

# Decision Making Using Excel

## LEARNING OUTCOMES

1. Describe the use of the IF function.
2. Compare the functions of Goal Seek and Solver.
3. List the advantages of using the Scenario Manager.

## Introduction

Most of the decision-analysis tools on the market focus on one specific analytical technique, like simulation or decision trees. They may be tailored to a specific industry need, such as insurance claims modeling. Furthermore, the cost of these tools can run into the tens of thousands, even millions, of dollars—such as SAS and Cognos. One integrated set of tools that combines the best analytical methods, can be applied to different problems, and is reasonably priced is Microsoft Excel.

The measure of any business intelligence solution is its ability to derive knowledge from data, as discussed in the core units of this book. This plug-in will examine a few of the advanced business analysis tools that have the capability to identify patterns, trends, and rules and create “what-if” analyses. There are four areas in this plug-in:

1. The IF function is used to conduct conditional tests on values and formulas.
2. The Goal Seek function is used to find an unknown value that produces a desired result.
3. The Solver function is used to calculate an optimum solution based on several variables and constraints.
4. The Scenario Manager function is used to create and evaluate a collection of “what-if” scenarios containing multiple input values.

## Creating Formulas Using the IF Function

The IF logical function will return one value if a condition is TRUE and another value if the condition is FALSE. Use the IF function when you want to compare two items in your workbook. The IF function looks like this:

=IF(logical\_test,value\_if\_true, value\_if\_false)

- **Logical\_test** is any value or expression that can be evaluated to TRUE or FALSE. For example,  $A10 = 100$  is a logical expression; if the value in cell A10 is equal to 100, the expression evaluates to TRUE. Otherwise, the expression evaluates to FALSE. This argument can use any comparison calculation operator.
- **Value\_if\_true** is the value that is returned if the logical\_test is TRUE. For example, if this argument is the text string “Within budget” and the logical\_test argument evaluates to TRUE, then the IF function displays the text “Within budget.” **Note:** Value\_if\_true can be another formula.
- **Value\_if\_false** is the value that is returned if the logical\_test is FALSE. For example, if this argument is the text string “Over budget” and the logical\_test argument evaluates to FALSE, then the IF function displays the text “Over budget.” **Note:** Value\_if\_false can be another formula.

To use the IF function follow these steps:

1. Select the cell in which you want to enter the function.
2. Click the **Insert Function** button.
3. Click **IF** from the list of Logical functions and click **OK**.
4. Enter the Logical\_test argument. This argument states the condition you want to test for. Use cell references and/or values with logical operators. Figure T4.1 displays the list of logical operators.
5. Enter the **value\_if\_true** argument. This is the text string or value that will be displayed if the Logical\_test argument is true.
6. Enter the **value\_if\_false** argument. This is the text string or value that will be displayed if the Logical\_test argument is false.
7. Click **OK**.

For example, in a loan analysis worksheet, you want to write a conditional expression that examines the ratio of a loan amount to a purchase price. The logic for solving this is if the ratio is greater than 0.8, then the assessment is \$300. Otherwise, the assessment is \$0.

To create a conditional expression, complete the following steps:

1. Open the workbook **T4\_LoanAnalysis\_Data.xls** that accompanies this textbook.
2. Click cell **B14**, the cell that will display Assessment if the ratio of loan amount to purchase price is greater than 0.8—the same criteria for displaying (or not) an assessment fee of \$300.
3. Type **= IF (B13 / B4 > 0.8, 300, 0)** and press **Enter**. The cell displays **300** because the loan-to-price ratio is 0.875. Otherwise, nothing is displayed.

When you are unsure of a function and want help writing it, you can use the Insert Function command. Executing the Insert Function command opens a dialog box that lists functions by categories and helps you build the function.

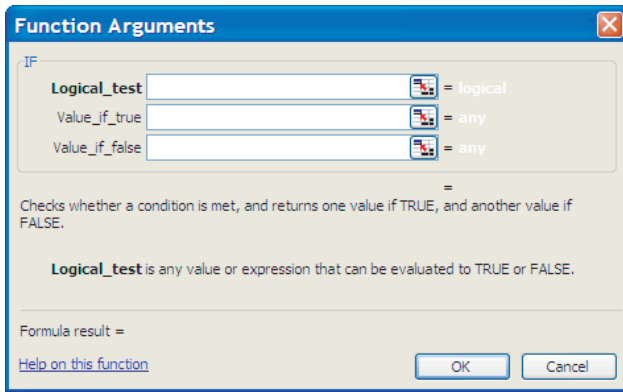
To write an IF function using the Insert Function complete the following steps:

1. Click cell **B16** to make it active.
2. Click **Insert** on the menu bar, and then click **Function** to open the Insert Function dialog box.
3. Click the **Or select a category** list box to display its list of function categories.
4. Click **Logical** in the list of function category choices, click **IF** in the Select a function list box, and then click **OK**. The Function Arguments dialog box opens (see Figure T4.2).
5. Click the **Logical\_Test** text box and type **B13 / B4 > 0.8** (there are no spaces in this line). Notice that the moment you type 0.8, the label TRUE appears to the right of

Logical operators are used to compare numbers in two or more cells to a constant.	
=	Equal to
<	Less than
>	Greater than
≤	Less than or equal to
≥	Greater than or equal to
≠	Not equal to
NOT	Logical Not
AND	Logical And
OR	Logical Or

**FIGURE T4.1**  
Logical Operators





**FIGURE T4.2**  
Function Arguments  
Dialog Box

## Goal Seek

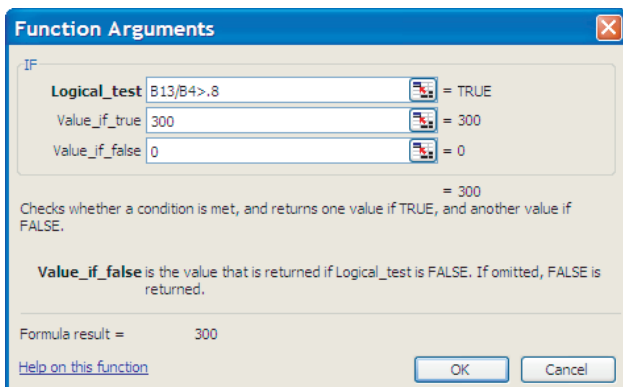
*Goal Seek* is an analytical function that allows a value in a formula to be adjusted to reach a desired result or answer. Goal Seek can eliminate unnecessary calculations that can be used to determine a single variable value in a formula. For example, a salesperson might participate in a bonus program that pays 3 percent of all sales dollars. The salesperson wants to receive a bonus of at least \$2,500 and needs to know the target sales dollar amount needed.

