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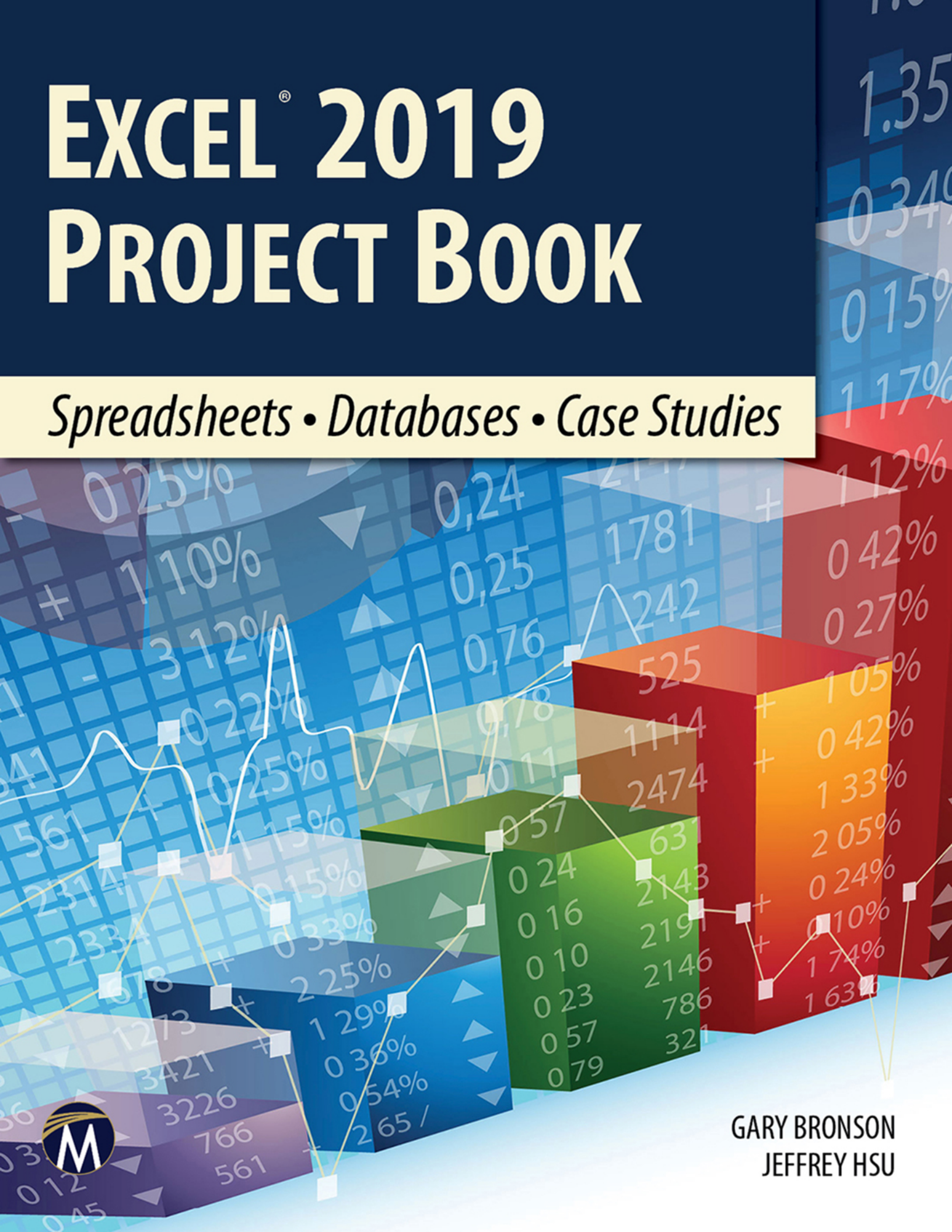
Spreadsheets • Databases • Case Studies



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EXCEL® 2019
PROJECT BOOK

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To Sarah, Matthew, and Tessa

—Gary Bronson

To My Father

—Jeffrey Hsu

CONTENTS

PREFACE

Over the past twenty years, Excel has become the essential and primary spreadsheet program used in commercial and scientific fields. This text was written based on the authors' experience that:

1. The best method of learning a program such as Excel is by doing. That is, the reader must create actual and practical spreadsheets. This is the approach taken in this project book; each spreadsheet application either requires using a newly introduced capability or reinforces one or more previously learned capabilities. This is done in incrementally and increasingly more demanding ways so that the reader can master the presented skill.
2. With the price of many books being over $150, an affordable, quality text, written by professionals in the field and expert instructors should be available.

This book was written to address these items. It provides over thirty projects, distributed among a set of seven project sets; each set consists of a varying number of individual applications that address one or more specific Excel capabilities. Subsequent projects within each project set are then of increasing complexity in reinforcing and extending the main capability being presented. The projects are stand-alone and can be used as a supplement within any introductory Excel course or for self-instruction by professionals.

The cases in each set, except for the first set, introduce a basic capability, such as the IF( ) function in Set 4. Subsequent cases in the set then expand upon and increase the complexity of the capability under consideration. However, each case can also be used as a stand-alone case without the reader first completing an earlier case. Where a case is a direct extension of a prior case, the cases are given designations, such as Part I and Part II. Set 1 deviates a little from this format by covering a number of basic capabilities. The features presented in this first set include data types, formatting, basic formulas, relative addressing, and copying formulas.

In addition, many of the cases in all of the sets contain one unique feature that readers typically miss if they are not paying attention. For example, in the second case in Set 1, the identification codes with leading zeros are included. If the reader simply formats these as numbers, or overlooks formatting altogether, the leading zero is not printed. This reinforces the idea that data types are extremely important in a much more accessible and instructive manner than simply presenting the fact that Excel has three data types. It also highlights the importance of reviewing a spreadsheet before handing it in, either in class or in a business environment.

Every spreadsheet in this text has been successfully developed and implemented using Excel on both Windows® and Apple® compatible laptop computers. This ensures that readers can both experiment and extend the existing spreadsheets and more easily modify them as required by a number of end-of-section exercises.

All of the projects can easily be completed within a one-semester course, with time for in-class or Web presentations, discussions, and the inclusion of additional concepts common in an introductory course. Upon completing all of the cases, the reader should have an extremely good grasp of basic Excel capabilities.

Finally, the appendices include an in-depth presentation of commonly encountered application types; these include sections on cash flow concepts, database concepts, break-even analysis, and economic order quantity (EOQ), and database capabilities. Although each project develops its own application-related information, the main focus within each case is the introduction and/or reinforcement of one or more specific Excel features. The appendices simply provide a more complete enrichment discussion for four of these topics.

DISTINCTIVE FEATURES OF THIS TEXT

To facilitate the goal of making Excel accessible to beginners, the following pedagogical features are used throughout the project cases:

Progressively Reinforcing Projects: Each project either introduces a new Excel element and/or reinforces the element from another project.

Getting Started: These sections provide an explanation and a template for how the spreadsheet should be structured. In most cases, how the final spreadsheet should appear is also presented so that students can check if their formulas are correct.

Key Concepts: Each project's key concept is listed at the top of the project statement, as well as a secondary concept that will be needed to complete the application.

Background: Background material is provided for applications that are typically new to beginning readers. These include explanations and examples on amortization, weighted averages, standard deviations, and other basic topics. Additionally, extensive information on cash flow, break-even analysis, economic order quantity (EOQ), and database concepts are provided.

Improving Your Spreadsheet: These questions are presented to improve your thinking process about how successful applications are developed.

Spot the Weaknesses: These are spreadsheet segments that produce correct results, but highlight typical misunderstandings of an important feature. The most common of these is the retyping of a formula rather than copying it when this can be done.

Spot the Errors: These spreadsheet segments show the typical errors that many beginning Excel users make. The most common of these is using number data types for text items such as zip codes and ID numbers. The result is that beginning users either completely miss or cannot understand why the leading zeros of these items are not printed.

About the Authors

Gary Bronson, Ph.D., is a professor of information systems, at the Silberman College of Business, Fairleigh Dickinson University, where he was twice voted Teacher of the Year of the college and received the Distinguished Research award of the university. He has worked as a senior engineer at Lockheed Electronics, an invited lecturer and consultant to Bell Laboratories, and a software consultant to a number of Wall Street financial firms. He is the author of the highly acclaimed *A First Book of C* and has authored several other successful programming textbooks on C++, Java, and Visual Basic. He is a co-author of *Excel Basics* with Jeffrey Hsu and the co-author of *Mathematics for Business* with Richard Bronson, and Maureen Kieff. Additionally, he is the author of a number of journal articles in the fixed-income financial and programming areas. Dr. Bronson received his Ph.D. from Stevens Institute of Technology.

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Project Set 1

Simple Spreadsheets Using Basic Excel Capabilities

Project 1

CALCULATING A GRADE AVERAGE

Key Concept: Basic Spreadsheet and Data Types
Secondary Concept: Copying a Formula

THE PROJECT

In this project, you are to complete the table shown in Figure 1.1

	A	B	C	D	E	F	G
1	**Name:**	<Your Name Here>				**Project No:**	<Project. No. Here>
2							
3	**Student ID**	**Name**	**Test 1**	**Test 2**	**Test 3**	**Final**	**Average Grade**
4	37853	Best, Harriet	90	70	83	92	
5	28971	Brody, Helen	70	90	85	85	
6	25263	Flavano, Anthony	70	85	72	70	
7	47845	Glover, Jane	85	92	89	95	
8	86592	Restin, Ann	60	70	80	80	
9	67938	Williams, Bill	79	72	63	60	

FIGURE 1.1 Data for Project 1

RELATIONSHIPS

Average Grade = Average of all four tests.

NOTE *Any of the following four formulas will work in cell G4:*
=AVERAGE(C4:F4) *=SUM(C4:F4)/4*
=SUM(C4:F4)/COUNT(C4:F4) *=(C4+D4+E4+F4)/4*

GETTING STARTED

Enter one of the above formulas into cell G4 and then copy it down from cell G4 to cell G5 and down through cell G9. (How to do this is described in *How-To Guide 4: Copying Cell Contents.*) If you do not do this, you will have to type a formula in each cell from G4 to G9.

NOTE *If you use one of the first three formulas, see if you can enter the range C4:F4 by highlighting the cells rather than typing the cell references. (How to do this is described in How-To Guide 3: Copying Cell Contents.)*

Your spreadsheet should look like the table given in Figure 1.2 when it is completed.

	A	B	C	D	E	F	G
1	**Name:**	<Your Name Here>				**Project No:**	<Project. No. in Here>
2							
3	**Student ID**	**Name**	**Test 1**	**Test 2**	**Test 3**	**Final**	**Average Grade**
4	37853	Best, Harriet	90	70	83	92	83.75
5	28971	Brody, Helen	70	90	85	85	82.50
6	25263	Flavano, Anthony	70	85	72	70	74.25
7	47845	Glover, Jane	85	92	89	95	90.25
8	86592	Restin, Ann	60	70	80	80	72.50
9	67938	Williams, Bill	79	72	63	60	68.50

FIGURE 1.2 Completed table for Project 1

REQUIRED

Prepare a spreadsheet that looks like Figure 1 and a second spreadsheet that displays all of the formulas. To display the formulas, press the **Ctrl** and **~ keys** at the same time. (Pressing them again returns the spreadsheet to its original form.) Print both spreadsheets using the Landscape and Fit-to-page formats. (How to do this is described in Appendix B.)

IMPROVING YOUR SPREADSHEET

1. Which one of the provided formulas do you think is preferable and what makes it preferable?
2. Did you check the IDs in cells A4 through A9 to see if they are correct? Even though they are labelled as numbers, what is their correct data type? (***Hint*:** How many numbers have you seen where a leading zero is printed?)
3. What is the relationship between a column's heading and the data listed in the column? Whose responsibility is it to check that a column's heading and the data displayed in the column are consistent?

Project 2

CALCULATING NET PAY

Key Concepts: User-entered and Spreadsheet Supplied Formulas
Secondary Concepts: Data Types and Formatting

Rotech Systems is a company that provides hand-made widgets. Use the following information to create a spreadsheet showing the company's payroll for the week:

Employee Number	Employee Name	Hourly Rate	Hours Worked
32479	Abrams, B	10.72	35
03623	Bohm, P	9.54	30
14145	Gwodz, K	8.72	25
25987	Hanson, H	9.64	40
07634	Robbins,L	8.50	36.5
39567	Williams, B	7.30	39

The spreadsheet should compute and display each employee's gross pay, taxes withheld, and net pay. In computing these values, the appropriate relationships are as follows:

RELATIONSHIPS

1. *Gross Pay = Hourly rate * Hours worked*
2. *Taxes withheld = Tax rate * Gross pay (**Note:** Use a tax rate of 15%.)*
3. *Net pay = Gross pay – Taxes withheld*

Additionally, the spreadsheet should contain the total of the gross pay, taxes withheld, and net pay columns. The average hourly rate and average hours worked should also be provided. When completed, your spreadsheet should appear as shown in Figure 1.3.

	A	B	C	D	E	F	G
1	**Your Name**	<Name Here>				**Project No.**	<Proj. No. Here>
2	**Tax Rate**	**15%**					
3							
4	**Employee Code**	**Employee Name**	**Hourly Rate**	**Hours Worked**	**Gross Pay**	**Taxes Withheld**	**Net Pay**
5	32479	Abrams, B	$10.72	35	$375.20	$56.28	$318.92
6	03623	Bohm, P.	9.54	30	286.20	42.93	243.27
7	14145	Gwodz, K	8.72	25	218.00	32.70	185.30
8	25987	Hanson, H	9.64	40	385.60	57.84	327.76
9	07634	Robbins, L	8.5	36.5	310.25	46.54	263.71
10	39567	Williams, B	7.3	39	284.70	42.71	242.00
11				**Totals:**	$1,859.95	$279.00	$485.27
12		**Average Hourly Rate:**	$9.07				
13		**Average Hours Worked:**	34.25				

FIGURE 1.3 Project 2's net pay results

GETTING STARTED

Figure 1.4 shows how your spreadsheet can be constructed. The arrows indicate that the formula is copied, in this case downwards.

	A	B	C	D	E	F	G
1	**Your Name in Here**						**Project 2**
2	**Tax Rate:**	15.00%					
3							
4	**Employee Code**	**Employee Name**	**Hourly Rate**	**Hours Worked**	**Gross Pay**	**Taxes Withheld**	**Net Pay**
5	32479	Abrams, B	$10.72	35.00	=C5*D5	=.15*E5	=E5 - F5
6	03623	Bohm, P	$9.54	30.00	↓	↓	↓
7	14145	Gwodz, K	$8.72	25.00	↓	↓	↓
8	25987	Hanson, H	$9.64	40.00	↓	↓	↓
9	07634	Robbins, L	$8.50	36.50	↓	↓	↓
10	39567	Williams, B	$7.30	39.00	↓	↓	↓
11				**Totals:**	=SUM(E5:E10)		
12	**Average Hourly Rate:**		=AVERAGE(C5:C10)				
13	**Average Hours Worked:**		=AVERAGE(D5:D10)				

FIGURE 1.4 Possible layout for Project 2

NOTE

1. *Pay attention to the Employee Codes displayed by your spreadsheet in the first column.*
2. *Formatting: Align labels and adjust column widths where needed. All numbers should be formatted to two decimal places.*

REQUIRED

Prepare a spreadsheet that looks like that given in Figure 1.3 and a second spreadsheet that displays all of the formulas. To display the formulas, press the **Ctrl** and **~ keys** at the same time. (Pressing them again will return the spreadsheet to its original form.) Both spreadsheets should be printed in Landscape and Fit-to-page formats. (How to do this is described in Appendix B.)

NOTICE THE STRENGTHS

Because cell addresses are used in the formulas, if one or more rows had to be inserted, all the cell addresses would automatically be adjusted by Excel to ensure that the calculations were still correct. For example, if one or more rows are added between rows 5 and 10, Excel would automatically adjust the formulas to account for the additonal rows.

IMPROVING YOUR SPREADSHEET

1. As constructed, in Figure 1.4, if the tax rate changes, each new rate must be changed in seven cells (B2 and F5 through F10). Why is this a weakness in the spreadsheet?
2. What do you think would be a remedy for the problem listed in item 1?
3. Why is changing the formula in cell G5 to = *B2*E5* and then copying this formula downward to cells G6 through G7 *not* a solution for the problem listed in item 1?

SPOT THE ERRORS

A student handed in the spreadsheet with the formulas shown in Figure 1.5. This spreadsheet contains one or more errors. Can you find where the errors are and the nature of the error(s)?

	A	B	C	D	E	F	G
1							
2	**Tax Rate**	**0.15**					
3							
4	**Employee Code**	**Employee Name**	**Hourly Rate**	**Hours Worked**	**Regular Pay**	**Taxes Withheld**	**Net Pay**
5	32479	Abrams, B	10.72	35	375.2	56.28	318.92
6	03623	Bohm, P.	9.54	30	286.2	42.93	243.27
7	14145	Gwodz, K	8.72	25	218	32.7	185.3
8	25987	Hanson, H	9.64	40	385.6	57.84	327.76
9	07634	Robbins, L	8.5	36.5	310.25	46.54	263.71
10	39567	Williams, B	7.3	39	284.7	42.71	242
11				Totals:	=SUM(E5:E10)	=SUM(F5:F10)	=SUM(G6,G10)
12	Avg. Hourly Rate:	=AVERAGE(C5:C10)					
13	Avg. Hrs Worked:	=AVERAGE(D5:D10)					

FIGURE 1.5 Student spreadsheet containing errors

Project 3

CALCULATING CHARGES FOR SERVICE

Key Concepts: Data Types and Simple Formulas
Secondary Concepts: Formatting, Using an Absolute Address, and Merging Cells

THE PROJECT

Prepare a spreadsheet that determines the total cost and profit from a nursing employment agency. This agency sends out nurses as requested by patients in a hospital, for private duty; that is, the nurse is requested by the patient and stays with the patient for the desired shift. The charge for each nurse depends on their qualifications as either a Registered Nurse (RN), Licensed Practical Nurse (LPN), or Aide. In addition to the charge for the nurses' services, the agency receives a 7% fee for providing a nurse with the desired qualifications for the required shift.

REQUIRED

Prepare and turn in a spreadsheet that calculates the cost, profit, and charges for nursing services on a daily basis. Figure 1.6 can serve as a guide, and make sure to use the appropriate formulas to fill in the costs, profit, and charge for service.

Profit:	7%							
			First Shift		**Second Shift**		**Third Shift**	
Designation	**Nursing**	**Cost**	**Hired**	**Cost**	**Hired**	**Cost**	**Hired**	**Cost**
RN	$400.00	/shift	2		3		6	
LPN	$310.00	/shift	4		8		9	
Aide	$200.00	/shift	0		4		8	
		Total Cost						
		Profit						
	Charge for Service							

FIGURE 1.6 Reference information for Project 3

Create a completed spreadsheet that looks like the one in Figure 1.6, with all of the Costs, Profits, and Charge for Service filled in (use the appropriate formulas) and a second spreadsheet that displays all of the formulas. To display the formulas, press the

Ctrl and **~ keys** at the same time. (Pressing them again will return the spreadsheet to its original form.) Make sure to include your name and the project number and print your spreadsheets in the Landscape and Fit-to-page formats. When completed, your complespreadsheet should look like Figure 1.7.

Profit: 7%

Designation	Nursing Cost	First Shift Hired	First Shift Cost	Second Shift Hired	Second Shift Cost	Third Shift Hired	Third Shift Cost
RN	$400.00 /shift	2	$800.00	3	$1,200.00	6	$2,400.00
LPN	$310.00 /shift	4	1240.00	8	2480.00	9	2790.00
Aide	$200.00 /shift	0	0.00	4	800.00	8	1600.00
	Total Cost		$2,040.00		$4,480.00		$6,790.00
	Profit		142.80		313.60		475.30
	Charge for Service		$2,182.80		$4,793.60		$7,265.30

FIGURE 1.7 Completed spreadsheet for Project 3 using the information in Figure 1.6

GETTING STARTED

Figure 1.8 shows how the spreadsheet shown in Figure 1.7 can be constructed. The arrows shown on the figure indicate that the entered formulas should be copied either across rows or down columns, as indicated; they *should not be retyped* into each cell. You must still pay attention to how each column is formatted, especially Column C.

	A	B	C	D	E	F	G	H	I
1	Your Name <Here>							Project No: 3	
2									
3	Profit:	7%							
4					First Shift		Second Shift		Third Shift
5	Designation	Nursing Cost		Hired	Cost	Hired	Cost	Hired	Cost
6	RN	$400 /shift		2	=B6*D6	3	=B6*F6	6	=B6*H6
7	LPN	$310 /shift		4		8		9	
8	Aide	$200 /shift		0		4		8	
9		Total Cost:			=SUM(E6:E8)				
10		Profit:			=B3*E9		=B3*G9		=B3*I9
11		Charge for Service:			=E9+E10				

FIGURE 1.8 Possible method of constructing the Project 3 spreadsheet

Figure 1.9 is more indicative of how a professional spreadsheet would appear in that all the input values are clearly presented at the top of the spreadsheet. This follows the pattern for professional spreadsheets presented in *How-To Guide 1: Creating a Professional Spreadsheet Layout.*

	A	B	C	D	E	F	G	H	I
1	**Your Name <Here>**							**Project No: 3**	
2									
3	**RN**	$400	/shift			**Profit:**	7%		
4	**LPN**	$310	/shift						
5	**Aide**	$200	/shift						
6									
7				**First Shift**		**Second Shift**		**Third Shift**	
8	**Desig.**	**Nursing Cost**		**Hired**	**Cost**	**Hired**	**Cost**	**Hired**	**Cost**
9	RN	$400	/shift	2	$800.00	3	$1,200.00	6	$2,400.00
10	LPN	$310	/shift	4	$1,240.00	8	2480.00	9	$2,790.00
11	Aide	$200	/shift	0	$0.00	4	800.00	8	$1,600.00
12			Total Cost		$2,040.00		$4,480.00		$6,790.00
13			Profit		142.80		313.60		475.30
13		Charge for Service:			$2,182.80		$4,793.60		$7,265.30

FIGURE 1.9 Professional layout for Project 3 spreadsheet data

NOTICE THE STRENGTHS

A strength of Figure 1.8's spreadsheet is that if the profit rate is changed in cell B3, the change will automatically be made in cells E10, G10, and I10. Additionally, because cell addresses are used in Figure 1.8, if you needed to insert one or more rows, the cell addresses would automatically adjust. This ensures all calculations are still correct.

SPOT THE WEAKNESSES

A weakness in Figure 1.8 is that the actual formulas in cells E10, G10, and I10 have to be entered individually; that is, if one of these formulas were copied, the reference to cell B3 would change. Entering the number 0.07 rather than B3 does allow the formula to be copied; however, it means that if the profit rate changes, it would have to be changed within the formula in one of these cells and then recopied. It would be preferable if the rate, once entered in cell B3, would automatically cause the rate to change in cells E10, G10, and I10 without the need to recopy or change any of the formulas in these cells. Achieving this requires the use of an absolute address.

Project 4

An Amortization Schedule — Part I

Key Concepts: Creating Simple User-entered Formulas and Copying Formulas
Secondary Concepts: Text Formatting using the Wrap Text Option

BACKGROUND

An amortized loan is one in which a debt is repaid using a series of payments, usually each payment being equal in amount. One part of each payment is used to pay the interest due on the loan, while the remaining part repays the outstanding loan balance. The interest amount that is due for each payment period is calculated as the interest rate per period times the outstanding balance.

For example, assume you have taken out a 3-year loan for $5,000 at 9% annual interest, and the payment due each month is $159.00. (How this payment is calculated is explained in Project 8.) For this loan, the interest rate per month is 9%/12 = .09/12. Thus, the interest due at the end of the first month is ($5000)*(.09/12) = $37.50.

Because the payment is $159.00, the amount of this payment that goes toward reducing the loan balance (that is, the repayment on the loan itself) is $159.00 - $37.50 = $121.50. This means that after the first payment is made, you will owe $5,000-$121.50 = $4,878.50.

An *amortization schedule* is a table of payments that shows how the loan is paid over time. For a $5,000, 3-year loan, with a monthly payment of $159.00, the amortization schedule would appear as shown in Figure 1.10.

In computing an amortization schedule, the appropriate relationships are as follows:

1. *Interest Paid = Beginning Balance * Interest Rate per Period*
2. *Principal Paid = Payment – Interest Paid*
3. *Ending Balance = Beginning Balance – Principal Paid*
4. *Beginning Balance = Prior Ending Balance*

REQUIRED

Construct an amortization table for a $5,000, 3-year loan that must be repaid in monthly payments of $159.00, assuming a 9% interest rate. Your completed spread-

sheet for this project should appear as shown in Figure 1.10. Each label should be centered (format the labels as text with the wrap text option on; to access this option, use the alignment tab once the text format has been selected) and adjust column widths where needed. Format all numbers to two decimal places.

Create a spreadsheet that looks like the one in Figure 1.10 on the next page and a second spreadsheet that displays all of the formulas. To display the formulas, press the **Ctrl** and **~ keys** at the same time. (Pressing them again returns the spreadsheet to its original form.) Make sure to include your name and the project number on the spreadsheets. Print the spreadsheet and formula sheet using Portrait and Fit-to-Page formats.

	A	B	C	D	E	F
1	**Your Name**	<here>			**Project No.**	<here>
2						
3	**Loan Amt:**	**$5,000**				
4	**Interest:**	**9%**				
5	**Years:**	**3**				
6	**Payment:**	**$159**				
7						
8	**Payment No.**	**Beginning Balance**	**Payment**	**Interest**	**Principal Paid**	**Ending Balance**
9	1	$5,000.00	$159.00	$37.50	$121.50	$4,878.50
10	2	$4,878.50	$159.00	$36.59	$122.41	$4,756.09
11	3	$4,756.09	$159.00	$35.67	$123.33	$4,632.76
12	4	$4,632.76	$159.00	$34.75	$124.25	$4,508.51
13	5	$4,508.51	$159.00	$33.81	$125.19	$4,383.32
14	6	$4,383.32	$159.00	$32.87	$126.13	$4,257.19
15	7	$4,257.19	$159.00	$31.93	$127.07	$4,130.12
16	8	$4,130.12	$159.00	$30.98	$128.02	$4,002.10
17	9	$4,002.10	$159.00	$30.02	$128.98	$3,873.11
18	10	$3,873.11	$159.00	$29.05	$129.95	$3,743.16
19	11	$3,743.16	$159.00	$28.07	$130.93	$3,612.24
20	12	$3,612.24	$159.00	$27.09	$131.91	$3,480.33
21	13	$3,480.33	$159.00	$26.10	$132.90	$3,347.43
22	14	$3,347.43	$159.00	$25.11	$133.89	$3,213.54
23	15	$3,213.54	$159.00	$24.10	$134.90	$3,078.64
24	16	$3,078.64	$159.00	$23.09	$135.91	$2,942.73
25	17	$2,942.73	$159.00	$22.07	$136.93	$2,805.80
26	18	$2,805.80	$159.00	$21.04	$137.96	$2,667.84
27	19	$2,667.84	$159.00	$20.01	$138.99	$2,528.85
28	20	$2,528.85	$159.00	$18.97	$140.03	$2,388.82
29	21	$2,388.82	$159.00	$17.92	$141.08	$2,247.73
30	22	$2,247.73	$159.00	$16.86	$142.14	$2,105.59
31	23	$2,105.59	$159.00	$15.79	$143.21	$1,962.38
32	24	$1,962.38	$159.00	$14.72	$144.28	$1,818.10
33	25	$1,818.10	$159.00	$13.64	$145.36	$1,672.74
34	26	$1,672.74	$159.00	$12.55	$146.45	$1,526.28
35	27	$1,526.28	$159.00	$11.45	$147.55	$1,378.73
36	28	$1,378.73	$159.00	$10.34	$148.66	$1,230.07
37	29	$1,230.07	$159.00	$9.23	$149.77	$1,080.30
38	30	$1,080.30	$159.00	$8.10	$150.90	$929.40
39	31	$929.40	$159.00	$6.97	$152.03	$777.37
40	32	$777.37	$159.00	$5.83	$153.17	$624.20
41	33	$624.20	$159.00	$4.68	$154.32	$469.88
42	34	$469.88	$159.00	$3.52	$155.48	$314.40
43	35	$314.40	$159.00	$2.36	$156.64	$157.76
44	36	$157.76	$159.00	$1.18	$157.82	-$0.06

FIGURE 1.10 Amortization schedule for Project 4

GETTING STARTED

The spreadsheet shown in Figure 1.10 is easy to create. It requires the input section shown in the first six rows of columns A and B. For rows 9 and 10, only six formulas should be entered, as shown in Figure 1.11. Once the correct formula is entered, it can be copied down the entire column. The only exception is in cell B9, where the first Beginning Balance is copied once from cell B3. For the payment numbers in cells A9 through A44, only the first two payment numbers, 1 and 2, need be entered. These two values can then be highlighted and copied down. As shown in Appendix C, Excel will continue the pattern of incrementing each payment value by one.

	A	B	C	D	E	F
1	**Your Name**	<here>			**Project No.**	<here>
2						
3	**Loan Amt:**	**$5,000**				
4	**Interest:**	**9%**				
5	**Years:**	**3**				
6	**Payment:**	**$159**				
7						
8	**Payment No.**	**Beginning Balance**	**Payment**	**Interest**	**Principal Paid**	**Ending Balance**
9	1	A Formula	A Formula	A Formula	A Formula	A Formula
10	2	A Formula				
11						
12						
13						
14						
15						
16						

FIGURE 1.11 Creating the amortization schedule for Project 4

SPOT THE WEAKNESSES

A student handed in the spreadsheet formulas shown in Figure 1.12. Determine two weaknesses contained in the spreadsheet.

	A	B	C	D	E	F
1	**Your Name**	<here>			**Project No.**	<here>
2						
3	**Loan Amt:**	**5000**				
4	**Interest:**	**0.09**				
5	**Years:**	**3**				
6	**Payment:**	**159**				
7						
8	**Payment No.**	**Beginning Balance**	**Payment**	**Interest**	**Principal Paid**	**Ending Balance**
9	1	5000	159	=0.09/12*B9	=C9-D9	=B9-E9
10	2	=F9	159	=0.09/12*B10	=C10-D10	=B10-E10
11	3	=F10	159	=0.09/12*B11	=C11-D11	=B11-E11
12	4	=F11	159	=0.09/12*B12	=C12-D12	=B12-E12
13	5	=F12	159	=0.09/12*B13	=C13-D13	=B13-E13
14	6	=F13	159	=0.09/12*B14	=C14-D14	=B14-E14
15	7	=F14	159	=0.09/12*B15	=C15-D15	=B15-E15
16	8	=F15	159	=0.09/12*B16	=C16-D16	=B16-E16
17	9	=F16	159	=0.09/12*B17	=C17-D17	=B17-E17
18	10	=F17	159	=0.09/12*B18	=C18-D18	=B18-E18
19	11	=F18	159	=0.09/12*B19	=C19-D19	=B19-E19
20	12	=F19	159	=0.09/12*B20	=C20-D20	=B20-E20
21	13	=F20	159	=0.09/12*B21	=C21-D21	=B21-E21
22	14	=F21	159	=0.09/12*B22	=C22-D22	=B22-E22
23	15	=F22	159	=0.09/12*B23	=C23-D23	=B23-E23
24	16	=F23	159	=0.09/12*B24	=C24-D24	=B24-E24
25	17	=F24	159	=0.09/12*B25	=C25-D25	=B25-E25
26	18	=F25	159	=0.09/12*B26	=C26-D26	=B26-E26
27	19	=F26	159	=0.09/12*B27	=C27-D27	=B27-E27
28	20	=F27	159	=0.09/12*B28	=C28-D28	=B28-E28
29	21	=F28	159	=0.09/12*B29	=C29-D29	=B29-E29
30	22	=F29	159	=0.09/12*B30	=C30-D30	=B30-E30
31	23	=F30	159	=0.09/12*B31	=C31-D31	=B31-E31
32	24	=F31	159	=0.09/12*B32	=C32-D32	=B32-E32
33	25	=F32	159	=0.09/12*B33	=C33-D33	=B33-E33
34	26	=F33	159	=0.09/12*B34	=C34-D34	=B34-E34
35	27	=F34	159	=0.09/12*B35	=C35-D35	=B35-E35
36	28	=F35	159	=0.09/12*B36	=C36-D36	=B36-E36
37	29	=F36	159	=0.09/12*B37	=C37-D37	=B37-E37
38	30	=F37	159	=0.09/12*B38	=C38-D38	=B38-E38
39	31	=F38	159	=0.09/12*B39	=C39-D39	=B39-E39
40	32	=F39	159	=0.09/12*B40	=C40-D40	=B40-E40
41	33	=F40	159	=0.09/12*B41	=C41-D41	=B41-E41
42	34	=F41	159	=0.09/12*B42	=C42-D42	=B42-E42
43	35	=F42	159	=0.09/12*B43	=C43-D43	=B43-E43
44	36	=F43	159	=0.09/12*B44	=C44-D44	=B44-E44

FIGURE 1.12 Student worksheet with errors for Project 4

WEAKNESSES

1. The $159 payment in cell B6 is user-entered. It should be automatically calculated in Excel from the values in cells B3 through C5. How to do this is explained in Project 8.
2. If the payment were to change in cell B6, the payment values in Column C would have to be changed by the user. This automatic change requires absolute addresses, which are presented in Project 8.

Project 5

THE FUTURE VALUE OF INVESTED FUNDS

Key Concepts: Data Input and Formulas
Secondary Concepts: Formatting and Word Wrap

THE PROJECT

In this project, you are to construct a spreadsheet that can be used to determine the amount of funds available in a bank account at different points in time; that is, how much money will be available at a future date when it is invested at a fixed rate of interest.

The input section of your spre[adsheet should] appear as shown in Figure 1.13, where the actual amounts are to be ent[ered by the user.]

Project 4 An Amortization Schedule – Part I

1		B
2	In	,000.00
3	Y	$200.00
4	Interest Rate:	4%

FIGURE 1.13 Input section of the spreadsheet for Project 5

The rest of the worksheet should show how these amounts would grow each year. For example, for the above inputs, your spreadsheet listing the ending balances for the first 25 years should look like that shown in Figure 1.14.

