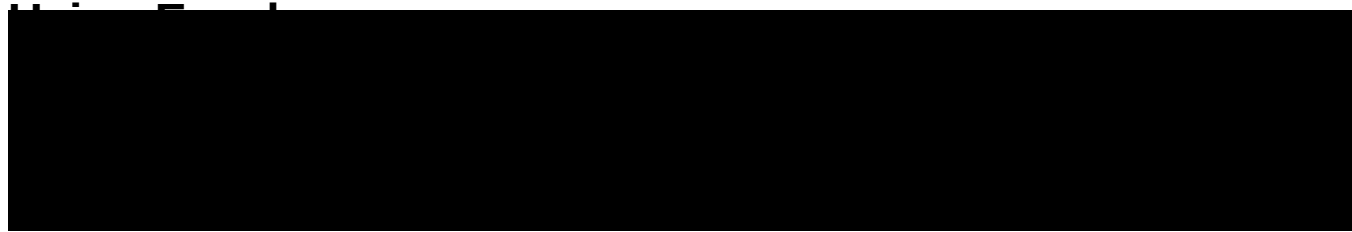


Sensitivity Analysis



The main goal of sensitivity analysis is to gain insight into which assumptions are critical, i.e., which assumptions affect choice. The process involves various ways of changing input values of the model to see the effect on the output value. In some decision situations you can use a single model to investigate several alternatives. In other cases, you may use a separate spreadsheet model for each alternative.

2.1 MANUAL WHAT-IF ANALYSIS

Using this approach, you enter values into cells C4:C6 and see what the effect is on net cash flow. For example, with the predetermined price of \$29, you may think that Units Sold will be in the range between 500 and 900 units. Keeping other input assumptions at base case, the corresponding Net Cash Flows are \$-1,500 and \$6,900. When we vary a single input assumption, keeping all other input assumptions at their base case values, we say we are doing "one at a time" or "single-factor" sensitivity analysis.

Figure 2.1 Model Display and Formula View

A	B	C
Controllable Input		
	Unit Price	\$29
Uncontrollable Inputs		
	Units Sold	700
	Unit Variable Cost	\$8
	Fixed Costs	\$12,000
Performance Measure		
	Net Cash Flow	\$2,700

	A	B	C
1	Controllable Input		
2		Unit Price	\$29
3	Uncontrollable Inputs		
4		Units Sold	700
5		Unit Variable Cost	\$8
6		Fixed Costs	\$12,000
7	Performance Measure		
8		Net Cash Flow	=C4*(C2-C5)-C6

2.2 THRESHOLD VALUES

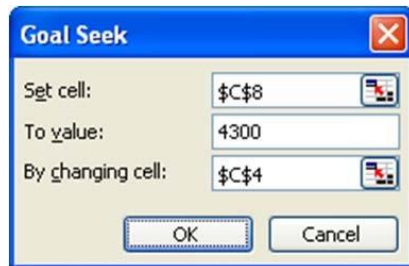
You are usually interested in how the input assumptions eventually affect the recommended choice in the decision problem an example of a threshold is to ask "How many units must I sell to do better with software than with teaching?"

In other words, in the software spreadsheet model, what must the value of Units Sold in cell C4 be so that the value of Net Cash Flow in cell C8 is equal to \$4,300? You could find the answer by repeatedly trying different values in cell C4. Or, you could solve a single algebra equation involving one unknown. Or, you could let Excel find the answer.

Goal Seek

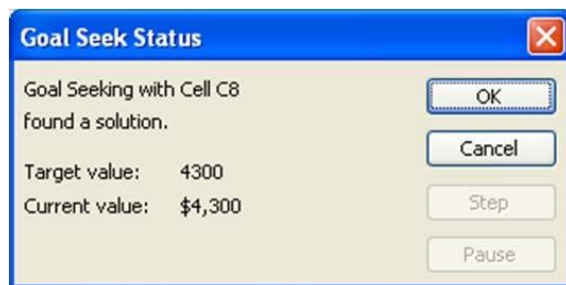
To answer the question using an Excel, In Excel 2007 or 2010, choose Data | What-If Analysis | Goal Seek (**Données | Analyse de scénario | valeur cible ...**).. In Excel terminology, you want to "Set cell" C8 "To value" 4300 "By changing cell" C4. Figure 2.2 shows the entries when you point to cells C8 and C4, in which case they appear in the range edit boxes as absolute references, indicated by the dollar signs.