Create a worksheet with the following information (see Figure T4.4 for a layout sample):

Label	Cell Address	Value
Sales Dollars	B1	(unknown—leave blank)
Bonus Percentage	B2	3%
Bonus Amount	B3	=B1*B2

When the Goal Seek command starts to run, it repeatedly tries new values in the variable cell to find a solution to the problem. This process is called *iteration*, and it continues until Excel has run the problem 100 times or has found an answer within .001 of the target value specified. The iteration settings can be adjusted by choosing Tools, Options, and adjusting the Iteration options in the Calculations tab. It calculates so fast, the Goal Seek command can save significant time and effort over the brute force method of trying one number after another in a formula.

**FIGURE T4.3**  
Function Arguments  
Dialog Box



the value. That indicates the current value of the expression based on the condition you just completed.

- Click the **Value-if-true** text box and type **300**, which is the value to return if the condition is true.
- Click the **Value-if-false** text box and type **0**, which is the value to return if the condition is false (see Figure T4.3).
- Click **OK** to complete the function. Excel places the completed IF function into cell B16, calculates the value of the function, and displays 300.00 because the ratio of the down payment to the purchase price is greater than 0.8.

## USING THE GOAL SEEK COMMAND

The Goal Seek feature is used to fill in the target value of the cell containing the *Sales Dollar* amount. The Goal Seek values read “Set cell = B3, To value = 2500, By changing cell = \$B\$1.”

To use the Goal Seek command:

- Select **Tools** from the main menu, then select **Goal Seek**.
- Specify the cell that contains the desired value in the **Set cell** text box. Type in or select **B3**.
- Enter the desired value or answer in the **To value** text box. Type in **2500**.
- Enter the cell whose value will be changed in the **By changing cell** text box. Type in or select **\$B\$1**.

5. The Goal Seek dialog box should look like Figure T4.5.
6. Choose **OK**.
  - a. If a solution is found, the Goal Seek Status dialog box appears.
  - b. The results are shown in Figure T4.6.

## 7. Select **OK**.

Goal Seek is used to adjust a single variable in a formula. Use the Solver feature to adjust multiple variables in a formula, as described in the next section.

## Solver

*Solver* is part of a suite of functions sometimes called *what-if analysis tools* used for optimizing problems that contain more than one variable. The Solver add-in utility is needed to analyze the scenarios in decision-making situations that involve consideration of values and constraints for several variables simultaneously. This powerful function uses multiple changing variables and constraints to find the optimal solution to solve a problem.

For example, consider a coffee shop that currently sells three beverages: (1) regular fresh-brewed coffee, (2) premium caffe latte, and (3) premium caffe mocha. The current price for regular coffee is set at \$1.25, caffe latte at \$2.00, and caffe mocha at \$2.25, but the revenue potential is uncertain. What special emphasis (or marketing) should be given to each of the beverages to maximize revenue? Although the premium coffees bring in more money, their ingredients are more expensive and they take more time to make than regular coffee. Making some basic calculations by hand is easy, but there needs to be some structure to the sales data in a worksheet so that periodic changes can be made and analyzed. To set up the Solver scenario, follow these steps:

## INSTALLING SOLVER

Solver comes with the standard Excel package, but it has to be installed. To install Solver, do the following:

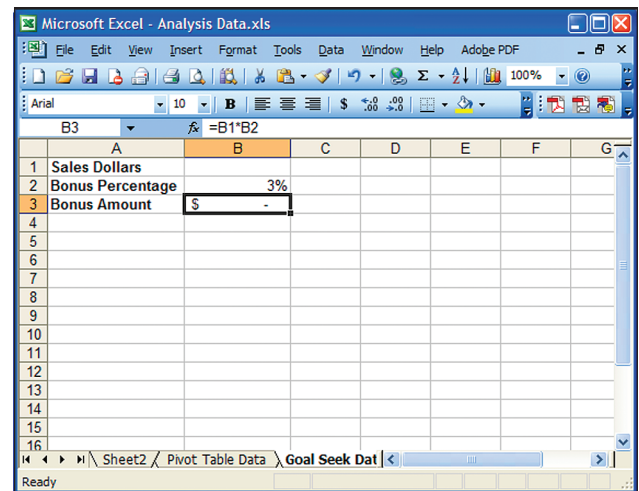
1. Select **Tools** from the main menu, then select **Add-Ins**.
2. After clicking **Add-Ins**, scroll down to **Solver Add-in** and click the box.