1	A	B	C	D	E
2	Initial Amount:	$5,000.00			
3	Yearly Addition:	$200.00			
4	Interest Rate:	4%			
5					
6		Beg. Balance	Additional Capital	Interest	Ending Balance
7	Year 1	5,000.00	0.00	203.71	5,203.71
8	Year 2	5,203.71	200.00	220.16	5,623.86
9	Year 3	5,623.86	200.00	237.27	6,061.14
10	Year 4	6,061.14	200.00	255.09	6,516.22
11	Year 5	6,516.22	200.00	273.63	6,989.85
12	Year 6	6,989.85	200.00	292.93	7,482.78
13	Year 7	7,482.78	200.00	313.01	7,995.79
14	Year 8	7,995.79	200.00	333.91	8,529.70
15	Year 9	8,529.70	200.00	355.66	9,085.36
16	Year 10	9,085.36	200.00	378.30	9,663.66
17	Year 11	9,663.66	200.00	401.86	10,265.52
18	Year 12	10,265.52	200.00	426.38	10,891.90
19	Year 13	10,891.90	200.00	451.90	11,543.80
20	Year 14	11,543.80	200.00	478.46	12,222.26
21	Year 15	12,222.26	200.00	506.10	12,928.36
22	Year 16	12,928.36	200.00	534.87	13,663.23
23	Year 17	13,663.23	200.00	564.81	14,428.04
24	Year 18	14,428.04	200.00	595.97	15,224.01
25	Year 19	15,224.01	200.00	628.40	16,052.41

FIGURE 1.14 Spreadsheet for Project 5

RELATIONSHIPS

1. *Interest = (Beginning Balance + Additional Capital) * ((1 + interest rate / 12)^12-1)*

   a. *This assumes monthly compounding, where the interest rate is either a decimal value, such as .04, or a percentage, such as 4%.*

NOTE

   b. *You can raise a quantity to a power, such as (1 + interest rate/12)*12*, using either of the following formulas:*

   = (1 + interest rate/12)^12 or

   = POWER((1 + interest rate/12),12)

2. *Ending Balance = (Beginning Balance + Additional Capital + Interest)*
3. *Starting in year 2, the Beginning Balance at the start of a year equals the Ending Balance of the previous year.*

REQUIRED

Once you have completed your worksheet, use it to determine the following information:

a. How much you would have at age 17, if your parents had made a one-time deposit of $4,000 into a bank account paying 3.5% interest compounded monthly when you were born, and no deposit thereafter.

b. How much you will have in 15 years if you deposit $2,000 in an account now, and add $200 each year for the next 14 years in an account that pays 4% interest, compounded monthly.

c. How much you will have in 40 years if you deposit $1,000 each year (that is, $1,000 initially, and $1,000 each year, thereafter) in a bank account paying 3.75% interest, compounded monthly.

Create a spreadsheet with the extra three values entered at the bottom of the sheet and a second spreadsheet containing the formulas. Both spreadsheets should be printed in Portrait and Fit-to-Page formats.

Project 6

Useful Spreadsheet Functions

Key Concept: Commonly Used Spreadsheet Functions

Background: Excel provides a complete set of functions for performing date and time, financial, general mathematical, and statistical calculations. For this project, you will use a number of these functions. (You can see all of the available functions by clicking on the *fx* tool bar and then selecting a function by clicking on it, or by using Insert Function menu options.)

In this project, you are to create and print a spreadsheet that should appear as shown in Figure 1.15, where all calculated values are to be created using existing Excel functions.

	A	B	C
1	Your Name <here>		Project 6
2			
3	**Date and Time Functions**		
4	Today's Date:		[A Calculated Value]
5	Today's Date and Time:		[A Calculated Value]
6	Today's Month:		[A Calculated Value]
7	Today's Day:		[A Calculated Value]
8	Today's Year:		[A Calculated Value]
9			
10	**Loan Calculator**		
11	Annual Interest Rate:	6.75%	
12	Number of Years:	30	
13	Amount Borrowed:	$125,000	
14	Monthly Payment:		[A Calculated Value]
15	Annual Payment:		[A Calculated Value]
16	Total Payment:		[A Calculated Value]
17			
18	**Miscellaneous Functions**		
19	1st Number	90.00	
20	2nd Number	100.00	
21	3rd Number	78.00	
22	4th Number	84.00	
23	5th Number	86.00	
24	Sum:		[A Calculated Value]
25	Average:		[A Calculated Value]
26	Standard Deviation:		[A Calculated Value]
27	Maximum Number:		[A Calculated Value]
28	Minimum Number:		[A Calculated Value]
29	Median Number:		[A Calculated Value]

FIGURE 1.15 The Project 5 spreadsheet setup

RELATIONSHIPS

Today's Date: = TODAY( )
Today's Date and Time: = NOW( )
Today's Month: = MONTH(TODAY( ))
Today's Day: = DAY(TODAY( ))
Today's Year: = YEAR(TODAY( ))
Monthly Payment: =–PMT(*Annual Interest Rate*/12, *No. of Years* * 12, *Amount Borrowed*)
Annual Payment: = *12 * Monthly Payment*
Total Payment: = *Number of Years * Annual Payment*
Sum: use the = SUM( ) function
Average: use the = AVERAGE( ) function
Standard Deviation: use the = STDEVA( ) function
Maximum Number: use the = MAX( ) function
Minimum Number: use the = MIN( ) function
Median Number: use the = MEDIAN( ) function

When you have entered all of the functions, your spreadsheet should appear as shown in Figure 1.16 on the next page, with the actual Date and Time values corresponding to when you ran your spreadsheet.

REQUIRED

Prepare a spreadsheet that looks like Figure 1.16, and a second spreadsheet that displays all of the formulas. Both spreadsheets should be printed in Portrait and Fit-to-Page formats.

	A	B	C
1	Your Name <here>		Project 6
2			
3	**Date and Time Functions**		
4	Today's Date:		2/23/2020
5	Today's Date and Time:		9/28/2009 16:49
6	Today's Month:		2
7	Today's Day:		23
8	Today's Year:		2020
9			
10	**Loan Calculator**		
11	Annual Interest Rate:	6.75%	
12	Number of Years:	30	
13	Amount Borrowed:	$125,000	
14	Monthly Payment:		$810.75
15	Annual Payment:		$9,728.97
16	Total Payment:		$291,869.14
17			
18	**Miscellaneous Functions**		
19	1st Number	90.00	
20	2nd Number	100.00	
21	3rd Number	78.00	
22	4th Number	84.00	
23	5th Number	86.00	
24	Sum:		438.00
25	Average:		87.60
26	Standard Deviation:		8.17
27	Maximum Number:		100.00
28	Minimum Number:		78.00
29	Median Number:		86.00

FIGURE 1.16 Project 5 spreadsheet results

Project Set 2

Absolute Addressing

Project 7

Using an Absolute Address

Key Concepts: Absolute Addresses

Secondary Concepts: Copying Formulas containing an Absolute Address

In Project 2, you created a spreadsheet that appeared similar to that shown in Figure 2.1 (If you have not completed Project 2, do so now.)

	A	B	C	D	E	F	G
1	**<Your name here>**					**Project No.**	**<here>**
2	**Tax Rate:**	15.00%					
3							
4	**Employee Number**	**Employee Name**	**Hourly Rate**	**Hours Worked**	**Gross Pay**	**Taxes Withheld**	**Net Pay**
5	32479	Abrams, B	$10.72	35.00	$375.20	$56.28	$318.92
6	03623	Bohm, P	9.54	30.00	286.20	42.93	243.27
7	14145	Gwodz, K	8.72	25.00	218.00	32.70	185.30
8	25987	Hanson, H	9.64	40.00	385.60	57.84	327.76
9	07634	Robbins, L	8.50	36.50	310.25	46.54	263.71
10	39567	Williams, B	7.30	39.00	284.70	42.71	242.00
11				**Totals:**	$1,859.95	$278.99	$1,580.96
12	**Average Hourly Rate:**		$9.07				
13	**Average Hours Worked:**		34.3				

FIGURE 2.1 Spreadsheet from Project 2 showing employee information

Figure 2.2 shows how Figure 2.1 was constructed, and again, the arrows indicate that the formulas were copied down.

	A	B	C	D	E	F	G
1	**Your Name in Here**						**Project 2**
2	**Tax Rate:**	15.00%					
3							
4	**Employee Number**	**Employee Name**	**Hourly Rate**	**Hours Worked**	**Gross Pay**	**Taxes Withheld**	**Net Pay**
5	32479	Abrams, B	$10.72	35.00	=C5*D5	=.15*E5	=E5 - F5
6	03623	Bohm, P	$9.54	30.00			
7	14145	Gwodz, K	$8.72	25.00			
8	25987	Hanson, H	$9.64	40.00			
9	07634	Robbins, L	$8.50	36.50			
10	39567	Williams, B	$7.30	39.00			
11				**Totals:**	=SUM(E5:E10)		
12	**Average Hourly Rate:**		=AVERAGE(C5:C10)				
13	**Average Hours Worked:**		=AVERAGE(D5:D10)				

FIGURE 2.2 Spreadsheet showing how Figure 2.1's spreadsheet was created

BACKGROUND

A fundamental weakness in Figure 2.2's spreadsheet is that when cell's F5 formula is copied downwards, the 15% tax rate will appear in cells F6 through F10.

This means that the formulas in all of these cells would have to be recopied if (or when) the tax rate is changed. Doing this violates the following basic spreadsheet development principle.

Basic Spreadsheet Development Principle: *Once a value is entered or changed in the Input Section, it must not be entered or changed anywhere else in the Main Spreadsheet Results Section.*

Following this principle ensures that an entered input value is not incorrectly entered or incorrectly changed elsewhere in the spreadsheet. Additionally, it ensures that a user need not be concerned with modifying any formulas in the main spreadsheet results section once an input value is entered. Using an absolute address for referencing input data within a formula both ensures that the data's address is not changed when the formula is copied, and that any change to an input's value will automatically be reflected wherever the input is subsequently referenced in spreadsheet.

REQUIRED

Create a spreadsheet identical to Figure 2.1 but that uses an absolute address for cell B2 in cell F5's formula. Then change the interest rate in cell B2 to 0% and verify that the calculated values in cells F5 through F10 automatically get recalculated to zero.

Prepare a spreadsheet that looks like Figure 2.1 and a second spreadsheet that displays all of the formulas. To display the formulas, press the **Ctrl** and **~ keys** at the same time (Pressing them again returns the spreadsheet to its original form.) Make sure to include your name and the project number on the spreadsheets. The main spreadsheet should be printed in Portrait and Fit-to-Page format and the formula spreadsheet should be printed in Landscape and Fit-to-Page format.

GETTING STARTED

The only change that needs to be made is to enter the formula =$B$2*E5 in cell F5 (see Figure 2.2) and then copy this formula downward, as shown. Then, when cell F5's formula is copied into cells F6 through F10, the reference to cell B2 remains fixed. (If this is not clear to you, change the formula in cell F5 to =*B2*E5*, copy the formula down through cell F10, and see what the formula changes to in each cell.). Using the absolute address $B$2 ensures that a change to cell B2's value will automatically cause this value to be changed everywhere else in the spreadsheet where cell B2 is referenced.

Project 8

AN AMORTIZATION SCHEDULE — PART II

Key Concepts: The PMT () Functions and Using Absolute Addresses in Formulas
Secondary Concepts: Data Input, Formatting, and Copying Formulas

THE PROJECT

In this project, you modify the spreadsheet prepared for Project 4, the first part of which is shown in Figure 2.3, so that the payment in cell B6 is directly computed in the Input Section. This is accomplished using Excel's PMT( ) function. Then, using absolute addresses, make the Results Section of your spreadsheet automatically use the calculated payment value in all of its computations.

	A	B	C	D	E	F
1	**Your Name**	<here>			**Project No.**	<here>
2						
3	**Loan Amt:**	**$5,000**				
4	**Interest:**	**9%**				
5	**Years:**	**3**				
6	**Payment:**	**$159**				
7						
8	**Payment No.**	**Beginning Balance**	**Payment**	**Interest**	**Principal Paid**	**Ending Balance**
9	1	$5,000.00	$159.00	$37.50	$121.50	$4,878.50
10	2	$4,878.50	$159.00	$36.59	$122.41	$4,756.09
11	3	$4,756.09	$159.00	$35.67	$123.33	$4,632.76
12	4	$4,632.76	$159.00	$34.75	$124.25	$4,508.51
13	5	$4,508.51	$159.00	$33.81	$125.19	$4,383.32
14	6	$4,383.32	$159.00	$32.87	$126.13	$4,257.19
15	7	$4,257.19	$159.00	$31.93	$127.07	$4,130.12
16	8	$4,130.12	$159.00	$30.98	$128.02	$4,002.10
17	9	$4,002.10	$159.00	$30.02	$128.98	$3,873.11
18	10	$3,873.11	$159.00	$29.05	$129.95	$3,743.16
19	11	$3,743.16	$159.00	$28.07	$130.93	$3,612.24
20	12	$3,612.24	$159.00	$27.09	$131.91	$3,480.33

FIGURE 2.3 Amortization schedule for Project 8 (originally for Project 4)

BACKGROUND

A major problem with the spreadsheet created for Project 4, and reproduced for convenience in Figure 2.3, is that the $159 payment value entered in cell B6 was user- entered. In practice, however, the payment is always calculated directly from the three values entered in cells B1, B2, and B3 (that is, the amount of the loan, the interest rate, and the number of years for the loan) using a payment function that is supplied by Excel.

GETTING STARTED

In Excel, the name of the function for calculating a loan payment is PMT( ). This function requires three input values; the amount of the loan, the monthly interest rate, and the number of months in which the loan is to be repaid.

To use this function, enter the following formula in cell B4 in the spreadsheet you created for Project 4:

*= -PMT(B4/12,B5*12,B3)*

The reason for the negative sign in front of the PMT( ) function has to do with the convention of money flows. Positive values, such as the amount of the loan, indicate funds being paid to the borrower. As such, they are considered funds that *flow to* the borrower. Negative values, such as the payment, indicate funds that the borrower pays. As such, they are considered funds that *flow away* from the borrower. The PMT( ) function will report *flows away* from the borrower. To counteract this, the negative sign in front of the PMT( ) function forces the calculated payment to appear as a positive value. Additionally, because the PMT( ) function requires a monthly interest rate and cell B4 contains a yearly interest rate, it must be divided by 12 to produce the monthly rate. Similarly, as cell B5 contains the number of years for the loan, multiplying by 12 converts this to the corresponding number of months.

VERIFICATION

Whenever you enter a formula, you should always verify that it is working correctly by checking its operation. This can be done either by manually calculating a single value or by reproducing a calculation that you know is correct. For example, before using the PMT( ) function for any new loans, you should first check that it is working for the existing loan used in Project 4. Thus, if you enter a loan amount of $5,000 in cell B3, an annual interest rate of 9% in cell B4, and 3 for the length of the loan in years in cell B5, cell B6 should calculate and display a value of 159.00. Enter these amounts now, to verify that the PMT( ) function yields the correct value.

THE PROJECT

After you have verified that the PMT( ) function is working correctly, construct an amortization table for an $8,000, 3-year loan that has an 8% interest rate. The payment for this loan should be automatically calculated using the PMT( ) function. Use absolute addresses in the main section of your spreadsheet for both the Payment and Interest calculations in columns C and D.

REQUIRED

Prepare two spreadsheets, the first containing the actual amortization schedule and the second that displays all of the formulas. Print the first spreadsheet in Portrait format and the second in Landscape format. Both spreadsheets should be printed in Fit-to-Page formats.

NOTE *Format all values, except the payment numbers, to 2 decimal places.*

Project 9 Calculating Weighted-Average Grades

Key Concept: Using Absolute Addresses in Formulas and Copying Formulas
Secondary Concept: Formatting

BACKGROUND

The calculation of an average is well-known. For example, the average of the three grades 85, 75, 90, and a final exam grade of 90 is as follows:

$$\text{Average} = (85 + 75 + 90 + 90) / 4 = 85$$

This type of average is referred to as a *straight or equally-weighted average*, because each grade contributes equally to the final average. Mathematically, this average can also be calculated as follows:

Average = (¼) 85 + (¼) 75 + (¼) 90 + (¼) 90
= (.25) 85 + (.25) 75 + (.25) 90 + (.25) 90 ← **Notice this line**
= 21.25 + 18.75 + 22.5 + 22.5 = 85 ← **The same average**

The advantage of this second method of calculation is that it explicitly illustrates that ¼, or 25%, of each grade is used to compute the final average. The values ¼ and .25 in this second calculation method are referred to as *weights*. *The only requirement of the weights is that all of the weights used in the calculation add up to 1.*

Frequently, it is desirable to assign different weights to different grades. For example, if the last grade, in this case a 90, was from a cumulative final exam, it would not be inappropriate to have it carry more weight than each of the test grades when determining the final grade average. This is easily done by assigning a higher weight, say .4, to the last grade. (This means that the final test is 40% of the average.) To accommodate for this higher weight, the sum of the rest of the weights must be reduced, so that all of the weights add up to 1 again. A possible selection of weights might then be

$$\text{Average} = (.2) 85 + (.2) 75 + (.2) 90 + (.4) 90$$

When different weights are assigned to the values used in computing an average, the average is referred to as a *weighted-average*.

THE PROJECT

In this project, you are to create and complete the spreadsheet shown in Figure 2.4. You must first enter the labels and data shown in the figure, and then add formulas to arrive at the following:

1. Sum the weights to verify that they total 1.
2. Determine each student's final grade average as a weighted average of three tests and a final exam.
3. Determine the class average for each test.

	A	B	C	D	E	F	G	H	I
1	**Name:**	<Name>					**Project :**	<Proj. No Here.>	
2									
3		**Weights:**	0.1	0.2	0.3	0.4		**Sum of Weights:**	
4								1	
5	**Last Name**	**First Name**	**Test 1**	**Test 2**	**Test 3**	**Final Exam**	**Fiinal Grade**		
6	Abrams	Bill	40	60	70	80	69.00		
7	Best	Jane	70	90	60	82	75.80		
8	Fideist	Harry	70	70	70	75	72.00		
9	Terrific	Ursala	85	80	60	70	70.50		
10	Uxorius	Louisa	70	80	60	70	69.00		
11									
12	**Class**	**Average:**	67	76	64	75.4	71.26		

FIGURE 2.4 Spreadsheet for Project 9

RELATIONSHIPS

1. Although the weights assigned to each test can be changed, they must add up to 1. Thus, the value in cell H4 is to be calculated as the sum of the weights (use a SUM( ) formula for this calculation).
2. The final grades calculated in column G should be a weighted average, where each grade is multiplied by the weight above it in Row 3, and then added together with the other weighted grades in the same row. Make sure to use absolute addresses for the weights so that you can copy the formula from cell G6 down to cells G7 through G10.

REQUIRED

Prepare a spreadsheet that completes Figure 2.4 and a second spreadsheet that displays all of the formulas. Make sure that the second spreadsheet, with the formulas, is printed in Landscape and Fit-to-Page formats.

Project 10 Calculating Miles per Gallon (mpg)

Key Concepts: Using Absolute Addresses in Formulas and Copying Formulas
Secondary Concept: Formatting

THE PROJECT

Prepare a spreadsheet that calculates and displays the miles per gallon (mpg) you get on a trip that you have just taken. Specifically, you want to know both the miles per gallon (mpg) for each individual segment of the trip (after each fill-up) and the cumulative miles per gallon from the start of the trip until the latest fill-up.

Enter the data shown in Figure 2.5 in the first three columns of your spreadsheet. Then use formulas to calculate the Fill-up and Cumulative mpg in columns D and E, respectively.

	A	B	C	D	E
1	**Name:**	<Here>		**Project:**	<Proj. No. Here>
2					
3	**Date**	**Miles**	**Gallons**	**Fill-up mpg**	**Cumulative mpg**
4	June 15	34625	Full		
5	June 17	34952	12.4		
6	June 20	35215	10.2		
7	June 23	35490	10.5		
8	June 26	35810	12.7		
9	June 30	36165	14.2		
10	July 3	36380	8.4		
11	July 7	36600	9.0		
12	July 10	36875	10.1		
13	July 14	37150	9.9		

FIGURE 2.5 Data for Project 10

In computing the miles-per-gallon in the last two columns, use the following relationships:

1. Fill up mpg

$$= \frac{\begin{array}{c}\text{Odometer reading when the fill up took place} - \\ \text{Odometer Reading at the previous fill up}\end{array}}{\text{Gallons of gas just purchased when the fill up took place}}$$

For example, the Fill up mpg for June 23 is

$$\frac{(35490-35215)}{10.5} = 26.19 \text{ miles per gallon}$$

2. Cumulative mpg

$$= \frac{\begin{array}{c}\text{Odometer reading when the fill up took place} - \\ \text{Odometer Reading at the start of the trip}\end{array}}{\text{Total Gallons of gas purchased since the start of the trip}}$$

For example, the Cumulative mpg for June 23 is

$$\frac{(35490-34625)}{(12.4+10.2+10.5)} = 26.13 \text{ miles per gallon}$$

Figure 2.6 illustrates how your final spreadsheet appears when you have completed it.

	A	B	C	D	E
1	**Name:**	<Here>		**Project:**	<Proj. No. Here>
2					
3	**Date**	**Miles**	**Gallons**	**Fill-up mpg**	**Cumulative mpg**
4	June 15	34625	Full		
5	June 17	34952	12.4	26.37	26.37
6	June 20	35215	10.2	25.78	26.11
7	June 23	35490	10.5	26.19	26.13
8	June 26	35810	12.7	25.20	25.87
9	June 30	36165	14.2	25.00	25.67
10	July 3	36380	8.4	25.60	25.66
11	July 7	36600	9.0	24.44	25.52
12	July 10	36875	10.1	27.23	25.71
13	July 14	37150	9.9	27.78	25.92

FIGURE 2.6 Spreadsheet results for Project 10

1. *After entering the data for the first three columns, you should only have to enter two formulas; one in cell D5 for the Fill-up mpg and one in cell E5 for the Cumulative mpg, and then copy the formulas down to fill in the rest of each column.*

NOTE

2. *You should use relative addresses for the Fill-up mpg column and will need to use both relative and absolute addresses for the Cumulative mpg column.*
3. *Use a =SUM( ) formula to calculate the total gallons purchased from the start of the trip for each Cumulative mpg calculation.*

REQUIRED

Prepare a spreadsheet that looks like Figure 2.6 and a second spreadsheet that displays all of the formulas. Print the formula spreadsheet in the Landscape and Fit-to-Page formats.

SPOT THE ERRORS

A student handed in the spreadsheet shown in Figure 2.7. Can you spot the errors? (All of the errors are located in column E.)

	A	B	C	D	E
1					
2					
3		Odometer		Fill-up	Cumulative
4	Date	Miles	Gallons	mpg	mpg
5	June 15	34625	Full		
6	June 17	34952	12.4	=(B6-B5)/C6	=(B6-$B$5)/($C$6)
7	June 20	35215	10.2	=(B7-B6)/C7	=(B7-$B$5)/($C$6+C$7)
8	June 23	35490	10.5	=(B8-B7)/C8	=(B8-$B$5)/(C6+C7+C8)
9	June 26	35810	12.7	=(B9-B8)/C9	=(B9-$B$5)/(C6+C7+C8+C9)
10	June 30	36165	14.2	=(B10-B9)/C10	=(B10-$B$5)/(C6+C7 + C8 + C9+C10)
11	July 3	36380	8.4	=(B11-B10)/C11	=(B11-$B$5)/(C6+C7+C8 + C9 + C10+C11)
12	July 7	36600	9	=(B12-B11)/C12	=(B12-$B$5)/(C6+C7+C8+C9 + C10 + C11+C12)
13	July 10	36875	10.1	=(B13-B12)/C13	=(B13-$B$5)/(C6+C7+C8+C9+C10 + C11 + C12+C13)
14	July 14	37150	9.9	=(B14-B13)/C14	=(B14-$B$5)/(C6+C7+C8+C9+C10+C11 + C12 + C13+C14)

FIGURE 2.7 Spreadsheet for Project 10 showing student errors

ERRORS

Each cumulative mpg formula in Column E was entered individually. To convince yourself this is the case, type in any single formula in a cell in column E and copy it down. You will see that additional + signs will not be entered into the copied cells. Only one formula should be entered in one E column cell, and that formula should be copied in the remaining column cells.

Project Set 3

CASH FLOW PROJECTS

NOTE *Additional background for Cash Flow and Cash Balance applications is provided in Appendix A.*

Project 11 NET CASH INFLOWS

Key Concept: Creating a Cash Flow Spreadsheet
Secondary Concept: Formulas and Formatting

THE PROJECT

You are to prepare a five-year cash budget for the Nurses Association for their annual nurses' reunion luncheon. Figure 3.1 provides the cash inflows and outflows for the five-year period under consideration, with the data for 2021 being an estimate.

	2017	2018	2019	2020	2021
Cash Inflows:					
Luncheon Payments:	$2,500	$3,000	$3,200	$3,300	$3,025
Raffle Tickets:	600	750	820	850	880
Contributions:	250	225	120	100	100
Cash Outflows:					
Cost of Luncheons:	$1,500	$1,800	$2,560	$2,400	$2,200
Cost of Raffle Prizes:	275	250	280	280	280
Cost of Table Favors:	125	130	90	125	140
Tips:	300	300	350	350	350

FIGURE 3.1 The cash inflows and outflows for Project 11

REQUIRED

Construct a cash flow spreadsheet that shows the total cash inflows for each year, the total cash outflows for each year, and the net cash inflows produced by the luncheons each year.

RELATIONSHIPS

Total Cash Inflows = Sum of the individual cash inflows
Total Cash Outflows = Sum of the individual cash outflows
Net Cash Inflows = Total Cash Inflows – Total Cash Outflows

Prepare a spreadsheet that looks like Figure 3.2 with all cells filled in with the correctly calculated values and a second spreadsheet that displays all of the formulas. Make sure that each of these spreadsheets is printed using the Fit-to-Page format.

	A	B	C	D	E	F	G
1	**Your Name <Here>**					**Project**	**11**
2							
3			**2017**	**2018**	**2019**	**2020**	**2021**
4							
5	**Cash Inflows:**						
6	**Luncheon Payment:**		$2,500	$3,000	$3,200	$3,300	$3,025
7	**Raffle Tickets:**		600	750	820	850	880
8	**Contributions:**		250	225	120	100	100
9	**Total Cash Inflows:**		$3,350	$3,975	$4,140	$4,250	$4,005
10							
11	**Cash Outflows:**						
12	**Cost of Luncheon:**		$1,500	$1,800	$2,560	$2,400	$2,200
13	**Cost of Raffle Prizes:**		275	250	280	280	280
14	**Cost of Table Favors:**		125	130	90	125	140
15	**Tips:**		300	300	350	350	350
16	**Total Cash Outflows:**		$2,200	$2,480	$3,280	$3,155	$2,970
17	**Net Cash Inflows:**		$1,150	$1,495	$860	$1,095	$1,035

FIGURE 3.2 Project 11 spreadsheet results

GETTING STARTED

Include the three highlighted rows shown in Figure 3.3 and a formula for each of the total and net cash flows for 2017. Once the formulas for 2017 have been entered in column C, they can be copied over for the additional years.

	A	B	C	D	E	F	G
1	**Your Name <Here>**					**Project:**	**11**
2							
3			**2017**	**2018**	**2019**	**2020**	**2021**
4							
5	**Cash Inflows:**						
6	**Luncheon Payment:**		$2,500	$3,000	$3,200	$3,300	$3,025
7	**Raffle Tickets:**		600	750	820	850	880
8	**Contributions:**		250	225	120	100	100
9	**Total Cash Inflows:**	**=SUM(C6:C8)** →					
10							
11	**Cash Outflows:**						
12	**Cost of Luncheon:**		$1,500	$1,800	$2,560	$2,400	$2,200
13	**Cost of Raffle Prizes:**		275	250	280	280	280
14	**Cost of Table Favors:**		125	130	90	125	140
15	**Tips:**		300	300	350	350	350
16	**Total Cash Outflows:**	**A Fomula** →					
17	**Net Cash Inflows:**	**A Formula** →					

FIGURE 3.3 Project 11 spreadsheet

Project 12 A Cash Balance Spreadsheet

Key Concept: Creating a Cash Balance Spreadsheet
Secondary Concept: Formulas and Formatting

THE PROJECT

You are to modify the spreadsheet completed in Project 11 to include cash balances at the beginning and end of each year, as shown in Figure 3.4a. The highlighted cells indicate the additional information you will have to add to the spreadsheet used in Project 11.

	A	B	C	D	E	F	G
1	**Your Name <Here>**					**Project**	**12**
2							
3	**Beginning Cash Balance**						
4	**Year:**	**2017**					
5	**Amount:**	**$2,340**					
6							
7			**2017**	**2018**	**2019**	**2020**	**2021**
8	**Beginning Cash Balance:**		$2,340	$3,490	$4,985	$5,845	$6,940
9							
10	**Cash Inflows**						
11	**Luncheon Payments:**		$2,500	$3,000	$3,200	$3,300	$3,025
12	**Raffle Tickets:**		600	750	820	850	880
13	**Contributions:**		250	225	120	100	100
14	**Total Cash Inflows:**		$3,350	$3,975	$4,140	$4,250	$4,005
15							
16	**Cash Outflows**						
17	**Cost of Luncheon:**		$1,500	$1,800	$2,560	$2,400	$2,200
18	**Cost of Raffle Prizes:**		275	250	280	280	280
19	**Cost of Table Favors:**		125	130	90	125	140
20	**Tips:**		300	300	350	350	350
21	**Total Cash Outflows:**		$2,200	$2,480	$3,280	$3,155	$2,970
22	**Net Cash Inflows:**		$1,150	$1,495	$860	$1,095	$1,035
23	**Ending Cash Balance:**		$3,490	$4,985	$5,845	$6,940	$7,975

FIGURE 3.4A Cash balance spreadsheet for Project 12

REQUIRED

Using the fact that at the beginning of 2017, there was a cash balance of $2,340, modify the spreadsheet constructed for Project 11 so that it shows the cash balance at the beginning and end of each year.

RELATIONSHIPS

Beginning Cash Balance for 2017 = $2,340
Net Cash Inflows = Total Cash Inflows – Total Cash Outflows
Ending Cash Balance for each year = Beginning Cash Balance + Net Cash Inflows
Beginning Cash Balance for each year after 2017 = Prior Year's Ending Cash Balance

Create a spreadsheet that looks like Figure 3.3 with all of the highlighted cells filled in with correctly calculated values, and a second spreadsheet that displays all of the formulas. Make sure that each of these spreadsheets is printed using the Fit-to-Page format.

GETTING STARTED

Add the highlighted rows shown in Figure 3.4b and formulas as indicated. Once the formulas have been entered, they can be copied over for the additional years, as shown in Figure 3.4b.

Beginning Cash Balance					
Year:	2017				
Amount:	$2,340				
	2017	2018	2019	2020	2021
Beginning Cash Balance:	A Formula	A Formula	→	→	→
Cash Inflows					
Luncheon Payments:	$2,500	$3,000	$3,200	$3,300	$3,025
Raffle Tickets:	600	750	820	850	880
Contributions:	250	225	120	100	100
Total Cash Inflows:	=Sum(C11:C14)	→	→	→	→
Cash Outflows					
Cost of Luncheon:	$1,500	$1,800	$2,560	$2,400	$2,200
Cost of Raffle Prizes:	275	250	280	280	280
Cost of Table Favors:	125	130	90	125	140
Tips:	300	300	350	350	350
Total Cash Outflows:	A Formula	→	→	→	→
Net Cash Inflows:	A Formula	→	→	→	→
Ending Cash Balance:	A Formula	→	→	→	→

FIGURE 3.4B Project 12 spreadsheet showing formulas copied over

Project 13 A Cash Flow Budget

Key Concept: Creating a Cash Flow Budget
Secondary Concept: Formulas and Formatting

BACKGROUND

Rotech Systems, Inc., is an information systems consulting firm that provides both contractual work for its clients and technology seminars open to the public. The contractual work is paid under contracts with the various firms that Rotech does business with, while the seminars are paid for by registration fees.

THE PROJECT

You are to create a six-month budget for Rotech Systems for January through June. Use the following data:

CASH BALANCE

As of the beginning of the year, Rotech has $150,000 in cash, which includes the funds from a bank loan of $100,000.

PROJECTED REVENUES

CONTRACTS

Rotech currently has contracts for January through June of $250,000. Thirty-six percent of this amount is collected in the first quarter of the year, with each month generating 1/3 of this amount (that is, 12% per month). The remaining 64% of the contract revenue is generated in the second quarter, with each month again providing 1/3 of the amount.

SEMINARS

Six seminars are planned, one per month, for a total six-month income of $180,000. The seminar revenue is evenly divided among the six months.

PROJECTED EXPENSES

COMPENSATION

Rotech hires its personnel as independent contractors who are assigned to various contracts. In total, the contractors are paid $90,000 for the first six months, which is evenly divided among the months.

RENT

The total rent expenses for Rotech's company headquarters is $24,000 for the first six months, which is evenly divided among the months.

ADMINISTRATIVE

Rotech pays an administrator $3,250 each month, for a total six-month salary of $19,500.

UTILITIES

The utilities consist of a range of costs, such as those for the telephone, office supplies, and postage. These expenses are $12,000 for six months and are evenly divided among the months.

SEMINAR COSTS

Seminars do not provide much profit to the company but are held primarily as an introduction to the services and expertise provided by Rotech. As such, 75% of each seminar's revenue is used to cover instructor costs, room rental, and food.

LOANS

The company currently has a loan of $100,000. Each month the company must pay interest at the rate of 0.5% of the unpaid balance.

REQUIRED

Prepare a cash budget for each month from January through June. The format for your spreadsheet is shown in Figure 3.5.

	A	B	C	D	E	F	G	H
1	**Name:**	<Name in Here>					**Project No:**	**13**
2								
3		**Prior Balances**						
4		**Cash:**	$50,000					
5		**Loan:**	$100,000					
6								
7	**Six Month Projected Revenue**							
8		**Contracts:**	$250,000					
9		**Seminars:**	$180,000					
10								
11	**Six Month Projected Expenses**							
12		**Compensation:**	$90,000					
13		**Rent:**	$24,000					
14		**Administrative:**	$19,500					
15		**Utilities:**	$12,000					
16		**Seminar Costs:**	75%					
17		**Monthly Loan Int:**	0.50%					
18								
19			**January**	**February**	**March**	**April**	**May**	**June**
20								
21	**Beinning Cash Balance:**							
22								
23	**Projected Revenue**							
24		**Contracts:**						
25		**Seminars:**						
26		**Total Revenue:**						
27								
28	**Projected Expenses**							
29		**Compensation:**						
30		**Rent:**						
31		**Administrative:**						
32		**Utilities:**						
33		**Seminar Costs:**						
34		**Interest on Loan:**						
35		**Total Expenses:**						
36								
37	**Total Rev. - Total Exp:**							
38								
39	**Ending Cash Balance:**							

FIGURE 3.5 Rotech budget spreadsheet layout for Project 13

Create both the spreadsheet and the cell formulas for this project. When completed, your spreadsheet should appear as shown in Figure 3.6. Except for the numbers shown in the input section, you must enter a formula in each cell of the main spreadsheet, not numbers.