Figure 2.2 Goal Seek Dialog Box



Alternatively, you could type C8 and C4 into the edit boxes instead of pointing. When you click OK, Excel displays a Goal Seek Status message, as shown in Figure 2.3. If there is a complex or discontinuous relationship between the changing cell and the set cell, the Goal Seek Status message may say that it was not able to find a solution.

Figure 2.3 Goal Seek Status



To dismiss the message, click OK, in which case Excel shows the results in the spreadsheet model. Figure 2.4 shows that you must sell at least 776 units to have higher cash flow with the software than teaching MBAs. Cell C4 is formatted to display integer values. The formula bar shows that the exact value is 776.190476190476, using Excel's precision of fifteen significant digits.

Figure 2.4 Units Sold Threshold for \$4,300 Net Cash Flow

	A	B	C
1	Controllable Input		
2		Unit Price	\$29
3	Uncontrollable Inputs		
4		Units Sold	776
5		Unit Variable Cost	\$8
6		Fixed Costs	\$12,000
7	Performance Measure		
8		Net Cash Flow	\$4,300

2.3 ONE-VARIABLE DATA TABLE

For a model with numerical input and numerical output, use the One Input One Output feature of the SensIt sensitivity analysis add-in.

Use Excel's Data Table command to perform sensitivity analysis for ranges of values of a model input, not just specific points.

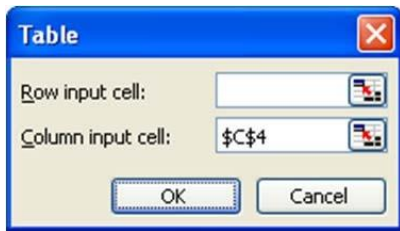
- (1) enter a list of input values in a column, e.g., cells E3:E11 in Figure 2.5
- (2) enter a reference to an output formula at top of adjacent column, e.g., =C8 in cell F2
- (3) select entire table (two columns including formula), e.g., cells E2:F11

Figure 2.5 Setup for One-Variable Data Table

	A	B	C	D	E	F
1	Controllable Input				Units Sold	Net Cash Flow
2		Unit Price	\$29			=C8
3	Uncontrollable Inputs				500	
4		Units Sold	700		550	
5		Unit Variable Cost	\$8		600	
6		Fixed Costs	\$12,000		650	
7	Performance Measure				700	
8		Net Cash Flow	\$2,700		750	
9					800	
10					850	
11					900	

- (4) choose Data | Table; in Excel 2007 or 2010, choose Data | What-If Analysis | Data Table
- (5) since the list of values are in a column, use the "Column input cell" edit box to specify where those values should be input into the model, e.g., cell C4, as shown in Figure 2.6

Figure 2.6 Data Table Dialog Box for One-Variable Example



(6) the results appear as shown in columns E and F in Figure 2.7

(7) select cell F2, right-click, choose Format Cells | Number | Custom, and enter a three-semicolon custom format so that the base case result is not displayed

Figure 2.7 Data Table Results for One-Variable

	E	F
1	Units Sold	Net Cash Flow
2		
3	500	-\$1,500
4	550	-\$450
5	600	\$600
6	650	\$1,650
7	700	\$2,700
8	750	\$3,750
9	800	\$4,800
10	850	\$5,850
11	900	\$6,900
12		
13		

2.4 TWO-VARIABLE DATA TABLE

For ranges of values for two model inputs

Useful for examining possible relationships and threshold combinations

Steps: enter list of one input's values in a column
 enter list of other input's values in a row
 enter reference to output formula in top left corner

Figure 2.9 Setup for Two-Variable Example

[illegible]

select entire table, choose Data | Table or Data | What-If Analysis | Data Table
specify two input cells of the model, click OK