## SETTING UP THE PROBLEM

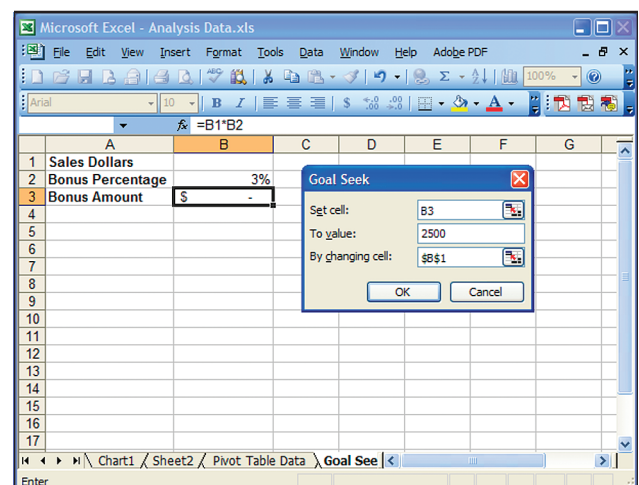
The first step in using the Solver command is to build a “Solver-friendly” worksheet. This involves creating a target cell to be the goal of your problem—for example, a formula that calculates total revenue—and assigning one or more variable cells that the Solver can change to reach the goal.

To use Solver, complete the following:

1. Set up a worksheet similar to Figure T4.7.
2. The three variable cells in the worksheet are cells **D5**, **D9**, and **D13**. These are the cells whose values the Solver needs to determine to maximize the weekly revenue.
3. In the bottom-right corner of the table is a list of constraints to use for forecasting.



**FIGURE T4.4**  
Goal Seek Worksheet



**FIGURE T4.5**  
Goal Seek Function



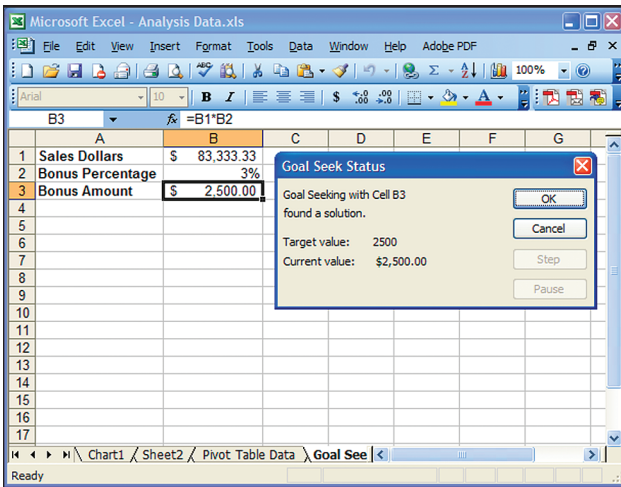


FIGURE T4.6

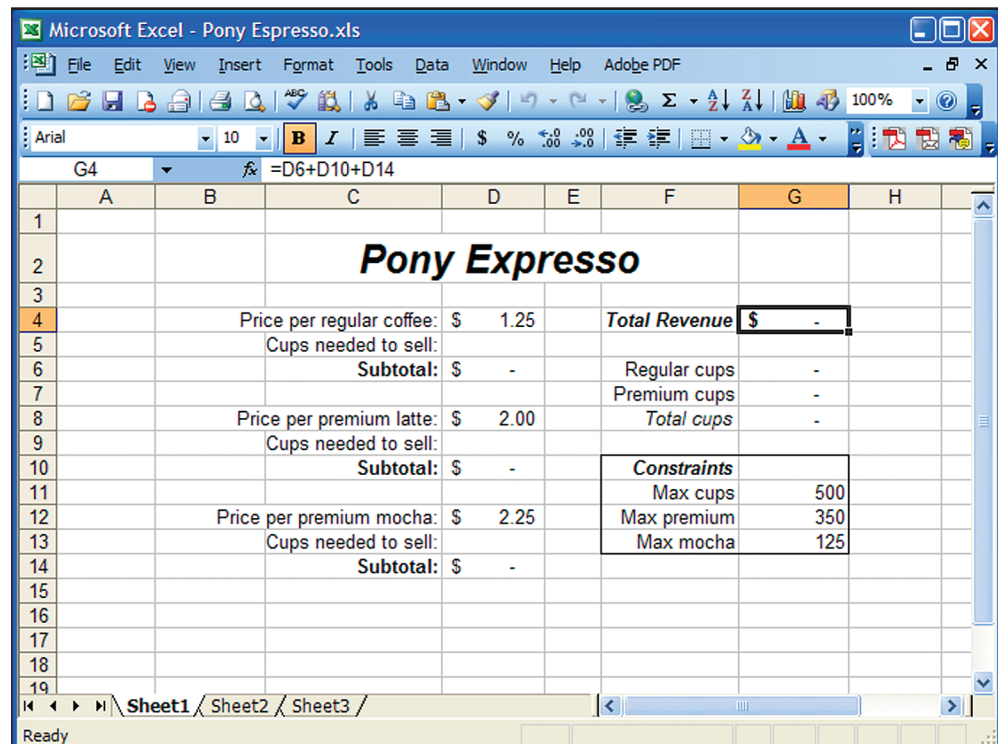
Goal Seek Results

4. The worksheet must contain cells (G6 through G8) that include the formulas used as constraints. The limiting values for the constraints are listed in cells G11 through G13.
  - No more than 500 total cups of coffee (both regular and premium).
  - No more than 350 cups of premium coffee (both caffe latte and caffe mocha).
  - No more than 125 caffe mochas.
5. The subtotals for cells **D6**, **D10**, **D14** need to be calculated, as well as the **Total Revenue** (sum of D6, D10, and D14) in **G4**.
6. The value for cell **G6** should equal the value that will be calculated for **D5** and the value for cell **G7** will be the sum of the values from D9 and D13. The calculation of **G8** = SUM of D5, D9, and D13.

