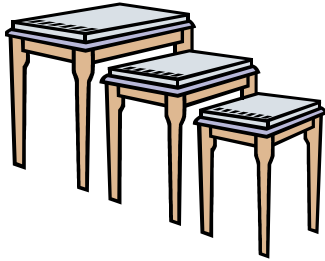# Tutorial 9

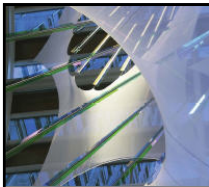## Data Tables and Scenario Management

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Review

- Data Validation

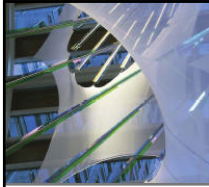- Protecting Worksheet

- Range Names

- Macros

Examine cost-volume-profit relationships

- Suppose you were the owner of a water store. An advertising agency offers to guarantee that using their ad campaign would increase the volume of your business by 50 percent.
  - How could you decide if the ad campaign would be worth the cost?
- Or, suppose that you are the chairman of a group that is considering beginning a charter school.
  - What kind of information would you need to figure out if the school would be feasible?
- In both of these cases, what you need is a cost-volume-profit analysis, also called a *CVP analysis* or a *break-even analysis*.
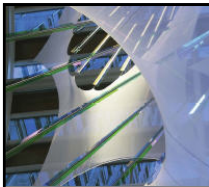
What is a CVP analysis?

- A CVP analysis shows the relationship between a business's expenses, volume of business, and profit.
- It shows how much volume the business needs to break even, given the expenses that the business incurs.
- It also shows what happens to the profit if the volume of business increases above the break-even point, or decreases below the break-even point.
- To do a CVP analysis, it is first necessary to figure the expenses of the business.
- Three types of expenses need to be considered: variable, fixed, and mixed.

Expense types used for a CVP analysis

- *Variable* expenses are those that change with the volume of business. For example, the cost of renting a desk for each student increases as the number of students increases.
- *Fixed* expenses are those that must be paid, regardless of the number of customers. For example, at the school, the teachers' salaries are a fixed cost that must be met, no matter how many students there are
- *Mixed* expenses are part variable and part fixed.
  - Teacher expense is both a variable expense, based on the volume of business, and a fixed expense, in that once a teacher is hired, the salary must be met regardless of the volume
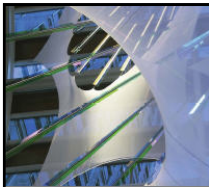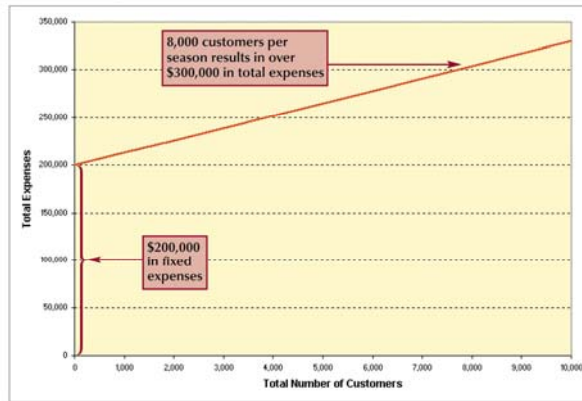
Calculate the income for a CVP analysis

- Once you have determined the expenses, you need to calculate the income, based on the volume of business.
- In the case of the school, income would be the tuition paid by each student multiplied by the number of students.
- Then, to find the CVP relationship, you would add the fixed costs to the total variable costs and compare that to the total income.
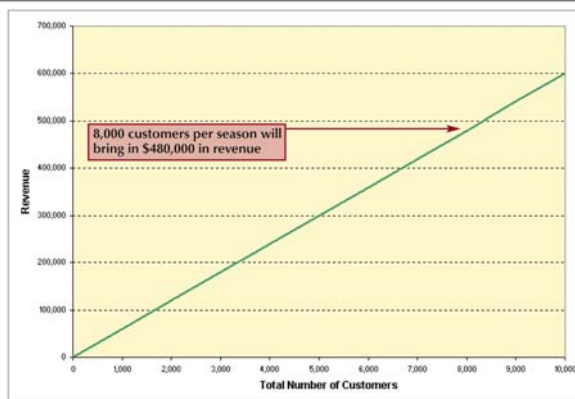
An example of a total expenses chart