Figure 2.10 Data Table Dialog Box for Two-Variable Example

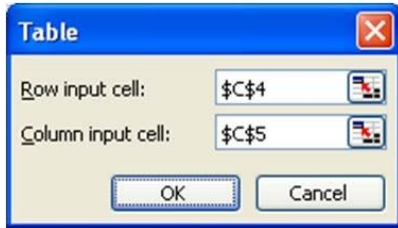


Figure 2.11 Data Table Results for Two-Variable Example

	E	F	G	H	I	J	K	L	M	N	O
1											
2	Net Cash Flow		Units Sold								
3			500	550	600	650	700	750	800	850	900
4	Unit	\$6.00	-\$500	\$650	\$1,800	\$2,950	\$4,100	\$5,250	\$6,400	\$7,550	\$8,700
5	Variable	\$6.50	-\$750	\$375	\$1,500	\$2,625	\$3,750	\$4,875	\$6,000	\$7,125	\$8,250
6	Cost	\$7.00	-\$1,000	\$100	\$1,200	\$2,300	\$3,400	\$4,500	\$5,600	\$6,700	\$7,800
7		\$7.50	-\$1,250	-\$175	\$900	\$1,975	\$3,050	\$4,125	\$5,200	\$6,275	\$7,350
8		\$8.00	-\$1,500	-\$450	\$600	\$1,650	\$2,700	\$3,750	\$4,800	\$5,850	\$6,900
9		\$8.50	-\$1,750	-\$725	\$300	\$1,325	\$2,350	\$3,375	\$4,400	\$5,425	\$6,450
10		\$9.00	-\$2,000	-\$1,000	\$0	\$1,000	\$2,000	\$3,000	\$4,000	\$5,000	\$6,000
11		\$9.50	-\$2,250	-\$1,275	-\$300	\$675	\$1,650	\$2,625	\$3,600	\$4,575	\$5,550
12		\$10.00	-\$2,500	-\$1,550	-\$600	\$350	\$1,300	\$2,250	\$3,200	\$4,150	\$5,100
13		\$10.50	-\$2,750	-\$1,825	-\$900	\$25	\$950	\$1,875	\$2,800	\$3,725	\$4,650
14		\$11.00	-\$3,000	-\$2,100	-\$1,200	-\$300	\$600	\$1,500	\$2,400	\$3,300	\$4,200

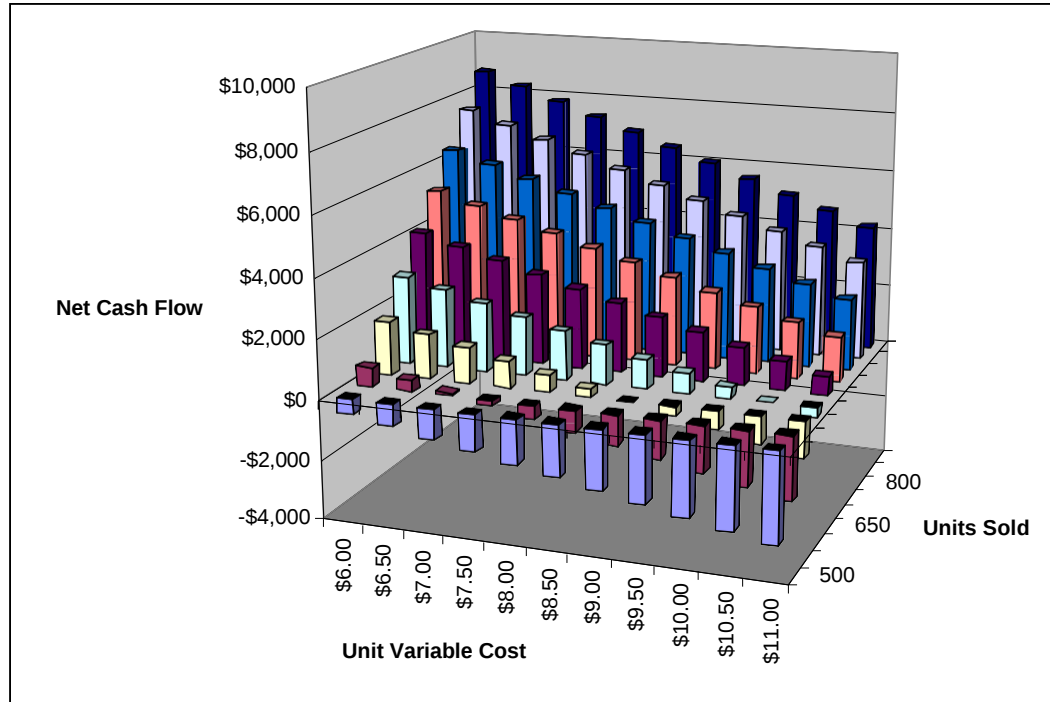
To display the results as a 3-D Column chart or 3-D Surface chart, the cell at the intersection of the X labels and Y labels must be empty. If you clear the contents of F3, the values in the body of the data table change to zero. Copy the entire table, e.g., cells E1:O14, select cell Q1, and choose Edit | Paste Special | Values and number formats. Select cell R3, and choose Edit | Clear contents. Select R3:AA14 (in general, X labels on the left, Y labels on the top, Z values in the body of the table, and a blank cell in the top left corner of the range).