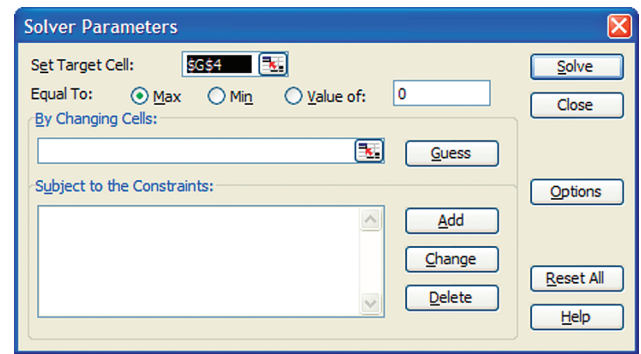
7. Click the target cell **G4**—the one containing the formula that is based on the variable cells you want the Solver to determine.
8. Select **Tools** from the main menu, then select **Solver**. The Solver Parameters dialog box opens, as shown in Figure T4.8. Select the **Set Target Cell** text box (unless it already contains the correct reference), and then click cell **G4** to insert **\$G\$4** as the target cell. The **Equal To** option button (Max) is already selected. Do not change this since the problem requests the maximum value for the target cell.
9. Select the **By Changing Cells** text box. Click the button in the text box to collapse the dialog box. Select each of the variable cells by holding down the **Ctrl** key and clicking **D5**, **D9**, and **D13**. This places commas between the three cell entries in the text box: **\$D\$5, \$D\$9, \$D\$13** (refer to Figure T4.9).

FIGURE T4.7

Coffee Sales Data  
Sheet for Solver



10. This problem has three constraints. Click **Add** to add the first constraint in the Add Constraint dialog box.
  - a. The first constraint is Pony Espresso can sell only 500 cups of coffee in one week. To enter this constraint, click cell **G8**, click **<=** in the operator drop-down list, and with the insertion point in the Constraint text box, type or click cell **G11**.
  - b. Click **Add** to enter the first constraint and begin the second constraint—Pony Espresso can sell only 350 premium coffees in one week. With the insertion point in the Cell Reference text box, click cell **G7**, click **<=** in the operator drop-down list, and in the Constraint text box, type or click cell **G12**.
  - c. Click **Add** to enter the second constraint and begin the third—Pony Espresso can sell only 125 caffe mochas in one week. Click cell **D13**, click **<=** in the operator drop-down list, and in the Constraint text box, type, or click cell **G13**.
  - d. Click **OK** to add all three constraints to the Solver Parameters dialog box as shown in Figure T4.10.
11. Click **Solve** to calculate the result.
12. Solver displays a dialog box describing the results of the analysis. If the Solver runs into a problem, an error message will be displayed. If the Solver finds a solution, a Solver Results dialog box like Figure T4.11 will appear.
13. To display the new solution in the worksheet, click the **Keep Solver Solution** option button, and then click **OK**. The Solver places an optimum value in the target cell and fills the variable cells with the solutions that satisfy the constraints specified and provide the optimal result, as shown in Figure T4.12.



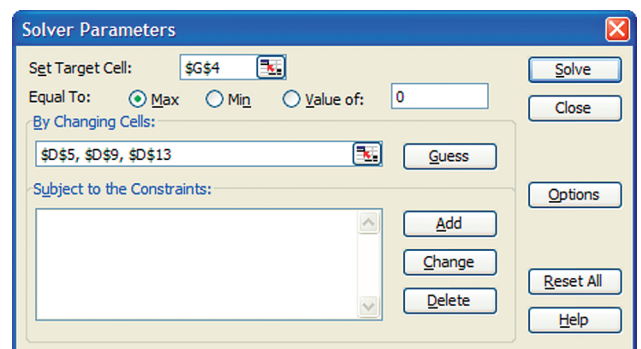
**FIGURE T4.8**  
Solver Parameters  
Dialog Box

## EDITING A SOLVER FORECAST

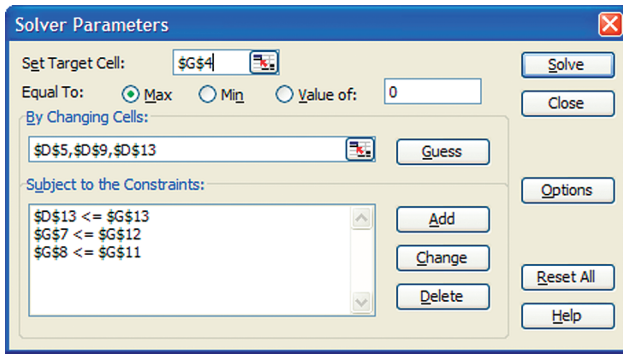
The Solver tool is very useful in modifying the constraints to evaluate new goals and possibilities. For example, if Pony Espresso wants to earn exactly \$800 per week from coffee drinks, use the Solver to “solve” for the optimum combination of drinks. Setting a target value in the Solver is a little like using the Goal Seek command to determine a value for an unknown variable, although Solver can use more than one variable. To edit the Solver forecast to find the variables to reach a specific goal, follow these steps:

1. Select **Tools** from the main menu, then select **Solver**. The Solver Parameters dialog box appears, still displaying the variables and constraints of the last Solver problem. These will be adjusted to compute a new forecasting goal.
2. Click the **Value of** option button and type **800** in the text box to the right. The **Value of** option button sets the target cell to a particular goal to determine the variable mix needed to reach the milestone. The dialog box should look similar to Figure T4.13.
3. Click **Solve** to find a solution to the problem. When the Solver has finished, click **OK** to display the new solution.
4. Figure T4.14 shows the new solution that Solver generates.

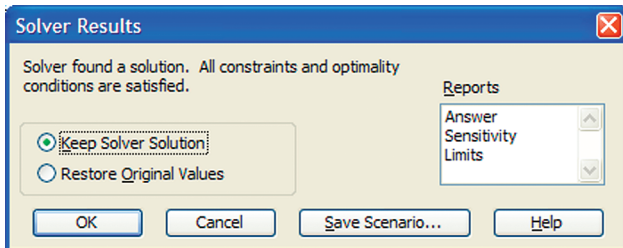
**Note:** The results presented in Figure T4.14 is one possible solution that Solver may return.