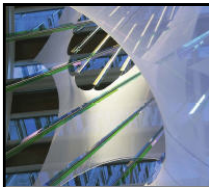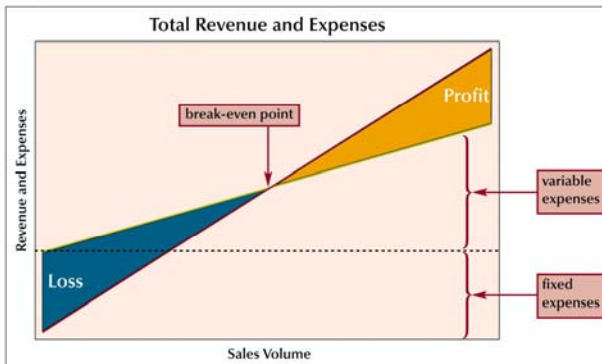Figure 9-2 — Chart of total expenses

An example of a revenue chart

Chart of revenue — Figure 9-3

An example of a CVP chart

Figure 9-4 ▸ Sample CVP chart

Total Revenue and Expenses

break-even point

Profit

Revenue and Expenses

variable expenses

Loss

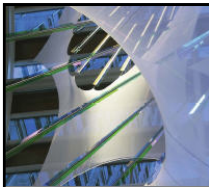fixed expenses

Sales Volume

Calculate profit or loss

- How can you calculate the profits from a business? If you know:
  - the fixed expenses
  - the total variable expenses for a given volume of business
  - the total revenue for that same volume of business
- All you have to do is add the expenses and subtract them from the revenue.

Calculate the net income

- For example, suppose that you want to figure the profits from a charter school. You know that:
  - you are going to have 60 students
  - the total fixed cost per month is $25,000
  - the variable cost per student is $500
  - the tuition income per student is $1000
- To figure the monthly profit:
  - Calculate the total expenses ($25,000 + $500*60 = $55,000)
  - And the total revenue ($1000*50 = $60,000)
  - Then you subtract the expenses from the revenue ($60,000 - $55,000) to get the net income ($5,000)

Use Excel to calculate net income

Income statement for Front Range Rafting   Figure 9-5

	A	B	C
1	**Front Range Rafting**		
2	Income Statement		
3	Seasonal Estimates		
4			
5	Season Information		
6	Length of Season (days)	120	
7	Avg. Number of Customers (per day)	45	
8	Total Number of Customers	5,400	
9			
10	Revenue		
11	Fee per Customer	60	
12	Total Revenue	$ 324,000	
13			
14	Variable Expenses		
15	Expense per Customer	3	
16	River Usage Tax per Customer	10	
17	Total Variable Expenses	$ 70,200	
18			
19	Fixed Expenses		
20	Insurance	10,000	
21	Maintenance	25,000	
22	Salary and Benefits	95,000	
23	Administrative & Advertising	35,000	
24	Est. Taxes	35,000	
25	Total Fixed Expenses	$ 200,000	
26			
27	Summary		
28	Total Revenue	324,000	
29	Total Expenses	270,200	
30	Net Income	$ 53,800	

Use a what-if analysis

- Suppose you think that it might be better for the students if you limited the enrolment to 40. How would you calculate the net income?
- On the spreadsheet that you have set up to figure the profits, change the number of students from 60 to 40, and recalculate.
- The spreadsheet will show a net income of $5000.
- Thus, at only 40 students, the school would lose $5,000 per month.
- This process of changing the value of a variable in a calculation to see how the new answer compares with the old answer is called a *what-if analysis*.

Use multiple what-if analyses

- If you are interested in doing several what-if analyses (for example, you'd like to see what the net income for the school would be for several different enrolments), you could do it by repeating the above analysis for each scenario.
  - That is, change the enrollment to several different values, and see what effect this has on the net income
- Also, suppose that you would like to see what would happen to the net income if you raised (or lowered) the tuition.
- You could do this by entering several tuition amounts into the spreadsheet and noting the resulting net income.
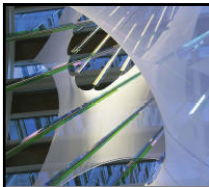- This is the principle of multiple what-if analyses.