That is, this exercise is not to be done by hand with manual entry of numbers in the cells. Align the labels and adjust the column widths were needed. Format all dollar amounts to the closest dollar. Print the spreadsheet in Portrait, Fit-to-Page format. The formula sheet should be printed in Landscape, Fit-to-Page format, with the gridlines and cell addresses shown.

	A	B	C	D	E	F	G	H
1	**Name:**	<Name in Here>					**Project No:**	**13**
2								
3		**Prior Balances**						
4		**Cash:**	$50,000					
5		**Loan:**	$100,000					
6								
7	**Six Month Projected Revenue**							
8		**Contracts:**	$250,000					
9		**Seminars:**	$180,000					
10								
11	**Six Month Projected Expenses**							
12		**Compensation:**	$90,000					
13		**Rent:**	$24,000					
14		**Administrative:**	$19,500					
15		**Utilities:**	$12,000					
16		**Seminar Costs:**	75.00%					
17		**Monthly Loan Int:**	0.50%					
18								
19			**January**	**February**	**March**	**April**	**May**	**June**
20								
21	**Bginning Cash Balance:**		$150,000	$162,750	$175,500	$188,250	$224,333	$260,417
22								
23	**Projected Revenue**							
24		**Contracts:**	$30,000	$30,000	$30,000	$53,333	$53,333	$53,333
25		**Seminars:**	30,000	30,000	30,000	30,000	30,000	30,000
26		**Total Revenue:**	$60,000	$60,000	$60,000	$83,333	$83,333	$83,333
27								
28	**Projected Expenses**							
29		**Compensation:**	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
30		**Rent:**	4,000	4,000	4,000	4,000	4,000	4,000
31		**Administrative:**	3,250	3,250	3,250	3,250	3,250	3,250
32		**Utilities:**	2,000	2,000	2,000	2,000	2,000	2,000
33		**Seminar Costs:**	22,500	22,500	22,500	22,500	22,500	22,500
34		**Interest on Loan:**	500	500	500	500	500	500
35		**Total Expenses:**	$47,250	$47,250	$47,250	$47,250	$47,250	$47,250
36								
37	**Total Rev. - Total Exp:**		$12,750	$12,750	$12,750	$36,083	$36,083	$36,083
38								
39	**Ending Cash Balance:**		$162,750	$175,500	$188,250	$224,333	$260,417	$296,500

FIGURE 3.6 Completed spreadsheet for Project 13, Rotech budget

GETTING STARTED

Figure 3.7 shows the formulas that need to be entered and copied to create the desired spreadsheet.

	A	B	C	D	E	F	G	H
1	Your name <Here>						Project No:	13
2								
3		Prior Balances						
4		Cash:	$50,000					
5		Loan:	$10,000					
6								
7	Six Month Projected Revenue							
8		Contracts:	$250,000					
9		Seminars:	$180,000					
10								
11	Six Month Projected Expense							
12		Compensation:	$90,000					
13		Rent:	$24,000					
14		Adminstraton:	$19,500					
15		Utilities:	$12,000					
16		Seminar Costs:	75%					
17		Monthly Loan Int:	0.50%					
18								
19			January	February	March	April	May	June
20								
21	Beginning Cash Balance:		=Sum(C4:C5)	=C39 →				
22								
23	Projected Revenue							
24		Contracts:	=0.36/3*$C$8 →			=0.64/3*$C$8 →		
25		Seminars:	=$C$9/6 →					
26	Total Revenue		=Sum(C24:C25) →					
27								
28	Projected Expenses							
29		Compensation:	=$C$12/6 →					
30		Rent:	=$C$13/6 →					
31		Administrative:	=$C$14/6 →					
32		Utilities:	=$C$15/6 →					
33		Seminar Costs:	=$C$16*C25 →					
34		Interest on Loan:	=$C$17*$C$5 →					
35		Total Expenses:	=SUM(C29:C34) →					
36								
37		Total Rev. - Total Exp:	=C26-C35 →					
38								
39		Ending Cash Balance:	=C21+C37 →					

FIGURE 3.7 Rotech budget spreadsheet for Project 13 showing the formulas

Project 14 A Cash Flow Budget with Loan Repayment

Key Concept: Loan Repayment
Secondary Concepts: Formulas and Formatting

THE PROJECT

Modify the spreadsheet completed in Project 13 to include a loan repayment, which is a fixed monthly expense of $3,000. The format for this project is shown in Figure 3.8. The highlighted cells are the additional information you will have to add to Project 13's spreadsheet to complete this project.

	A	B	C	D	E	F	G	H
1	Your Name <Here>						Project No:	14
2								
3	Prior Balances							
4		Cash:	$50,000					
5		Loan:	$100,000					
6								
7	Six Month Projected Revenue							
8		Contracts:	$250,000					
9		Seminars:	$180,000					
10								
11	Six Month Projected Expenses							
12		Compensation	$90,000					
13		Rent:	$24,000					
14		Administrative:	$19,500					
15		Utilities:	$12,000					
16		Seminar Costs:	75%					
17		Monthly Loan Int:	0.5%					
18		Monthly Loan Pmt:	$3,000					
19								
20			January	February	March	April	May	June
21								
22		Loan Balance:						
23	Beinning Cash Balance:							
24								
25	Projected Revenue							
26		Contracts:						
27		Seminars:						
28		Total Revenue:						
29								
30	Projected Expenses							
31		Compenasation:						
32		Rent:						
33		Administrative:						
34		Utilities:						
35		Seminar Costs:						
36		Interest on Loan:						
37		Loan Payment:						
38		Total Expenses:						
39								
40	Total Rev. - Total Exp:							
41								
42	Ending Cash Balance:							

FIGURE 3.8 Format for the Project 14 spreadsheet

REQUIRED

Prepare a spreadsheet and the cell formulas for this project. Both should use Fit-to-Page formats, with the spreadsheet in Portrait layout and the formulas in Landscape layout. When completed, your spreadsheet should appear as shown in Figure 3.9.

	A	B	C	D	E	F	G	H
1	Your Name <Here>						Project No:	14
2								
3		Prior Balances						
4		Cash:	$50,000					
5		Loan:	$100,000					
6								
7		Six Month Projected Revenue						
8		Contracts:	$250,000					
9		Seminars:	$180,000					
10								
11		Six Month Projected Expenses						
12		Compensation	$90,000					
13		Rent:	$24,000					
14		Administrative:	$19,500					
15		Utilities:	$12,000					
16		Seminar Costs:	75%					
17		Monthly Loan Int:	0.50%					
18		Monthly Loan Pmt:	$3,000					
19								
20			January	February	March	April	May	June
21								
22		Loan Balance:	$100,000	$97,000	$94,000	$91,000	$88,000	$85,000
23		Beginning Cash Balance:	150,000	162,750	175,515	188,295	224,423	260,567
24								
25		Projected Revenue						
26		Contracts:	$30,000	$30,000	$30,000	$53,333	$53,333	$53,333
27		Seminars:	30,000	30,000	30,000	30,000	30,000	30,000
28		Total Revenue:	$60,000	$60,000	$60,000	$83,333	$83,333	$83,333
29								
30		Projected Expenses						
31		Compenasation:	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
32		Rent:	4,000	4,000	4,000	4,000	4,000	4,000
33		Administrative:	3,250	3,250	3,250	3,250	3,250	3,250
34		Utilities:	2,000	2,000	2,000	2,000	2,000	2,000
35		Seminar Costs:	22,500	22,500	22,500	22,500	22,500	22,500
36		Interest on Loan:	500	485	470	455	440	425
37		Loan Payment:	3,000	3,000	3,000	3,000	3,000	3,000
38		Total Expenses:	$47,250	$47,235	$47,220	$47,205	$47,190	$47,175
39								
40		Total Rev. - Total Exp:	$12,750	$12,765	$12,780	$36,128	$36,143	$36,158
41								
42		Ending Cash Balance:	$162,750	$175,515	$188,295	$224,423	$260,567	$296,725

FIGURE 3.9 Project 14 spreadsheet showing budget and loan information

GETTING STARTED

To take into account the loan repayment, you will have to add the highlighted rows shown in Figure 3.8 to the spreadsheet you created in Project 13. (If you did not do Project 13, do it now.)

1. As shown by highlighted row 18 in Figure 3.8, add a line labelled **Monthly Loan Pmt:** into the Input Section.

2. As shown by highlighted row 22 in Figure 3.8, add a row labelled **Loan Balance:** *above* the **Beginning Cash Balance:** row. This loan balance will change each month as a repayment is made. The relationships used for each month in this new row are:

   For January: *The Loan Balance at the Beginning of the Month = Original Loan Amount*

   For February through June: *The Loan Balance at the Beginning of the Month = Loan Balance at the Beginning of the Prior Month – the Loan Repayment.*

3. As shown by highlighted row 37 in Figure 3.8, add a row labelled **Loan Payment:** *below* the **Interest on Loan:** row. The loan repayment amount is $3,000 per month.

4. Make sure that the **Interest on Loan:** expense is calculated as .5% of the **Loan Balance** at the beginning of the month (**not** 0.5% of the original loan amount, as was the case in Project 13).

Project 15 A Second Cash Flow Budget

Key Concept: Cash-Balance Analysis
Secondary Concept: Calculations

BACKGROUND

Rolling Acres Motel is located in Lenox, Massachusetts. The motel has 18 rooms and is used year-round for people wanting to enjoy the winter skiing, summer vacations, and the fall foliage.

THE PROJECT

You are to prepare a monthly cash-balance analysis for the motel for a twelve-month period. Use the following data:

Monthly occupancy rates

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec
30%	25%	15%	15%	15%	90%	100%	100%	75%	10%	10%	15%

Revenue Data

The average room charge per night is $119 in June, July, August, and September.
The average room charge per night is $55 in all other months.
*The total monthly room revenue = No. of rooms * average room charge per night*occupancy rate* days in the month*

Expense Data

Breakfast provided by the motel is 7% of the room revenue.
Staff expenses are 27% of the room charges.
Utilities (heat, light, electricity) are 22% of the room charges.
Maintenance expenses are 26% of the room charges.
A property tax of $5,300 is due in January, April, July, and October.
The motel has an initial cash balance in the bank of $10,000.

REQUIRED

Create a 12-month cash-balance spreadsheet for the motel. The format for your spreadsheet is shown in Figure 3.10 on the next page.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Name: <Here>**											**Project No:**	**15**
2													
3	**In-Season Room Rate:**	$119											
4	**Off-Season Room Rate:**	$55											
5	**No. of Rooms:**	18											
6	**Meal Cost Rate:**	7%											
7	**Staff Rate:**	27%											
8	**Utilities Rate:**	22%											
9	**Maintenance Rate:**	26%											
10	**Initial Cash on Hand:**	$5,300											
11													
12		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
13	**Rental Days:**	31	28	31	30	31	30	31	31	30	31	30	31
14	**Occupancy:**	30%	25%	15%	15%	15%	90%	100%	100%	75%	10%	10%	15%
15	**Room Rate:**	$55	$55	$55	$55	$55	$119	$119	$119	$119	$55	$55	$55
16	**Property Tax:**	$5,300			$5,300			$5,300			$5,300		
17													
18		**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
19	**Beginning Cash Balance:**												
20													
21	**Income**												
22	**Room Rental:**												
23	**Total Income:**												
24													
25	**Expenses**												
26	**Property tax:**												
27	**Meal Cost:**												
28	**Staff:**												
29	**Utilities:**												
30	**Maintenance:**												
31	**Total Expenses:**												
32													
33	**Income-Expenses:**												
34													
35	**Ending Cash Balance:**												

FIGURE 3.10 Rolling Acres budget spreadsheet for Project 15

Create a cash-flow spreadsheet and a spreadsheet with all of the formulas. Print both spreadsheets in Landscape and Fit-to-Page formats. Your completed spreadsheet should appear as shown in Figure 3.11.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Name: <Here>**											**Project No:**	**15**
2													
3	**In-Season Room Rate:**	$119											
4	**Off-Season Room Rate:**	$55											
5	**No. of Rooms:**	18											
6	**Meal Cost Rate:**	7%											
7	**Staff Rate:**	27%											
8	**Utilities Rate:**	22%											
9	**Maintenance Rate:**	26%											
10	**Initial Cash on Hand:**	$5,300											
11													
12		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
13	**Rental Days:**	31	28	31	30	31	30	31	31	30	31	30	31
14	**Occupancy:**	30%	25%	15%	15%	15%	90%	100%	100%	75%	10%	10%	15%
15	**Room Rate:**	$55	$55	$55	$55	$55	$119	$119	$119	$119	$55	$55	$55
16	**Property Tax:**	$5,300			$5,300			$5,300			$5,300		
17													
18		**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
19	**Beginning Cash Balance:**	$5,300	$1,657	$4,706	$6,732	$3,392	$5,418	$30,865	$54,782	$83,998	$105,204	$101,255	$102,561
20													
21	**Income**												
22	**Room Rental:**	$9,207	$6,930	$4,604	$4,455	$4,604	$57,834	$66,402	$66,402	$48,195	$3,069	$2,970	$4,604
23	**Total Income:**	$9,207	$6,930	$4,604	$4,455	$4,604	$57,834	$66,402	$66,402	$48,195	$3,069	$2,970	$4,604
24													
25	**Expenses**												
26	**Property tax:**	$5,300			$5,300			$5,300			$5,300		
27	**Meal Cost:**	644	485	322	312	322	4,048	4,648	4,648	3,374	215	208	322
28	**Staff:**	2,486	1,871	1,243	1,203	1,243	15,615	17,929	17,929	13,013	829	802	1,243
29	**Utilities:**	2,026	1,525	1,013	980	1,013	12,723	14,608	14,608	10,603	675	653	1,013
30	**Maintenance:**	2,394	1,802	1,197	1,158	1,197	15,037	17,265	17,265	12,531	798	772	1,197
31	**Total Expenses:**	$12,850	$3,881	$2,578	$7,795	$2,578	$32,387	$42,485	$37,185	$26,989	$7,019	$1,663	$2,578
32													
33	**Income-Expenses:**	($3,643)	$3,049	$2,026	($3,340)	$2,026	$25,447	$23,917	$29,217	$21,206	($3,950)	$1,307	$2,026
34													
35	**Ending Cash Balance:**	$1,657	$4,706	$6,732	$3,392	$5,418	$30,865	$54,782	$83,998	$105,204	$101,255	$102,561	$104,587

FIGURE 3.11 Completed Rolling Acres budget for Project 15

GETTING STARTED

After you have created the basic spreadsheet shown in Figure 3.10, all cells with values should be filled in with formulas. The only formulas that need to be entered are those in column B, starting with cell B19. From there on, the remaining cells contents should be copied from the initial cell formulas.

Project Set 4

Simple Decisions Using the IF( ) Function

Project 16 Computing Pass/Fail Grades

Key Concept: The IF( ) Function
Secondary Concept: Formatting

THE PROJECT

You are given the following data:

Last Name	First Name	Test 1	Test 2	Test 3	Final Exam
Abrams	Bill	40	60	70	80
Best	Jane	82	90	90	82
Fideist	Harry	80	75	78	78
Terrific	Ursala	95	90	95	95
Uxorius	Louisa	70	80	60	80

Prepare a spreadsheet that calculates and displays the final grade average for each student, a designation whether the student passes or failed the class, and the class average for each test. Construct your spreadsheet to appear as shown in Figure 4.1.

	A	B	C	D	E	F	G	H
1	**Name: <Here>**					**Project No:**	**16**	
2								
3	**Pass/Fail Cutoff:**		70					
4								
5	**Last Name**	**First Name**	**Test 1**	**Test 2**	**Test 3**	**Final Exam**	**Final Average**	**Final Grade**
6	Abrams	Bill	40	60	70	80		
7	Best	Jane	82	90	90	82		
8	Fideist	Harry	80	75	78	78		
9	Terrific	Ursala	95	90	95	95		
10	Uxorius	Louisa	70	80	60	80		
11	**Class**	**Average:**						

FIGURE 4.1 Student grade spreadsheet for Project 16

RELATIONSHIPS

1. The Final Averages displayed in Column G should be a straight average of each student's four grades.
2. The Final Grade calculated in Column H is determined as follows:

   If the **Final Average** *is greater or equal to 70, a Final Grade of "Pass" is assigned; otherwise, a Final Grade of "Fail" is assigned.*

REQUIRED

Prepare the spreadsheet and the cell formulas for this project. When completed, your spreadsheet should appear as shown in Figure 4.2. All **Final Exam**, **Final Average**, **Final Grade,** and **Class Average** cells are to be computed using a formula in each cell, not numbers.

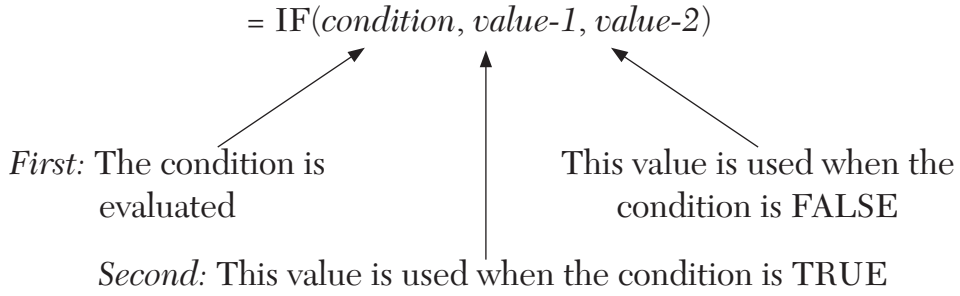
That is, this exercise is not to be done by hand with manual entry of numbers in the cells. The spreadsheet should be printed in Portrait, Fit-to-Page format, with gridlines and cell headers shown. The formula sheet should be printed in Landscape, Fit-to-Page format, with gridlines and cell headers shown.

	A	B	C	D	E	F	G	H
1	**Name: <Here>**					**Project No:**	**16**	
2								
3	**Pass/Fail Cutoff:**		70					
4								
5	**Last Name**	**First Name**	**Test 1**	**Test 2**	**Test 3**	**Final Exam**	**Final Average**	**Final Grade**
6	Abrams	Bill	40	60	70	80	62.50	Fail
7	Best	Jane	82	90	90	82	86.00	Pass
8	Fideist	Harry	80	75	78	78	77.75	Pass
9	Terrific	Ursala	95	90	95	95	93.75	Pass
10	Uxorius	Louisa	70	80	60	80	72.50	Pass
11	**Class**	**Average:**	73.4	79	78.6	83	78.5	

FIGURE 4.2 Completed student grade spreadsheet for Project 16

GETTING STARTED

1. You will need an =IF( ) formula to determine the **Final Grade** Pass or Fail designation. Only type the formula in once, in cell G6, and then copy the formula down to determine all of the remaining grades
2. The general form of the IF( ) function used within a formula is



where the *value-1* is the value displayed in the cell when the condition is true and *value-2* is the value displayed in the cell when the condition is false. (Note that *value-1* and *value-2* can be text, numbers, or another function or formula. Text values must be enclosed in quotation marks. For cell G6, this formula takes the form: =IF(F6 >= 70, "Pass", "Fail".)

Project 17 Calculating Pay with Overtime

Key Concepts: The IF( ) Function
Secondary Concepts: Formatting and Copying Formulas

THE PROJECT

In this project, you will modify the spreadsheet prepared for Project 2 so that each employee's pay takes into account an overtime pay rate. To do this, any hours worked above 40 should be paid at a rate that is 1½ times the normal hourly rate. Your final spreadsheet should appear as shown in Figure 4.3.

Your Name in Here **Project 17**

Cut-Off Hours: 40
Overtime Rate: 1.5

Employee Code	Employee Name	Hourly Rate	Hours Worked	Regular Pay	Overtime Pay	Gross Pay
32479	Abrams, B	$10.72	25.00	$268.00	$0.00	$268.00
03623	Bohm, P	9.54	35.50	338.67	0.00	338.67
14145	Gwodz, K	8.72	39.00	340.08	0.00	340.08
25987	Hanson, H	9.64	40.00	385.60	0.00	385.60
07634	Robbins, L	8.50	41.00	340.00	12.75	352.75
39567	Williams, B	7.30	45.00	292.00	54.75	346.75
			Totals:	$1,964.35	$67.50	$2,031.85

Average Hourly Rate: $9.07
Average Hours Worked: 37.58

FIGURE 4.3 Project 17 spreadsheet showing overtime pay

(Note that the Hours Worked shown in Figure 4.3 are different than those used in Project 2.)

To create the spreadsheet shown in Figure 4.3, you will have to use an IF( ) function that compares the hours worked to the number 40. One IF( ) function is needed to compute the regular pay and another IF( ) function is needed to compute the overtime pay.

RELATIONSHIPS

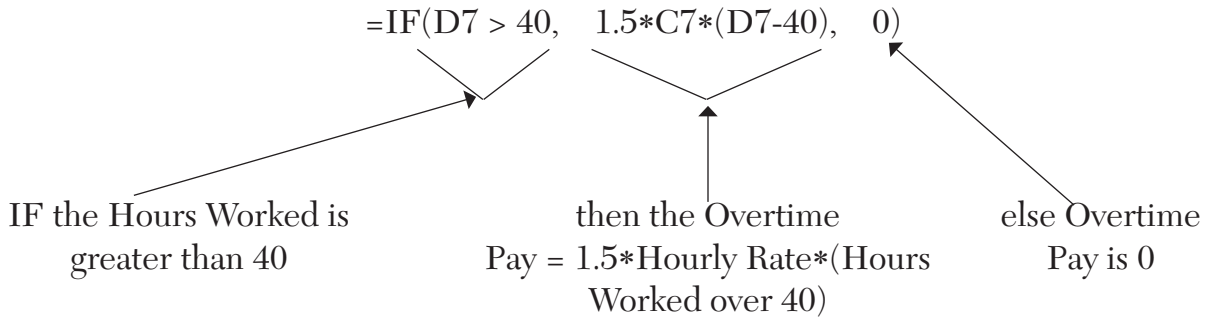
1. *If the hours worked is over 40, the hours over 40 are paid at is 1½ times the normal hourly rate; Otherwise, there is no overtime pay.*
2. *If the hours worked is over 40, the Regular Pay is 40* the normal hourly rate; otherwise the Regular Pay is the hours worked* the normal hourly rate.*

REQUIRED

Prepare a spreadsheet like that shown in Figure 4.3. This spreadsheet should be printed in Portrait, Fit-to-Page format. Your printout **should not** include gridlines or row and column headers. Print a second spreadsheet that displays all of the formulas, with the gridlines and row and column headers. The formula spreadsheet should be printed in Landscape and Fit-to-Page format.

GETTING STARTED

Figure 4.4 illustrates how your spreadsheet can be constructed. Note that the formula in cell F7 is equivalent to



Using absolute addresses in cell F7 ensures that if either or both the overtime hour cut-off and overtime rate are changed, the new values need only be entered once, in the input section. These values are then automatically applied to the formulas in the main spreadsheet section without the need to make any changes within the formulas.

	A	B	C	D	E	F	G
1	**Your Name <Here>**						**Project 17**
2							
3	**Cut-Off Hours:**	40					
4	**Overtime Rate:**	1.5					
5							
6	**Employee Code**	**Employee Name**	**Hourly Rate**	**Hours Worked**	**Regular Pay**	**Overtime Pay**	**Gross Pay**
7	32479	Abrams, B	$10.72	25.00	A Formula	=IF(D7>$B$3, $B$4*C7*($D$7-$B$3,0)	A Formula
8	03623	Bohm, P	9.54	35.50			
9	14145	Gwodz, K	8.72	39.00			
10	25987	Hanson, H	9.64	40.00			
11	07634	Robbins, L	8.50	41.00			
12	39567	Williams, B	7.30	45.00			
13				**Totals:**	A Formula		
14	**Average Hourly Rate:**	A Formula					
15	**Average Hours Worked:**			A Formula			

FIGURE 4.4 Project 17 spreadsheet showing overtime pay formulas

NOTE *You will also need a formula using an IF( ) function in cell E7 to compute the regular pay that satisfies Relationship 2. That is, only the hours less than or equal to 40 are paid at the regular hourly pay rate.*

Project 18 Payroll After Deductions

Key Concepts: The IF( ) Function
Secondary Concepts: Absolute Addresses and Formatting

THE PROJECT

For this project, you are to create a spreadsheet that calculates an employee's state taxes and their final net salary. Here is how your spreadsheet should look like when it is completed.

Name: <Here> **Project No: 18**

NJ State Tax Rates:	2.0%	2.5%
Base & Increment:	$20,000	$400
Pension Rate:	10%	

Employee	Gross Salary	Pension Plan	Pension Deduction	Salary After Pension Deduction	State Tax	Net Salary
Abrams, B	$28,200.00	No	$0.00	$28,200.00	$605.00	$27,595.00
Bohm, P	18,200.00	No	0.00	18,200.00	364.00	17,836.00
Jones, L	50,675.00	Yes	5,067.50	45,607.50	1,040.19	44,567.31
Robbins, A	25,600.00	Yes	2,560.00	23,040.00	476.00	22,564.00
Smith, B	30,314.00	Yes	3,031.40	27,282.60	582.07	26,700.54
Swain, K	26,425.00	No	0.00	26,425.00	560.63	25,864.38
Timmins, J	50,460.00	Yes	5,046.00	45,414.00	1,035.35	44,378.65
Williams, S	42,300.00	Yes	4,230.00	38,070.00	851.75	37,218.25

FIGURE 4.5 Project 18 spreadsheet results showing payroll after deductions

RELATIONSHIPS

1. *If an employee is in the pension plan, then a pension deduction of 10% of the employee's salary is deducted; else the pension deduction is 0.*
2. *Salary after Pension Deduction = Gross Salary - Pension Deduction*
3. *The State Tax is determined as follows:*

   If the Salary after the Pension Deduction is less than $20,000,
   then the State Tax is 2% of the Salary after the Pension Deduction;
   *else the State Tax =$400 + 2.5% * (Salary after Pension Deduction - $20,000)*
4. *Net Salary = Salary After Pension Deduction - State Taxes*

REQUIRED

Prepare a spreadsheet like Figure 4.5. This spreadsheet should be printed in Portrait, Fit-to-Page format. Your printout **should not** include gridlines or row and column headers. Create a second spreadsheet that displays all of the formulas, with gridlines and row and column headers. The formula spreadsheet should be printed in Landscape and Fit-to-Page format.

GETTING STARTED

Figure 4.6 illustrates how your spreadsheet can be constructed. The formula in cell D7 is =IF(C7="Yes",$B$5*B7,0). You will also need a formula with an IF( ) function in cell F7.

	A	B	C	D	E	F	G
1	**Name: <Here>**					**Project No:**	**18**
2							
3	**NJ State Tax Rates:**	2.0%	2.5%				
4	**Base & Increment:**	$20,000	$400				
5	**Pension Rate:**	10%					
6	**Employee**	**Gross Salary**	**Pension Plan**	**Pension Deduction**	**Salary After Pension Deduction**	**State Tax**	**Net Salary**
7	Abrams, B	$28,200.00	No	An IF( ) Formula	A Formula	An IF( ) Formula	A Formula
8	Bohm, P	18,200.00	No				
9	Jones, L	50,675.00	Yes				
10	Robbins, A	25,600.00	Yes				
11	Smith, B	30,314.00	Yes				
12	Swain, K	26,425.00	No				
13	Timmins, J	50,460.00	Yes				
14	Williams, S	42,300.00	Yes				

FIGURE 4.6 Project 18 spreadsheet showing the formulas

Project 19

CASH FLOW BUDGET WITH CONDITIONAL LOAN REPAYMENT

Key Concept: Cash Flow and Review of IF( ) function
Secondary Concepts: Formulas and Formatting

THE PROJECT

The spreadsheet shown in Figure 4.7 was created in Project 14 (If you did not do that project, do it now). In this project, you are to create an additional repayment row for Project 14's spreadsheet for the following condition: In any month for which the total revenues less total expenses exceeds $8,000, an additional loan repayment of $4,000 must be made; otherwise, there is no additional loan repayment.

Your Name <Here>					Project No:	19	
Prior Balances							
Cash:	$50,000						
Loan:	$100,000						
Six Month Projected Revenue							
Contracts:	$250,000						
Seminars:	$180,000						
Six Month Projected Expenses							
Compensation	$90,000						
Rent:	$24,000						
Administrative:	$19,500						
Utilities:	$12,000						
Seminar Costs:	75%						
Monthly Loan Int:	0.50%						
Monthly Loan Pmt:	$3,000						
	January	February	March	April	May	June	
Loan Balance:	$100,000	$97,000	$94,000	$91,000	$88,000	$85,000	
Beginning Cash Balance:	150,000	162,750	175,515	188,295	224,423	260,567	
Projected Revenue							
Contracts:	$30,000	$30,000	$30,000	$53,333	$53,333	$53,333	
Seminars:	30,000	30,000	30,000	30,000	30,000	30,000	
Total Revenue:	$60,000	$60,000	$60,000	$83,333	$83,333	$83,333	
Projected Expenses							
Compenasation:	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	
Rent:	4,000	4,000	4,000	4,000	4,000	4,000	
Administrative:	3,250	3,250	3,250	3,250	3,250	3,250	
Utilities:	2,000	2,000	2,000	2,000	2,000	2,000	
Seminar Costs:	22,500	22,500	22,500	22,500	22,500	22,500	
Interest on Loan	500	485	470	455	440	425	
Loan Payment:	3,000	3,000	3,000	3,000	3,000	3,000	
Total Expenses:	$47,250	$47,235	$47,220	$47,205	$47,190	$47,175	
Total Rev. - Total Exp:	$12,750	$12,765	$12,780	$36,128	$36,143	$36,158	
Ending Cash Balance:	$162,750	$175,515	$188,295	$224,423	$260,567	$296,725	

FIGURE 4.7 Spreadsheet for Project 19 (from Project 14)

REQUIRED

Prepare a spreadsheet and the cell formulas for the months January through June. When completed, your spreadsheet should look like that in Figure 4.8.

	A	B	C	D	E	F	G	H
1	Your Name <Here>:						Project No:	19
2								
3	Prior Balances							
4		Cash:	$50,000					
5		Loan:	$100,000					
6								
7	Six Month Projected Revenue:							
8		Contracts:	$250,000					
9		Seminars:	$180,000					
10								
11	Six Month Projected Expenses:							
12		Compensation	$90,000					
13		Rent:	$24,000					
14		Administrative:	$19,500					
15		Utilities:	$12,000					
16		Seminar Costs:	75%					
17		Monthly Loan Int:	0.50%					
18		Monthly Loan Pmt:	$3,000					
19		Add'l Repayment Cut-off:	$10,000					
20		Add'l Repayment Amt:	$4,000					
21								
22			January	February	March	April	May	June
23								
24		Loan Balance:	$100,000	$97,000	$94,000	$91,000	$84,000	$77,000
25	Beginning Cash Balance:		$150,000	$159,750	$169,515	$179,295	$208,423	$237,587
26								
27	Projected Revenue							
28		Contracts:	$30,000	$30,000	$30,000	$53,333	$53,333	$53,333
29		Seminars:	30,000	30,000	30,000	30,000	30,000	30,000
30		Total Revenue:	$60,000	$60,000	$60,000	$83,333	$83,333	$83,333
31								
32	Projected Expenses							
33		Compensation:	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
34		Rent:	4,000	4,000	4,000	4,000	4,000	4,000
35		Administrative:	3,250	3,250	3,250	3,250	3,250	3,250
36		Utilities:	2,000	2,000	2,000	2,000	2,000	2,000
37		Seminar Costs:	22,500	22,500	22,500	22,500	22,500	22,500
38		Interest on Loan:	500	485	470	455	420	385
39		Loan Payment:	3,000	3,000	3,000	3,000	3,000	3,000
40		Total Expenses:	$50,250	$50,235	$50,220	$50,205	$50,170	$50,135
41								
42	Total Rev. - Total Exp:		$9,750	$9,765	$9,780	$33,128	$33,163	$33,198
43								
44	Additional Loan Repayment:		$0	$0	$0	$4,000	$4,000	$4,000
45								
46	Ending Cash Balance:		$159,750	$169,515	$179,295	$208,423	$237,587	$266,785

FIGURE 4.8 Project 19 results for budget with conditional loan repayment

GETTING STARTED

You will have to make modifications to the spreadsheet you created for Project 14, which is reproduced as Figure 4.7. The required modifications, which are shown in Figure 4.8, are as follows:

1. Add the two inputs shown in rows 19 and 20.
2. Add a row labeled **Additional Loan Repayment**, shown in row 44**.** The values in this new row will enable you to determine if an additional repayment must be made based on the **Total Rev. – Total Exp** value in row 42. You will need an IF( ) function to make this determination.
3. Make sure to adjust the **Ending Cash Balance** in row 46 to include the Loan Repayment.
4. Adjust the **Loan Balance** in row 24 to include both the regular monthly loan payment in row 39 and the additional loan repayment amount in row 44 that was made the prior month.

Project Set 5

Making Multiple Choices Using VLOOKUP( )

Project 20 Determining a Letter Grade

Key Concept: The VLOOKUP( ) Function
Secondary Concept: Absolute Addresses, Formatting

THE PROJECT

In this project, you are to complete and format the spreadsheet shown in Figure 5.1. You will need to use a VLOOKUP( ) function and the lookup section of a lookup table to determine the values in Column G. A lookup table lists items vertically, as shown in cells F11 to G22. It is the lookup section of this table, cells F13 to G22, that is used by the VLOOKUP( ) function: the heading and labels are optional and are there for informational purposes only.

	A	B	C	D	E	F	G
1	**Name:**					**Project No:**	**20**
2							
3	**Name**	**Test 1**	**Test 2**	**Test 3**	**Final**	**Average Grade**	**Letter Grade**
4	Brien, Gary	70	90	85	85		
5	Best, Harriet	90	70	83	92		
6	Flavano, Anthoı	70	85	72	70		
7	Glover, Jane	85	92	89	95		
8	Restin, Ann	60	70	80	80		
9	Williams, Bill	79	72	63	60		
10							
11						**Lookup Table**	
12						**Grade Range**	**Letter Grade**
13						0	F
14						60	D
15						70	C-
16						73	C
17						77	C+
18						80	B-
19						83	B
20						87	B+
21						90	A-
22						93	A

FIGURE 5.1 Project 20 spreadsheet for determining a letter grade

RELATIONSHIPS

1. *Average Grade = Average of the three tests and the final*
2. To compute the Letter Grade, you will use a VLOOKUP( ) function

GETTING STARTED

Once you have entered all of the cell contents shown in Figure 5.1, you need a formula to calculate the averages needed in cells F4 through F9. The letter grades calculated in cells G4 through G9 are obtained using a VLOOKUP( ) function.