**FIGURE T4.9**  
Solver Parameters by  
Changing Cells Values



**FIGURE T4.10**  
Solver Parameters  
with Constraints



**FIGURE T4.11**  
Solver Results Dialog  
Box

**FIGURE T4.12**  
Optimum Revenue for  
Solver Results

values or scenario in the worksheet. The Scenario Manager eliminates the need to have multiple copies of the same worksheet representing different situations. For each group of input values a scenario must be named and stored before it can be used.

## Scenario Manager

A *scenario* is a set of input values and corresponding results from calculations that Excel can save and report as needed. A worksheet can be used to conduct a “what-if” analysis on a particular set of data. Several input values in a worksheet might change depending on different situations or circumstances. Values that produce different results can be stored as scenarios.

Excel's *Scenario Manager* allows 32 different scenarios or groups of values to be defined. The Scenario Manager can then be used to selectively display the desired

### SETTING UP SCENARIOS

Each group of input values or scenarios must be named and stored before it can be used. Scenarios are stored with the worksheet. To set up a scenario:

1. Open the file **T4\_Scenario\_Data.xls** on the CD. (see Figure T4.15).
2. Select the cells containing the first set of values to store in a scenario.
3. On the toolbar, select **Tools**, from the main menu, then select **Scenarios**.
4. Click **Add** to display the Add Scenario dialog box.
5. Enter **Original** for the Scenario name.
6. In the Changing Cells text box, type **D9:D11** or use the Collapse Dialog button at the right side of the text box to manually select the cells that hold the Number of

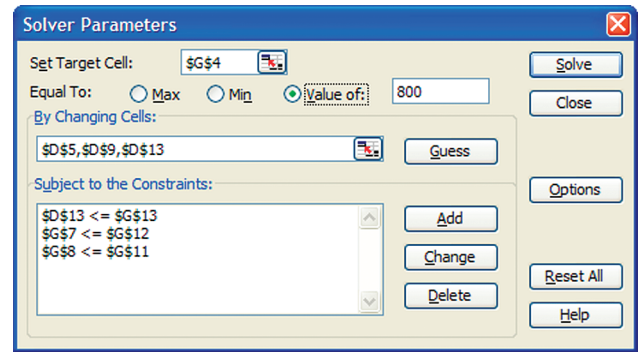
Microsoft Excel - Pony Espresso.xls

	A	B	C	D	E	F	G	H
1								
2								
3								
4			Price per regular coffee:	\$	1.25		Total Revenue	\$ 918.75
5			Cups needed to sell:		150			
6			Subtotal:	\$	187.50		Regular cups	150
7							Premium cups	350
8			Price per premium latte:	\$	2.00		Total cups	500
9			Cups needed to sell:		225			
10			Subtotal:	\$	450.00			
11							Constraints	
12			Price per premium mocha:	\$	2.25		Max cups	500
13			Cups needed to sell:		125		Max premium	350
14			Subtotal:	\$	281.25		Max mocha	125
15								
16								
17								
18								
19								

Sheet1 / Sheet2 / Sheet3 /

Technicians, Regular Hours, and Over Time Hours values.

7. Choose **OK**. The Scenario Values dialog box appears.
8. The Scenario Values dialog box will display the values for cells D9, D10, and D11 as 1, 300, and 0, respectively, as shown in Figure T4.16. Click **OK**.
9. Once the Original has been saved, the what-if scenarios need to be created.
10. Click **Add**. In the Add Scenario dialog box, type **Single Contractor Overtime**.
11. Click **OK**. In the Scenario Values dialog box for cell D10, type **300** and for cell D11 enter **40**. The value in D9 remains at **1**.
12. Click **OK**. Ensure that the Single Contractor Overtime scenario is selected, and click **Show**. Excel reports that this project will need an additional \$3,000, as shown in Figure T4.17.
13. Create one more scenario. In the Scenario Manager dialog box, click **Add** again.
14. The Add Scenario dialog box appears. In the Scenario Name text box, type **Two Contractors No Overtime**.
15. The Changing Cells (D9:D11) should already appear in the proper text box; if not, enter that range. Click **OK** to invoke the Scenario Values dialog box.
16. Two outside contractors are brought in (by charging \$200 for each additional technician). Enter **2** in the text box for cell D9 and **0** in the text box for cell D11. This time in cell D10's text box, type **=300/2** since there will be two technicians to split the time. Click **OK**. A message box shown in Figure T4.18 says that Excel converted the formula into a value.
17. Click **OK** to dismiss the message, and Excel returns you to the Scenario Manager dialog box.
18. Select **Two Contractors** and click **Show**. Excel displays 150 in cell D10 even though the total hours are 300. This scenario gives a completion cost of \$15,200.



**FIGURE T4.13**  
Editing Solver Forecast

Microsoft Excel - Pony Espresso.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF Type a question for help

Arial 10 B I U

G4 =D6+D10+D14

	A	B	C	D	E	F	G	H	I
3									
4			Price per regular coffee:	\$ 1.25		Total Revenue	\$ 800.00		
5			Cups needed to sell:	123					
6			Subtotal:	\$ 153.57		Regular cups	123		
7						Premium cups	309		
8			Price per premium latte:	\$ 2.00		Total cups	432		
9			Cups needed to sell:	197.85714					
10			Subtotal:	\$ 395.71		Constraints			
11						Max cups	500		
12			Price per premium mocha:	\$ 2.25		Max premium	350		
13			Cups needed to sell:	111.42857		Max mocha	125		
14			Subtotal:	\$ 250.71					
15									
16									
17									
18									
19									
20									
21									