Figure 2.12 Data Values for Two-Variable Example

	Q	R	S	T	U	V	W	X	Y	Z	AA
1											
2	Net Cash Flow		Units Sold								
3			500	550	600	650	700	750	800	850	900
4	Unit	\$6.00	-\$500	\$650	\$1,800	\$2,950	\$4,100	\$5,250	\$6,400	\$7,550	\$8,700
5	Variable	\$6.50	-\$750	\$375	\$1,500	\$2,625	\$3,750	\$4,875	\$6,000	\$7,125	\$8,250
6	Cost	\$7.00	-\$1,000	\$100	\$1,200	\$2,300	\$3,400	\$4,500	\$5,600	\$6,700	\$7,800
7		\$7.50	-\$1,250	-\$175	\$900	\$1,975	\$3,050	\$4,125	\$5,200	\$6,275	\$7,350
8		\$8.00	-\$1,500	-\$450	\$600	\$1,650	\$2,700	\$3,750	\$4,800	\$5,850	\$6,900
9		\$8.50	-\$1,750	-\$725	\$300	\$1,325	\$2,350	\$3,375	\$4,400	\$5,425	\$6,450
10		\$9.00	-\$2,000	-\$1,000	\$0	\$1,000	\$2,000	\$3,000	\$4,000	\$5,000	\$6,000
11		\$9.50	-\$2,250	-\$1,275	-\$300	\$675	\$1,650	\$2,625	\$3,600	\$4,575	\$5,550
12		\$10.00	-\$2,500	-\$1,550	-\$600	\$350	\$1,300	\$2,250	\$3,200	\$4,150	\$5,100
13		\$10.50	-\$2,750	-\$1,825	-\$900	\$25	\$950	\$1,875	\$2,800	\$3,725	\$4,650
14		\$11.00	-\$3,000	-\$2,100	-\$1,200	-\$300	\$600	\$1,500	\$2,400	\$3,300	\$4,200

Use the Chart Wizard to create a 3-D Column chart. In Excel 2007 or 2010, choose Insert | (Charts) Column | 3-D Column. Do not choose the Stacked or Clustered types of 3-D Column charts.

Select the legend, and press the Delete key. To add axis titles, click the chart to select it, and choose Chart | Chart Options | Titles. The X axis is Unit Variable Cost, the Y axis is Units Sold, and the Z axis is Net Cash Flow. In Excel 2007 or 2010, select the chart, and choose Chart Tools | Layout | (Labels) Axis Titles. The primary horizontal axis is Unit Variable Cost, the primary vertical axis is Net Cash Flow, and the depth axis is Units Sold.

Figure 2.13 3-D Column Chart for Two-Variable Example

2.5 OVERALL WORST CASE AND BEST CASE

Figure 2.14 shows ranges for each uncontrollable input assumption. The decision maker may investigate the base case or best-guess assumption first. Next extreme values are specified for each input. Each of the extreme values is based on business judgment, perhaps by consulting with colleagues. The extreme values may be the absolute minimum and maximum that the decision maker thinks are possible. Or, if the decision maker can think about the uncertainty using probability, he or she may use the 10% fractile as a minimum value and the 90% fractile as the maximum. Or, the 5% fractile and 95% fractile may be specified. Whatever method is used, the extreme values for each input assumption should be equally extreme so that the results are comparable.

