
Calculating Interest Costs, Part I .....	453
Calculating the Principal and Interest .....	453
Calculating Interest Costs, Part 2 .....	454
Calculating Cumulative Principal and Interest .....	455
Building a Loan Amortization Schedule .....	456
Building a Fixed-Rate Amortization Schedule .....	457
Building a Dynamic Amortization Schedule .....	458
Calculating the Term of the Loan .....	459
Calculating the Interest Rate Required for a Loan .....	461
Calculating How Much You Can Borrow .....	462
Working with Mortgages .....	463
Building a Variable-Rate Mortgage Amortization Schedule .....	464
Allowing for Mortgage Principal Paydowns .....	465
From Here .....	467
<b>19 Building Investment Formulas .....</b>	<b>469</b>
Working with Interest Rates .....	469
Understanding Compound Interest .....	470
Nominal Versus Effective Interest .....	470
Converting Between the Nominal Rate and the Effective Rate .....	471

Calculating the Future Value .....	472
The Future Value of a Lump Sum .....	473
The Future Value of a Series of Deposits .....	473
The Future Value of a Lump Sum Plus Deposits .....	474
Working Toward an Investment Goal .....	474
Calculating the Required Interest Rate .....	474
Calculating the Required Number of Periods .....	475
Calculating the Required Regular Deposit .....	476
Calculating the Required Initial Deposit .....	477
Calculating the Future Value with Varying Interest Rates .....	478
Building an Investment Schedule .....	479
From Here .....	481
<b>20 Building Discount Formulas .....</b>	<b>483</b>
Calculating the Present Value .....	484
Taking Inflation into Account .....	484
Calculating Present Value Using PV() .....	485
Income Investing Versus Purchasing a Rental Property .....	486
Buying Versus Leasing .....	487
Discounting Cash Flows .....	488
Calculating the Net Present Value .....	489
Calculating Net Present Value Using NPV() .....	490
Net Present Value with Varying Cash Flows .....	491
Net Present Value with Nonperiodic Cash Flows .....	492
Calculating the Payback Period .....	493
Simple Undiscounted Payback Period .....	494
Exact Undiscounted Payback Point .....	495
Discounted Payback Period .....	496
Calculating the Internal Rate of Return .....	496
Using the IRR() Function .....	497
Calculating the Internal Rate of Return for Nonperiodic Cash Flows .....	498
Calculating Multiple Internal Rates of Return .....	498
Publishing a Book .....	499
From Here .....	503
<b>Index .....</b>	<b>505</b>

Click the Microsoft Office button, found at the upper left of your Excel screen, to view the selections found under the File menu in earlier versions of Excel. Figure 1-1 shows the new look for accessing basic functions such as opening, saving, printing, and closing your Excel files (not to mention a number of other nifty functions to boot!). Figure 1-1: Seeing how to use basic Excel program functions. Chapter 1: Tapping into Formula and Function Fundamentals Excel 2007 files have the .xlsx extension. Older version Excel files have the .xls extension. When Excel starts up, it displays a blank Most Microsoft® Excel users learn only a small percentage of the program's features. They know they could get more out of Excel if they could just get a leg up on building formulas and using functions. Unfortunately, this side of Excel appears complex and intimidating to the uninitiated—shrouded in the mysteries of mathematics, finance, and impenetrable spreadsheet jargon. Sound familiar? If you're a businessperson who needs to use Excel as an everyday part of your job, then you've come to the right book. Formulas and Functions with Microsoft® Office Excel 2007 demystifies worksheet formulas a...