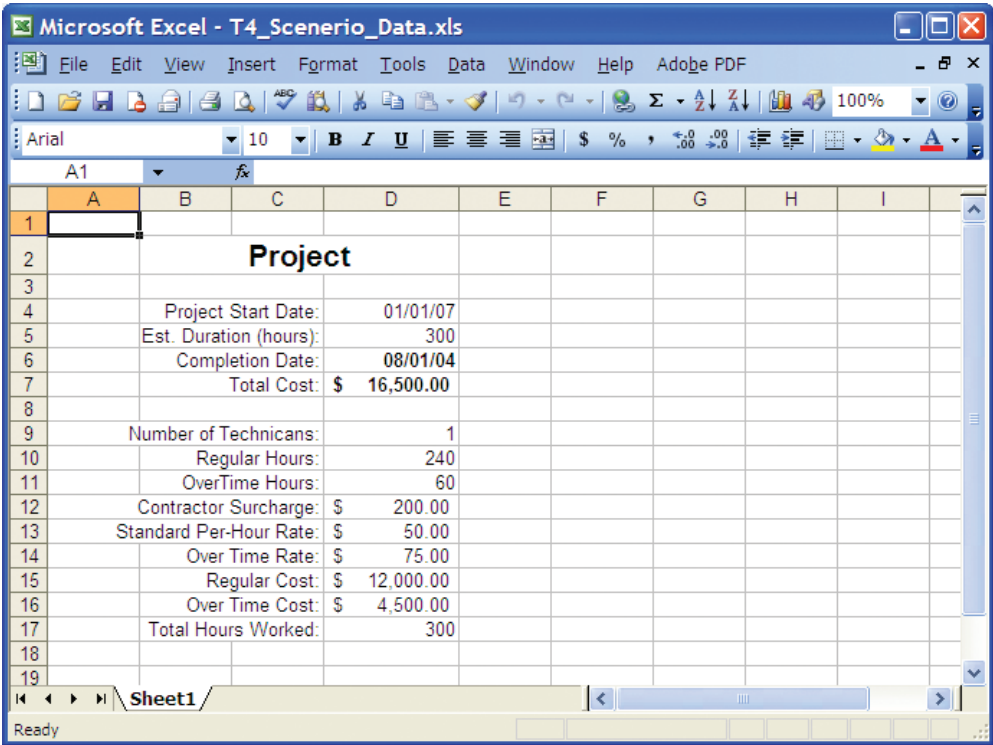
Sheet1 Sheet2 Sheet3

Ready

**FIGURE T4.14**  
Solver Solution



**FIGURE T4.15**  
Scenario Data  
Template Example



**Compare the Scenarios**

Compare each scenario to determine the best solution, such as:

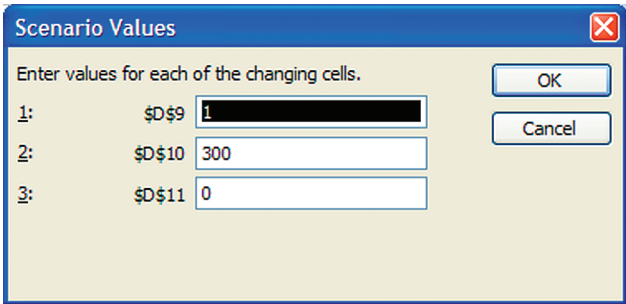
Scenario	Cost
Original	\$15,000
Single Contractor Overtime	\$18,000
Two Contractors No Overtime	\$15,200

**MODIFYING A SCENARIO**

**FIGURE T4.16**  
Scenario Values Dialog  
Box Values

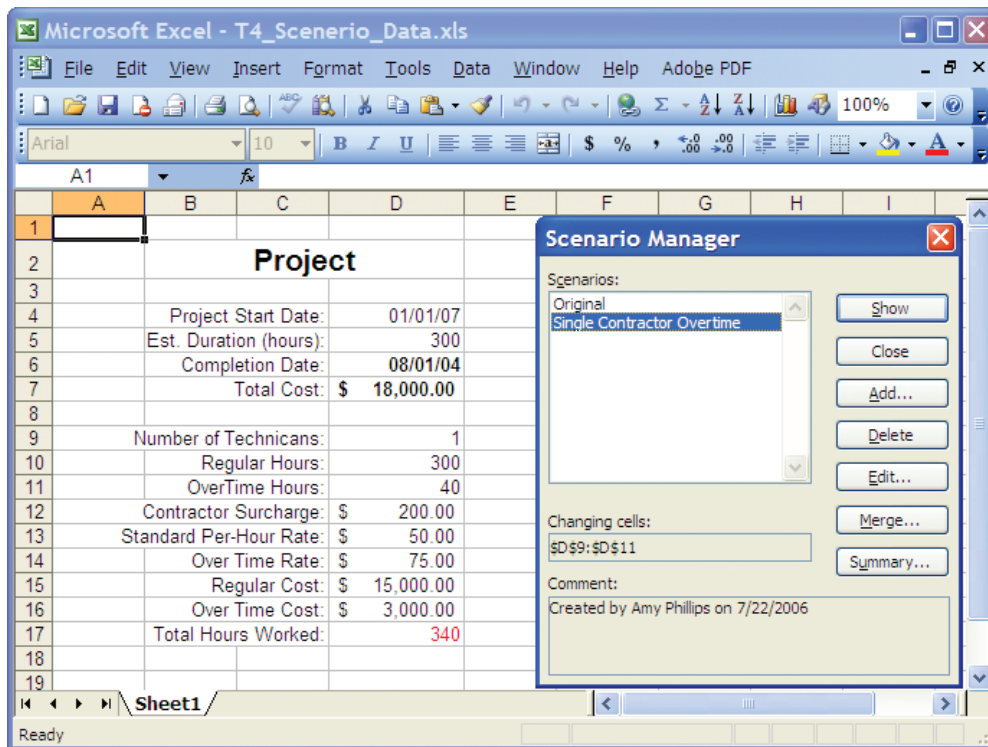
Once scenarios have been defined, the data values in the scenarios can be modified, as needed. To modify a scenario:

1. Select **Tools** from the main menu, then select **Scenarios**.
2. Select the desired scenario name.
3. Choose **Edit**.
4. Modify the scenario information as desired.
5. Close the Scenario Manager dialog box.



