Simple Minimization Problem Using QM

In this tutorial, we will solve a simple minimization linear programming problem using Excel QM.

The dean of the Western College of Business must plan the school's course offering for the upcoming fall semester. Student demands make it necessary to offer at least 30 undergraduate and 20 graduate classes in the term. Faculty contracts also dictate that at least 60 courses be offered in total. Each undergraduate class costs the college an average of \$2,500 and each graduate class costs \$3,000. How many of each should be taught in the fall to minimize total costs?

Before we get started on Excel, it is best if we try to first identify the objective functions and the constraints. Clues to identifying the objective function include the words minimize or maximize and in this case, it's *minimizing* total costs.

 X_1 = number of undergraduate courses X_2 = number of graduate courses Minimize cost = \$2,500 X_1 + \$3,000 X_2

Next, we need to identify our constraints. We have a constraint on the total number of classes taught and the minimum number of undergraduate and graduate classes that need to be included. These can be expressed as:

 $X_1 \ge 30$ $X_2 \ge 20$ $X_1 + X_2 \ge 60$ Now, let's open Excel QM and solve our problem. Click on the Excel QM tab \rightarrow Alphabetical \rightarrow Linear, Integer, & Mixed Integer Programming.

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In the Spreadsheet Initialization window, be sure to identify that we have two variables (X1 and X2) and 3 constraints and that it's a minimization problem.

Spreadsheet Initialization	×
Title:	Sheet name:
Enter the number of constraints 3	
Name for constraint Constraint	
(Use A for A, B, C or a for a, b, c)	
Enter the number of variables 2	
Name for variable X	
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Minimize	Help Cancel OK
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Click **OK**. A spreadsheet will display.

	А	В	С	D	E	F	G	Н	I	J	К	L	Μ
1	Linear, Intege	ixed En	Enter the values in the shaded area. Then go to the DATA Tab on the ribbon, click on Solver in the Data										
2			An	alysis Group	o and then d	ata Tab the	n nlease se	e the Heln f	ile (Solver)	for instructio	ns		
3	Signs												
4		<	less than o	r equal to									
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6		>	greater tha	n or equal t	0								
7													
8	Data						Results			Problem se	tup area		
9		x 1	x 2				LHS	Slack/Surp	us				
10	Objective			sign	RHS		0			< cons	traints	> constraint	S
11	Constraint 1			>			0	0		0	0	0	0
12	Constraint 2			>			0	0		0	0	0	0
13	Constraint 3			>			0	0		0	0	0	0
14													
15	Results												
16	Variables	0	0										
17	Objective				0								
18													

In the boxes for our objective function, enter 2,500 under x1 and 3,000 under x2. Our constraints are identified as follows: for **Constraint 1**, enter a 1 under x1 and 30 under **RHS**; for **Constraint 2**, enter a 1 under x2, and 20 under **RHS**; and for **Constraint 3**, enter a 1 under each variable and 60 under **RHS**. Here we are literally telling the computer that our first constraint has one X1 that is greater than 30; our second has 1 X2 that is greater than 20; and our third has one of each and has to be greater than 60. That is it. We have now entered our objective function and all our constraints.

Once you have the data entered correctly, click the Data tab and then Solver.



A Solver Parameters window will appear.

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To: <u>M</u> ax O	Mi <u>n</u>	◎ <u>V</u> alue Of:	C)	
By Changing Variable Cells:					
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Subject to the Constraints:					
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Solving Method					
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Click **Solve** and then **OK** in the **Solver Results** window. Our results are shown below.

Data

	x 1	x 2		
Objective	2500	3000	sign	RHS
Constraint 1	1		>	30
Constraint 2		1	>	20
Constraint 3	1	1	>	60

Results

Variables	40	20	
Objective			160000

We can see that it is telling us that we can minimize our costs at \$160,000 by offering 40 undergraduate classes and 20 graduate classes. <u>Click here</u> to download the completed spreadsheet table so you can compare it to yours.

This concludes our tutorial on a simple minimization linear programming problem using Excel QM.