The correct formula for cell G4 is

=VLOOKUP(F4,$F$13:$G$22,2,TRUE)

The first argument, F4, tells the VLOOKUP( ) function to search a table, which is called a **lookup table**, to see if the value in cell F4 is contained in the table. Only the first column in the table is searched.

The next argument, the range $F$13:$G$22, specifies that the location of the lookup table. Here the address $F$13 specifies that the lookup section starts at cell F13 and the address $G$22 specifies that the lookup section ends at cell G22. Note that the range consists of only the data in the lookup section of the complete table and must not include any labels above the lookup section.

The third argument, the value 2, tells the function to return the value in the 2nd column of the table when a match for the searched value is found in the first column. Here, the lookup table only has two columns, but in Project 22, you will use a table that has more than 2 columns. Thus, regardless of the number of columns, a return column value must always be entered.

Finally, the fourth argument, TRUE, tells the VLOOKUP( ) function that if an exact match is not found in column one, the function should select the closest value in column one that is less than the searched for value.

REQUIRED

Prepare a completed spreadsheet, in Portrait format, that includes the average numerical grades and their equivalent letter grades, as shown in Figure 5.2. Additionally, print the corresponding formula sheet, in the Landscape and Fit-to-Page formats.

	A	B	C	D	E	F	G
1	**Name:**					**Project No:**	**20**
2							
3	**Name**	**Test 1**	**Test 2**	**Test 3**	**Final**	**Average Grade**	**Letter Grade**
4	Brien, Gary	70	90	85	85	82.50	B-
5	Best, Harriet	90	70	83	92	83.75	B
6	Flavano, Anthony	70	85	72	70	74.25	C
7	Glover, Jane	85	92	89	95	90.25	A-
8	Restin, Ann	60	70	80	80	72.50	C-
9	Williams, Bill	79	72	63	60	68.50	D
10							
11						**Lookup Table**	
12						**Grade Range**	**Letter Grade**
13						0	F
14						60	D
15						70	C-
16						73	C
17						77	C+
18						80	B-
19						83	B
20						87	B+
21						90	A-
22						93	A

FIGURE 5.2 Completed Project 20 spreadsheet showing letter grades

Project 21 DETERMINING A DISCOUNT

Key Concept: The VLOOKUP( ) Function
Secondary Concept: Absolute Addresses, Formatting

THE PROJECT

In this project, you are to complete and format the spreadsheet shown in Figure 5.3. To do this, you will need to use a VLOOKUP( ) function and the lookup section of a Lookup Table to determine the Discount Percentages required in column E.

	A	B	C	D	E	F	G
1	**Name:**					**Project No:**	**21**
2							
3	**Customer**	**Units**	**Cost per Unit**	**Amount**	**Discount Percentage**	**Discount Amount**	**Amount After Discount**
4	Bronson	1,125	$25	$28,125			
5	Stern	900	$20	$18,000			
6	Qin	1,125	$98	$110,250			
7	Adams	2,008	$46	$92,368			
8	Yoon	675	$73	$49,275			
9	Gilbert	1,200	$30	$36,000			
10	Sullivan	300	$18	$5,400			
11					**Total:**		
12					**Average:**		
13					**Maximum:**		
14							
15					**Lookup Table**		
16					**Amount**	**Discount Percentage**	
17					0	0%	
18					10000	2%	
19					25000	4%	
20					40000	6%	
21					80000	8%	
22					100000	10%	

FIGURE 5.3 Setup of Project 21 for determining a discount

RELATIONSHIPS

1. *Amount = Units * Cost per Unit*
2. *Discount Percentage: Use a formula incorporating a VLOOKUP( ) function to determine the discount percentage.*
3. *Discount Amount = Amount * Discount Percentage*
4. *Amount after Discount = Amount - Discount Amount*
5. Use the SUM( ), AVERAGE( ), and MAX( ) functions to calculate the Total, Average, and Maximum amounts in cells C11, C12, and C13, respectively.

GETTING STARTED

The correct formula for cell E4 is: =VLOOKUP(D4, $E$17:$F$22,2,TRUE). In this formula, the first argument, D4, tells the VLOOKUP( ) function to search a table, which is called a **lookup table**, to see if the value in cell D4 is contained in the table. Only the first column in the table is searched.

The next argument, the range $E$17 : $F$22, specifies that the lookup section starts in cell E17 and ends in cell F22. Note that the range consists of only the data in the lookup section of the complete table; any labels above the data ***must not*** be included in the range.

The third argument, the value 2, tells the function to return the value in the second column of the table when a match is found in the first column for the searched value. In this case, the lookup table only has two columns, but in Project 22, you will use a table that has more than 2 columns.

The last argument, TRUE, tells the VLOOKUP( ) function that if an exact match is not found in column one, the function should select the closest value in column one that is less than the searched for value.

REQUIRED

Prepare a completed spreadsheet, in Portrait format, as shown in Figure 5.4, and a second spreadsheet that displays all of the formulas. The formula spreadsheet should be printed in the Landscape and Fit-to-Page formats.

	A	B	C	D	E	F	G
1	**Name:**					**Project No:**	**21**
2							
3	**Customer**	**Units**	**Cost per Unit**	**Amount**	**Discount Percentage**	**Discount Amount**	**Amount After Discount**
4	Bronson	1,125	$25	$28,125	0.04	$1,125	$27,000
5	Stern	900	$20	$18,000	0.02	$360	$17,640
6	Qin	1,125	$98	$110,250	0.1	$11,025	$99,225
7	Adams	2,008	$46	$92,368	0.08	$7,389	$84,979
8	Yoon	675	$73	$49,275	0.06	$2,957	$46,319
9	Gilbert	1,200	$30	$36,000	0.04	$1,440	$34,560
10	Sullivan	300	$18	$5,400	0	$0	$5,400
11					**Total:**	$24,296	$315,122
12					**Average:**	$3,471	$45,017
13					**Maximum:**	$11,025	$99,225
14							
15					**Lookup Table**		
16					**Amount**	**Discount Percentage**	
17					0	0%	
18					10000	2%	
19					25000	4%	
20					40000	6%	
21					80000	8%	
22					100000	10%	

FIGURE 5.4 Completed spreadsheet for Project 21 showing the discounts

Project 22 Using Multiple Lookup Tables

Key Concept: The VLOOKUP( ) function
Secondary Concept: Absolute Addresses, Formatting

BACKGROUND

A fluid flowing through a pipe can flow in one of three different ways. The fluid flow can be either smooth, turbulent, or in-transition between smooth and turbulent. The Reynold's Number is used by engineers to determine which type of flow is occurring when a liquid, such as water or oil, travels through a pipe. The determination is made as follows:

If the Reynold's Number is less than 2,000, the flow is smooth.

If the Reynold's Number is greater than or equal to 2000 and less than 3,000, the flow is in-transition.

If the Reynold's Number is greater than or equal to 3,000, the flow is turbulent.

The Reynold's Number is found using the fluid's density and viscosity, along with the diameter of the pipe through which the fluid is flowing, and the average speed of the fluid through the pipe. The density and viscosity are inherent properties of the fluid flowing through the pipe.

THE PROJECT

For this project you are to complete the spreadsheet shown in Figure 5.5. To do this, you need two lookup tables; the first to determine the fluid's density and viscosity, from which the fluid's *kinematic viscosity* can be calculated and displayed in the appropriate cell in column D. Then, based on the fluid's kinematic viscosity, the pipe's diameter, and the fluid's average speed through the pipe, a Reynold's number can be calculated and displayed in the appropriate cell in column G.

A second look-up table is then used to determine the type of flow occurring through the pipe (smooth, turbulent, or in-transition) based on the Reynold's Number.

	A	B	C	D	E	F	G	H
1	**Name:**						**Project No:**	**22**
2								
3	**Fluid**	**Density**	**Viscosity**	**Kinematic Viscosity**	**Pipe Diameter**	**Avg. Fluid Speed**	**Reynold's Number**	**Type of Flow**
4	Water				0.1	0.09		
5	Water				0.2	0.09		
6	Gasoline				0.1	0.09		
7	Gasoline				0.2	0.09		
8	Lubricating Oil				0.1	0.09		
9	Lubricating Oil				0.2	0.09		
10	Fuel Oil				0.1	0.09		
11	Fuel Oil				0.2	0.09		
12								
13	**Lookup Table 1**						**Lookup Table 2**	
14	**Fluid Type**	**Density**	**Viscosity**				**Reynold's Number**	**Flow Type**
15	Fuel Oil	849.6	0.00299				0	Smooth
16	Gasoline	718.6	0.00045				2000	In-Transition
17	Lubricating Oil	886.5	0.08707				3000	Turbulent
18	Water	997.3	0.00089					

FIGURE 5.5 Project 22 spreadsheet setup for determining the Reynold's Number and types of flow

RELATIONSHIPS

1. The *Kinematic Viscosity* values in column D are determined as *(Viscosity / Density).*
2. The Reynold's Number values in column E are determined using the formula:

   *Reynold's Number = (Pipe Diameter * Avg. Fluid Speed) / (Kinematic Viscosity).*

GETTING STARTED

1. Use a VLOOKUP( ) function with the data in Figure 5.5's Lookup Table 1 to determine the Density values required in column B.
2. Use a VLOOKUP( ) function with the data in Figure 5.5's Lookup Table 1 to determine the Viscosity values required in column C.
3. Calculate the Kinematic Viscosity and Reynold's Number in columns D and G, respectively, using the relationships provided above.
4. For cells H4 through H11, use a VLOOKUP( ) function on the Reynold's Number in the corresponding column G cell to determine the type of fluid flow through the pipe. Use Lookup Table 2 for this lookup.

REQUIRED

Prepare a completed spreadsheet, in the Portrait and Fit-to-Page formats, as shown in Figure 5.6 and a second spreadsheet that displays all of the formulas. The formula spreadsheet should be printed in the Landscape and Fit-to-Page formats.

	A	B	C	D	E	F	G	H
1	**Name:**						**Project No:**	**22**
2								
3	**Fluid**	**Density**	**Viscosity**	**Kinematic Viscosity**	**Pipe Diameter**	**Avg. Fluid Speed**	**Reynold's Number**	**Type of Flow**
4	Water	997.3	0.00089	8.9241E-07	0.1	0.09	10085	Turbulent
5	Water	997.3	0.00089	8.9241E-07	0.2	0.09	20170	Turbulent
6	Gasoline	718.6	0.00045	6.2622E-07	0.1	0.09	14372	Turbulent
7	Gasoline	718.6	0.00045	6.2622E-07	0.2	0.09	28744	Turbulent
8	Lubricating Oil	886.5	0.08707	9.8218E-05	0.1	0.09	92	Smooth
9	Lubricating Oil	886.5	0.08707	9.8218E-05	0.2	0.09	183	Smooth
10	Fuel Oil	849.6	0.00299	3.5193E-06	0.1	0.09	2557	In-Transition
11	Fuel Oil	849.6	0.00299	3.5193E-06	0.2	0.09	5115	Turbulent
12								
13	**Lookup Table 1**						**Lookup Table 2**	
14	**Fluid Type**	**Density**	**Viscosity**				**Reynold's Number**	**Flow Type**
15	Fuel Oil	849.6	0.00299				0	Smooth
16	Gasoline	718.6	0.00045				2000	In-Transition
17	Lubricating Oil	886.5	0.08707				3000	Turbulent
18	Water	997.3	0.00089					

FIGURE 5.6 Completed Project 22 spreadsheet showing the Reynold's Numbers and types of flow

Project 23 Using One Lookup Table Multiple Times

Key Concept: The VLOOKUP( ) Function
Secondary Concepts: Absolute Addresses, Formatting

THE PROJECT

For this project, you are to complete Figure 5.6's spreadsheet by computing each employee's Federal Tax and displaying it in column C. To do this, use the boxed 2020 Tax Rate Schedule in columns E through H as a lookup table.

	A	B	C	D	E	F	G	H
1	**Name:**	**<Here>**					**Project:**	**23**
2								
3					**2020 Federal Tax Rate Schedule for Individuals**			
4	**Employee**	**Taxable Income**	**Federal Tax**		**Income Range**	**Base Tax**	**Tax Rate**	**Base Amount**
5	Abrams, B	$7,500.00			$0	$0	10%	$0
6	Bohm, P	$18,200.00			$9,700	$970	12%	$9,700
7	Jones, L	$50,675.00			$39,475	$4,543	22%	$39,475
8	Robbins, A	$25,600.00			$84,200	$14,382	24%	$84,200
9	Smith, B	$30,314.00			$160,725	$32,748	32%	$160,725
10	Swain, K	$82,300.00			$204,100	$46,628	35%	$204,100
11	Timmins, J	$175,000.00			$510,300	$153,798	37%	$510,300
12	Williams, S	$500,000.00						

FIGURE 5.7 Project 23 spreadsheet setup to use a lookup table multiple times

RELATIONSHIPS

Each employee's Federal Tax is computed using the following formula:

$$Federal\ Tax = Base\ Tax + Tax\ Rate * (Taxable\ Income - Base\ Amount) \quad \text{(Eq. 1)}$$

where the *Base Tax*, *Tax Rate*, and *Base Amount* are found in the Federal Tax Rate Schedule, and the person's *Taxable Income* is listed in column C.

For example, the Taxable Income for L. Jones (third employee) is $50,675. In the Federal Tax Rate Schedule, this income is within the Income Range $39,475 to $84,200.

To compute the tax, always use the values corresponding to the lower amount in the income range, which in this case, are the entries for the value $39,475 (the first

column in the lookup table). This provides a Base Tax of $4,543, and a 22% tax rate that is applied to the Jones' income that is above $39,475. Thus, Jones' Federal Tax is

$$\begin{aligned}\text{Federal Tax} &= \$4{,}543 + .22 * (\$50{,}675 - \$39{,}475) \\ &= \$4{,}543 + .22 * (\$11{,}200) \\ &= \$4{,}543 + \$2{,}464 = \$7{,}007\end{aligned}$$

GETTING STARTED

In computing each person's Federal Tax using Eq. 1, you should include the following three VLOOKUP( ) functions in the formula:

1. *a first LOOKUP( ) function to determine the Base Tax*
2. *a second VLOOKUP( ) function to determine Tax Rate*
3. *a third VLOOKUP( ) function to determine the Base Amount*

REQUIRED

Prepare a spreadsheet that, when completed, looks like Figure 5.8 and a second spreadsheet that displays all of the formulas. Print the first spreadsheet in Portrait format and the formula sheet in Landscape format. Both spreadsheets should use Fit-to-Page formats.

	A	B	C	D	E	F	G	H
1	**Name:**	**<Here>**					**Project:**	23
2								
3					**2020 Federal Tax Rate Schedule for Individuals**			
4	**Employee**	**Taxable Income**	**Federal Tax**		**Income Range**	**Base Tax**	**Tax Rate**	**Base Amount**
5	Abrams, B	$7,500.00	$750.00		$0	$0	10%	$0
6	Bohm, P	$18,200.00	$1,990.00		$9,700	$970	12%	$9,700
7	Jones, L	$50,675.00	$7,007.00		$39,475	$4,543	22%	$39,475
8	Robbins, A	$25,600.00	$2,878.00		$84,200	$14,382	24%	$84,200
9	Smith, B	$30,314.00	$3,443.68		$160,725	$32,748	32%	$160,725
10	Swain, K	$82,300.00	$13,964.50		$204,100	$46,628	35%	$204,100
11	Timmins, J	$175,000.00	$37,316.00		$510,300	$153,798	37%	$510,300
12	Williams, S	$500,000.00	$150,193.00					

FIGURE 5.8 Completed spreadsheet for Project 23 showing the federal tax

Project Set 6

APPLICATIONS AND GRAPHING

NOTE

1. *Additional background information on Break-Even Analysis (Project 24) is provided in Appendix B.*
2. *Additional background information on Economic Order Quantity (Project 25) is provided in Appendix C.*
3. *Detailed instructions for creating Line Graphs is presented in How-To Guide 5.*

Project 24 Break-Even Analysis and Line Graphs

Key Concept: Break-Even Point, Line Graph
Secondary Concept: Calculations

BACKGROUND

Every sales operation involves *revenue* and *costs*, where costs consist of both fixed costs and variable costs.

Revenue is the income obtained from selling items that were either manufactured or purchased. In its simplest form, it is equal to the item's price per item, which is the price that each unit sold for, times the number of items sold.

Fixed costs: These include rent, insurance, property taxes, and other expenses that are present regardless of the number of items produced and sold. Over the short run, these are fixed, and they exist even if no items are produced and sold.

V*ariable costs:* These are expenses directly attributable to the manufacture or purchase of the items themselves, such as labor and raw materials. Variable costs depend directly on the number of items produced or purchased: the more items, the higher the variable costs.

The *Break-Even Point (BEP)* occurs when the revenue from the sale of the manufactured or purchased items equals the total cost of producing or purchasing the items. When this happens, the manufacturer neither makes nor loses money, but simply breaks even. (See Appendix B for a more complete introduction to Break-Even analysis.)

THE PROJECT

This is a three-part project. The first two parts require you to complete the spreadsheet shown in Figure 6.1. The shaded region in cells A3 through B6 corresponds to Part 1 and the shaded region in cells A9 through F12, corresponds to Part 2. The third part is a set of line graphs described later.

	A	B	C	D	E	F	G
1	**Name:**					**Project No:**	**24**
2							
3	Cost per book((a):	$50					
4	Fixed Costs (F):	$150,000					
5	Price per book (p):	$80					
6	Break-Even Point:						
7							
8							
9	Sales (x):						
10	Revenue:						
11	Total Cost:						
12	Profit:						

FIGURE 6.1 Project 24 spreadsheet setup for the Break-Even Analysis

PART 1

For the first part of this project, you are to create the input section shown in Figure 6.1 as the shaded cells A3 through B5. Once the values shown are entered, which are the cost of manufacturing one textbook, *a*, the fixed manufacturing cost, *F*, and the sale price per book, *p*, the break-even value, formally referred to the Break-Even Point, or BEP, is calculated and displayed in cell B6.

RELATIONSHIPS

The Break-Even Point calculation is as follows:

Break-Even Point = Fixed costs / (price per book – variable cost per book).

or

$$BEP = F/(p-a)$$

Any sales above the BEP result in a profit, while any sales below this value result in a loss.

PART 2

The second part of this project requires calculating and displaying the revenue, cost, and profit associated with sales both below, at, and above the BEP. This display consists of the shaded cells A9 through F12 shown in Figure 6.1.

RELATIONSHIPS

1. Row 9: *Sales(x)*
   The sales displayed in this row should be calculated as the sales that are equal to 25%, 50%, 100%, 150%, and 200% of the BEP, respectively.
2. Row 10: *Revenue*
   The revenues displayed in this row are calculated as follows:
   *Revenue = (price-per- book in cell B5) * (sales value in the Sales row)*
3. Row 11: *Total Cost*
   The Total Costs displayed in this row are calculated as follows:
   *Total Cost = (Cost-per-book in cell B3) * (sales value in the Sales row) + Fixed Costs in cell B4*
4. Row 12: *Profit*
   The Profit displayed in this row are calculated as follows:
   Profit =Income –Total Cost

When all of the calculations are complete, Parts 1 and 2 will appear as shown in Figure 6.2. This spreadsheet is for verification purposes only.

	A	B	C	D	E	F	G
1	**Name:**					**Project No:**	**24**
2							
3	Cost per book((a):	$50					
4	Fixed Costs (F):	$150,000					
5	Price per book (p):	$80					
6	Break-Even Point:	5,000					
7							
8							
9	Sales (x):	1,250	2,500	5,000	7,500	10,000	
10	Revenue:	$100,000	$200,000	$400,000	$600,000	$800,000	
11	Total Cost:	$212,500	$275,000	$400,000	$525,000	$650,000	
12	Profit:	-$112,500	-$75,000	$0	$75,000	$150,000	

FIGURE 6.2 Project 24 spreadsheet for verification

PART 3

The final part of this project is to create line graphs of the Revenues, Total Costs, and Profits. Your completed spreadsheet should appear as shown in Figure 6.3.

In reviewing Figure 6.3, notice that the BEP occurs at the intersection of the Revenue and Total Cost lines. At this point, the profit is zero. Above this point, the profit is positive, and below this point, it is negative (which means a loss).

NOTE *To create the line graphs shown in Figure 6.3, first highlight cells A9 through F12, and then follow the directions provided in Guide 5: Creating Line Graphs.*

	A	B	C	D	E	F	G
1	Name:					Project No:	24
2							
3	Cost per book((a):	$50					
4	Fixed Costs (F):	$150,000					
5	Price per book (p):	$80					
6	Break-Even Point:	5,000					
7							
8							
9	Sales (x):	1,250	2,500	5,000	7,500	10,000	
10	Revenue:	$100,000	$200,000	$400,000	$600,000	$800,000	
11	Total Cost:	$212,500	$275,000	$400,000	$525,000	$650,000	
12	Profit:	-$112,500	-$75,000	$0	$75,000	$150,000	

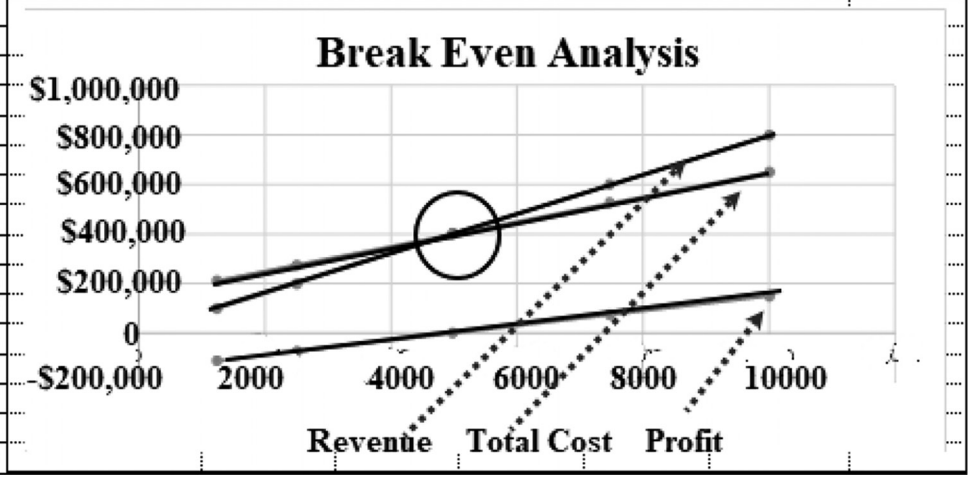


FIGURE 6.3 Project 24 spreadsheet showing line graphs

REQUIRED

Once you have created the spreadsheet in Figure 6.2 and verified your results, prepare a spreadsheet that calculates the BEP for the following data:

Variable cost per book (a): $45 per book
Fixed Costs (F): $200,000
Price per book (p): $110

Your spreadsheet should include line graphs for the same proportion of sales as shown in Figure 6.3 and a second spreadsheet with all formulas. Use the appropriate formats for each spreadsheet.

TROUBLE-SHOOTING

If the line graphs do not print on the same sheet as the data, make sure that the page is not set for draft quality.

Project 25 Economic Order Quantity and Line Graphs

Key Concepts: Economic Order Quantity and Line Graphs
Secondary Concept: Calculations

BACKGROUND

Optimization techniques are valuable in inventory control problems for minimizing storage costs while simultaneously ensuring that enough items are on hand to meet current demand for a product. In situations where the demand for items is known and constant, the costs associated with ordering and storing inventory over a one-year period can be described using the following parameters:

Number of items ordered in a year (D):

These are the total number of items that will be ordered in a year.

Fixed costs per order (m):

These costs are fixed for each order and cover such expenses as processing and accounting charges.

Cost of storing one item for one year (k):

This is the cost of storing one unit of inventory for a period of one year.

The *Economic Order Quantity (EOQ)* is the number of items, x, that should be ordered each time an order is placed. This value minimizes the total cost associated with ordering and storing the items needed over a year without running into shortages. (See Appendix C, for a more complete introduction to the Economic Order Quantity.)

THE PROJECT

This is a three-part project. The first two parts require you to complete the spreadsheet shown in Figure 6.4. The shaded region in cells A3 through B6 corresponds to Part 1, and the shaded region in cells A8 through F11 corresponds to Part 2. The third part is a set of line graphs described later.

	A	B	C	D	E	F
1	**Name:**				**Project No:**	**25**
2						
3	Number of items ordered in a year (D):	1,000				
4	Cost of placing one order (m):	$40				
5	Cost of storing one item for one year (k):	$64				
6	Economic Order Quantity (EOQ):					
7						
8	Order Size (x):					
9	Total Annual Ordering Costs (TOC):					
10	Total Annual Storage Costs (TSC):					
11	Total Annual Cost (TC):					

FIGURE 6.4 Project 25 spreadsheet setup for the Economic Order Quantity

PART 1

For the first part of this project, you are to create the input section shown as the shaded cells A3 through B5 in Figure 6.4. Once the values shown are entered, which are the number of items ordered in a year, D, the cost of placing a single order, m, and the cost of storing one item for one year, k, the Economic Order Quantity (EOQ) is calculated and displayed in cell B6.

RELATIONSHIPS

The EOQ is calculated as follows:

$$\text{Economic Order Quantity} = EOQ = \sqrt{\frac{2mD}{k}}$$

Any quantity ordered above or below the EOQ results in a larger total annual inventory cost.

PART 2

The second part of this project requires calculating and displaying the Total Annual Ordering Costs (TOC), Total Annual Storage Costs (TSC), and the sum of these two costs for order quantities both below, at, and above the EOQ. This display consists of the shaded cells A8 through F11 shown in Figure 6.4.

RELATIONSHIPS

1. Row 8: *Order Size(x)*

   The order sizes displayed in this row should be calculated as order sizes that are equal to 25%, 50%, 100%, 150%, and 175% of the EOQ, respectively.

2. Row 9 : *Total Annual Ordering Costs (TOC)*

   The Total Annual Storage Costs displayed in this row are calculated as follows:
   TOC = m(D/x)* , where *x* is the order size in row 8.

3. Row 10: *Total Annual Storage Costs (TSC)*

   The Total Annual Storage Costs displayed in this row are calculated as follows:
   TSC = k (x/2),* where *x* is the order size in row 8.

4. Row 11: *Total Annual Costs (TC)*

   The Total Annual Costs displayed in this row are calculated as follows:
   TC = TOC + TSC

When all of the calculations are complete, Parts 1 and 2 will appear as shown in Figure 6.5. Figure 6.5 is for verification purposes only.

	A	B	C	D	E	F
1	**Name:**				**Project No:**	**25**
2						
3	Number of items ordered in a year (D):	1,000				
4	Cost of placing one order (m):	$40				
5	Cost of storing one item for one year (k):	$64				
6	Economic Order Quantity (EOQ):	35				
7						
8	Order Size (x):	9	18	35	53	62
9	Total Annual Ordering Costs (TOC):	$4,525	$2,263	$1,131	$754	$646
10	Total Annual Storage Costs (TSC):	$283	$566	$1,131	$1,697	$1,980
11	Total Annual Cost (TC):	$4,808	$2,828	$2,263	$2,451	$2,626

FIGURE 6.5 Project 25 spreadsheet for verification

PART 3

The final part of this project is to create a line graph of the Total Ordering Costs, Total Storage Costs and Total Costs. Your completed spreadsheet should appear as shown in Figure 3.

In reviewing Figure 6.6, notice that the EOQ occurs at the intersection of the Total Annual Ordering Cost and Total Annual Storage curves. Also notice that the Total Cost, which is the sum of the previous two costs, is a minimum at the EOQ.

NOTE *To create the line graphs shown in Figure 6.6, first highlight cells A8 through F11, and then follow the directions provided in Guide 5: Creating Line Graphs.*

	A	B	C	D	E	F
1	Name:				Project No:	25
2						
3	Number of items ordered in a year (D):	1000				
4	Cost of placing one order (m):	$40				
5	Cost of storing one item for one year (k):	$64				
6	Economic Order Quantity (EOQ):	35				
7						
8	Order Size (x):	9	18	35	53	62
9	Total Annual Ordering Costs (TOC):	$4,525	$2,263	$1,131	$754	$646
10	Total Annual Storage Costs (TSC):	$283	$566	$1,131	$1,697	$1,980
11	Total Annual Cost (TC):	$4,808	$2,828	$2,263	$2,451	$2,626
12						

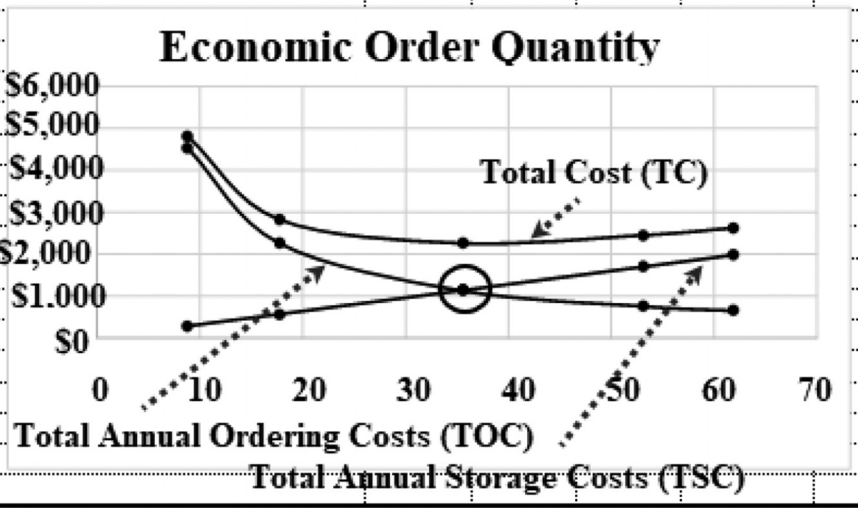


FIGURE 6.6 Completed Project 25 spreadsheet with line graphs

REQUIRED

Once you have verified that your spreadsheet is working and have checked your results, prepare a spreadsheet that calculates the EOQ for the following data, including a line graph:

Number of items ordered in a year (D): 12,000.

Cost of placing one order (m): $55

Cost of storing one unit for one year (k): $60.

Your spreadsheet should include line graphs for the same percentage of order quantities as those shown in Figure 6.6 and a second a spreadsheet with all formulas. Use the appropriate formats for each spreadsheet.

TROUBLE-SHOOTING

If the scatter diagram does not print on the same sheet as the data, ensure that the page is not set for draft quality.

Project Set 7

DATABASE PROJECTS

NOTE *Additional background for database concepts is provided in Appendix D.*

Project 26 Sorting a Database Spreadsheet

Key Concept: Sorting
Secondary Concept: Formatting

BACKGROUND

When an Excel spreadsheet is used as a simple database, each row in the spreadsheet corresponds to an individual database record (see Appendix D for a more complete description of spreadsheets as databases). These records are made up of individual data items known as fields. Records can then be easily sorted, reorganized, and relisted in any desired order. In this project, you will construct a spreadsheet that will be used to construct both simple and more complicated record sorts. Save this spreadsheet because you will use it in the next two projects.

THE PROJECT

You are to construct a spreadsheet that will be used as the basis for sorting its data with respect to various criteria. To begin with, construct the spreadsheet shown in Figure 7.1 and then highlight the complete spreadsheet, including the headings in row 1.

	A	B	C	D	E	F
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Finance	52	F	MBA	15	$92,250
3	Management	39	F	MBA	11	$82,480
4	Production	46	M	BA	5	$56,195
5	Research	28	F	BS	5	$73,485
6	Production	51	M	MA	12	$71,648
7	Management	36	F	MBA	10	$78,511
8	Finance	43	M	MBA	12	$82,365
9	Marketing	27	F	MBA	12	$74,150
10	Research	28	M	BS	5	$54,527
11	Production	52	F	MA	13	$64,225
12	Research	32	M	BS	7	$58,746
13	Finance	36	F	MBA	6	$73,000
14	Accounting	45	M	BA	2	$62,800
15	Accounting	28	F	BA	1	$52,800
16	Production	39	M	BA	5	$58,500
17	Production	26	F	MA	4	$48,527
18	Research	45	M	Ph.D	12	$84,250
19	Administration	57	F	MBA	17	$58,380
20	Production	42	M	MA	7	$66,251

FIGURE 7.1 The initial spreadsheet data for Project 26

Sorting

Once you have created the spreadsheet shown in Figure 7.1 and highlighted the appropriate cell, select the Excel ribbon Data tab, Sort & Filter Group, followed by Sort, as shown in Figure 7.2.

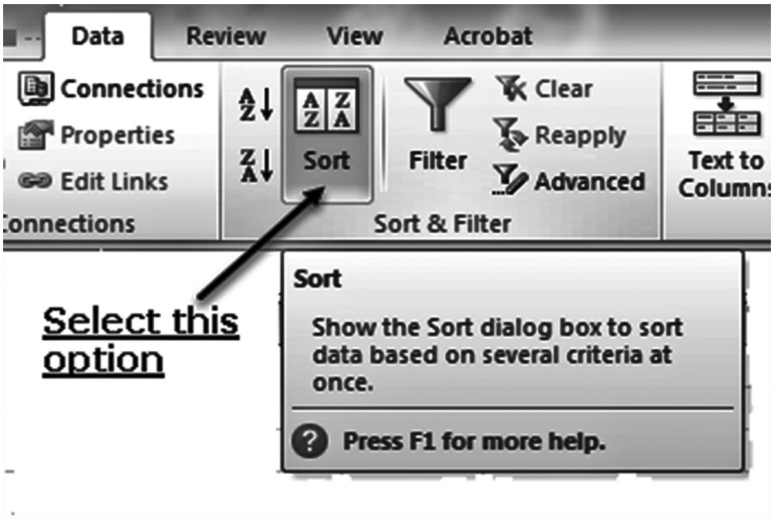


FIGURE 7.2 Selecting the Sort option on the Data tab

When the Sort dialog box opens, as shown in Figure 7.3, fill it in as indicated and click the OK button.

