

Introduction to Excel Solver (1 of 2)

- Excel has the capability to solve linear (and often nonlinear) programming problems with the SOLVER tool, which May be used to solve linear and nonlinear optimization problems – Allows integer or binary restrictions to be placed on decision variables – Can be used to solve problems with up to 200 decision variables
- SOLVER is an Add-In program that you will need to load in Excel

Microsoft users

1. Click the Microsoft Office Button, and then click “Excel Options”.
2. Click “Add-Ins”, and then in the “Manage” box, select “Excel Add-ins” and click “Go”.
3. In the “Add-Ins available” box, select the “Solver Add-in” check box, and then click “OK” – If “Solver Add-in” is not listed in the “Add-Ins available” box, click “Browse” to locate it – If you get prompted that Solver is not currently installed, click Yes to install it.
4. After you load Solver, the Solver command is available in the “Analysis group” on the “Data” tab.

MAC users

1. Open Excel for Mac 2011 and begin by clicking on the “Tools” menu.
2. Click “Add-Ins”, and then in the Add-Ins box, check “Solver.xlam” and then click “OK”.
3. Restart Excel for Mac 2011 (fully quit the program), select the “Data” tab, then select “Solver” to launch.

Introduction to Excel Solver (2 of 2)

There are 4 steps on how to use SOLVER to solve an LP – The key to solving an LP on a spreadsheet is:

Set up a spreadsheet that tracks everything of interest (e.g. costs, profits, resource usage).

1. Identify the cell that contains the value of your objective function as the Target Cell.
2. Identify the decision variables that can be varied, called **Changing (Variable) Cells**.
3. Identify the constraints and enter them into the program to tell **SOLVER** how to solve the problem – At this point, the optimal solution to our problem will be placed on the spreadsheet, with its value in the target cell.

Diet Problem: Set-Up (1 of 7)

Problem Statement

- Consider the problem of diet optimization based on cost and different nutritional factors
- There are four different types of food: Brownies, Ice Cream, Cola, and Cheese Cake, with nutrition values and cost per unit as follows:

	Brownies	Ice Cream	Cola	Cheese Cake
Calories	400	200	150	500
Chocolate	3	2	0	0
Sugar	2	2	4	4
Fat	2	4	1	5
Cost	\$0.50	\$0.20	\$0.30	\$0.80

Task: Find a minimum-cost diet that contains

- at least 500 calories
- at least 6 grams of chocolate
- at least 10 grams of sugar
- at least 8 grams of fat

Diet Problem: Set-Up (2 of 7)

First, we must format our spreadsheet correctly to be entered into SOLVER

Identify the decision variables (changing cells)

- To begin we enter heading for each type of food in B2:E2
- In the range B3:E3, we input random trial values for the amount of each food eaten (any values will work, but at least one should be positive)
- In the example shown below, we indicate that we are considering eating 3 brownies, 0 scoops of chocolate ice cream, 1 bottle of cola, and 7 pieces of pineapple cheesecake:

	A	B	C	D	E
1.	DECISION VARIABLES				
2.		Brownies	Ice Cream	Cola	Cheese Cake
3.	Eaten	3	0	1	7

Diet Problem: Set-Up (3 of 7)

Write and enter objective function (target cell)

- To see if the diet is optimal, we must determine its cost as well as the calories, chocolate, sugar, and fat it provides.
- In the range B7:E7 we reference the number of units, and in B8:E8 we input the per-unit cost for each available food.
 - We compute the cost of the diet in cell B10 with the formula

$$= B7*B8 + C7*C8 + D7*D8 + E7*E8$$

But it is usually easier to enter the formula

$$= \text{SUMPRODUCT} (B7:E7, B8:E8)$$

And this is much easier to understand for anyone reading the spreadsheet

The **=SUMPRODUCT** function requires two ranges as inputs

- The first cell in range 1 is multiplied by the first cell in range 2, then the second cell in range 1 is multiplied by the second cell in range 2, and so on
- All of these products are then added
- Thus, in cell B10 the “=SUMPRODUCT” function computes total cost as

$$3*50 + 0*20 + 1*30 + 7*80 = 740 \text{ cents.}$$

Diet Problem: Set-Up (4 of 7)

Now, the spreadsheet should look like:

	A	B	C	D	E
1.	DECISION VARIABLES				
2.		Brownies	Ice Cream	Cola	Cheese Cake
3.	Eaten	3	0	1	7
4.					
5.	OBJECTION FUNCTION				
6.		Brownies	Ice Cream	Cola	Cheese Cake
7.	Eaten	=B3	=C3	=D3	=E3
8.	Cost	50	20	30	80
9.					
10.	Total	740	=SUM PRODUCT (B7:E7, B8:E8)		

Diet Problem: Set-Up (5 of 7)

Finally, we must set up the given problem constraints (for calories, chocolate, sugar, and fat).

To begin, we recreate the table in Excel that defines how many calories and units of chocolate, sugar, and fat are in each type of dessert.

- We can use this information to calculate total amounts based on the quantities of different decision variables.

Next, take the =SUMPRODUCT of the number of items with the calories in each to calculate total calories in our dessert selection.

= SUMPRODUCT (B7:E7, B14:E14)

Finally, indicate the limitations highlighted in the problem

- Add a >= or <= to identify maximum versus minimum constraints in Column G, and use Column H to indicate those limits:

Diet Problem: Set-Up (6 of 7)

The formulas will look like:

	A	B	C	D	E	F	G	H
13.		Brownies	Ice Cream	Cola	Cheese Cake	Totals		Required
14.	Calories	400	200	150	500	=SUMPRODUCT (\$B\$7:\$E\$7, B14:E14)	>=	500
15.	Chocolate	3	2	0	0	=SUMPRODUCT (\$B\$7:\$E\$7, B15:E15)	>=	6
16.	Sugar	2	2	4	4	=SUMPRODUCT (\$B\$7:\$E\$7, B16:E16)	>=	10
17.	Fat	2	4	1	5	=SUMPRODUCT (\$B\$7:\$E\$7, B17:E17)	>=	8

The constraint values that will show up on your screen look like:

	A	B	C	D	E	F	G	H
13.		Brownies	Ice Cream	Cola	Cheese Cake	Totals		Required
14.	Calories	400	200	150	500	4850	>=	500
15.	Chocolate	3	2	0	0	9	>=	6
16.	Sugar	2	2	4	4	38	>=	10
17.	Fat	2	4	1	5	42	>=	8

Diet Problem: Set-Up (7 of 7)

The complete LP to be entered into SOLVER now looks like:

	A	B	C	D	E	F	G	H
1.	DECISION VARIABLES							
2.		Brownies	Ice Cream	Cola	Cheese Cake			
3.	Eaten	3	0	1	7			
4.								
5.	OBJECTIVE FUNCTION							
6.		Brownies	Ice Cream	Cola	Cheese Cake			
7.	Eaten	3	0	1	7			
8.	Cost	50	20	30	80			
9.								
10.	Total	740						
11.								
12.	CONSTRAINTS							
13.		Brownies	Ice Cream	Cola	Cheese Cake	Totals		Required
14.	Calories	400	200	150	500	4850	>=	500
15.	Chocolate	3	2	0	0	9	>=	6
16.	Sugar	2	2	4	4	38	>=	10
17.	Fat	2	4	1	5	42	>=	8