Data Tables - organize and display results of what-if analysis

Two types of data tables:

- One–variable: allows single input but unlimited number of formulas
- Two-variable: Allows two input variables, but only one formula

- Input cells – contain values you want to modify
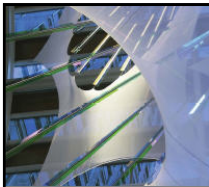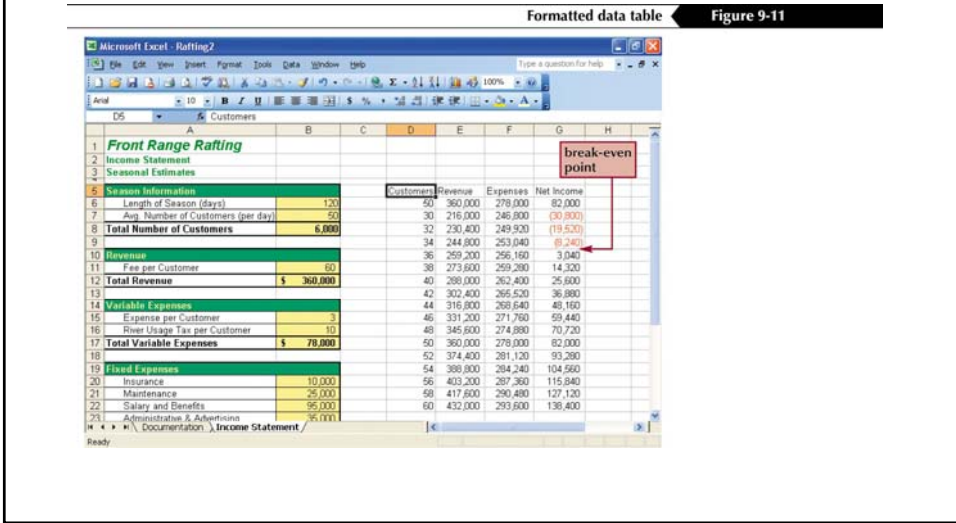- Result cells – contain values you want to examine

Use one-variable data tables to perform a what-if analysis

- Doing multiple what-if analyses is time-consuming and tedious if you do it by hand.
- You can ask Excel to do multiple what-if analyses, and display the results in a table.
  - For example, you could ask Excel to show you how the net income from the charter school varies as the number of students changes from 30 to 70
- To set up a one-variable data table in Excel, you first need to set up a spreadsheet that calculates the result you are interested in, based on a particular input. (model)
- Once you have the spreadsheet set up with the proper formulas, you can proceed to create the data table.

An example of a one-variable data table
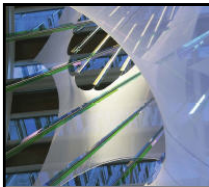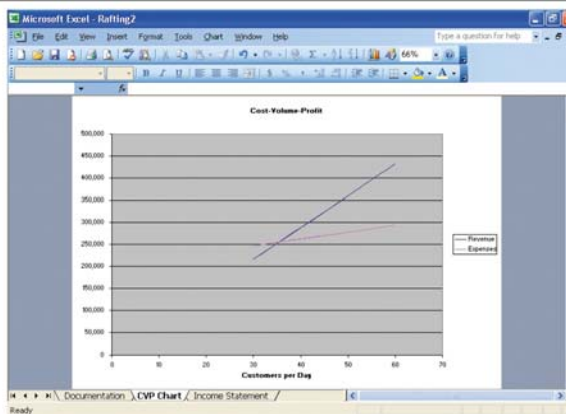

Formatted data table — Figure 9-11

Create a chart from a data table

- It is often easier to understand data if it is displayed on a chart or graph.
- Excel provides the capability of displaying the cost-volume-profit data in a CVP chart.
- If you ask Excel to plot the expenses and the revenue against the volume, the result will be a CVP chart.
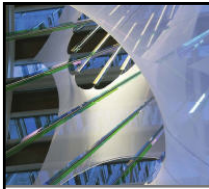- To create the CVP chart, highlight the part of the data table you want to chart.

A CVP chart based on a data table

Figure 9-13   The completed CVP chart

Use two-variable data tables to perform a what-if analysis

- Excel provides the capability to create two-variable data tables, which allow two input variables, and one result variable.
    - The data table will have the values for one input variable across the top row of the table, and the values for the other input variable down the first column
- Excel can create a data table that will display the net income based on different tuition values and different student counts.
    - As with a one-variable data table, to create a two-variable data table in Excel, you must first create a spreadsheet that calculates net income based on the number of students and the amount of tuition
    - Once the spreadsheet is set up, you can create the two-variable data table