**CREATING A SCENARIO SUMMARY REPORT**

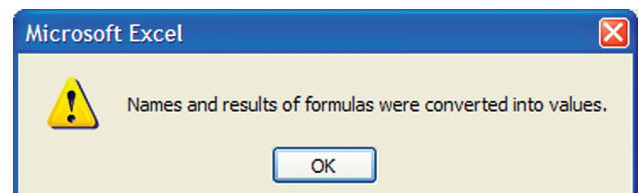
Included in the Scenario Manager is a feature called the Summary Report that creates a report that summarizes the result cells that are affected by a scenario. The Summary Report appears in the form of a summary table that is placed on a new worksheet, which can be printed.



**FIGURE T4.17**  
Single Contractor  
Overtime Scenario

To create a Scenario Summary Report:

1. Select **Tools** from the main menu, then select **Scenarios**.
2. Choose **Summary**.
3. Choose **Scenario summary** in the Report type group box.
4. In the Result cells text box, type in **D7, D12, D15, D16, D17**. Result cells are the cells affected by the specified scenario.
5. Choose **OK**.
6. Excel produces a Scenario Summary Report like Figure T4.19.



**FIGURE T4.18**  
Message Dialog Box

Current Values:		Original	Single Contractor Overtime	Two Contractors No Overtime
Changing Cells:				
\$D\$9	2	1	1	2
\$D\$10	150	300	300	150
\$D\$11	0	0	40	0
Result Cells:				
\$D\$7	\$ 15,200.00	\$ 15,000.00	\$ 18,000.00	\$ 15,200.00
\$D\$12	\$ 200.00	\$ 200.00	\$ 200.00	\$ 200.00
\$D\$15	\$ 15,000.00	\$ 15,000.00	\$ 15,000.00	\$ 15,000.00
\$D\$16	\$ -	\$ -	\$ 3,000.00	\$ -
\$D\$17	300	300	340	300

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

**FIGURE T4.19**  
Scenario Summary  
Report



## \* PLUG-IN SUMMARY

Technology can and does play a vitally important role in both supporting decision making and, in some instances, actually making decisions or recommendations. Microsoft Excel is spreadsheet software that has an integrated set of tools that combine the analytical methods that can be applied to different problems. If function, Goal Seek, Solver, and Scenario Manager are analysis tools that have the capability to identify patterns, trends, and rules and create “what-if” analyses.

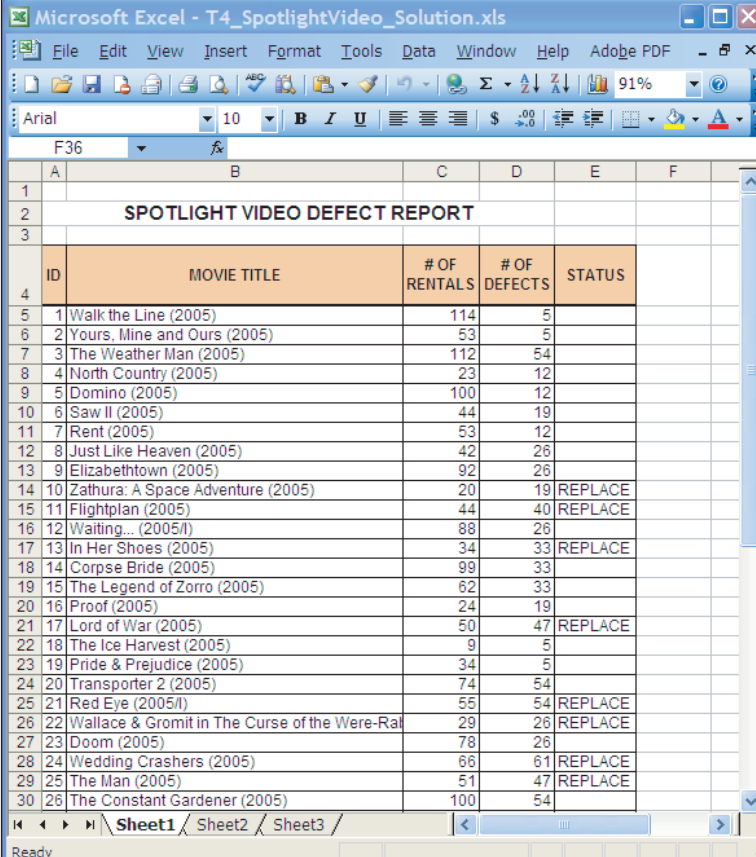
## \* MAKING BUSINESS DECISIONS

### 1. Spotlight Video Rentals

Spotlight Video is a premier video rental company in Denver, Colorado, offering the latest selections on DVD, game, and VHS releases. After DVDs and VHS tapes have been viewed a certain number of times, their quality deteriorates to the point that Spotlight Video considers them to be defective. Furthermore, some customers own DVD and VHS players that are defective and can ruin Spotlight Video’s merchandise.

Spotlight Video wants to maintain an inventory of DVDs and VHS tapes that are at least 85 percent acceptable; although 95 percent is preferable. However, since it can’t keep customers’ machines from damaging the rentals, Spotlight Video has had to relax its criterion

**FIGURE T4.20**  
Spotlight Video  
Report Sample



ID	MOVIE TITLE	# OF RENTALS	# OF DEFECTS	STATUS
1	Walk the Line (2005)	114	5	
2	Yours, Mine and Ours (2005)	53	5	
3	The Weather Man (2005)	112	54	
4	North Country (2005)	23	12	
5	Domino (2005)	100	12	
6	Saw II (2005)	44	19	
7	Rent (2005)	53	12	
8	Just Like Heaven (2005)	42	26	
9	Elizabethtown (2005)	92	26	
10	Zathura: A Space Adventure (2005)	20	19	REPLACE
11	Flightplan (2005)	44	40	REPLACE
12	Waiting... (2005/I)	88	26	
13	In Her Shoes (2005)	34	33	REPLACE
14	Corpse Bride (2005)	99	33	
15	The Legend of Zorro (2005)	62	33	
16	Proof (2005)	24	19	
17	Lord of War (2005)	50	47	REPLACE
18	The Ice Harvest (2005)	9	5	
19	Pride & Prejudice (2005)	34	5	
20	Transporter 2 (2005)	74	54	
21	Red Eye (2005/I)	55	54	REPLACE
22	Wallace & Gromit in The Curse of the Were-Rat	29	26	REPLACE
23	Doom (2005)	78	26	
24	Wedding Crashers (2005)	66	61	REPLACE
25	The Man (2005)	51	47	REPLACE
26	The Constant Gardener (2005)	100	54	

a little. You have been hired to create a spreadsheet that will evaluate each DVD and VHS based on the following criteria:

- Number of times each title has been rented.
- Number of defects that have been reported.
- The percent of defects must be above 85 percent based on usage. If the percentage reported is below 85 percent, then Spotlight Video wants to flag this video as “REPLACE.”

Spotlight Video has provided you with the data in a file called **T4\_SpotlightVideo\_Data.xls**. You will want to create an IF function to write a conditional expression that examines the criteria mentioned above. Figure T4.20 displays a sample of the output that Spotlight Video needs.

## 2. Scheduling Solver

AirPlains Airline is a new airline company that maintains a schedule of two daily flights each way between Salt Lake City, Denver, and Chicago. AirPlains Airline must strategically position itself as a low-cost provider in a volatile industry. Therefore, it must work toward finding a minimum cost for assigning flight crews to a given flight schedule while satisfying restrictions dictated by the Federal Aviation Administration.

Using Excel Solver, determine all the possible crew rotations based on the flight schedule below. You will want to find an approximate expected cost of each combination and then solve the original crew scheduling problem by using these costs. Secondly, you will want to calculate the crew constraints to determine the decision variables, constraints, and objectives.

The AirPlains Airline flight schedule is as follows:

From	To	Departure	Arrival
Salt Lake City	Denver	9:00AM	12:00PM
Salt Lake City	Denver	2:00PM	5:00PM
Salt Lake City	Chicago	10:00AM	2:00PM
Salt Lake City	Chicago	3:00PM	7:00PM
Denver	Salt Lake City	8:00AM	11:00AM
Denver	Salt Lake City	2:00PM	5:00PM
Denver	Chicago	9:00AM	11:00AM
Denver	Chicago	3:00PM	5:00PM
Chicago	Salt Lake City	8:00AM	12:00PM
Chicago	Salt Lake City	2:00PM	6:00PM
Chicago	Denver	10:00AM	12:00PM
Chicago	Denver	4:00PM	6:00PM

Apply the following business rules (constraints) to your model:

1. A crew that leaves a city in the morning has to return to the same city at night.
2. The crew can return on another airplane. There are six airplanes in use.
3. When a crew is flying, the cost is \$200 per hour.
4. When a crew is waiting or returning, the cost is \$75 per hour.

### 3. DVD Sales

Hans Hultgren, the sales manager for DVD Sales, wants to maximize his profit on the sale of portable DVD players. He already has two portable models he plans to sell:

Products	Retail Price	Wholesale Cost
Panasonic DVD-LS50	\$349.95	\$192.47
Mintek MDP-1810	\$199.95	\$109.99

Hans needs your help in calculating his maximum profit. First, he would like you to use the Web to locate the retail price of two other portable DVD players not listed in the table above. The wholesale price of each unit is 55 percent of the retail price for both units you find. Hans has two constraints:

1. Hans has \$200,000 to purchase new DVD players. The total wholesale cost of the four types of DVD units must be less than \$200,000.
2. Hans must purchase a minimum of 100 units of each player from his wholesaler.

You want to use Excel Solver to maximize the total profit for Hans with the constraints mentioned above and limiting the number of units to positive integers.

### 4. Maximizing Profit

HotSprings Spas manufactures and sells two spa models: the Steamboat and the Classic. HotSprings Spas receives spa bodies from another manufacturer and then adds a pump and tubing to circulate the water. The Steamboat model demands 15.5 hours of labor and 14.5 feet of tubing. The Classic model requires 10.5 hours of labor and uses 20 feet of tubing. Based on selling patterns, the owner, Deborah Liebson, has determined that the Steamboat model generates a profit of \$400 per unit, and the Classic model generates \$345 profit. While Deborah would like a large labor capacity and sufficient tubing and motors to build any number of spas, her resources are limited. For the next production period, Deborah has 2,650 labor hours, 3,450 feet of tubing, and 231 pumps available. Deborah

**FIGURE T4.21**  
HotSprings Spa  
Template

HotSprings Spas			
Assumptions		Steamboat	Classic
Quantity to produce			
Profit per unit		\$ 400	\$ 345
Total Profit		\$ -	
Constraints		Steamboat	Classic
Labor to build (hours)		15.50	10.50
Piping required (feet)		14.50	20.00
Pumps required		1	1
Pool of available resources		Allocated	Available
Labor		-	2,650
Piping		-	3,450
Pumps		-	231

needs assistance in figuring out how many Steamboat and Classic models to build in order to maximize her profit. Given the constraints above, use Solver to assist Deborah in her what-if analysis.

Deborah has provided you with a screen shot (see Figure T4.21) of a template you can use to get started.

## 5. Budget Constraints

Joanne Krol wants to purchase a newer model automobile to replace her rusty 1989 car. The bank where Joanne has a checking account, US Bank, is advertising an annual interest rate of 6.75 percent for a three-year loan on used cars. By selling her old car and using some cash she has accumulated, Joanne has \$3,000 available as a down payment. Under her current budget, Joanne figures that the maximum monthly loan payment she can afford is \$300. She wants to find out the maximum car price she can afford and keep the monthly payment no higher than \$300. She cannot alter the interest rate or the three-year term. Use the Excel Goal Seek command to figure out the highest purchase price Joanne can afford.