Figure 2.14 Extreme Values for Input Assumptions

	A	B	C	D	E	F	G
1	Controllable Input						
2		Unit Price	\$29				
3	Uncontrollable Inputs						
4		Units Sold	700		Minimum	Base Case	Maximum
5		Unit Variable Cost	\$8		500	700	900
6		Fixed Costs	\$12,000		\$6	\$8	\$11
7	Performance Measure						
8		Net Cash Flow	\$2,700		\$10,000	\$12,000	\$15,000

Figure 2.15 shows the net cash flow of \$10,700 using the best case scenario: high values for revenue inputs and low values for cost inputs.

Figure 2.15 Best Case Scenario

	A	B	C	D	E	F	G
1	Controllable Input						
2		Unit Price	\$29				
3	Uncontrollable Inputs				Minimum	Base Case	Maximum
4		Units Sold	900		500	700	900
5		Unit Variable Cost	\$6		\$6	\$8	\$11
6		Fixed Costs	\$10,000		\$10,000	\$12,000	\$15,000
7	Performance Measure						
8		Net Cash Flow	\$10,700				

Figure 2.16 shows the net cash flow of -\$6,000 using the worst case scenario: low values for revenue inputs and high values for cost inputs.

Figure 2.16 Worst Case Scenario

	A	B	C	D	E	F	G
1	Controllable Input						
2		Unit Price	\$29				
3	Uncontrollable Inputs				Minimum	Base Case	Maximum
4		Units Sold	500		500	700	900
5		Unit Variable Cost	\$11		\$6	\$8	\$11
6		Fixed Costs	\$15,000		\$10,000	\$12,000	\$15,000
7	Performance Measure						
8		Net Cash Flow	-\$6,000				

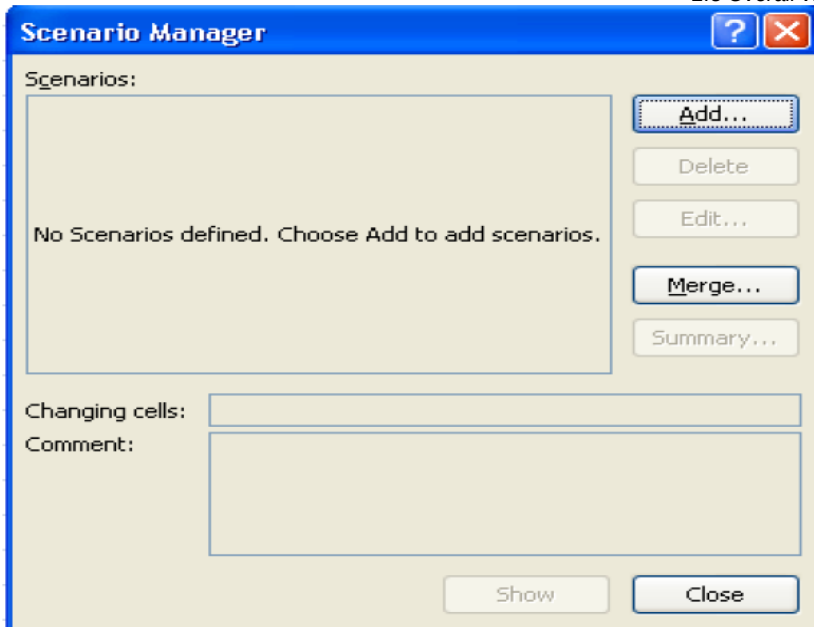
2.6 Scenarios

Scenarios come under the heading of "What-If Analysis" in Excel 2007.