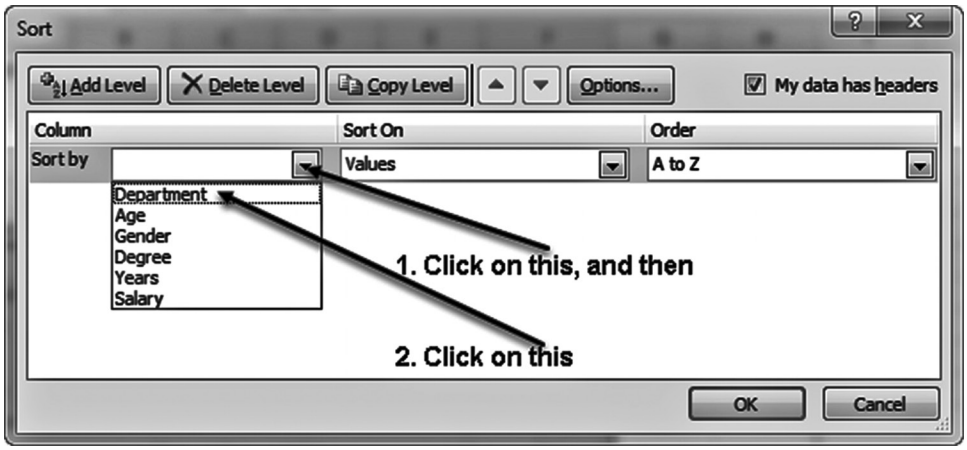


FIGURE 7.3 The Sort dialog box

When you have clicked the OK button, the spreadsheet will be sorted in Departmental order, as shown in Figure 7.4.

	A	B	C	D	E	F
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Accounting	45	M	BA	2	$62,800
3	Accounting	28	F	BA	1	$52,800
4	Administration	57	F	MBA	17	$58,380
5	Finance	52	F	MBA	15	$92,250
6	Finance	43	M	MBA	12	$82,365
7	Finance	36	F	MBA	6	$73,000
8	Management	39	F	MBA	11	$82,480
9	Management	36	F	MBA	10	$78,511
10	Marketing	27	F	MBA	12	$74,150
11	Production	46	M	BA	5	$56,195
12	Production	51	M	MA	12	$71,648
13	Production	52	F	MA	13	$64,225
14	Production	39	M	BA	5	$58,500
15	Production	26	F	MA	4	$48,527
16	Production	42	M	MA	7	$66,251
17	Research	28	F	BS	5	$73,485
18	Research	28	M	BS	5	$54,527
19	Research	32	M	BS	7	$58,746
20	Research	45	M	Ph.D	12	$84,250

FIGURE 7.4 The records in department sorted order

CREATING A THREE-LEVEL SORT

Once you have verified that the sort works and your spreadsheet looks like the one shown in Figure 7.4, create a new three-level sort in which the spreadsheet is sorted first by Department (in Ascending, that is, A to Z order), then by Degree (again in Ascending, or A to Z order), and then finally by Salary (in Descending, or largest to smallest order).

To create this new three-level sort, you will have to add two additional sort columns to the Department sort used to create Figure 7.4. Figure 7.5 illustrates how to add the second sort column using the sort dialog box. After you have added the Degree column, you will still have to add the Salary column.

After you have included all three columns (Department, Degree, and Salary) to your sort and pressed the OK button, as shown in Figure 7.5, your spreadsheet should appear as shown in Figure 7.6.

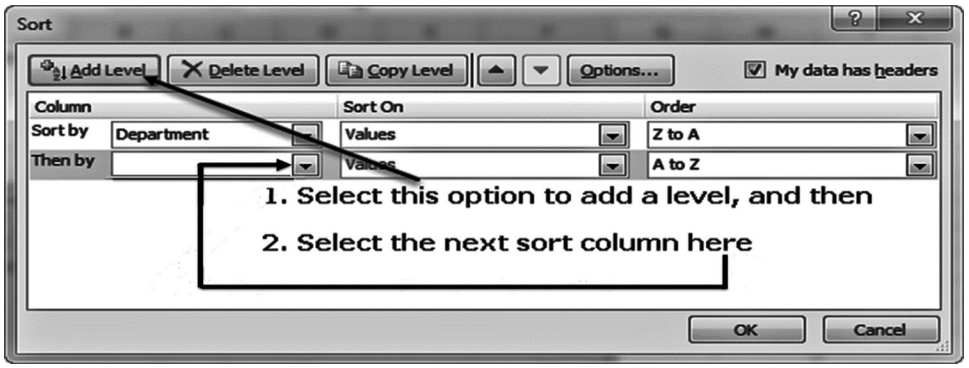


FIGURE 7.5 Adding a second sort column after the initial department sort column

	A	B	C	D	E	F
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Accounting	45	M	BA	2	$62,800
3	Accounting	28	F	BA	1	$52,800
4	Administration	57	F	MBA	17	$58,380
5	Finance	52	F	MBA	15	$92,250
6	Finance	43	M	MBA	12	$82,365
7	Finance	36	F	MBA	6	$73,000
8	Management	39	F	MBA	11	$82,480
9	Management	36	F	MBA	10	$78,511
10	Marketing	27	F	MBA	12	$74,150
11	Production	39	M	BA	5	$58,500
12	Production	46	M	BA	5	$56,195
13	Production	52	F	MA	13	$64,225
14	Production	51	M	MA	12	$71,648
15	Production	42	M	MA	7	$66,251
16	Production	26	F	MA	4	$48,527
17	Research	32	M	BS	7	$58,746
18	Research	28	F	BS	5	$73,485
19	Research	28	M	BS	5	$54,527
20	Research	45	M	Ph.D	12	$84,250

FIGURE 7.6 The data sorted in departmental, degree, and salary order

REQUIRED

When you have produced the spreadsheet shown in Figure 7.6, create a spreadsheet for the original database that is sorted first by Department, in ascending (A to Z) order, then by Age, in ascending (smallest to largest) order, and then by Salary, in ascending (smallest to largest) order.

Project 27 Searching a Database Spreadsheet

Key Concept: Searching
Secondary Concept: Formatting

BACKGROUND

When an Excel spreadsheet is used as a simple database, each row in the spreadsheet corresponds to an individual database record (see Appendix D for a more complete description of spreadsheets as databases). In addition to being easily sorted (see Project 26), the database can also be easily searched (filtered) for records meeting explicit user specified criteria. For example, the data used in Project 26 (repeated, for convenience as Figure 7.7) can be searched for all personnel who are over 30 years of age, are female, and have an MBA degree, or any other combination of desired criteria.

	A	B	C	D	E	F
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Finance	52	F	MBA	15	$92,250
3	Management	39	F	MBA	11	$82,480
4	Production	46	M	BA	5	$56,195
5	Research	28	F	BS	5	$73,485
6	Production	51	M	MA	12	$71,648
7	Management	36	F	MBA	10	$78,511
8	Finance	43	M	MBA	12	$82,365
9	Marketing	27	F	MBA	12	$74,150
10	Research	28	M	BS	5	$54,527
11	Production	52	F	MA	13	$64,225
12	Research	32	M	BS	7	$58,746
13	Finance	36	F	MBA	6	$73,000
14	Accounting	45	M	BA	2	$62,800
15	Accounting	28	F	BA	1	$52,800
16	Production	39	M	BA	5	$58,500
17	Production	26	F	MA	4	$48,527
18	Research	45	M	Ph.D	12	$84,250
19	Administration	57	F	MBA	17	$58,380
20	Production	42	M	MA	7	$66,251

FIGURE 7.7 Project 26's spreadsheet data

Searching a spreadsheet database is accomplished using the Excel ribbon Data Tab, Sort & Filter group, Advanced Filter option. To see how a search is accomplished, enter the data listed in Figure 7.7 and copy the data's column headings to another section of the spreadsheet (your choice as to where you copy them). Then enter the desired criteria under the appropriate heading.

As an example of this procedure, consider Figure 7.8. As shown, the column headings in cells A1 through F1 have been copied to columns H1 through M1. Under three of the copied headings, Age, Gender, and Degrees, the data, >30, F, and MBA, respectively, have been entered. This indicates that a search will be conducted to locate all records of employees who are over 30 years of age, identify as female, and have an MBA degree. Collectively, the copied headings and the values placed under them are referred to as a *criteria table*[1] (or criteria range).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**		**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Accounting	45	M	BA	2	$62,800			>30	F	MBA		
3	Accounting	28	F	BA	1	$52,800							
4	Administration	57	F	MBA	17	$58,380							
5	Finance	52	F	MBA	15	$92,250							
6	Finance	43	M	MBA	12	$82,365							
7	Finance	36	F	MBA	6	$73,000							
8	Management	39	F	MBA	11	$82,480							
9	Management	36	F	MBA	10	$78,511							
10	Marketing	27	F	MBA	12	$74,150							
11	Production	39	M	BA	5	$58,500							
12	Production	46	M	BA	5	$56,195							
13	Production	52	F	MA	13	$64,225							
14	Production	51	M	MA	12	$71,648							
15	Production	42	M	MA	7	$66,251							
16	Production	26	F	MA	4	$48,527							
17	Research	32	M	BS	7	$58,746							
18	Research	28	F	BS	5	$73,485							
19	Research	28	M	BS	5	$54,527							
20	Research	45	M	Ph.D	12	$84,250							

The Criteria Table

FIGURE 7.8 Preparing for a data search

In creating a criteria table (range), you must

1. Make sure that the formats of the cells in the criteria table (range) match the formats of the data in the original database. Formatting all of the cells in the original database and those in the criteria table (range) as General or another desired format typically avoids any possible mismatches. Make sure that you are consistent when you format your data and your criteria range.
2. Make sure there are no spaces both before and after criteria values (such as the >30, F, and MBA in cells I2 through K2 in Figure 7.8). If necessary, delete the criteria cell's criteria and retype the desired search value. Another option is to Copy/Paste values from the header row to the criteria table (range).

The actual search for records matching the criteria in a criteria table (range) is started by selecting the Excel ribbon Data tab followed by the Sort & Filter group, Advanced Filter option, as shown in Figure 7.9. Doing this brings up the Advanced Filter dialog box shown in Figure 7.10.

[1] A criteria range (table) can consist of more than two rows, which occurs when more involved AND/OR criteria are required.

Notice that the List range in the Advanced Filter dialog shown in Figure 7.10 includes the heading row in the original database. These headings are necessary to correlate the criteria table (range) headings with their corresponding headings in the database.

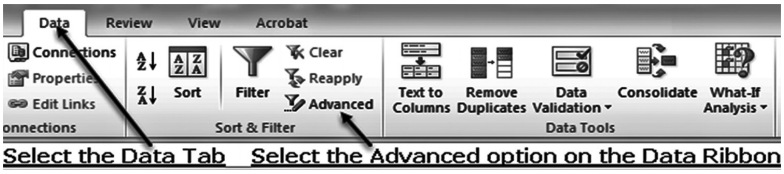
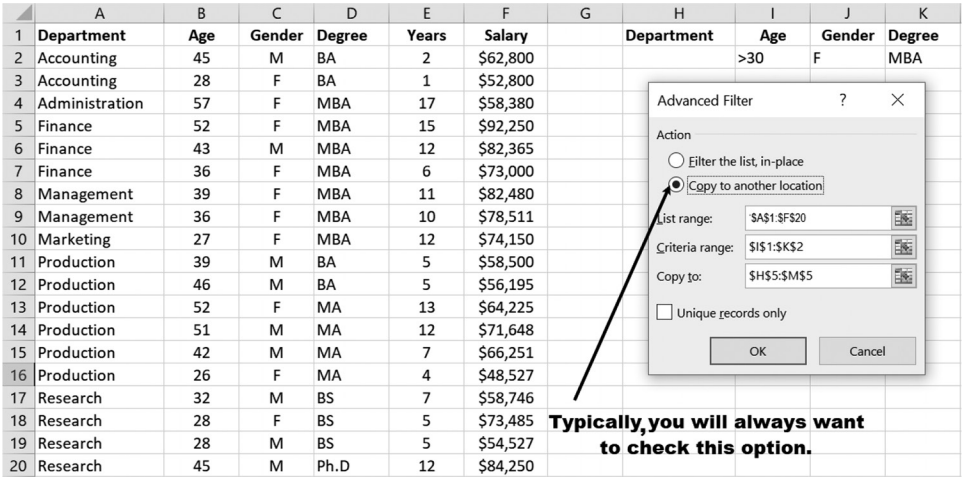


FIGURE 7.9 Selecting the Advanced option on the Data ribbon

When the dialog box is filled in, as shown in Figure 7.10, and the OK button is pressed, the search results shown in Figure 7.11, which provides all of records that meet the given criteria, is displayed.

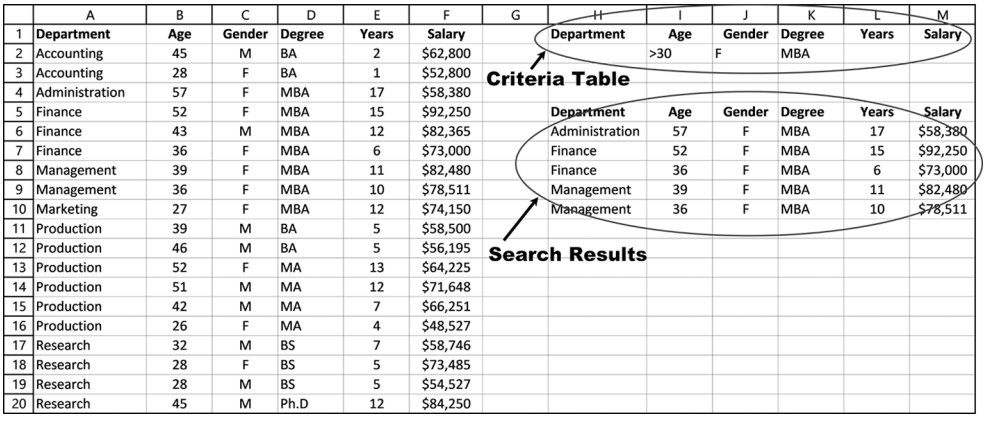


	A	B	C	D	E	F	G	H	I	J	K
1	Department	Age	Gender	Degree	Years	Salary		Department	Age	Gender	Degree
2	Accounting	45	M	BA	2	$62,800			>30	F	MBA
3	Accounting	28	F	BA	1	$52,800					
4	Administration	57	F	MBA	17	$58,380					
5	Finance	52	F	MBA	15	$92,250					
6	Finance	43	M	MBA	12	$82,365					
7	Finance	36	F	MBA	6	$73,000					
8	Management	39	F	MBA	11	$82,480					
9	Management	36	F	MBA	10	$78,511					
10	Marketing	27	F	MBA	12	$74,150					
11	Production	39	M	BA	5	$58,500					
12	Production	46	M	BA	5	$56,195					
13	Production	52	F	MA	13	$64,225					
14	Production	51	M	MA	12	$71,648					
15	Production	42	M	MA	7	$66,251					
16	Production	26	F	MA	4	$48,527					
17	Research	32	M	BS	7	$58,746					
18	Research	28	F	BS	5	$73,485					
19	Research	28	M	BS	5	$54,527					
20	Research	45	M	Ph.D	12	$84,250					

FIGURE 7.10 The Advanced Filter dialog box

NOTE

To reset a spreadsheet back to its original form after a search, which clears all search results, you can either press the Undo curved arrow at the top of the Excel Toolbar or click the Sort & Filter's **Clear** *option. This option, as can be seen in Figure 7.9, is located above the* **Advanced** *option.*



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Department	Age	Gender	Degree	Years	Salary		Department	Age	Gender	Degree	Years	Salary
2	Accounting	45	M	BA	2	$62,800			>30	F	MBA		
3	Accounting	28	F	BA	1	$52,800							
4	Administration	57	F	MBA	17	$58,380							
5	Finance	52	F	MBA	15	$92,250		Department	Age	Gender	Degree	Years	Salary
6	Finance	43	M	MBA	12	$82,365		Administration	57	F	MBA	17	$58,380
7	Finance	36	F	MBA	6	$73,000		Finance	52	F	MBA	15	$92,250
8	Management	39	F	MBA	11	$82,480		Finance	36	F	MBA	6	$73,000
9	Management	36	F	MBA	10	$78,511		Management	39	F	MBA	11	$82,480
10	Marketing	27	F	MBA	12	$74,150		Management	36	F	MBA	10	$78,511
11	Production	39	M	BA	5	$58,500							
12	Production	46	M	BA	5	$56,195							
13	Production	52	F	MA	13	$64,225							
14	Production	51	M	MA	12	$71,648							
15	Production	42	M	MA	7	$66,251							
16	Production	26	F	MA	4	$48,527							
17	Research	32	M	BS	7	$58,746							
18	Research	28	F	BS	5	$73,485							
19	Research	28	M	BS	5	$54,527							
20	Research	45	M	Ph.D	12	$84,250							

FIGURE 7.11 Spreadsheet report with results

SEARCH CAUTION

The reason for selecting the ***Copy to another location*** option in the Advanced Filter dialog shown in Figure 7.10 is that if this option is not selected, the report displays the selected records with the row numbers as they appear in the original database, but missing the non-matching records, as shown in Figure 7.12. While the remaining records have their record numbers displayed in a different color, this form of output can still lead to confusion especially since the "filtered" output takes the place of the original list. For example, if the salaries shown in Figure 7.12's column F were highlighted, the range for the highlighted cells would appear as F4:F9 and would include all salaries in the original data base between rows 4 and 9, and **not** just the five salaries listed in Figure 7.12's column F. Thus, if you intend to perform any operations on advanced filtered data, as opposed to simply listing the selected records, make sure to use the ***Copy to another location*** option in the Advanced Filter dialog, and not the default ***Filter the list in-place*** option.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**		**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
4	Administration	57	F	MBA	17	$58,380			>30	F	MBA		
5	Finance	52	F	MBA	15	$92,250							
7	Finance	36	F	MBA	6	$73,000							
8	Management	39	F	MBA	11	$82,480							
9	Management	36	F	MBA	10	$78,511							

Notice that the row numbers are not consecutive, and only the row numbers of the filtered rows are displayed.

FIGURE 7.12 Filtered records are displayed with their original row numbers

REQUIRED

Using the data shown in Figure 7.7, prepare a report that displays all personnel with a BA degree who have been with the company for more than 1 year. At the bottom of the selected records, use the SUM( ), AVERAGE( ), MAX( ), and MIN( ) functions so that the total, average, maximum, and minimum salaries for the selected records are displayed. The results of your search should appear as shown in Figure 7.13.

	H	I	J	K	L	M
5	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
6	Accounting	45	M	BA	2	$62,800
7	Production	39	M	BA	5	$58,500
8	Production	46	M	BA	5	$56,195
9					**Sum:**	$177,495
10					**Average:**	$59,165
11					**Maximum:**	$62,800
12					**Minimum:**	$56,195

FIGURE 7.13 All employees with a BA degree and more than 1 year of service

Project 28 DATABASE FUNCTIONS

Key Concept: Database Functions
Secondary Concept: Formatting

BACKGROUND

In Project 27, you created a selected set of records from an existing database using Excel's Data Tab, Sort & Filter Group, Advanced Filter option. At the completion of Project 27, your filtered data report should have appeared as shown in Figure 7.14. The sum, average, maximum, and minimum salary figures shown in cells M9 through M12 were created using Excel formulas on the salary data in column M, after the selected records were determined.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**		**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Accounting	45	M	BA	2	$62,800					BA	>1	
3	Accounting	28	F	BA	1	$52,800							
4	Administration	57	F	MBA	17	$58,380							
5	Finance	52	F	MBA	15	$92,250		**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
6	Finance	43	M	MBA	12	$82,365		Accounting	45	M	BA	2	$62,800
7	Finance	36	F	MBA	6	$73,000		Production	39	M	BA	5	$58,500
8	Management	39	F	MBA	11	$82,480		Production	46	M	BA	5	$56,195
9	Management	36	F	MBA	10	$78,511						**Sum:**	$177,495
10	Marketing	27	F	MBA	12	$74,150						**Average:**	$59,165
11	Production	39	M	BA	5	$58,500						**Maximum:**	$62,800
12	Production	46	M	BA	5	$56,195						**Minimum:**	$56,195
13	Production	52	F	MA	13	$64,225							
14	Production	51	M	MA	12	$71,648							
15	Production	42	M	MA	7	$66,251							
16	Production	26	F	MA	4	$48,527							
17	Research	32	M	BS	7	$58,746							
18	Research	28	F	BS	5	$73,485							
19	Research	28	M	BS	5	$54,527							
20	Research	45	M	Ph.D	12	$84,250							

FIGURE 7.14 The output of Project 27

It should be noted that the summary data shown in cells M9 through M12 can be obtained directly, without the need of first determining the filtered data. This is accomplished using Excel's database functions; the most commonly used are listed in Table 7.1.

For example, the following function can be used to create and display the sum of the salaries for all personnel who have a BA degree and more than 1 year of service directly from the original data provided in Figure 7.14.

=DSUM(A1:F20,"Salary",K1:L2)

Here, the range A1:F20 provides the function with the range of the original data that you want to examine. "Salary" provides the name of the column whose data you want the sum of, and K1:L2 is the range of the criteria for selecting the data.

TABLE 7.1 Commonly used database functions

Function	Description
DAVERAGE( )	Returns the average of selected database entries
DCOUNT( )	Counts the number of cells that contain numbers in a database
DCOUNTA( )	Counts nonblank cells in a database
DMAX( )	Returns the maximum value from selected database entries
DMIN( )	Returns the minimum value from selected database entries
DSUM( )	Adds the numbers in the designated column of records in the database that match the criteria

All database functions require these three pieces of information: the range where the original data is located, the name of the column whose data is being calculated, and the range where the criteria are.

Thus, the following database functions can be used to obtain the average, maximum, and minimum salaries of the same filtered group of employees shown in Figure 7.14:

=DAVERAGE(A6:F25,"Salary",D1:E2)
=DMAX(A6:F25,"Salary",D1:E2)
=DMIN(A6:F25,"Salary",D1:E2)

REQUIRED

Using the database in Figure 7.15, prepare a spreadsheet that displays the sum, average, maximum, and minimum salaries using only the database functions to obtain the desired data. Your spreadsheet should not use an advanced data search to obtain the data, as was done in Project 27.

	A	B	C	D	E	F
1	**Department**	**Age**	**Gender**	**Degree**	**Years**	**Salary**
2	Finance	52	F	MBA	15	$92,250
3	Management	39	F	MBA	11	$82,480
4	Production	46	M	BA	5	$56,195
5	Research	28	F	BS	5	$73,485
6	Production	51	M	MA	12	$71,648
7	Management	36	F	MBA	10	$78,511
8	Finance	43	M	MBA	12	$82,365
9	Marketing	27	F	MBA	12	$74,150
10	Research	28	M	BS	5	$54,527
11	Production	52	F	MA	13	$64,225
12	Research	32	M	BS	7	$58,746
13	Finance	36	F	MBA	6	$73,000
14	Accounting	45	M	BA	2	$62,800
15	Accounting	28	F	BA	1	$52,800
16	Production	39	M	BA	5	$58,500
17	Production	26	F	MA	4	$48,527
18	Research	45	M	Ph.D	12	$84,250
19	Administration	57	F	MBA	17	$58,380
20	Production	42	M	MA	7	$66,251

FIGURE 7.15 Data for Project 28

Project 29 Creating Subtotal Groups

Key Concepts: Sorting and creating group subtotals

BACKGROUND

In this project, you will sort a list of sales data and then use Excel's Subtotal capability to create subtotal dollar values for the sorted categories.

THE PROJECT

After entering the data provided in Figure 7.16, determine which Sales Company has the highest total sales for the years listed.

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2012	Lower	$180,000	Olney
4	2012	Middle	$179,000	Olney
5	2012	Middle	$235,000	Olney
6	2012	Upper	$235,000	Lenox
7	2013	Lower	$195,000	Lenox
8	2013	Lower	$219,000	Berkshire
9	2013	Lower	$225,000	Berkshire
10	2013	Middle	$225,000	Olney
11	2013	Middle	$245,000	Lenox
12	2013	Upper	$240,000	Berkshire
13	2014	Lower	$285,000	Lenox
14	2014	Lower	$216,000	Lenox
15	2014	Middle	$188,000	Lenox
16	2014	Middle	$198,000	Berkshire
17	2014	Upper	$224,000	Olney

FIGURE 7.16 The initial sales data

First, to determine which sales company had the highest dollar value of sales, you will have to sort the data by Sales Company. After this is accomplished, Excel's Subtotal option is used to subtotal the sales for each company.

To begin, highlight the complete set of initial data (cells A1 through D17) and then, as shown in Figure 7.17, use the Excel ribbon Data Tab, Sort & Filter Group, **Sort** option to sort the list by Sales Company. (If you are unsure how this is accomplished, review Project 26.)

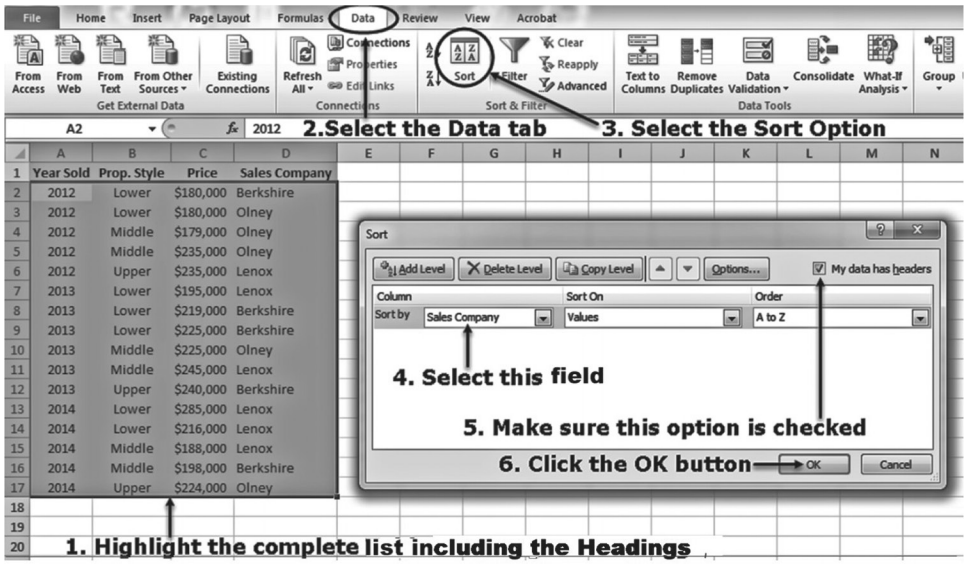


FIGURE 7.17 Sorting the original data by sales company

After completing the steps shown in Figure 7.17, you will have the sorted list shown in Figure 7.18. Once the list is in this sorted order, it is ready to have the subtotals for each Sales Company computed.

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5	2013	Upper	$240,000	Berkshire
6	2014	Middle	$198,000	Berkshire
7	2012	Upper	$235,000	Lenox
8	2013	Lower	$195,000	Lenox
9	2013	Middle	$245,000	Lenox
10	2014	Lower	$285,000	Lenox
11	2014	Lower	$216,000	Lenox
12	2014	Middle	$188,000	Lenox
13	2012	Lower	$180,000	Olney
14	2012	Middle	$179,000	Olney
15	2012	Middle	$235,000	Olney
16	2013	Middle	$225,000	Olney
17	2014	Upper	$224,000	Olney

FIGURE 7.18 The initial data in sorted order by Sales Company

To create the price subtotals for each Sales Company, highlight the complete list (clicking on a cell within the list and then pressing the Ctrl and A keys at the same time will also cause the complete list to be highlighted), and then click on the Subtotal Icon in the Excel ribbon Data Tab, Outline Group, as shown in Figure 7.19. Doing this will bring up the Subtotal dialog box shown in Figure 7.20.

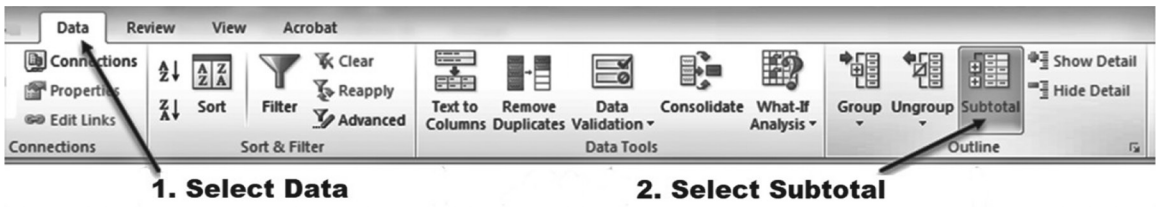


FIGURE 7.19 Selecting the Subtotal option

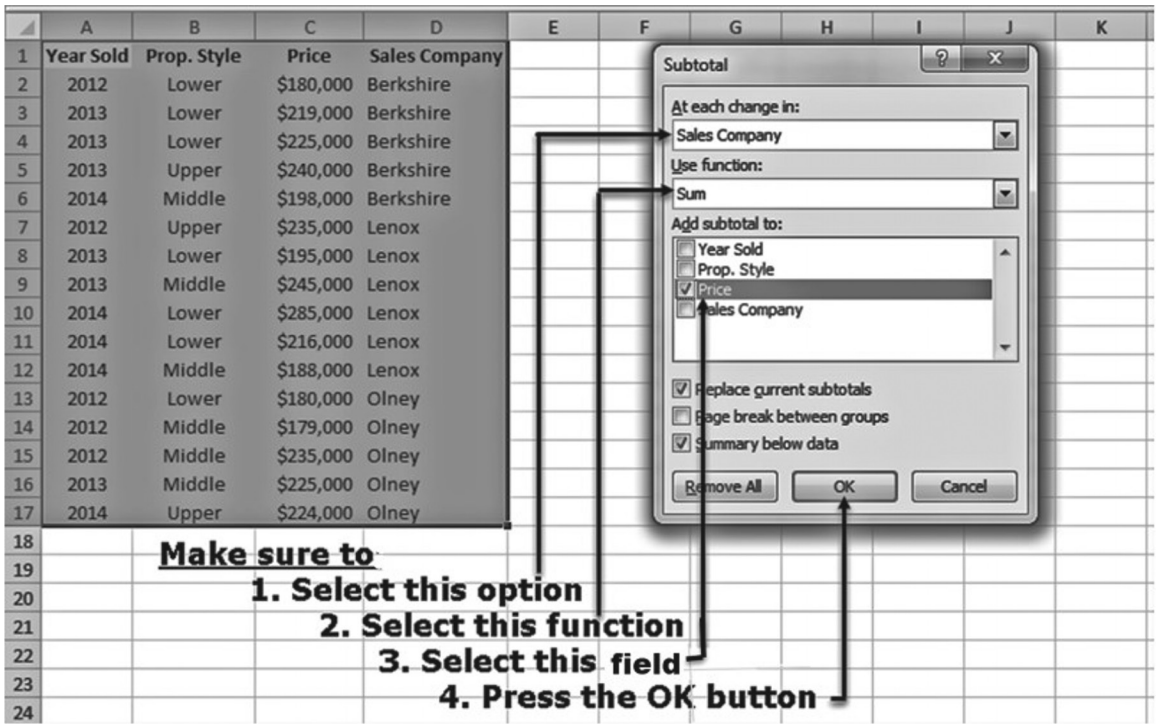
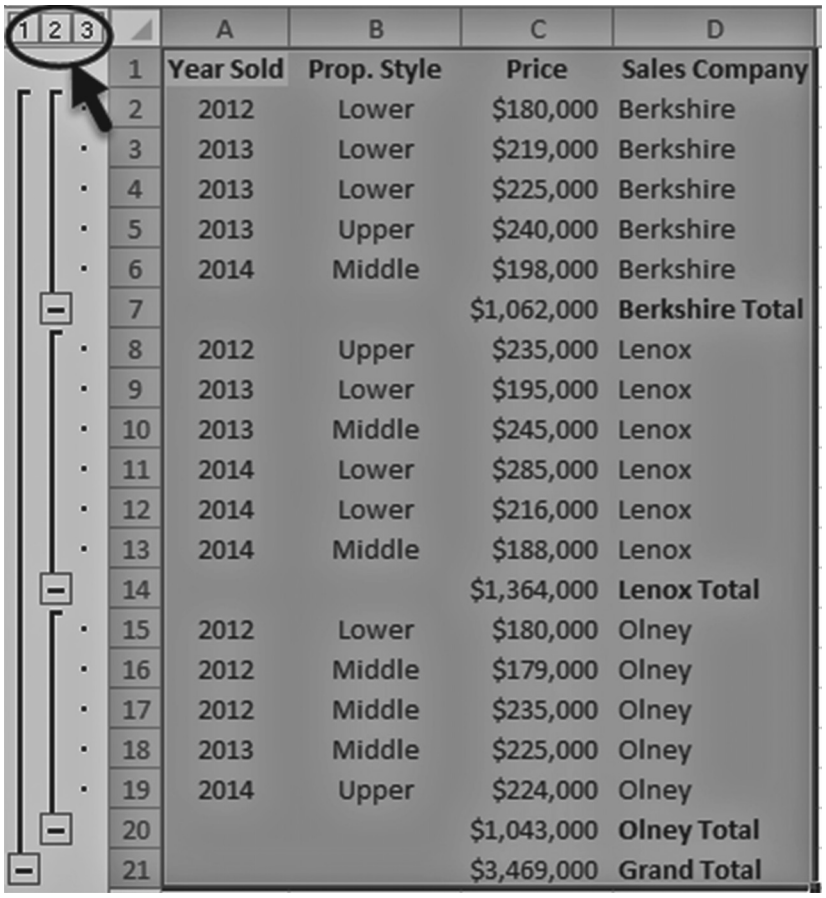


FIGURE 7.20 The Subtotal dialog box

Selecting the choices shown in Figure 7.20 causes the subtotals to appear, as shown in Figure 7.21. Notice that in Figure 7.21, the Property Styles are not grouped together for each Sales Company, but remain in the order they appear in the original list. Although this is not a problem, it would be preferable to have these grouped together for each Sales Company. (This can be accomplished by initially sorting the data by Sales Company and then by Style in the original sort, before any subtotals are taken.)



	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5	2013	Upper	$240,000	Berkshire
6	2014	Middle	$198,000	Berkshire
7			$1,062,000	Berkshire Total
8	2012	Upper	$235,000	Lenox
9	2013	Lower	$195,000	Lenox
10	2013	Middle	$245,000	Lenox
11	2014	Lower	$285,000	Lenox
12	2014	Lower	$216,000	Lenox
13	2014	Middle	$188,000	Lenox
14			$1,364,000	Lenox Total
15	2012	Lower	$180,000	Olney
16	2012	Middle	$179,000	Olney
17	2012	Middle	$235,000	Olney
18	2013	Middle	$225,000	Olney
19	2014	Upper	$224,000	Olney
20			$1,043,000	Olney Total
21			$3,469,000	Grand Total

FIGURE 7.21 The sorted data subtotaled by Sales Company

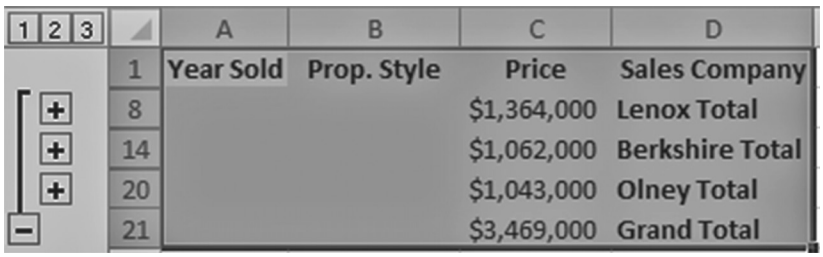
Notice the numbers circled at the top left side of the spreadsheet shown in Figure 7.21. Clicking on these allow you to contract and expand the individual subtotal groups. For example, if you click on the 2 box, the spreadsheet will appear as in Figure 7.22. Individual groups can be expanded by clicking on the + icons in the 2 column or the complete spreadsheet by clicking on the 3 box itself.

