EM384: Analytical Methods for Engineering Management

Lesson 5: Sensitivity Analysis using Spreadsheets II

23 January 2023

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Lesson Objectives

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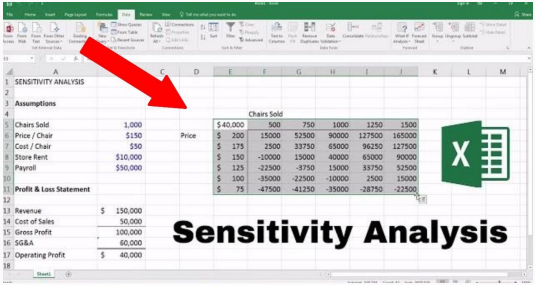
- Break-even analysis and apply using spreadsheet models.
- Apply Goal-Seek to a problem.

Review

Sensitivity Analysis

Sensitivity analysis is examining the effect that changing model inputs has on your model outputs.

- The tools you learn in Excel are simply ways for you to look at your model output(s) when you change the value of your parameter(s) or variable(s).
- Excel helps us to deal with the uncertainty coming from having to predict, project, and assume different input parameters.



Base Case Analysis

The base case analysis is your starting scenario with your initial assumptions. It provides a starting point for your sensitivity analysis. Base-case can describe the following:

- Current policy, most likely scenario, best- or worst-case scenarios.

Answers questions such as:

- If we follow last year's plan, how much profit should we expect next year?
- How many items do we expect to sell next week?

”What If” Analysis

”What if” Analysis is another term for sensitivity analysis.

- Analyzes how key outputs change with changes in one or more of the inputs
- May vary a parameter, a decision variable, or the model structure.
- Varying a Parameter.
- Asking what if given information were different.
- Helps us appreciate the potential importance of the numerical assumptions of model.
- Varying a Decision Variable.
- Exploring outcomes we can influence.
- Leads us to better decisions.

Excel One-way and Two-way Data Tables are a useful tool.

Break-even Analysis

Breakeven Analysis

Analyzes where a particular point of interest occurs.

Answers questions such as:

- How many items do we need to sell before we breakeven?
- How much should we charge to breakeven?

Excel Goal Seek is a useful tool.

In-class Example

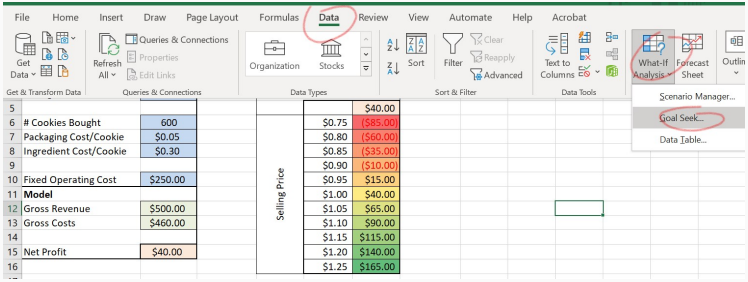
Download the Lesson 04 PE (Solution) file.

	A	B	C	D	E	F
3	# of Cookies Sold	500				
4	Selling Price	$1.00				Net Profit
5						$40.00
6	# Cookies Bought	600		Selling Price	$0.75	($85.00)
7	Packaging Cost/Cookie	$0.05			$0.80	($60.00)
8	Ingredient Cost/Cookie	$0.30			$0.85	($35.00)
9					$0.90	($10.00)
10	Fixed Operating Cost	$250.00			$0.95	$15.00
11	**Model**				$1.00	$40.00
12	Gross Revenue	$500.00			$1.05	$65.00
13	Gross Costs	$460.00			$1.10	$90.00
14					$1.15	$115.00
15	Net Profit	$40.00			$1.20	$140.00
16					$1.25	$165.00
17						

- The model is organized with the parameters at the top and the spreadsheet model at the bottom
- To the side we have a one-way data table that gives us the Net profit when we change the selling price per cookie.
- We see that we "break even" somewhere between $0.90 and $0.95 per cookie

Break-even Analysis

We can check what selling price we should set in order to break even (that is, have no profit and no loss).

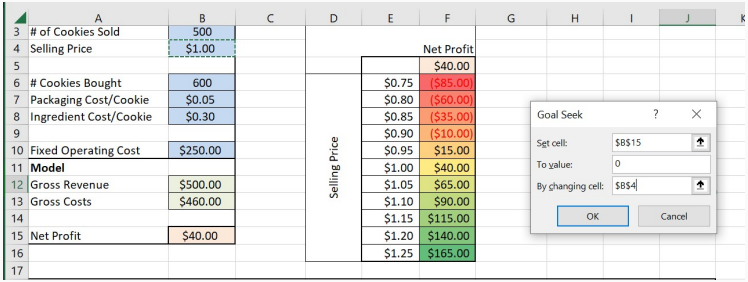


- Select **Goal Seek** from the menu.

Break-even Analysis

There are three boxes to set:

- The **target cell**
- The **target value**
- The **cell** that you will allow Excel **to change**.