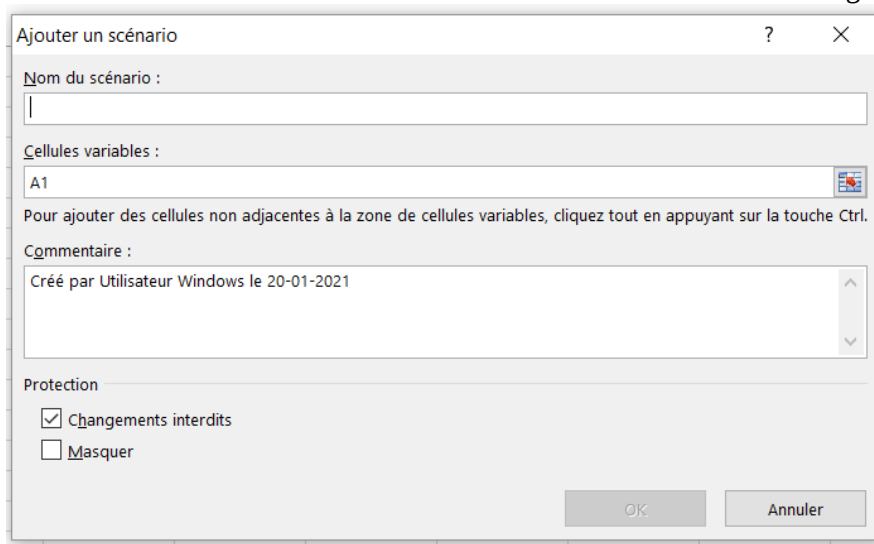
They are similar to tables in that you are changing values to get new results.

Scenarios can be saved, so that you can apply them with a quick click of the mouse.

- From the top of Excel click the Data menu
 - On the Data menu, locate the Data Tools panel
 - Click on the what if Analysis item, and select Scenario Manager from the menu:
- When you click Scenario Manager, you should the following dialogue box:



We want to create a new scenario. So click the Add button. You'll then get another dialogue box popping up:



The A1 in the image is just whatever cell you had selected when you brought up the dialogue boxes. We'll change this.

First, type a Name for your Scenario in the Scenario Name box. Call it **Best case Scenario**.

Excel now needs you to enter which cells in your spreadsheet will be changing. We need to specify which cells will be changing.. These are in cells C4 to C6 in our spreadsheet. So in the Changing Cells box, enter C4:C6 . your Add Scenario box should look like this:

Modifier un scénario

Nom du scénario :
Best case Scenario

Cellules variables :
\$C\$4:\$C\$6

Pour ajouter des cellules non adjacentes à la zone de cellules variables, cliquez tout en appuyant sur la touche Ctrl.

Commentaire :
Créé par Utilisateur Windows le 20-01-2021

Protection

☐ Changements interdits

☐ Masquer

OK Annuler

Click OK and Excel will ask you for some values:

Valeurs de scénarios

Tapez des valeurs pour chacune des cellules à modifier.

1 : \$C\$4

2 : \$C\$5

3 : \$C\$6

Ajouter OK Annuler

Enter the values of the best case scenario.

Valeurs de scénarios

Tapez des valeurs pour chacune des cellules à modifier.