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
7			$1,062,000	Berkshire Total
14			$1,364,000	Lenox Total
20			$1,043,000	Olney Total
21			$3,469,000	Grand Total

FIGURE 7.22 The data summarized by company and price subtotals

Once the data is summarized as shown in Figure 7.22, you can use Excel's sorting capability to sort by price, which would determine which sales company had the highest sales.

Although for the three sales companies shown in Figure 7.22, it is easy to visually determine that Lenox had the highest sales, for larger sets of data, this last sort is extremely useful. For completeness, Figure 7.23 shows how Figure 7.22 appears when sorted by Price, in descending order. (Again, refer to Project 26 to review how the sort is accomplished.)



	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
8			$1,364,000	Lenox Total
14			$1,062,000	Berkshire Total
20			$1,043,000	Olney Total
21			$3,469,000	Grand Total

FIGURE 7.23 The data summarized by company and sorted by price subtotals

REQUIRED

Prepare a spreadsheet that shows price subtotals for each property style, where prices listed in ascending (increasing) order. When you have completed this, your spreadsheet should appear as shown in Figure 7.24.

To create the summarized and sorted spreadsheet shown in Figure 7.24, you first must sort the original data by Property Style, then determine the price subtotals for each style, and finally sort the summarized data by price.

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
5		Upper Total	$699,000	
12		Middle Total	$1,270,000	
20		Lower Total	$1,500,000	
21		Grand Total	$3,469,000	

FIGURE 7.24 The data summarized by Property Style and sorted by Price subtotals

Project 30 Creating Nested Subtotal Groups

Key Concepts: Nested Group Subtotals

BACKGROUND

In this project, a data list is initially sorted in two levels. Then, using Excel's Subtotal capability on each of the levels, a nested set of subtotal groups is created.

THE PROJECT

In this project, you will summarize a list of data into nested groups of data, with each group having its own subtotal dollar values. Using the initial list provided in Project 29, which is repeated for convenience as Figure 7.25, the first, or primary, subtotal is on the Sales Company sales. The subtotals for each Property Style sold by each Company will then be listed. The final nested group subtotals will appear as shown in Figure 7.26.

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2012	Lower	$180,000	Olney
4	2012	Middle	$179,000	Olney
5	2012	Middle	$235,000	Olney
6	2012	Upper	$235,000	Lenox
7	2013	Lower	$195,000	Lenox
8	2013	Lower	$219,000	Berkshire
9	2013	Lower	$225,000	Berkshire
10	2013	Middle	$225,000	Olney
11	2013	Middle	$245,000	Lenox
12	2013	Upper	$240,000	Berkshire
13	2014	Lower	$285,000	Lenox
14	2014	Lower	$216,000	Lenox
15	2014	Middle	$188,000	Lenox
16	2014	Middle	$198,000	Berkshire
17	2014	Upper	$224,000	Olney

FIGURE 7.25 The initial database

Notice in Figure 7.26 that totals for each Sales Company are provided, as was done in Project 29. However, in addition, there are subtotals for each Property Style within each Sales Company group.

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5		Lower Total	$624,000	
6	2014	Middle	$198,000	Berkshire
7		Middle Total	$198,000	
8	2013	Upper	$240,000	Berkshire
9		Upper Total	$240,000	
10	2013	Lower	$195,000	Lenox
11	2014	Lower	$285,000	Lenox
12	2014	Lower	$216,000	Lenox
13		Lower Total	$696,000	
14	2013	Middle	$245,000	Lenox
15	2014	Middle	$188,000	Lenox
16		Middle Total	$433,000	
17	2012	Upper	$235,000	Lenox
18		Upper Total	$235,000	
19	2012	Lower	$180,000	Olney
20		Lower Total	$180,000	
21	2012	Middle	$179,000	Olney
22	2012	Middle	$235,000	Olney
23	2013	Middle	$225,000	Olney
24		Middle Total	$639,000	
25	2014	Upper	$224,000	Olney
26		Upper Total	$224,000	
27		Grand Total	$3,469,000	

FIGURE 7.26 The list with Property Style subtotals within the Sales Company subtotals

Because the primary subtotals are to be by Sales Company, within which subtotals for Property Style will then be made, the list you used in Project 29 must first be sorted by Sales Company and then by Property style. To do this, you need to use a two-level sort, as shown in Figure 7.27. This will produce the sorted list in Figure 7.28. Note that this sort can be made with any list that contains the original data. It need not be in the original list order.

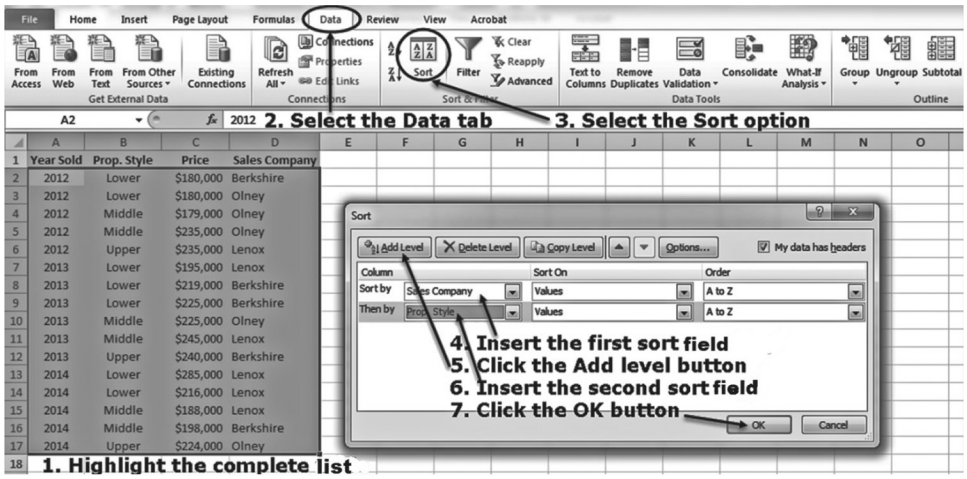


FIGURE 7.27 Creating the two-level sort

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5	2014	Middle	$198,000	Berkshire
6	2013	Upper	$240,000	Berkshire
7	2013	Lower	$195,000	Lenox
8	2014	Lower	$285,000	Lenox
9	2014	Lower	$216,000	Lenox
10	2013	Middle	$245,000	Lenox
11	2014	Middle	$188,000	Lenox
12	2012	Upper	$235,000	Lenox
13	2012	Lower	$180,000	Olney
14	2012	Middle	$179,000	Olney
15	2012	Middle	$235,000	Olney
16	2013	Middle	$225,000	Olney
17	2014	Upper	$224,000	Olney

FIGURE 7.28 The list sorted by Sales Company and then by Property Style

Once the list is in the order that corresponds to the subtotals that you want, as shown in Figure 7.28, you can do a Subtotal by either Sales Company first and then Property Style second, or do the subtotals in the reverse order, as the list itself is in the proper sorted order. Here, we will use the Subtotal first by Sales Company and then second by Property Style.

As was done in Project 29, and shown in Figure 7.29, highlight the complete list (clicking within the list and then pressing the Ctrl and A keys at the same time will do this), and then use the information shown in the Subtotal dialog box in Figure 7.29 to create the first set of subtotals. Pressing the OK button once the Subtotal dialog box is filled in correctly will create the list shown in Figure 7.30.

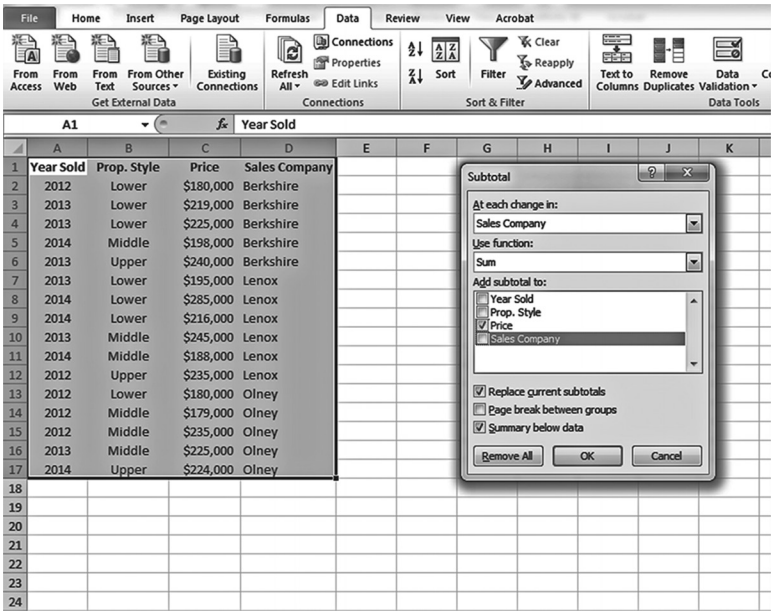
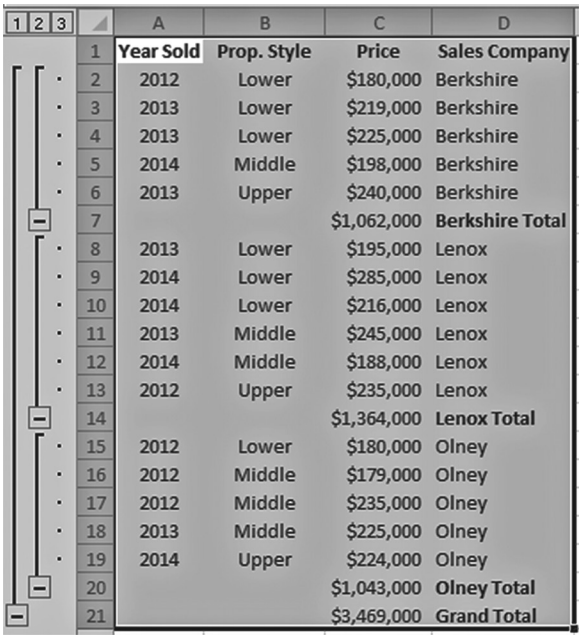


FIGURE 7.29 Creating the first set of subtotals

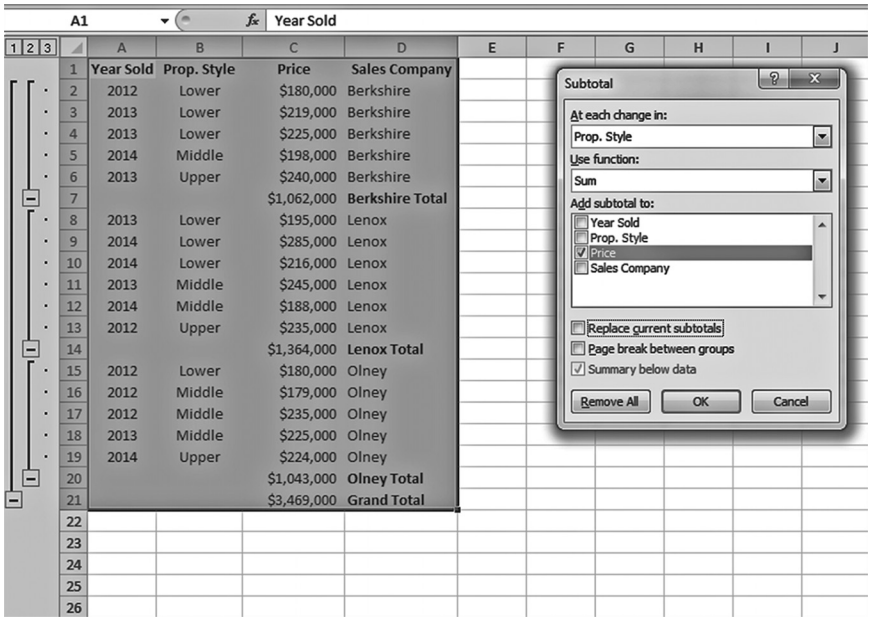
Notice in Figure 7.30 that within each Sales Company group, the Property Styles are in sorted order. Because of this, we can now create a subtotal for each Property Style while still retaining the Sales Company subtotals.



	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5	2014	Middle	$198,000	Berkshire
6	2013	Upper	$240,000	Berkshire
7			$1,062,000	**Berkshire Total**
8	2013	Lower	$195,000	Lenox
9	2014	Lower	$285,000	Lenox
10	2014	Lower	$216,000	Lenox
11	2013	Middle	$245,000	Lenox
12	2014	Middle	$188,000	Lenox
13	2012	Upper	$235,000	Lenox
14			$1,364,000	**Lenox Total**
15	2012	Lower	$180,000	Olney
16	2012	Middle	$179,000	Olney
17	2012	Middle	$235,000	Olney
18	2013	Middle	$225,000	Olney
19	2014	Upper	$224,000	Olney
20			$1,043,000	**Olney Total**
21			$3,469,000	**Grand Total**

FIGURE 7.30 The data subtotaled by Sales Company

To create the second set of subtotals, click on the Excel ribbon Data Tab, Outline Group, Subtotal option, and fill in the dialog box as shown in Figure 7.31. Make sure to uncheck the box labeled ***Replace current subtotals*** so that the first subtotals are not erased. When you complete the dialog and press the OK button, the doubly subtotaled list shown in Figure 7.32 will be produced.



	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5	2014	Middle	$198,000	Berkshire
6	2013	Upper	$240,000	Berkshire
7			$1,062,000	Berkshire Total
8	2013	Lower	$195,000	Lenox
9	2014	Lower	$285,000	Lenox
10	2014	Lower	$216,000	Lenox
11	2013	Middle	$245,000	Lenox
12	2014	Middle	$188,000	Lenox
13	2012	Upper	$235,000	Lenox
14			$1,364,000	Lenox Total
15	2012	Lower	$180,000	Olney
16	2012	Middle	$179,000	Olney
17	2012	Middle	$235,000	Olney
18	2013	Middle	$225,000	Olney
19	2014	Upper	$224,000	Olney
20			$1,043,000	Olney Total
21			$3,469,000	Grand Total

FIGURE 7.31 Creating the second (nested) set of subtotals

	A	B	C	D
1	Year Sold	Prop. Style	Price	Sales Company
2	2012	Lower	$180,000	Berkshire
3	2013	Lower	$219,000	Berkshire
4	2013	Lower	$225,000	Berkshire
5		Lower Total	$624,000	
6	2014	Middle	$198,000	Berkshire
7		Middle Total	$198,000	
8	2013	Upper	$240,000	Berkshire
9		Upper Total	$240,000	
10			$1,062,000	Berkshire Total
11	2013	Lower	$195,000	Lenox
12	2014	Lower	$285,000	Lenox
13	2014	Lower	$216,000	Lenox
14		Lower Total	$696,000	
15	2013	Middle	$245,000	Lenox
16	2014	Middle	$188,000	Lenox
17		Middle Total	$433,000	
18	2012	Upper	$235,000	Lenox
19		Upper Total	$235,000	
20			$1,364,000	Lenox Total
21	2012	Lower	$180,000	Olney
22		Lower Total	$180,000	
23	2012	Middle	$179,000	Olney
24	2012	Middle	$235,000	Olney
25	2013	Middle	$225,000	Olney
26		Middle Total	$639,000	
27	2014	Upper	$224,000	Olney
28		Upper Total	$224,000	
29			$1,043,000	Olney Total
30			$3,469,000	Grand Total

FIGURE 7.32 The list with Sales Company subtotals within the Property Style subtotals

REQUIRED

Create a list whose primary subtotal group is by Property Style, and whose second, or nested, groups are subtotaled by Sales Company.

How-to Guides

Guide 1

CREATING A PROFESSIONAL SPREADSHEET LAYOUT

When creating the Excel projects in this book, it is useful to remember that you are acting in two distinct roles: the first is as the developer of a spreadsheet and the second is as its end user. In many commercial applications, these two roles are separate. That is, one person develops the spreadsheet for an application that will be used by one or more other people, the end users. To ensure that the end users correctly use the spreadsheet and cannot erroneously change cell values or formulas within it, two features are typically designed into the spreadsheet by the developer.

The first of these features is to format the spreadsheet to have one or more clearly defined input areas for data entry by the end user. Here, cells are provided to permit the end user to enter the data necessary for the spreadsheet to produce its desired calculations and results.

The second feature is to restrict the user so that they must use the designated input areas and cannot access any other areas of the spreadsheet. This second feature is accomplished by password protecting all of the cells *except* the designated input cells. In this section, we address the first feature, correctly formatting a spreadsheet to have a clearly defined input data entry area. The locking of cells by password is presented in How-To Guide 8.

INPUT AND RESULTS SECTIONS

A professional spreadsheet layout separates the spreadsheet into two areas: an input area and a results area, as shown in Figure 8.1.

The purpose of the input area is to enable a user to clearly see what data is needed, and then provide an area for entering the input data. If possible, this area should be placed at the top left-hand corner of the spreadsheet, as shown in Figure 8.1. When not possible, it is placed within columns along the top of the spreadsheet and/or in the rows on the left side of the spreadsheet.

The results area, also illustrated in Figure 8.1, consists of two sections: one section, placed immediately after the input area, provides any single formula's results. An example of this configuration is illustrated in Figure 8.2.

Although professionally constructed spreadsheets require basic input and result sections such as shown in the figures, not all spreadsheets will conform to such a precise separation of areas due to specific application requirements. However, you

should have the goal of separating your spreadsheets into clearly defined input and results sections.

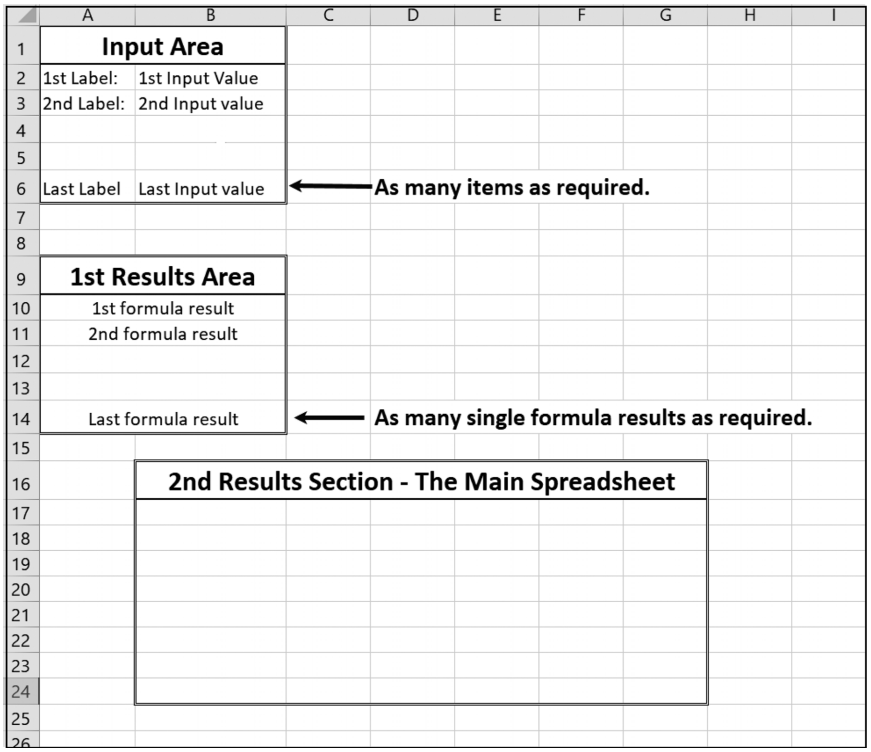


FIGURE 8.1 Spreadsheet showing the separate areas for input and results

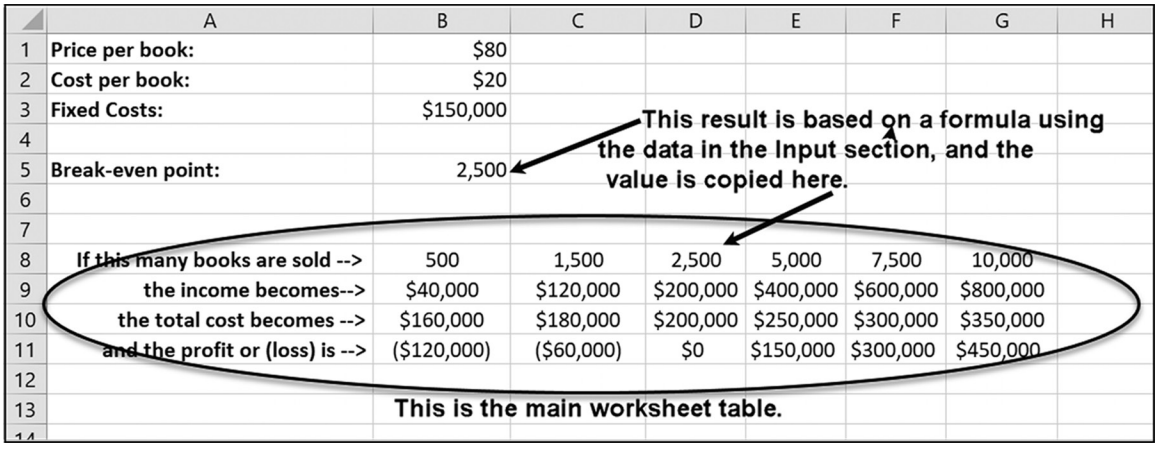


FIGURE 8.2 Configuration of the results area

An example of an application that does not fit directly into the preferred form of distinct input and results areas is given in Figure 8.3. In this spreadsheet, some of the inputs are entered in the results area. In this figure, all of the shaded cells contain input data. In keeping with the basic input format, however, the tax rate is at the top of the spreadsheet and the remaining input data is contained within the main results area.

The type of spreadsheets illustrated in Figure 8.3 is typical of the majority of spreadsheets you create in your college and professional careers. This type of spreadsheet lends itself extremely well to introducing such basic elements as entering and copying formulas, as well as formatting cells to distinguish between text and data values. Nevertheless, the spreadsheet formats shown in this book are based on the model of separate input and results areas given in Figure 8.1[1].

	A	B	C	D	E	F	G
1	Tax Rate:	18.50%					
2							
3	Employee Number	Employee Name	Hourly Rate	Hours Worked	Gross Pay	Taxes Withheld	Net Pay
4	32479	Abrams, B	$10.72	35.00	$375.20	$69.41	$305.79
5	03623	Bohm, P	9.54	30.00	286.20	52.95	233.25
6	14145	Gwodz, K	8.72	25.00	218.00	40.33	177.67
7	25987	Hanson, H	9.64	40.00	385.60	71.34	314.26
8	07634	Robbins, L	8.50	36.50	310.25	57.40	252.85
9	39567	Williams, B	7.30	39.00	284.70	52.67	232.03
10				Totals:	$1,859.95	$344.09	$1,515.86
11							
12	Average Hourly Rate:		$9.07				
13	Average Hours Worked:		34.3				

FIGURE 8.3 A different spreadsheet format

[1]Note that this spreadsheet follows conventional accounting guidelines in that only the first currency value at the start of a column, after an underline, and isolated single currency values, such as that in cell C12, receive a currency symbol (which, in this case, is the $ symbol).

Guide 2

Printing in Landscape and Fit-to-Page Modes

Printing your spreadsheet requires first selecting the File Tab, as shown in Figure 9.1.

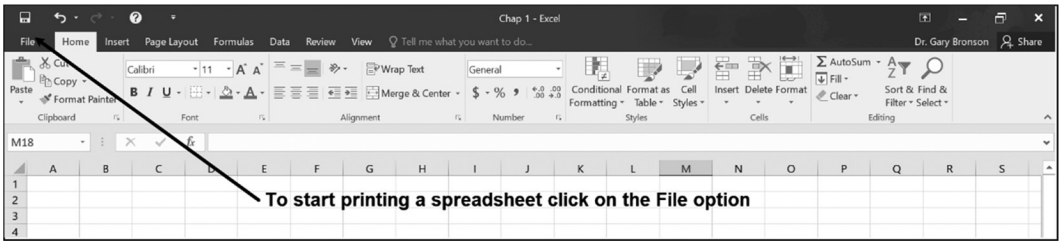


FIGURE 9.1 Click on the File tab

Clicking on the File tab as shown in Figure 9.1 brings up the File menu, shown in the left-hand side pane in Figure 9.2. From this menu, select the Print option, as indicated. This activates the Print menu, shown in the right-hand pane of Figure 9.2. Clicking on the Print button in this pane causes the spreadsheet to be printed from the top of the spreadsheet up to and including the last row and column in which data was entered.

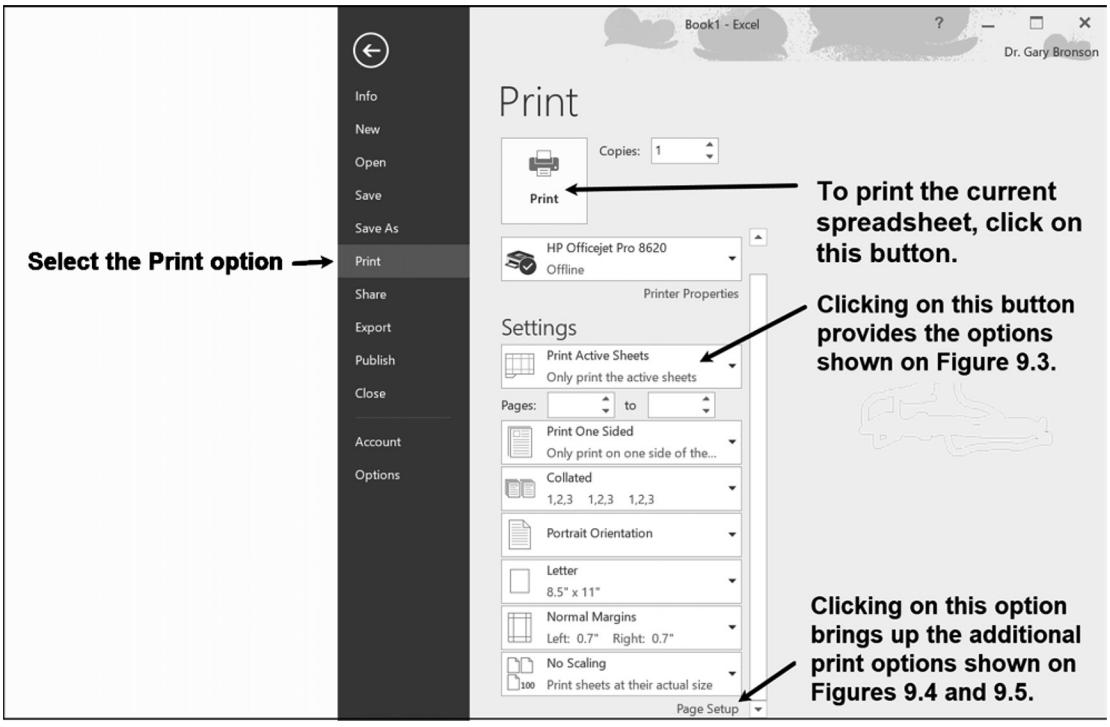


FIGURE 9.2 Print options

Additionally, as shown on Figure 9.2, clicking the Print Active Sheets button brings up the dialog shown in Figure 9.3. This dialog permits you to print any section of your spreadsheet that has been previously highlighted.

Extremely useful additional print options are the following:

1. Printing a spreadsheet in Landscape mode.
2. Forcing a spreadsheet to fit on a single page.
3. Printing a spreadsheet with gridlines that clearly delineate the rows and columns.
4. Printing the spreadsheet with Excel's row (1, 2, 3…) and column (A, B, C…) headings.

These options are activated by selecting the Page Setup option shown at the bottom of Figures 9.2 and 9.3. When this Page Setup option is selected, four sub-tabs are displayed, which can be seen in Figures 9.4 and 9.5. The annotations on these two figures illustrate how to activate the Landscape, Fit-to-Page, gridlines, and row and column headings.

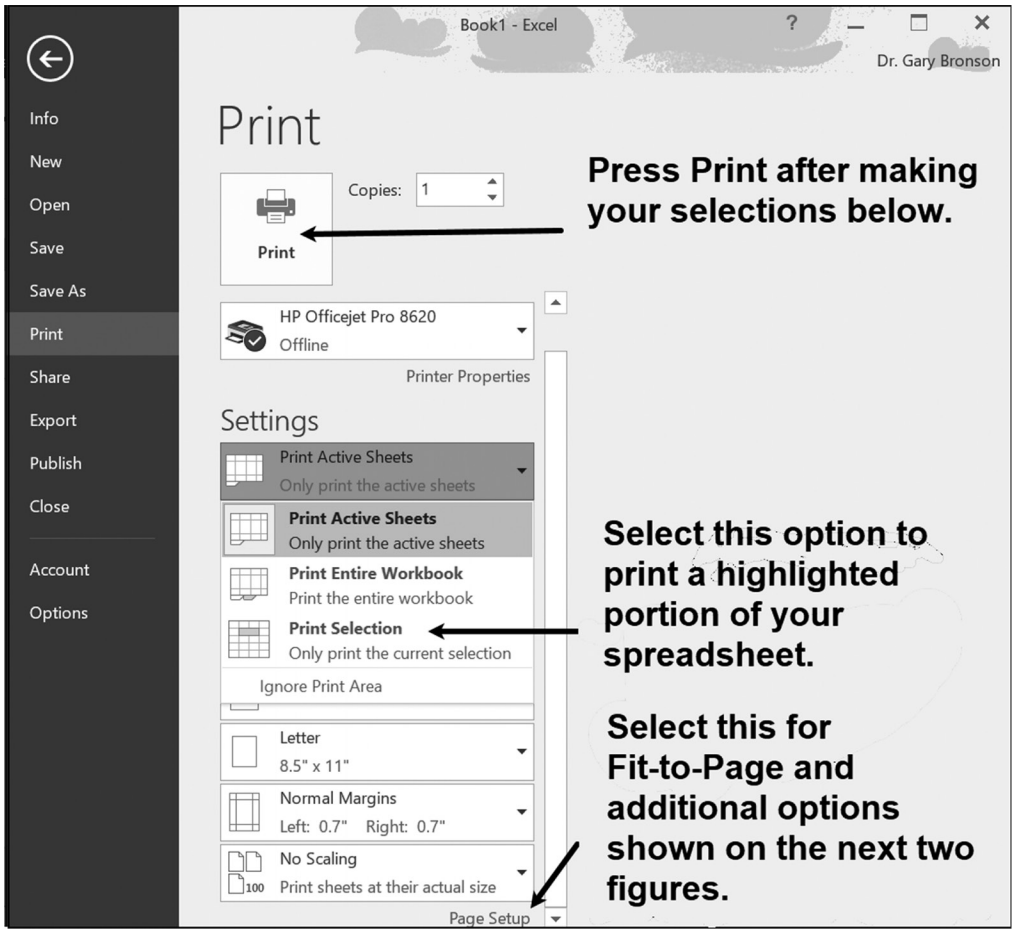


FIGURE 9.3 Additional print options

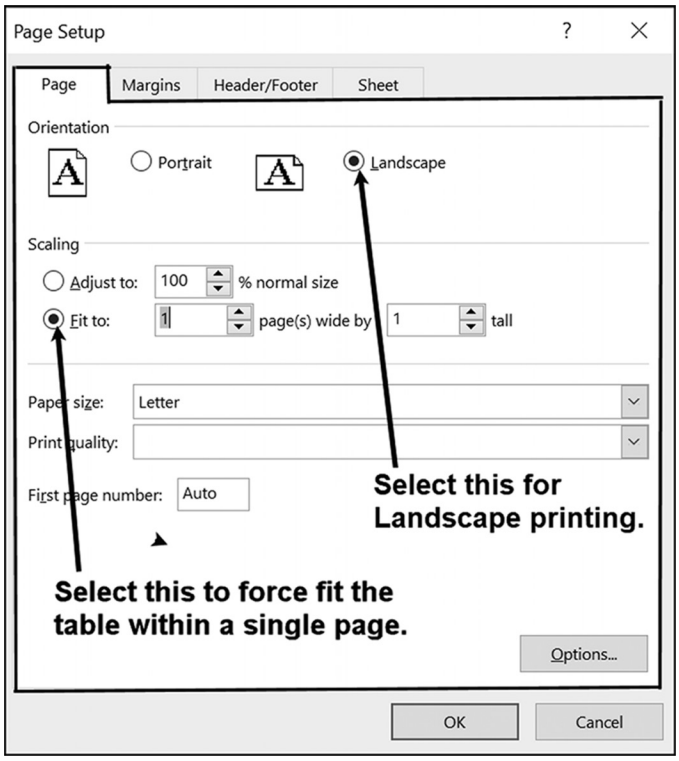


FIGURE 9.4 Orientation and scaling options

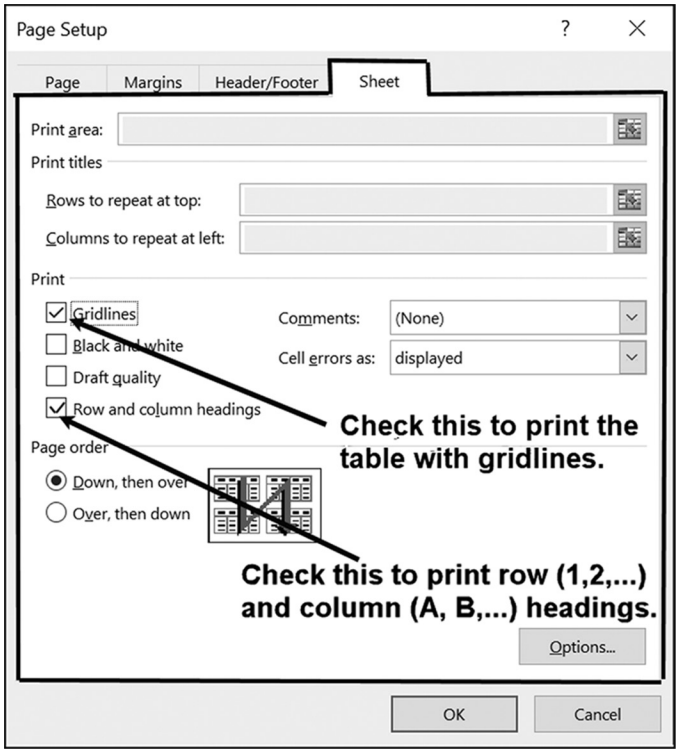


FIGURE 9.5 Gridline and heading options

Guide 3

HIGHLIGHTING CELLS

A large portion of spreadsheet processing requires using selected groups of related cells. For example, the sum of a column of data may be needed, or perhaps the average of grades in a row, where each row corresponds to a student's test grades. A commonly used technique for specifying a range of cells is to highlight the cells within the range[1]. While the cells are highlighted, they form a unit that can then be processed by a formula or configured so that all individual cell values in the group have the same format when displayed, and so on.