An example of a two-variable data table
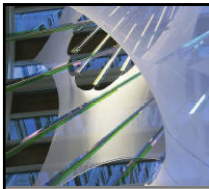
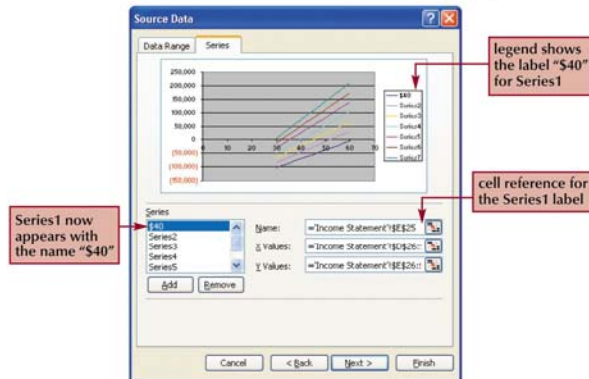Figure 9-15   A sample two-variable data table

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Create a graph for a two-variable table

- Just as Excel can create a graph of a one-variable data table, it can also create a graph of a two-variable data table.
- To do this, select the entire table.
- From the Insert menu, click Chart. Choose *XY (Scatter)* and *Scatter with data points connected by lines without markers*.
- Follow the instructions on the Chart dialog boxes to label the graph and the axes.
- Tell Excel to put the graph on a new sheet.
- When you click Finish, Excel will display a graph of the data table, with a different line for each of the rafting fees, using the example table from the previous slide.

A CCP chart for a two-variable data table

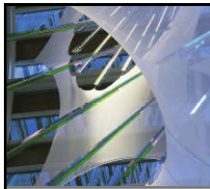Setting up the series titles — Figure 9-20

Use array formulas in Excel

- In Excel, an array is a set of cell ranges or a collection of data values.
  - For example, B5:B12 is an array of cell ranges; {2,4,6,8} is an array of data values
- Many Excel functions allow you to enter arrays as arguments.
- If you use an array argument in a formula, the formula is an *array formula*.
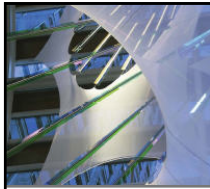- Excel uses each value in the array to produce its result.

Create and use array formulas

- For example, using the Excel function SUM, you could create the array formula =SUM(B3:B12*C2).
- To ask Excel to treat this as an array formula, press and hold the Ctrl key and the Shift key while you press the Enter key (rather than just using the Enter key to enter the formula into the cell).
- This will cause Excel to put brackets around the formula, so that it looks like this: {=SUM(B3:B12*C12)}.
  - Don't try to type in the brackets themselves; if you do, Excel will treat the formula as text
- Excel will interpret the formula {=SUM(B3:B12*C12)} as a command to multiply each of the values in B3:B12 by the value in C12, and calculate the sum of the values.

Create formulas using multiple arrays

- Another example of an array formula using SUM is {=SUM(B3:B12*C3:C12)}.

- Using this formula, Excel will multiply the first element in the first array by the first element in the second array, the second element of the first array by the second element of the second array, and so on, pair-wise through both arrays.

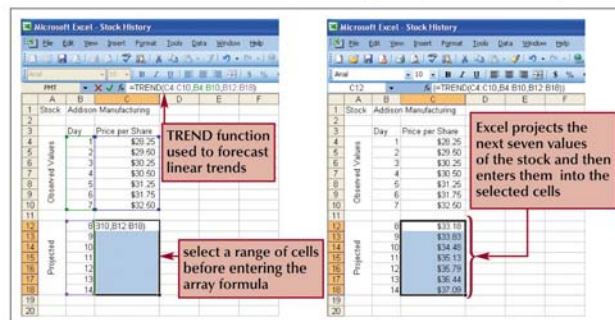- The two arrays must be the same size; if not, Excel returns an error message.

Functions can display multiple values

- A few of the functions in Excel can display multiple values when given array arguments.
- Some examples are TABLE and TREND.
- Formulas that display several values must be entered into a range of cells that has the same number of rows and columns as the input array arguments have.

An example of Excel's Trend function

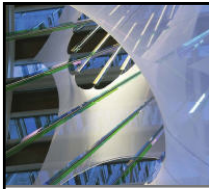Using an array formula for multiple values — Figure 9-24

Create scenarios to perform what-if analyses

- To perform what-if analyses with more than two input variables, you have to use *scenarios,* which are:
  - A set of values that Excel can put into a worksheet
  - Created based on existing spreadsheets in Excel
- You use the Scenario Manager to set up and view different scenarios.
- Once you have the spreadsheet with one set of values, you can create several scenarios with different values.
- As you view each scenario, Excel uses the values in the scenario as input to calculate the results.
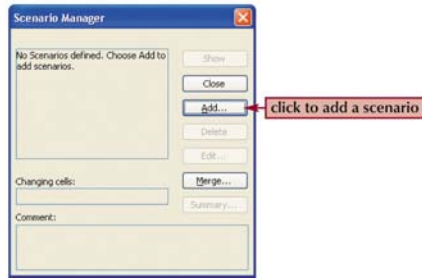
Use the Scenario Manager dialog box