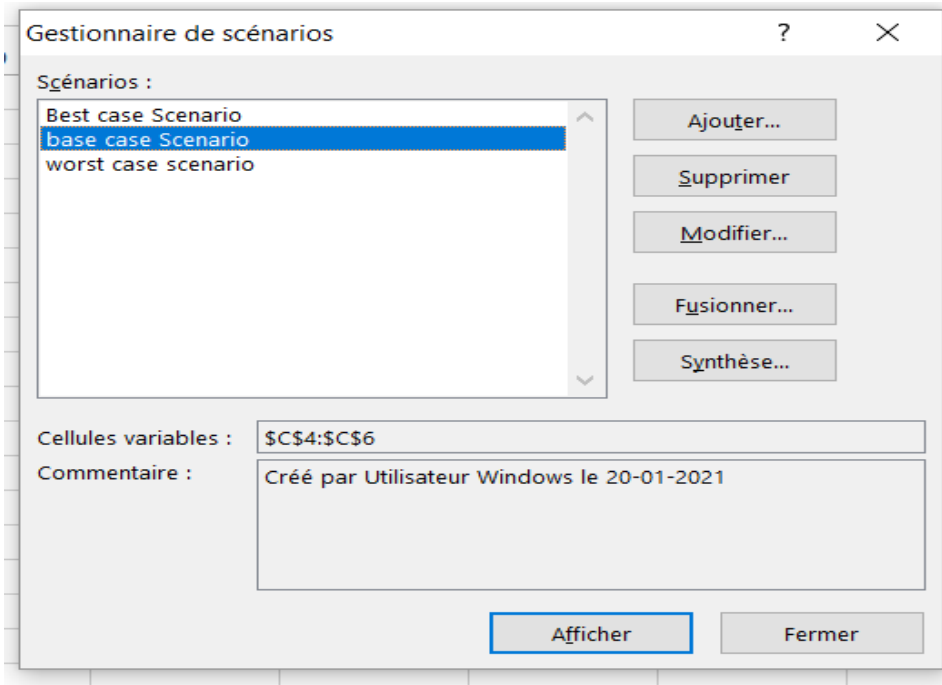
1 : \$C\$4 900

2 : \$C\$5 6

3 : \$C\$6 10

Ajouter OK Annuler

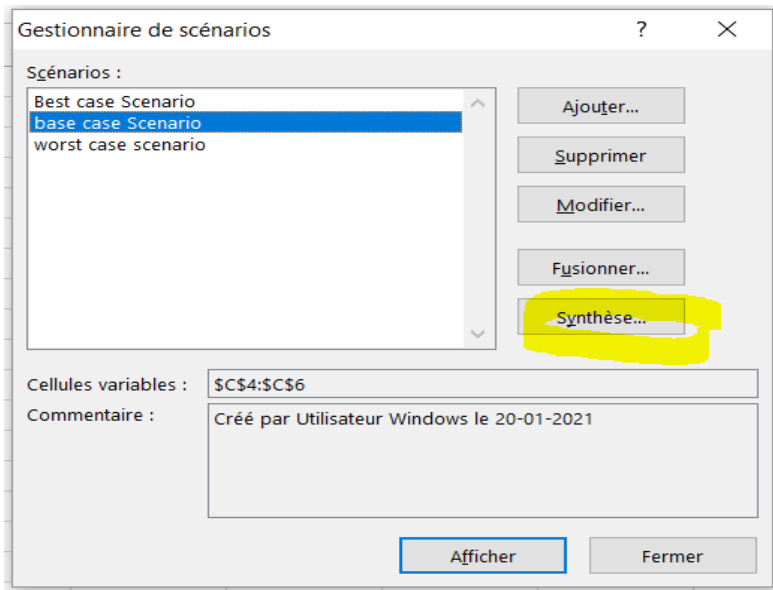
Click OK. Repeat the same procedure by adding the base scenario and the worst case scenarios.



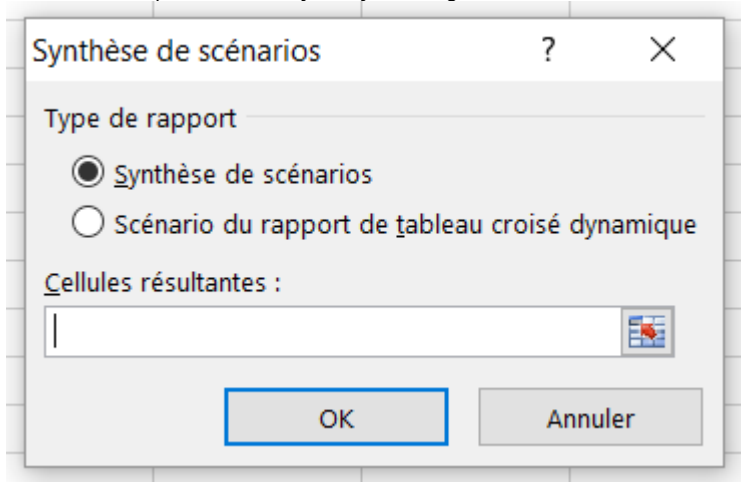
With best case Scenario selected, click the Show button (**Afficher**) at the bottom. The values in your spreadsheet will change, and the new Net Cash Flow will be calculated.

How to Create a Report from a Scenario

To create a report from your scenarios, choose Data | What-If Analysis | Scenario Manager



- Click the Summary button (**Synthèse**) to see the following dialogue box:



This dialog box gives you a choice between creating a (static) Scenario Summary (the default) and a (dynamic) Scenario PivotTable Report.

You can also modify the range of cells in the table that is included in the Result Cells section of the summary report by adjusting the cell range in the Result Cells text box before you click OK to generate the report.