Note that we are not referring to highlighting a cell's contents by changing the color of the cell's data. What is being highlighted is a set of one or more adjacent (that is, touching) cells that designates them as a single unit while they are highlighted. In Excel, a set of adjacent cells is referred to as a *range of cells*, or *cell range*.

Figure 10.1 shows a number of highlighted cell ranges. The underlying criteria for each range is that every cell in the range is adjacent to, that is, fully touches, at least one other cell in the range, either above, below, or to its side. Also shown under each range is how the range is designated using cell addresses.

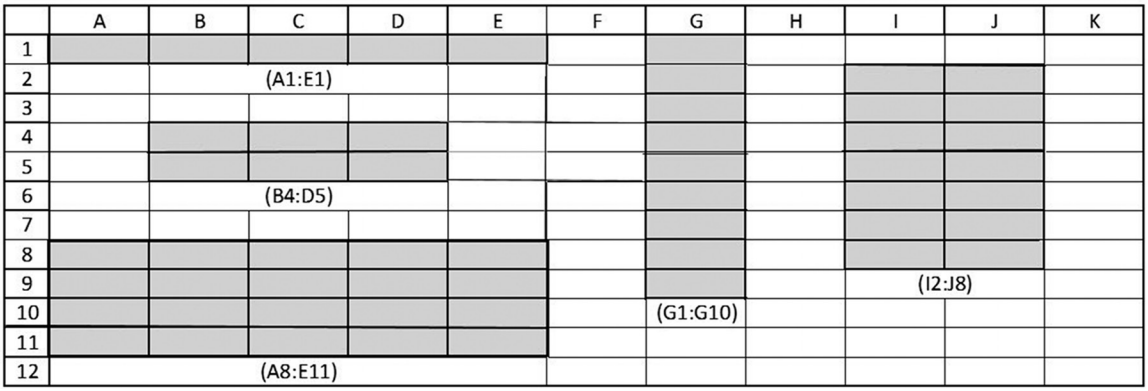


FIGURE 10.1 Examples of cell ranges

To highlight a range of cells**,** you must first select a single cell at the top or bottom or corner cell in the desired range. For example, in Figure 10.2, the cursor has been moved to a selected starting cell, which in this case is B4. Notice the shape of the cursor in the cell.

[1] A second method is to list the top left-most cell address in the range, followed by a colon, followed by the lowest right-most cell address, as listed in parentheses under each range (see Figure 10.1).

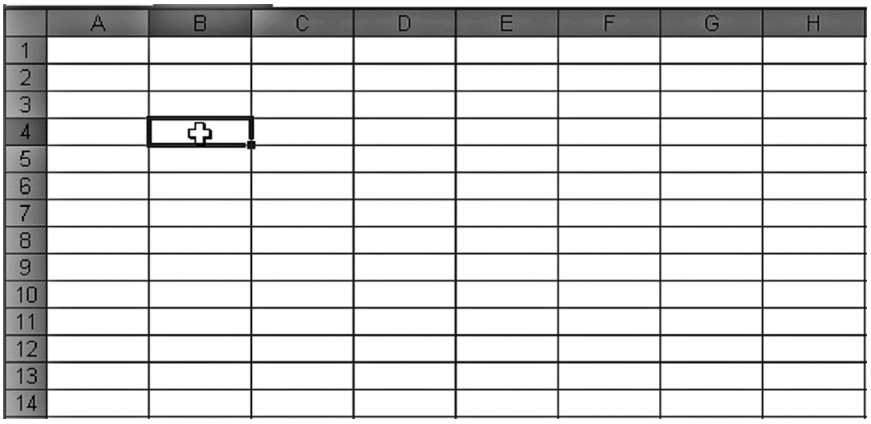


FIGURE 10.2 Selecting the first cell in a range of cells

Once you have selected the first cell in the desired range, you define the desired group of cells by doing **one** of the following:

1. Press and hold the left mouse button down, starting from the first cell and moving the mouse so that the cursor points to the desired last cell in the range. Then, release the left mouse button.
2. Click and then release the left mouse button on the first cell in the desired range. Then, hold the Shift key down and click and release the left mouse button on the last cell in the desired range.
3. Click and release the left mouse button on the first cell in the desired range. Then, hold the Shift key down and use the keyboard arrow keys (←↑ ↓ →) to go to the last cell in the desired range. Finally, release the Shift key.

Figure 10.3 shows how the selected cells look using the first method, where the left mouse button was pressed and held down as the mouse cursor was moved from its initial position in cell B4 to cell B11. The cells, as shown in Figure 10.3, became highlighted as they were included in the range. This same highlighting would occur if any of the other two methods were used.

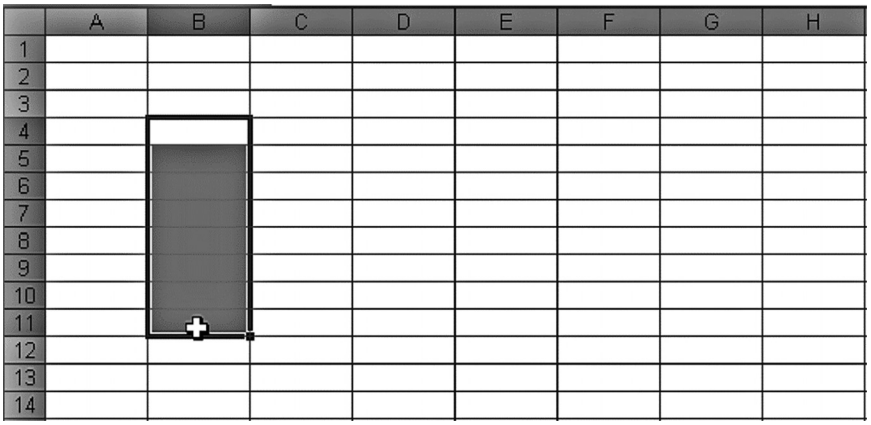


FIGURE 10.3 Completing the range selection

Guide 4

COPYING CELL CONTENTS

The contents of a single cell are copied by first moving the cursor to the lower right-hand corner of the selected cell, as shown in Figure 11.1.

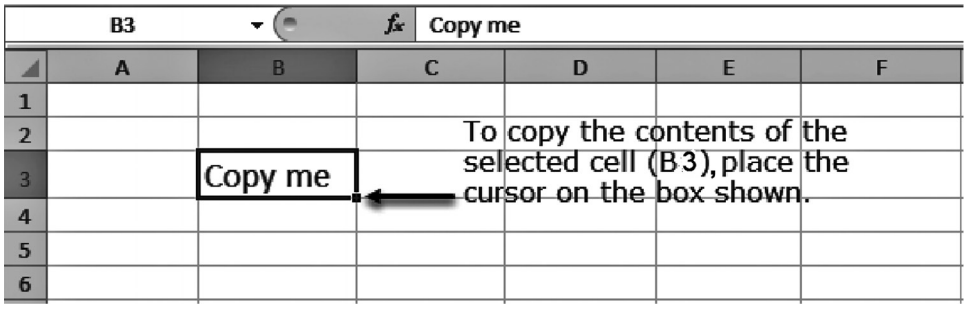


FIGURE 11.1 Locating the copy rectangle

When the cursor appears as a crosshair (+), also known as the fill handle, as shown in Figure 11.2, the selected cell is ready to be copied.

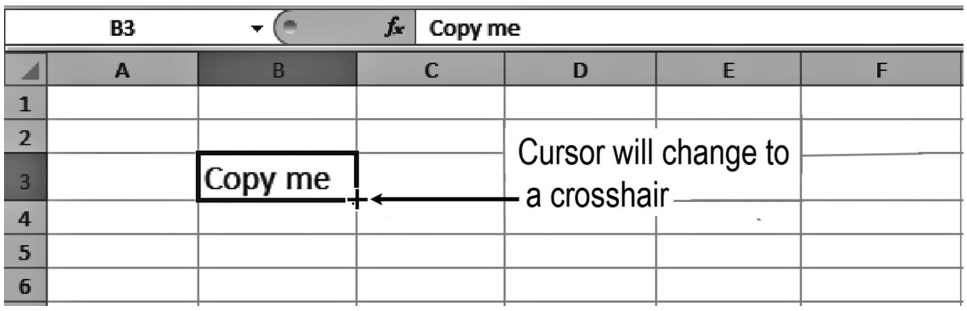


FIGURE 11.2 Placing the cursor on the copy rectangle (the cursor changes to a crosshair sign)

Once the cursor has changed to a crosshair (fill handle), press and hold the left mouse button while you drag the cursor over the cells where you want the copy to occur. As you do so, each cell where the copy will take place becomes highlighted, as shown in Figure 11.3. Here, the contents of cell B3 are being copied to cells C3 through E3. ***The copy takes place when the left mouse button is released.***

Note that the copy could just as easily been made to the left, into cell A3, or either up or down column B, rather than across the third row (row 3). The only restriction on this method is that the copy is always made to adjacent (touching cells), which is usually what is required. If a copy to non-adjacent cells is needed, standard cut-and-paste techniques must be used.

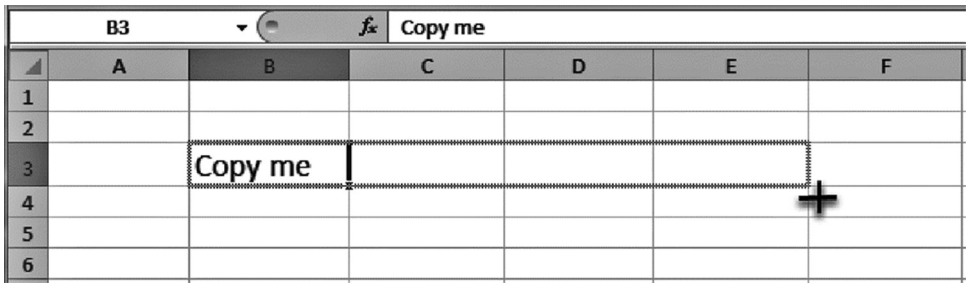


FIGURE 11.3 Copying cell B3 to cells C3, D3, and E3

ADAPTIVE PATTERN MATCHING

When dates, text, and numbers are copied, Excel tries to determine if a pattern exists. Based on any detected pattern, Excel places the next value in the pattern into the copied cell.

For formulas and text, such as days-of-the-week and months, Excel only requires *one cell* to determine the pattern. For example, consider the spreadsheet segment shown in Figure 11.4.

	A	B	C	D	E	F
1	January					

FIGURE 11.4 The original cell contents

Now, if cell A1 is copied to cells B1 through cell F1, the spreadsheet segment will appear as shown in Figure 11.5. Note, as the content of cell A1 was formatted to be centered in the cell, the copied cells retain this format.

	A	B	C	D	E	F
1	January	February	March	April	May	June

FIGURE 11.5 The cell contents after cell A1 is copied

For dates and numbers, *two adjacent cells* are typically needed; otherwise, the single date or number will be reproduced in the copied cells.

Guide 5

CREATING LINE GRAPHS

Figure 12.1 illustrates an example of a line graph. The majority of line graphs show the relationship between two variables, such as Sales versus Advertising, or between a quantity, such as revenue or profit, as it changes over time, such as years in business. Either straight or curved lines can be used to connect individual points on the graph[1].

Rain(In.)	1	1.7	2.3	3.2	3.8	4.3	4.8
Yield (Bu.)	9	18	25	30	34	40	45

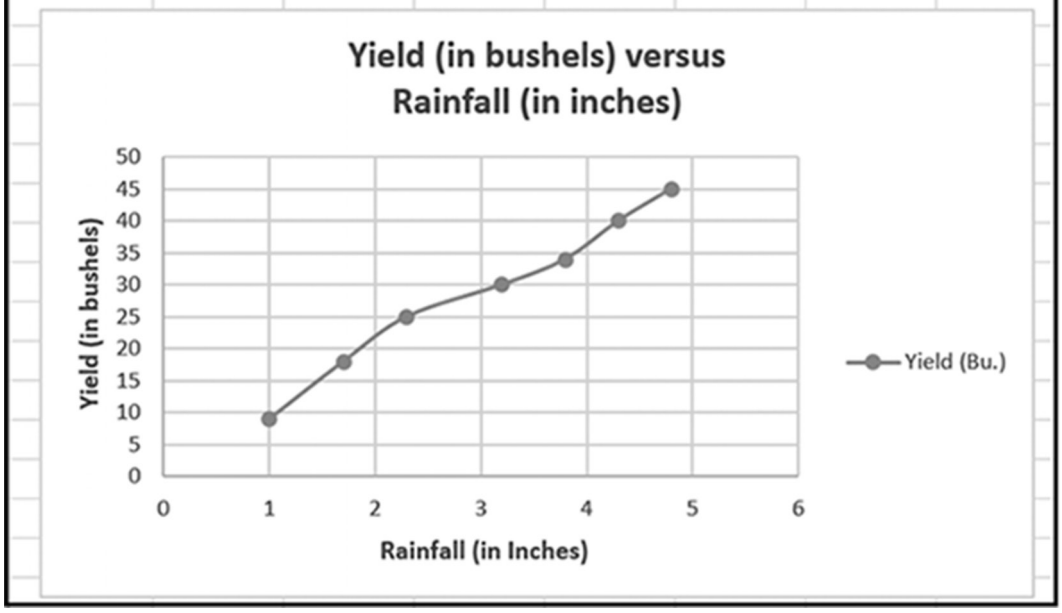


FIGURE 12.1 A line graph example

Creating a line graph requires that the data first be entered into either consecutive rows, as shown in the upper-left corner of Figure 12.1, or consecutive columns. Once entered, the data is highlighted, as shown as Step 1 in Figure 12.2, and the remaining steps shown in the figure must then be completed.

Although any two consecutive rows or columns can be used for the data, when rows are used, the data entered in the upper-most row becomes the x-axis values, and the data in the lower row becomes the y-axis values. Similarly, for data listed in columns, the data in the left-most column is plotted on the x-axis and the data in the right-most column is plotted on the y-axis.

---

[1] A line graph without connecting lines between data points is referred to as a *scatter diagram*. Scatter diagrams are typically used with trend lines, as presented in the next guide.

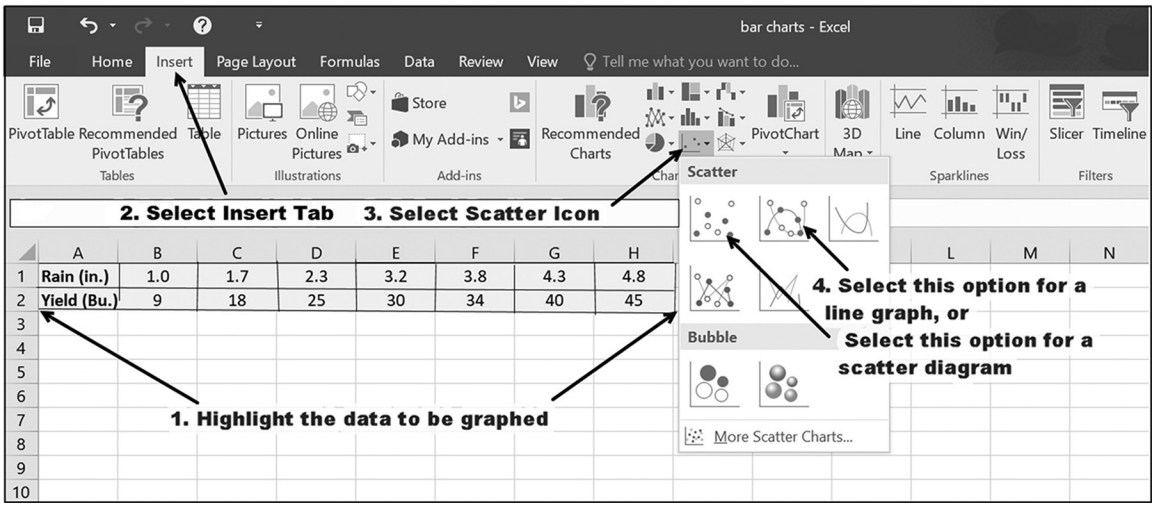


FIGURE 12.2 Creating the line graph

After selecting the line graph option shown as Step 4 in Figure 12.2, the line graph shown in Figure 12.3 is automatically created. Notice that the figure has no axis titles and that the chart's title is a copy of the data label in cell A2, which is the y-axis data label.

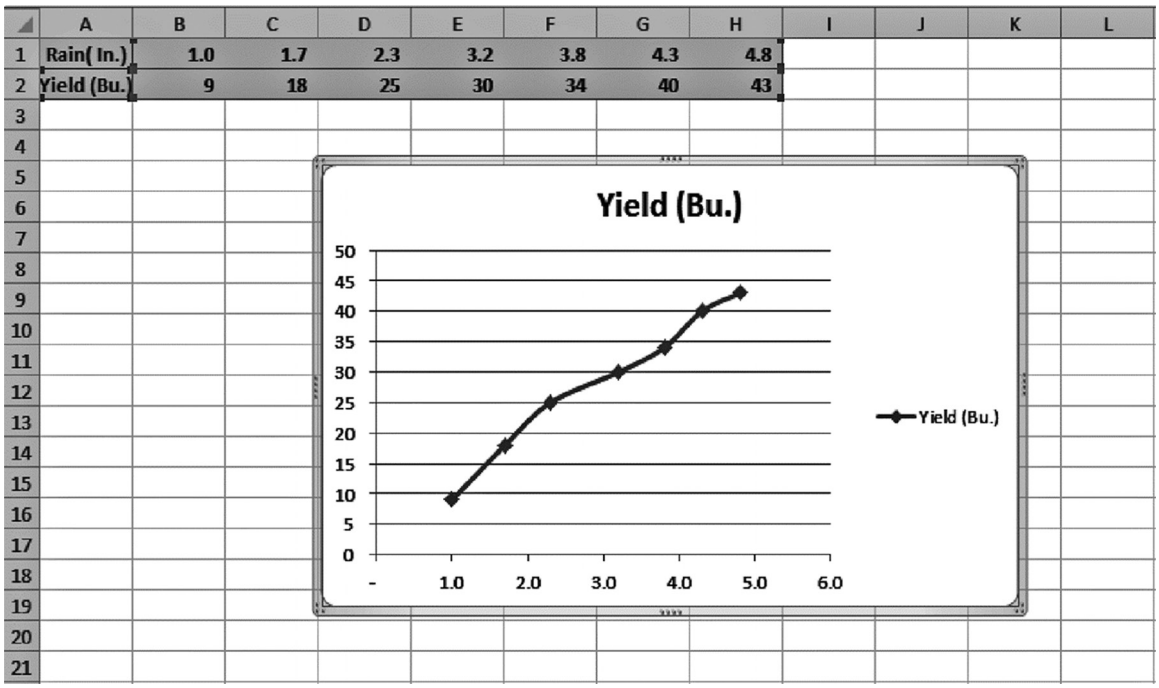


FIGURE 12.3 Example of data plotted in a line graph

Guide 6

Creating Scatter Diagrams and Trend Lines

In business, economics, and science, a line used to fit empirically obtained data is referred to as a *trend line*. A trend line can be linear, quadratic, exponential, or any other line that best fits the data.[1] The dotted line shown in Figure 13.1 is an example of a straight line trend line.

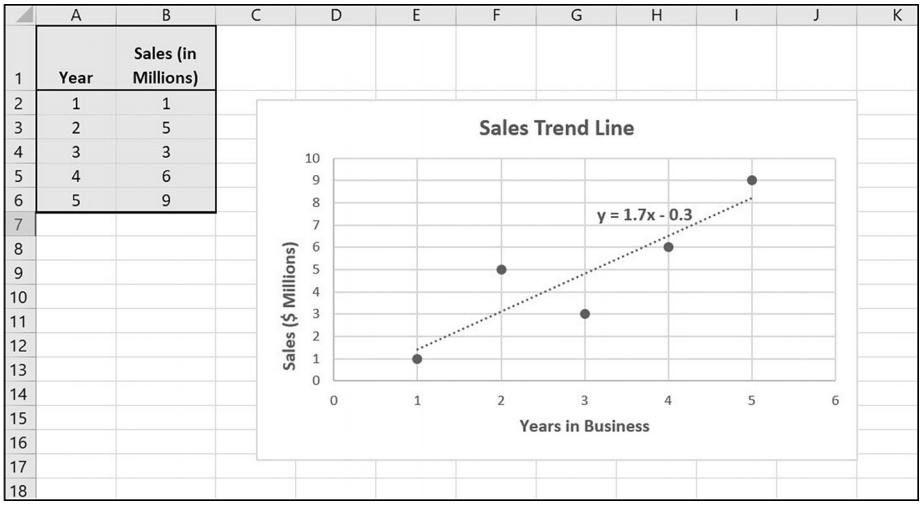


FIGURE 13.1 An example of a sales trend line

In constructing a trend line, the first step is to create a scatter diagram. A scatter diagram is a graph containing multiple data points, with no connecting lines between the points[2]. Figure 13.2 illustrates two examples of scatter diagrams. Trend lines are graphed on the resulting scatter diagram.

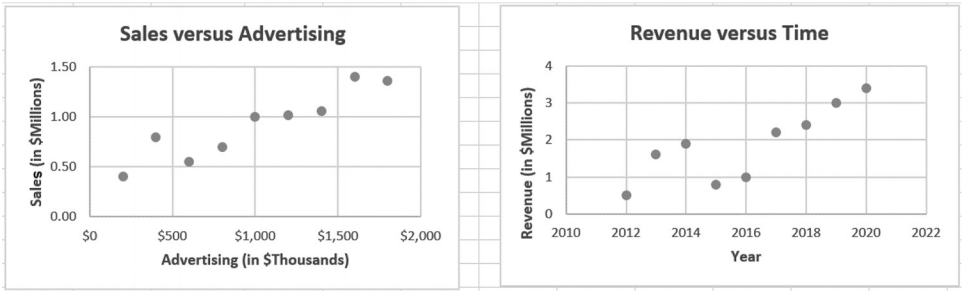


FIGURE 13.2 Examples of Scatter Diagrams

[1] The procedure is known as *the least-squares minimization method*, where a best fit is accomplished by minimizing the total squared error between the trend line and the actual data values. Refer to *Mathematics for Business*, by Bronson, Bronson, and Kieff for a detailed presentation of this method.

[2] When the data points are connected with lines between them, the scatter diagram is referred to as a *line graph*. Connecting lines are not used, so that they do not clutter the graph and obscure the trend line.

CREATING A SCATTER DIAGRAM

Creating a scatter diagram requires that the data is first entered into consecutive columns, as shown in the upper-left corner of Figure 13.3, or consecutive rows. The data is then highlighted, as shown as Step 1 in the figure, and the remaining steps listed in the figure are then completed.

Although any two consecutive columns or rows or can be used for the data, when columns are used, the data entered in the left-most column become the x-axis values, and the data in the right-most column become the y-axis values. For data listed in rows, the upper-most row data are plotted on the x-axis and the lowest-row data are plotted on the y-axis.

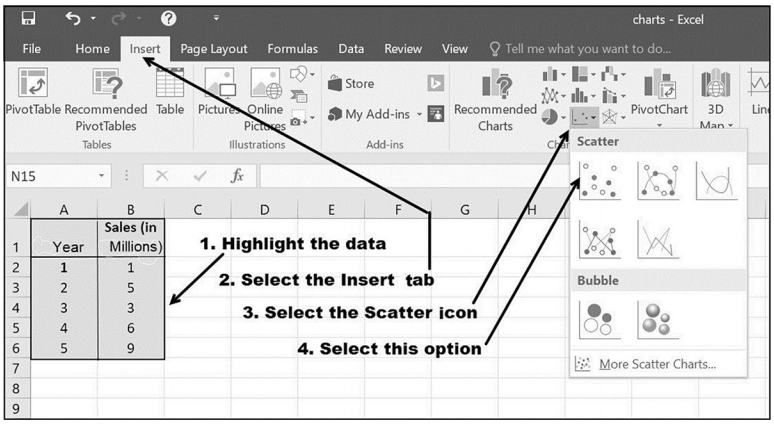


FIGURE 13.3 The steps required to produce a scatter diagram

After selecting the scatter option listed as Step 4 in Figure 13.3, the scatter diagram shown in Figure 13.4 will appear. Notice that the figure has no axis titles and that the chart's title is a copy of the data label in cell B2, which identifies the y-axis values.

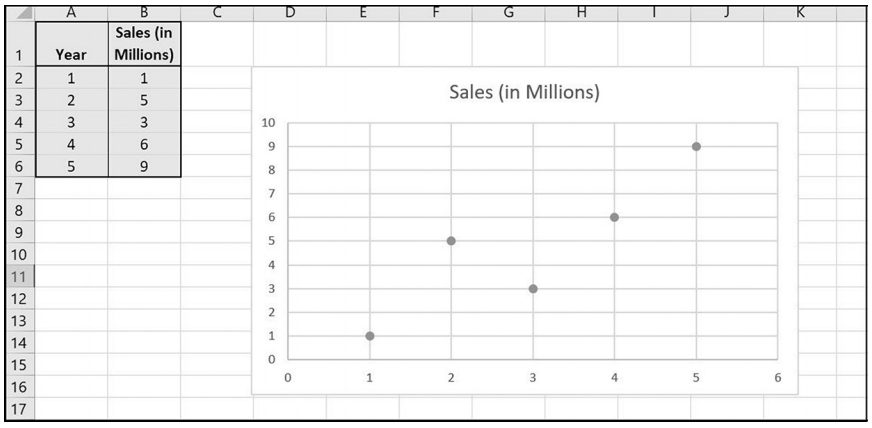


FIGURE 13.4 Scatter diagram

To add a trend line for the data shown on a scatter diagram, either click on the Add Chart Elements in the Chart Design Tools menu, as shown in Figure 13.5 (if this

menu is not shown, double clicking anywhere within the scatter diagram causes it to be displayed), or click on the Chart Elements icon (if this icon is not displayed, either right or left clicking within the scatter diagram activates it). Either of these actions produces the sub-menus shown in Figure 13.5.

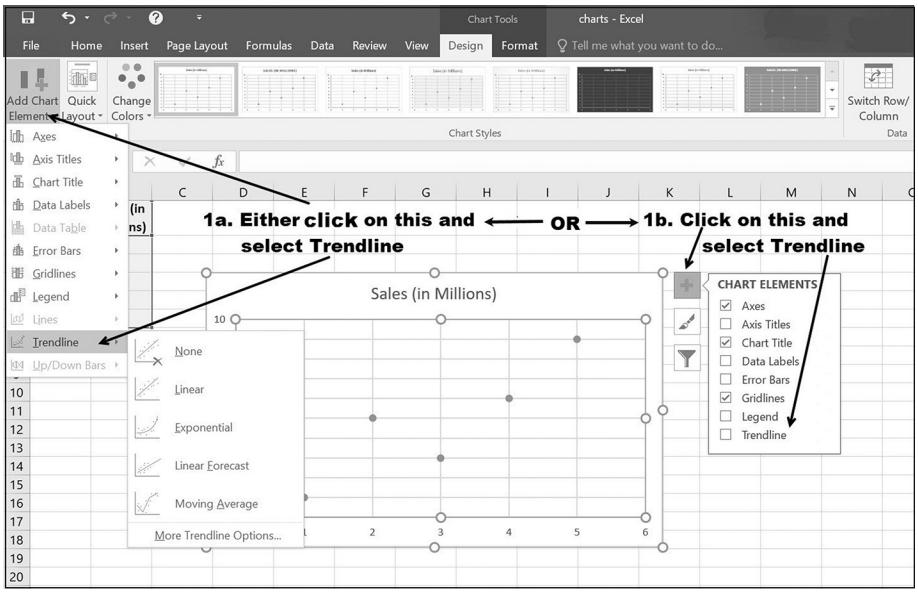


FIGURE 13.5 First step in adding a trend line

Clicking on the arrow to the right of the Trendline option from either of the sub-menus displayed in Figure 13.5 (hover over the Trendline option to activate the arrow) triggers the menu shown in Figure 13.6.

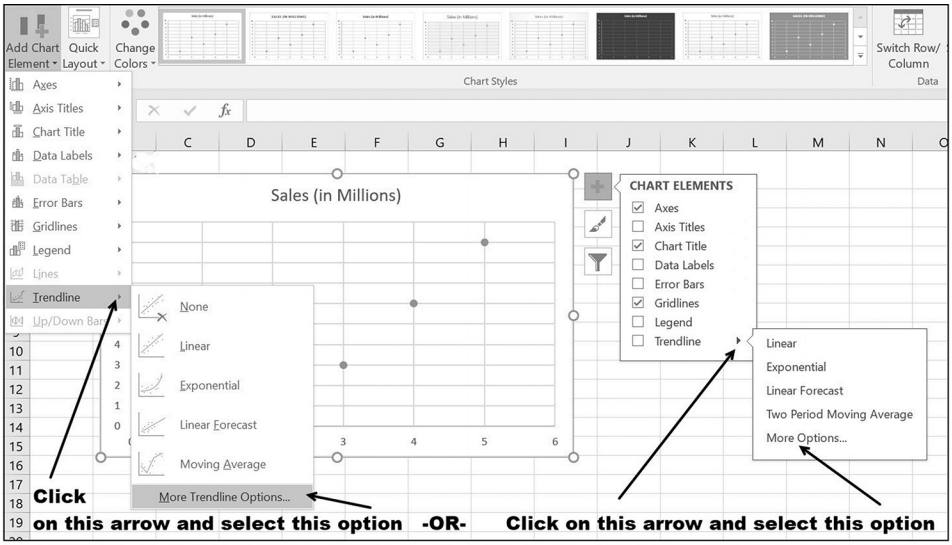


FIGURE 13.6 Next step in adding a trend line

When the Trendline drop-down menu shown in Figure 13.6 is displayed, you are ready to add the trend line and its equation onto the scatter diagram. To do so, click

on the last option, which is labeled **More Trendline Options**. Selecting this option will bring up the last menu needed, which is that shown on Figure 13.7.[3]

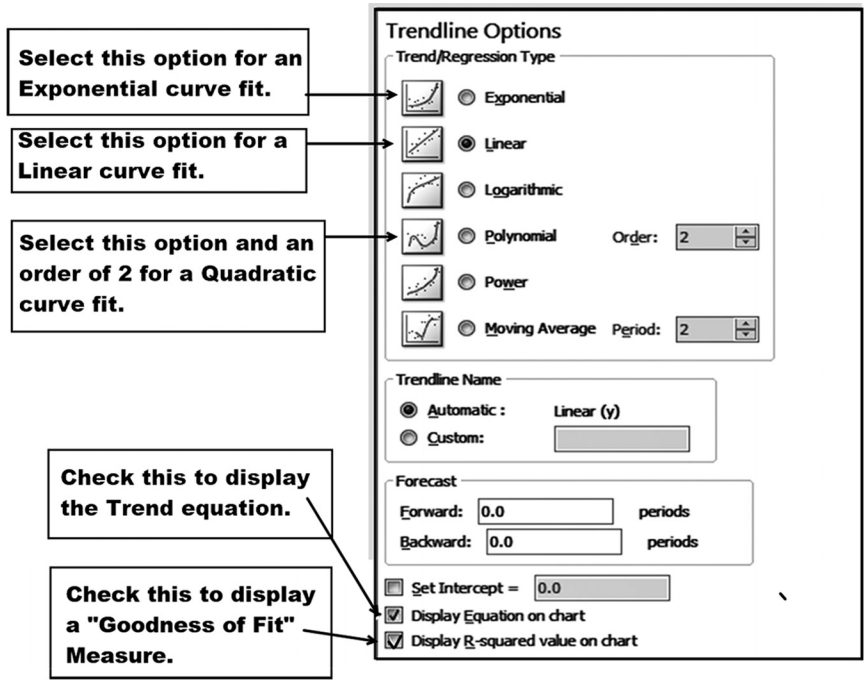


FIGURE 13.7 Trendline options

When the menu shown in Figure 13.7 is displayed, click on the desired trend line type as shown in the figure. Then check the *Display Equation* and *R-squared value on Chart* checkboxes at the bottom of the menu and click on the Close button. This will produce a display of the chosen trend line with its associated equation and R-squared value directly on the scatter diagram. Selecting a Linear Trendline for the Year and Sales data used throughout this example produces Figure 13.8.

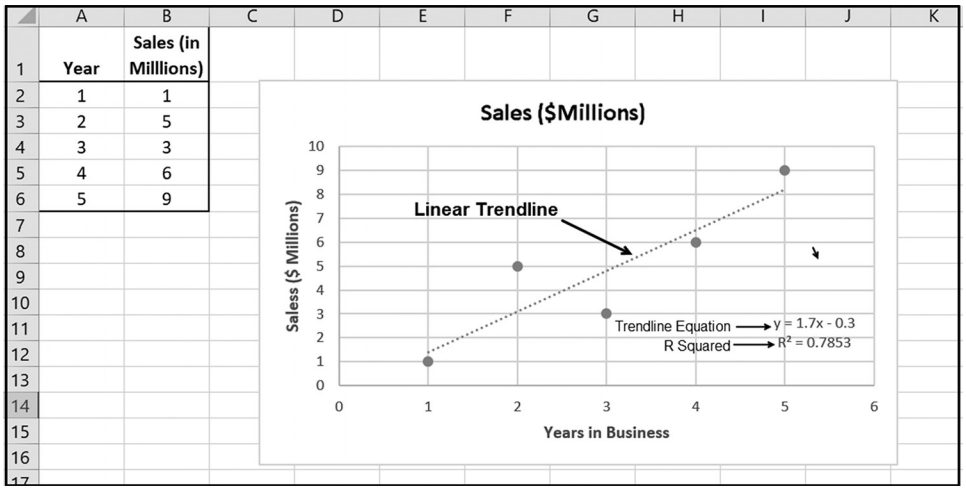


FIGURE 13.8 Completed scatter diagram with trend line

[3] ***Note:*** Checking the Trendline box on the Chart Elements sub-menu immediately produces a linear trend with no equation.

Guide 7

TRANSFERRING DATA BETWEEN SPREADSHEETS

In applications that use more than one sheet, it is frequently necessary to transfer one or more values from one sheet into a second sheet. This is known as *consolidation* and is easily accomplished by using the general formula

=SheetName-or-Number!cell-address

As specific example, consider Figures 14.1 and 14.2, which show the values and content of a spreadsheet that resides in sheet 1.