- To invoke the Scenario Manager and begin creating scenarios, start the Scenario Manager by choosing Scenarios from the Tools menu.
- In the Scenario Manager dialog box, click the Add button, and enter a name for the scenario.
- Enter the name for your first case, such as Normal Case.
- Type in the reference to each of the cells that are going to change during the scenarios.
- When you click OK, the Scenario Manager will prompt you for a set of values, one for each of the cells whose references you entered as changing cells.
- The original values will be entered. Since this is the original case, you can accept these values.
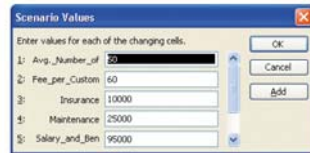
The Scenario Manager dialog box

Scenario Manager dialog box   Figure 9-26
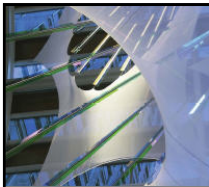
Add additional scenarios

Enter input values for the Average Season scenario   Figure 9-28

View and edit scenarios

- When you have the scenarios defined, you can view each one by selecting the name of the scenario you want to see in the Scenario Manager dialog box.
- After you have selected the name, click Show and then Close.
- Excel will display the original spreadsheet, with the values from the scenario you chose.
- You can edit your scenarios from the Scenario Manager
  - Select the scenario you want to edit, and click Edit
  - This will bring up a dialog box in which you can change any of the input values
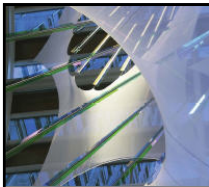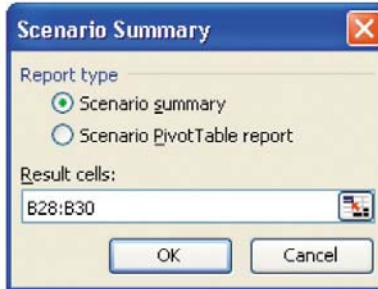 - You can then display the spreadsheet with the values from the edited scenario

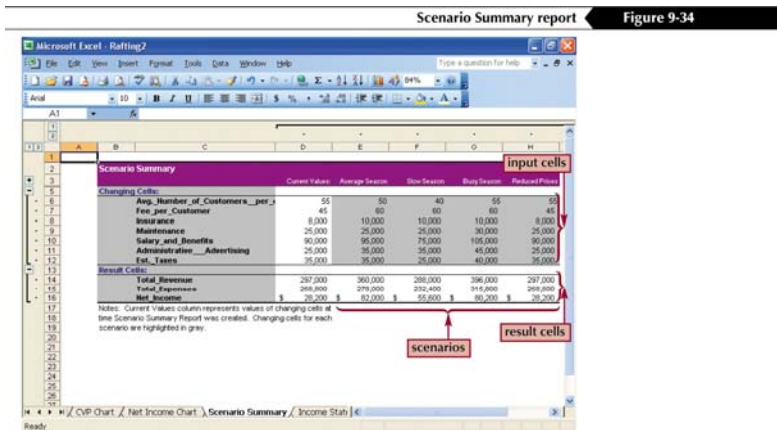## Create a scenario summary report to save your conclusions

- Using the Scenario Manager, you can display a summary of the results from all of the scenarios you have created.
- This data can be displayed in a summary table or a PivotTable.
- To create a summary table based on the scenarios you have created, open the Scenario Manager.
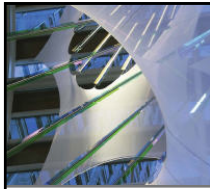- In the Scenario Manager dialog box, click Summary to view the Summary dialog box.

The Scenario Summary dialog box

A Scenario Summary report

Create a PivotTable report and chart

- To create a Scenario PivotTable report:
  - Open the Scenario Manager dialog box and click Summary
  - From the Scenario Summary dialog box, choose Scenario PivotTable report
  - Excel will create a Scenario PivotTable report for all of the scenarios you have created
- Excel can also chart the PivotTable. To do so:
  - Click on the Chart Wizard from the PivotTable tool
  - From the Menu bar, choose Chart and select the type of chart you want

An example of a PivotTable report

Formatted PivotTable report   Figure 9-36