	A	B	C	D	E	F	G	H	I	J	K
3	# of Cookies Sold	500									
4	Selling Price	$1.00				Net Profit					
5						$40.00					
6	# Cookies Bought	600			$0.75	($85.00)					
7	Packaging Cost/Cookie	$0.05			$0.80	($60.00)					
8	Ingredient Cost/Cookie	$0.30			$0.85	($35.00)					
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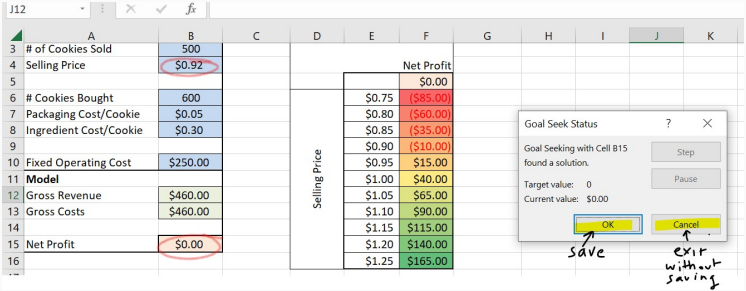
17											

Break-even Analysis

When you run goal seek, Excel will attempt to find the target value in the target cell, by changing the cell you specify. A solution cannot *always* be found (especially if one does not exist).

- If you click **OK**, Excel will keep the changes to the sheet.
- If you click **Cancel**, Excel will exit goal seek and revert back to your original sheet.



Goal Seek

Goal seek can do much more than break-even analysis. Using the Mr Cookie solution that you have open, answer the following questions (for each question, start off with the **base case** parameters):

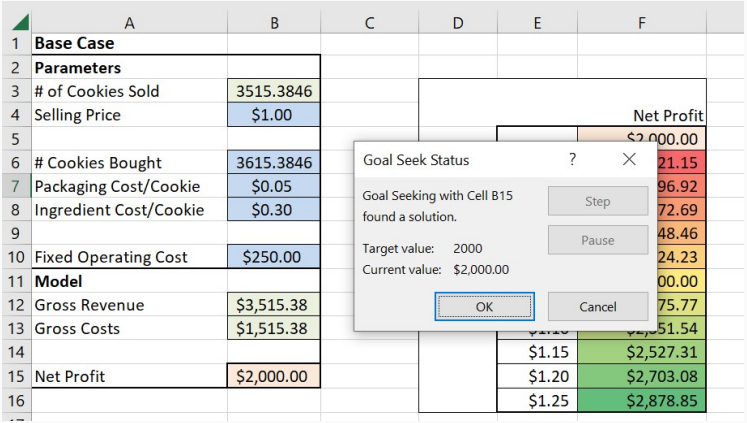
- How much do you need to charge per cookie to make $2000 in profit?
- How much should we pay in ingredient cost per cookie in order to make $2000 in profit?
- Now, change your model so that we always buy 100 more cookies than we sell (make a formula for number of cookies sold). Assume we can buy any number of cookies now. How many cookies do we need to buy to make $2000 profit without raising the price per cookie?

Goal Seek

Goal seek can do much more than break-even analysis. Using the Mr Cookie solution that you have open, answer the following questions (for each question, start off with the **base case** parameters):

- How much do you need to charge per cookie to make $2000 in profit? $4.92
- How much should we pay in ingredient cost per cookie in order to make $2000 in profit? Not possible - negative ingredient cost
- Now, change your model so that we always buy 100 more cookies than we sell (make a formula for number of cookies sold). Assume we can buy any number of cookies now. How many cookies do we need to buy to make $2000 profit without raising the price per cookie? between 3615 and 3616. See next slide

Break-even Analysis



	A	B
1	**Base Case**	
2	**Parameters**	
3	# of Cookies Sold	3515.3846
4	Selling Price	$1.00
5		
6	# Cookies Bought	3615.3846
7	Packaging Cost/Cookie	$0.05
8	Ingredient Cost/Cookie	$0.30
9		
10	Fixed Operating Cost	$250.00
11	**Model**	
12	Gross Revenue	$3,515.38
13	Gross Costs	$1,515.38
14		
15	Net Profit	$2,000.00
16		

E	F
	Net Profit
	$2,000.00
	21.15
	96.92
	72.69
	48.46
	24.23
	00.00
	75.77
	51.54
$1.15	$2,527.31
$1.20	$2,703.08
$1.25	$2,878.85

Goal Seek Status

Goal Seeking with Cell B15 found a solution.

Target value: 2000

Current value: $2,000.00

Step

Pause

OK

Cancel

Practical Exercise

Conclusion

Next Class

Homework:

- Read Lesson Handout ”Data Exploration and Analysis”
- Watch YouTube Video on Pivot Tables
- Complete PivotTable Tutorial.
- Install Anaconda Navigator and Spyder using the instructions.

Next Lesson:

- Understanding Data Analysis.
- Using Excel pivot tables for Data Analysis.