	A	B	C
1	20	16	36
2	18	20	38
3	38	36	74

FIGURE 14.1 Cell values in sheet 1's spreadsheet

	A	B	C
1	20	16	=A1+B1
2	18	20	=A2+B2
3	=A1+A2	=B1+B2	=C1+C2

FIGURE 14.2 Cell contents in sheet 1's spreadsheet

Now, assume that the sum in cell C3 shown in Figure 14.1 is required in sheet 2. For purposes of illustration, assume that the value needs to appear in cell M10 in sheet 2's spreadsheet.

Placing the formula **=sheet1!C3** into cell M10 within sheet 2's spreadsheet will cause the value in cell C3 on sheet 1 to also be placed into cell M10 on sheet 2. This placement is both a dynamic and one-way copy.

A *dynamic copy* means that if the value in cell C3 on sheet 1 changes, the new value will automatically appear in cell M10 on sheet 2. It does not matter if the new value in C3 is caused by entering a new value directly or is derived from the formula currently in cell C3.

A *one-way copy* means that the copy is only from sheet 1 to sheet 2. Thus, any change in the contents of cell M10 in sheet 2 will not be transferred back to sheet 1. In fact, the transfer from sheet 1 to sheet 2 will be broken if a change is made to the contents of cell M10, because a change in its contents will replace the formula that causes the transfer to take place.

Guide 8

RESTRICTING CELL ACCESS

In most professionally constructed spreadsheets, the end user is permitted access only to those cells that require user-input data, and is prevented from accessing any other cells. This restriction prevents the user from accidentally or deliberately modifying, deleting, or formatting any cells in the worksheet except for those that require user input.

Two conditions must be fulfilled for a cell to be in a restricted mode (that is, it cannot be accessed by a user). The cell itself must be formatted as locked and the spreadsheet itself, as a whole, must be put into protected mode. When a new spreadsheet is activated, all the cells in the worksheet are, by default, formatted as locked, but the spreadsheet is in an unprotected mode. Thus, initially only one of the two conditions is fulfilled and all cells in the worksheet can be accessed. To restrict user access from one or more cells, one of the following two procedures can be used. The details of implementing each procedure are presented in the following pages.

PROCEDURE 1

In this procedure, you first prevent user access to all the cells in the spreadsheet and then selectively open user access only to those cells that you ***do want*** the user to access.

Step 1: Verify and/or set the entire spreadsheet into ***unprotected*** mode.

Step 2: Verify and/or check that all cells are formatted as ***locked.*** (A locked state is the default for a new sheet).

Step 3: Format those cells that you want a user to have access to as ***unlocked***.

Step 4: Set the entire spreadsheet into ***protected*** mode.

PROCEDURE 2

In this procedure, you first open user access to all the cells in the spreadsheet and then selectively prevent access to those cells that you ***do not want*** the user to access.

Step 1: Verify and/or set the entire spreadsheet into ***unprotected*** mode.

Step 2: Format all of the cells in the worksheet as ***unlocked.***

Step 3: Format only those cells that you specifically want *to prevent* a user from accessing as ***locked***.

Step 4: Set the entire spreadsheet into ***protected*** mode.

The first procedure is more generally used because in a practical application, the user is only given access to a small number of input cells, with the remaining cells in the spreadsheet (which form the majority of cells in the worksheet) effectively being placed off-limits. Thus, it makes sense to first put all cells off-limits and then provide open access only to the few cells that you do want users to access. The step-by-step implementation of this first procedure follows.

IMPLEMENTING PROCEDURE 1

Step 1: To ensure that the spreadsheet, as a whole, is in its ***unprotected mode***, click on the Review tab and check that the Protect Sheet Option is as shown in Figure 15.1. This option is a toggle switch, so if you clicked on it as it is shown, it will protect the entire sheet and the Review menu will appear as shown in Figure 15.2. Thus, if the menu does appear as shown in Figure 15.2, click on the icon to unprotect the spreadsheet so that the menu appears as illustrated in Figure 15.1.

FIGURE 15.1 The entire worksheet is in Unprotected mode

FIGURE 15.2 The entire worksheet is in Protected mode

Step 2: To make sure that all the cells in the worksheet are formatted as ***locked***, select all of the cells by left clicking the left, upper-hand corner icon in the worksheet, as shown in Figure 15.3. Then right click the mouse to bring up the sub-menu shown in Figure 15.4. From this menu, select the Format option. Because all of the cells in the worksheet have been selected, the format that you select will apply to all of the cells in the worksheet.

FIGURE 15.3 Selecting all of the cells in a worksheet

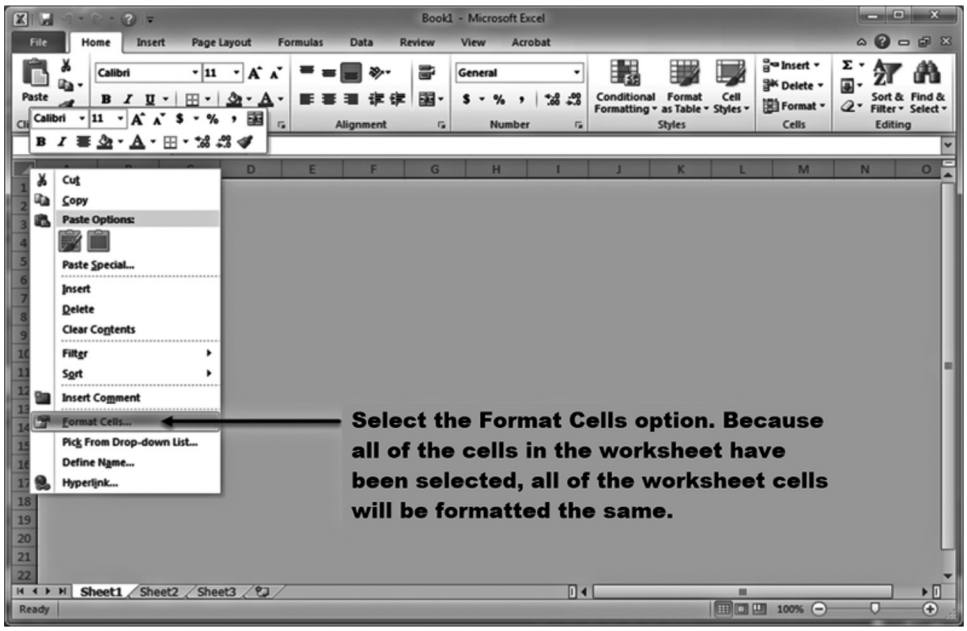


FIGURE 15.4 Formatting the complete worksheet

Once you have selected the Format option, the dialog shown in Figure 15.5 will appear. In this dialog box, click on the Protection tab; this will bring up the dialog box shown in Figure 15.6. Once this dialog appears, make sure the **Locked** box is checked (If it isn't, check it).

Doing this will place all of the cells into a locked format. Note that this locked cell format only becomes activated and into play when the worksheet itself is placed in a **Protected** mode.

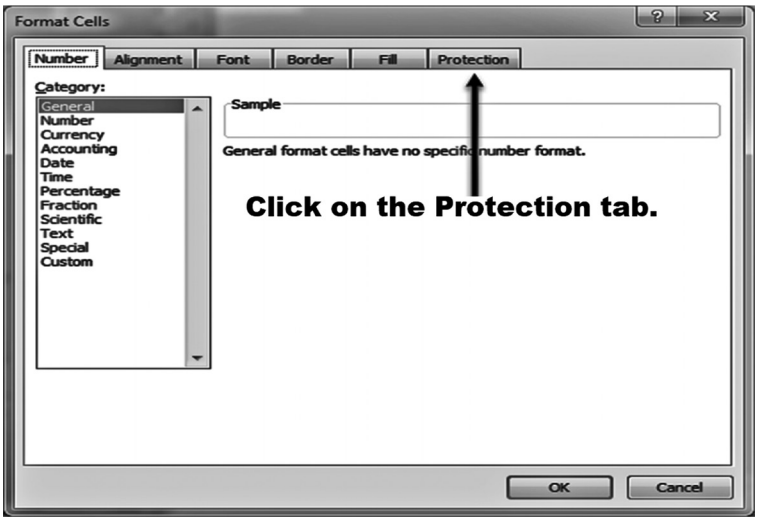


FIGURE 15.5 Figure 4 Selecting the Protection Tab

Step 3: Once all of the cells in the worksheet have been formatted as locked (see Figure 15.6), you must now unlock only those cells that you want the user to have access to. Generally, these are the input cells where you want the user to input data.

To do this, select an individual cell or a range of cells that you want to permit the user to access. Then, format these cells as unlocked by right clicking the mouse or selecting the Excel ribbon Home Tab's Format option. As before, select the Protection tab. Because all of the cells were locked in Step 2, you will find a check mark in the Locked box option for the cell or range of cells that you highlighted in your spreadsheet. De-select this format by clicking on the box, so that it appears as shown in Figure 15.7. Doing this unlocks these cells.

Repeat Step 3 for every cell or range of cells that you want the user to access. When this process is complete, proceed to Step 4 to activate all of the locks that remain from Step 2.

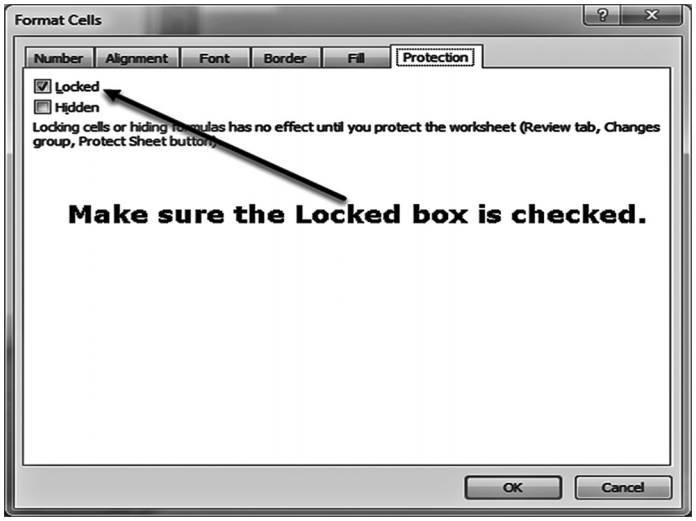


FIGURE 15.6 Selecting the locked format

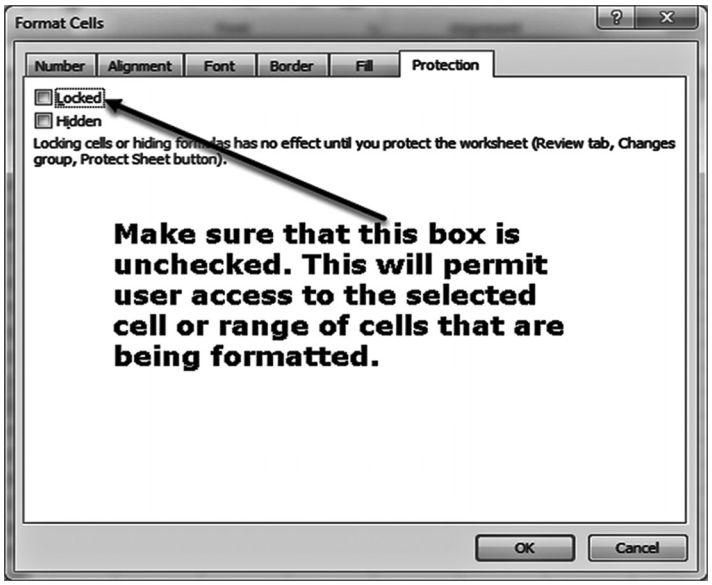


FIGURE 15.7 Unlocking the selected cell or range of cells

Step 4: To activate all of the locks that have been put in place and leave access open only to those cells that have been formatted as unlocked, click on the Review tab and check the Protect Sheet Option, as shown in Figure 15.8. You will be asked to supply a password, and then confirm this password. If you do not supply a password, any user can use the Review tab's option to unprotect the sheet by toggling the option shown in Figure 15.2. If you do supply a password, make sure to secure it in a safe place, as there is no method of retrieving it if it is lost.

FIGURE 15.8 Activating all of the cell locks

1. *The same procedure used to lock or unlock a cell can be used to hide the formula in a cell. That is, by enabling the hidden option in the Protection dialog, formulas in cells designated as hidden will not appear when using the Ctrl and (`) shortcut keys.*

NOTE

2. *To undo any of the locks you have put in place, or to lock additional cells, you first have to set the status of the complete worksheet to the unprotected state (Step 1). If you have used a password in Step 4, you will be asked to enter this password before being allowed to unprotect the spreadsheet.*

IMPLEMENTING PROCEDURE 2

The only difference in implementing procedure 2, as opposed to procedure 1, is that in procedure 2 every cell in the worksheet is first formatted as unlocked. Then, in Step 3, the formats of those cells that you **do not want** the user to have access to are formatted as locked. Steps 1 and 4 remain the same.

No matter which procedure you select to restrict user access to cells within your spreadsheet, the combination of individually formatting a cell as locked or not, along with the protection status of the spreadsheet as a whole remains the same. The effects of the various combinations are summarized in Worksheet 1.

TABLE 1 Effect of spreadsheet protection status and individual cell protection formats

Entire Spreadsheet	Individual Cell Format	Result
Unprotected	Locked or Unlocked	Data can be entered, changed, or formatted in *every* worksheet cell
Protected	Locked	Data cannot be entered, changed, or formatted in the locked cell
Protected	Unlocked	Data can be entered or changed, but not formatted in the unlocked cell. This prevents a user from locking the cell.

Basic Application Types

Appendices

Appendix A

Cash-Flow and Cash-Balance Spreadsheets

A cash-flow spreadsheet provides a detailed view of the cash that comes into a business, organization, seminar, or event and the cash paid out; it can be computed on a weekly, monthly, or yearly basis. Clearly, a healthy organization will have more money coming into the business than is going out. Another way of saying this is that the net cash flow is positive, where

Net Cash Flow = Net Cash In – Net Cash Out

Cash-flow spreadsheets are easily constructed using the Excel skills you already have. To familiarize yourself with the essential elements of a cash-flow spreadsheet, consider Figure A1.1, which presents a cash-flow spreadsheet for a student who will be working during the summer recess.

	A	B	C	D	E	F
1		**May**	**June**	**July**	**August**	**Totals**
2						
3	**Cash Inflows:**					
4	**Work:**	$500	$950	$875	$1,000	$3,325
5	**Gifts:**	0	50	100	500	650
6	**Odd Jobs:**	250	375	375	375	1,375
7	**Net Cash In:**	$750	$1,375	$1,350	$1,875	$5,350
8						
9						
10	**Cash Outflows:**					
11	**Gas:**	$125	$200	$180	$250	$755
12	**Lunch:**	80	160	130	150	520
13	**Car Insurance:**			1,000		1,000
14	**Net Cash Out:**	$205	$360	$1,310	$400	$2,275
15						
16	**Net Cash Flow:**	$545	$1,015	$40	$1,475	$3,075
17						

FIGURE A1.1 A cash-flow spreadsheet

The three main categories of a cash-flow statement, highlighted in Figure A1.1, are as follows:

1. *Net Cash In: This is the total of all the listed cash inflows*
2. *Net Cash Out: This is the total of all the listed cash outflows*
3. *Net Cash Flow: This is Net Cash (item 1) In less Net Cash Out (item 2)*

If Net Cash In (item 1) is greater than Net Cash Out (item 2), then Net Cash Flow (item 3) is positive. This indicates money is being accumulated; if it is negative, money is being lost. Clearly, a healthy operation will have more money coming in than is going out. Another way of saying this is that the Net Cash Flow is positive.

Interestingly enough, except for the individual cash inflow and cash outflow values that must be entered, the three cash-flow categories (items 1, 2, and 3) require entering only three formulas in the first cash-flow column. Once the correct three formulas are entered, they can be copied to the right for as many cash-flow columns that are contained in the spreadsheet. This is true for all cash balance spreadsheets, whether the columns are delimitated in weeks, months, or years. Similarly, as we have done before, any total formulas can also be copied. The highlighted cells in Figure A1.2 show the required three formulas for Figure A1.1's cash balance statement. These are the more heavily highlighted cells in column B in Figure A1.2. Also shown are the SUM( ) formulas that would be copied.

	A	B	C	D	E	F
1		**May**	**June**	**July**	**August**	**Totals**
2						
3	**Cash Inflows:**					
4	**Work:**	500	950	875	1000	=SUM(B4:E4)
5	**Gifts:**	0	50	100	500	
6	**Odd Jobs:**	250	375	375	375	
7	**Net Cash In:**	=SUM(B4:B6)	→	**Copy through**	→	
8						
9						
10	**Cash Outflows:**					
11	**Gas:**	125	200	180	250	=SUM(B11:E11)
12	**Lunch:**	80	160	120	150	
13	**Car Insurance:**			1000		
14	**Net Cash Out:**	=SUM(B11:B13)	→	**Copy through**	→	
15						
16	**Net Cash Flow:**	=B7-B14	→	**Copy through**	→	
17						

FIGURE A1.2 Copying the formulas through the cells

A CASH-BALANCE SPREADSHEET

A cash-balance spreadsheet is one that shows, in addition to the net cash flows, the cash balances of a business over a period of time. This type of spreadsheet is created by adding beginning and ending cash balances to each column of a cash-flow spreadsheet, as shown by the highlighted two rows in Figure A1.3.

For the first month, the *Beginning Balance* is a user-entered number representing the cash on hand at the start of the month (in this case May). In Figure A1.3, the Beginning Balance for May in cell B2 is $3,000. The *Ending Balance* is always the sum of the *Beginning Balance* plus the *Net Cash Flow.* For Figure A1.4 the correct formula in cell B17 is *=B2 + B16.* For all subsequent months, the *Beginning Balance* for the month is set equal to the prior month's *Ending Balance*.

	A	B	C	D	E	F
1		**May**	**June**	**July**	**August**	**Totals**
2	**Beginning Balance:**	$3,000	$3,545	$4,560	$4,600	
3	**Cash Inflows:**					
4	**Work:**	$500	$950	$875	$1,000	$3,325
5	**Gifts:**	0	50	100	500	650
6	**Odd Jobs:**	250	375	375	375	1,375
7	**Net Cash In:**	$750	$1,375	$1,350	$1,875	$5,350
8						
9						
10	**Cash Outflows:**					
11	**Gas:**	$125	$200	$180	$250	$755
12	**Lunch:**	80	160	130	150	520
13	**Car Insurance:**			1,000		1,000
14	**Net Cash Out:**	$205	$360	$1,310	$400	$2,275
15						
16	**Net Cash Flow:**	$545	$1,015	$40	$1,475	$3,075
17	**Ending Balance:**	$3,545	$4,560	$4,600	$6,075	

FIGURE A1.3 A cash-balance spreadsheet

As shown in Figure A1.4, the only three items that need to be entered for the cash balance rows have been circled. Once the correct formulas in cells B17 and C2 are entered, they can be copied to the right, as shown, for as many cash-flow columns contained in the spreadsheet. This is true for all cash balance spreadsheets, whether the columns are delimitated in weeks, months, or years.

	A	B	C	D	E	F
1		May	June	July	August	Totals
2	Beginning Balance	3000	=B17	=C17	=D17	
3	Cash Inflows:					
4	Work:	500	950	875	1000	=SUM(B4:E4)
5	Gifts:	0	50	100	500	=SUM(B5:E5)
6	Odd Jobs:	250	375	375	375	=SUM(B6:E6)
7	Net Cash In:	=SUM(B4:B6)	=SUM(C4:C6)	=SUM(D4:D6)	=SUM(E4:E6)	=SUM(F4:F6)
8						
9						
10	Cash Outflows:					
11	Gas:	125	200	180	250	=SUM(B11:E11)
12	Lunch:	80	160	130	150	=SUM(B12:E12)
13	Car Insurance:			1000		=SUM(B13:E13)
14	Net Cash Out:	=SUM(B11:B13)	=SUM(C11:C13)	=SUM(D11:D13)	=SUM(E11:E13)	=SUM(F11:F13)
15						
16	Net Cash Flow:	=B7-B14	=C7-C14	=D7-D14	=E7-E14	=F7-F14
17	Ending Balance:	=B2+B16	=C2+C16	=D2+D16	=E2+E16	

FIGURE A1.4 The three items that need to be entered for the cash balance rows

Appendix B

BREAK-EVEN ANALYSIS

Break-even analysis is a key concept in almost all businesses that sell a product. The break-even point is defined as the sales point at which the income received by a business for a product exactly matches the costs incurred, either by purchase or manufacture, in providing the product. If sales are above the break-even point, income exceeds costs and a profit is made; below the break-even point costs exceed income, and a loss occurs.

The reason the break-even point is so important is that it provides a business information about the income and costs at which a company switches over from incurring a loss to making a profit. If the break-even sales point cannot be reached within a reasonable period of time, and then ultimately exceeded, spending time and effort in initially producing or marketing the product becomes a futile endeavor that will only result in a loss.

Typically, break-even analysis is confined to the time period in which both the price and the cost of an item remain constant. This means that factors, such as inflation, supply and demand, and other economic factors do not come into play to change the cost and price structures. Thus, in determining the break-even point, only the income obtained from selling a product and the cost involved in providing the product are taken into account.

THE INCOME EQUATION

By definition, revenue is the income obtained from selling items. In its simplest form, the revenue produced from a sale, known as the *sales revenue*, is simply the price of each item times the number of items sold. Designating the sales revenue by R, the price per unit by p and the number of items sold by x, we have[1]

$$R = px \qquad \text{(Eq. B.1)}$$

Example 1: A company that manufactures calculators has a contract to sell them for $5.00 each to a discount electronics outlet chain. Determine the revenue equation and the actual revenue realized if 500 calculators are sold.

[1] Here, we are restricting ourselves to the case where the price of each item does not change.

Solution: Using Equation 1 the revenue equation is

$$R = \$5.00x$$

If 500 calculators are sold, the revenue, R, realized is

$$\$5.00(500) = \$2,500$$

THE COST EQUATION

The cost of items sold is commonly separated into two categories: fixed costs and variable costs.

Fixed costs include rent, insurance, property taxes, and other expenses that are present regardless of the number of items produced or purchased. Over the short run, these costs are fixed because they must be paid even if no items are sold. We represent the fixed cost by the variable F.

Variable costs are those expenses that are directly attributable to the manufacture or purchase of the items themselves, such as labor and raw materials. Variable costs depend directly on the number of items manufactured or purchased: the more items manufactured or purchased, the higher the variable costs. Designating the variable cost by V, the cost- per-item by a, and the number of items manufactured or purchased by x, we have[2]

$$V = ax \qquad \text{(Eq. 2)}$$

Because the total cost is the sum of the variable cost plus the fixed cost, the total cost equation becomes

$$C = V + F \qquad \text{(Eq. 3)}$$

Substituting Equation 2 for V into Equation 3, the final cost equation becomes

$$C = ax + F \qquad \text{(Eq. 4)}$$

That is, the total cost is the sum of the variable cost and the fixed cost. The numbers a and F are assumed known and fixed.

Example 2: A company manufacturing electronic calculators has recently signed contracts with its suppliers. For the duration of these contracts, the cost of manufacturing each calculator is $1.20. The company estimates that the fixed costs for this period will be $8,000. Determine the total cost equation for this process and the actual cost incurred if only 500 calculators are actually manufactured.

Solution: Using Eq. 4 with a = 1.20 and F = $10,000, we have

$$C = \$1.20x + \$8,000$$

[2] Here, we are restricting ourselves to the case where the cost of each item does not change.

If 500 calculators are produced, the cost will be C =$1.20(500) + $8,000 = $8,600. If no calculators are produced, the total cost will be C = $1.20(0) + $8,000 or $8,000, which is the fixed cost.

From Examples 1 and 2, we note that a production run of 500 calculators will result in a total cost of $8,600 and a sales revenue of only $2,500. The company will experience a loss of $6,100. Such embarrassing situations can be avoided with a break-even analysis. As the name suggests, this analysis involves finding the level of sales below which it will be unprofitable to produce items and above which a profit is made. This level is the break-even point. The break-even point occurs when total cost exactly equals sales revenue. With the assumption that all items produced can be sold, the break-even point occurs when R = C. Substituting for both the revenue, R, and cost, C, from Equations 1 and 4 yields

$$px = ax + F \qquad \text{Eq. 5)}$$

Equation 5 is one equation in the one unknown, x. Solving for x yields the break-even point, BEP, as

$$BEP = x = F/(p\text{-}a) \qquad \text{(Eq. 6)}$$

For the electronic calculator described in Examples 1 and 2, we found C = $1.20x + $8,000 and R = $5.00x. The break-even point occurs when R = C, or, from Equation 6, when x = 8,000/(5.00 – 1.20) = 2,106 calculators. At this point, there is neither a profit or a loss. Any production and sales below 2,106 calculators result in a loss, while any production and sales above 2,106 units produce a profit.

Example 3: A lamp component manufacturer determines that the manufacturing costs associated with each component are $5 and that the fixed costs are $7,000. Determine the break-even point if each component sells for $7. Assume that each unit made can be sold.

Solution: The total cost for this process, using Equation 4, is C = $5x + $7,000. The sales revenue is R = $7x. The break-even point is the value of x for which R = C. This point can be found by directly using Equation 6, which yields, x = 7000/ (7 – 5) = 3,500 components as the break-even point.

GRAPHICAL INTERPRETATION

Graphically, the break-even point occurs at the point of intersection where the graph of the revenue equation crosses the graph of the cost equation. This is illustrated in Figure B1.1. Because both the revenue and cost equations (Eq. 1 and Eq. 5) are linear equations, their graphs are both straight lines, as shown in Figure B1.1.

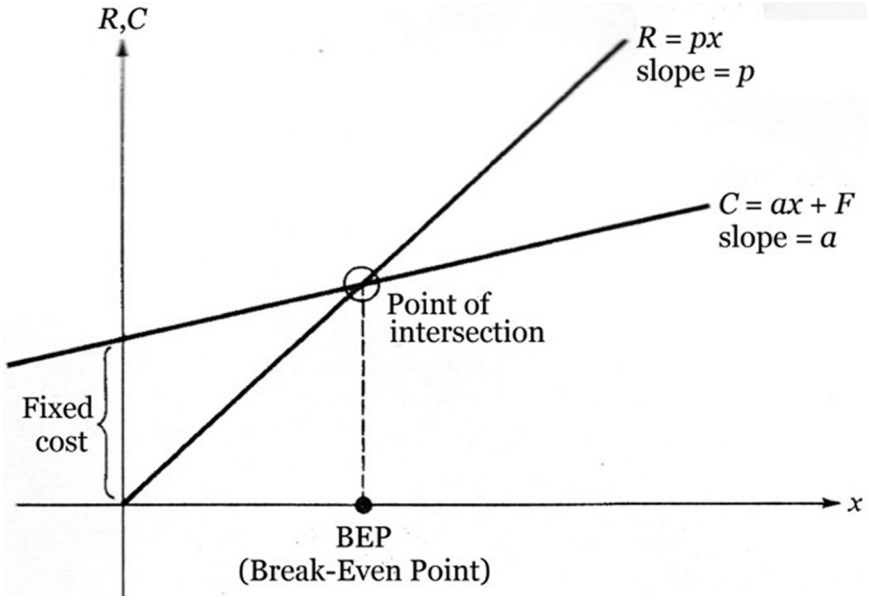


FIGURE B1.1 Graphical interpretation of the cost equation examples

In reviewing Figure B1.1, note that the horizontal axis is x, the number of units produced and sold, whereas the vertical axis is R and C, depending on which equation is being considered. It follows that the unit sales price, p, is the slope of the revenue equation (defined by Eq. 1), and the cost of manufacturing each unit, denoted as a, is the slope of the cost equation (defined by Eq. 4). The y-intercept corresponding to Equation 4 is simply the fixed cost.

The break-even point is the value of x for which R = C, which in Figure B1.1 is the value of x at the intersection point of the Revenue and Cost lines.

Appendix C

Economic Order Quantity (EOQ)

The Economic Order Quantity, (EOQ), concerns itself with a product that is ordered and then stored before being sold. Specifically, the EOQ is the quantity of a product that should be ordered at equal points in time to minimize the total yearly inventory costs, while ensuring that sufficient inventory is at hand, at all times, to meet the daily demand for the inventoried items. It is the theoretical point that also avoids over-stocking, with its resulting increase in storage costs, and under-stocking, with its resulting loss in sales.

Table C1 presents the parameters that are assumed known; they are used to determine the optimum number of items to be ordered each time an order is placed throughout a year.

TABLE C1 Known inventory parameters

Notation	Menaing	Comment
D	Annual demand for all of the items	A known number
m	Cost of placing a single order	A known dollar amount
k	Cost of storing one item for one year	A known dollar amount

In addition to the quantities that are assumed known, as listed in Table A1, two additional assumptions are made. These are:

1. The demand for items is uniform throughout the year. That is, as many items are sold during the first day as are sold during the 200th day, and as many items are sold during the fourth week as are sold during the seventeenth week.
2. Inventory is reordered at equal time intervals and in equal lots (for example, 700 cases every 2 weeks).

These two assumptions imply a depletion of inventory as shown in Figure C1.1.

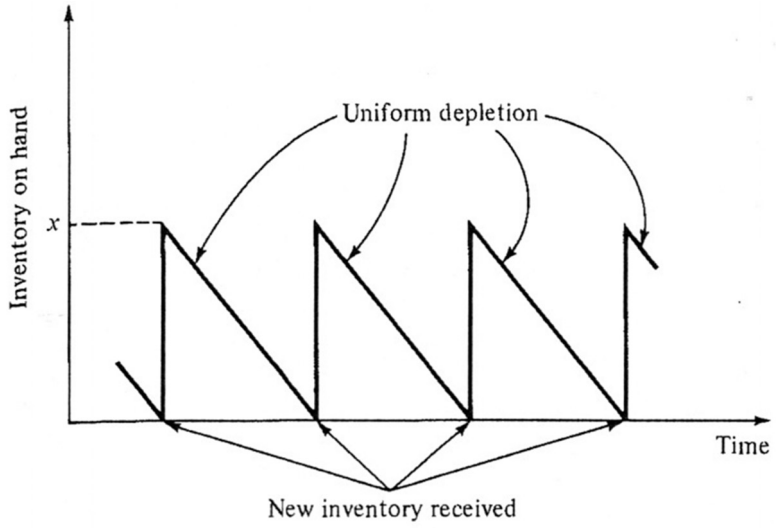


FIGURE C1.1 Inventory chart

The EOQ is the amount of product to order each time an order is placed that minimizes the total yearly cost, TC. It is calculated using the following equation:[1]

$$E = \sqrt{\frac{2mD}{k}} \qquad \text{(Eq. 1)}$$

Once the EOQ is determined, a number of additional quantities can be calculated. These are presented in Table C2.

TABLE C2 Calculated inventory parameters

Notation	Meaning	Formula
N	Number of orders placed in a year	N = (D/EOQ)
TOC	Total Annual Ordering Cost	TOC = (m)(D/EOQ) = (m)(N)
TSC	Total Annual Storage Cost	TSC = (k)(EOQ/2)
TC	Total Cost	TC = TOC + TSC

It is worthwhile noting that at the EOQ, the total annual ordering cost, TOC, is equal to the total annual storage cost, TSC.

Example 1: A distributor estimates that the annual demand for television sets is 1,000 units. The cost of placing a single order is $10, and storage cost per unit per year is $8. To minimize total inventory costs, determine

a. EOQ, which is the optimum order size, and

b. N, the number of orders that will be placed in a year.

[1] The derivation of this equation requires calculus and is beyond the scope of this book. For a derivation of this equation, see *Mathematics for Business* by Bronson, Bronson, and Kieff.

Solution: For this problem D = 1,000, m = 10, and k = 8, where all monetary figures have been expressed as dollars. With these values,

a. From Equation 1 the Economic Order Quantity is

$$EOQ = \sqrt{\frac{2mD}{k}} = \sqrt{\frac{2(10)(1{,}000)}{8}} = \sqrt{2{,}500} = 50$$

b. The total number of orders placed in a year, N, is determined from the equation (see Table 2) N = D/EOQ = 1,000/50 = 20. That is, one thousand units are required over the year and each order is for 50 items; hence, the distributor must place 1000/50 = 20 orders.

Example 2: A soda distributor's annual demand for cases of soda is 2,000 a year. The cost of placing a single order is $9.66 and the storage costs per case per year is $1.40. To minimize total inventory costs, determine the following:

a. EOQ, the optimum order size,

b. N, the number of orders that will be placed in a year.

Solution: Here D = 2,000, m = 9.66, and k = 1.40, where all monetary figures have been expressed as dollars. With these values,

a. From Eq. 1, the Economic Order Quantity rounded to the nearest single unit is

$$EOQ = \sqrt{\frac{2mD}{k}} = \sqrt{\frac{2(9.66)(12000)}{1.40}} = \sqrt{27{,}600} = 166$$

Unless there is a restriction that limits an order to below this amount, the EOQ will produce the minimum cost.

b. The total number of orders placed in a year, N, is determined as D/EOQ = 2000/166 = 12.0C. Thus, rounded to the nearest unit, the minimum inventory cost is achieved by placing 12 orders, equally spaced, throughout the year.

Appendix D

Basic Database Concepts

In its most basic form, a database is an organized set of fields and records, where a record is a collection of related fields (data items).

For example, a student record is a collection of fields related to an individual student and might contain the following items:

Student ID Number	Last Name	First Name	Major	Year Entered	Credits Earned	Grade Pt. Average

One type of database structure is the *relational database*. In a relational database, each row corresponds to a single record and the fields in the records correspond to the worksheet's columns. Excel spreadsheets can be used to store information in a manner similar to that of a relational database.

For example, storing student records in this form produces the following worksheet:

Student ID Number	**Last Name**	**First Name**	**Major**	**Year Entered**	**Credits Earned**	**Grade Pt. Average**
1st ID						
2nd ID						
3rd ID						
.						
.						
.						
.						
Last ID						

This of course, conforms exactly to the rows and columns of a spreadsheet. As such, a spreadsheet operates in a manner resembling a relational database when rows in a spreadsheet are used to store records, with the columns conforming to a record's fields (data items).

Once a spreadsheet is set up and used in this way, questions (also known as *queries*) can be asked of a database. The questions which could be asked may be of the general form: How many records have a specific item that meets a set of specific characteristics? For example, in our student record database, we might want to know how many

students are Liberal Arts majors; or how many students have a grade point average (GPA) above 3.4; or how many students have earned more than 80 credits and have a GPA above 3.4.

Each of these questions involves determining and then counting the records whose selected items have the desired characteristics. Excel has a number of methods of doing this and producing useful reports of the results. These methods are presented and explored in Project Set 7.

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