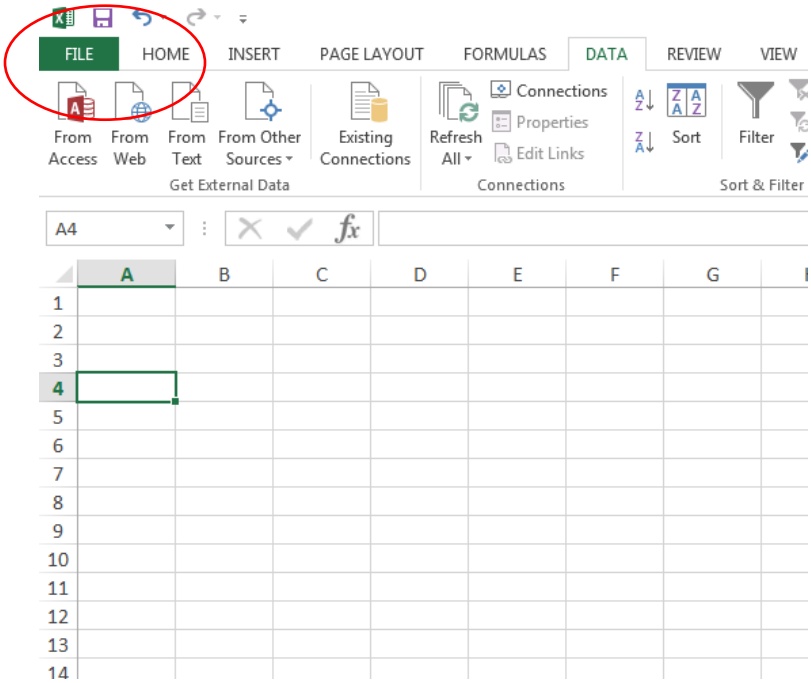
Math 3210 Tutorial 7

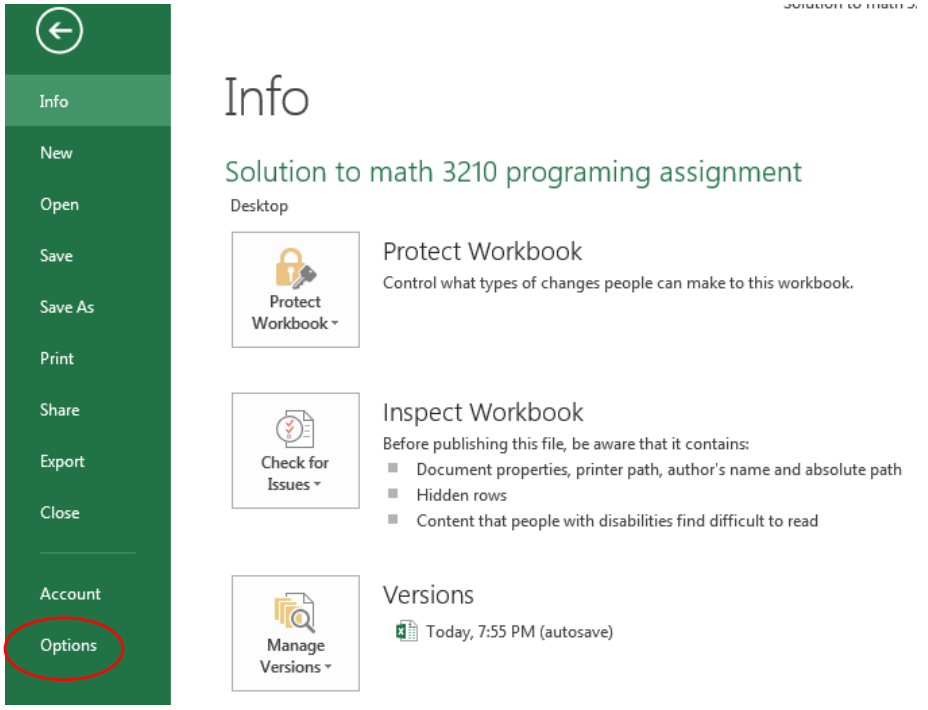
Introduction to solving Linear Programing problem in Excel:

The use of Solver:

Here the most important tools in solving LP (Linear Programming) is the Solver application. For Excel Office 2007 or above, the Solver can be found in the "Data" section. If you cannot find "Solver" in the tab "Tools", that means you have never used it on your machine before. Then you should add it to your machine. In Excel 2007, you should use the "File" and then "Excel Options" to get to "Add-ins". Then a window called "Add-ins available" pops up. Tick "Solver add-in" and then click the OK button. Then you will have the "Solver" in your "Data".

Adding in Solver in Excel:




Info
New
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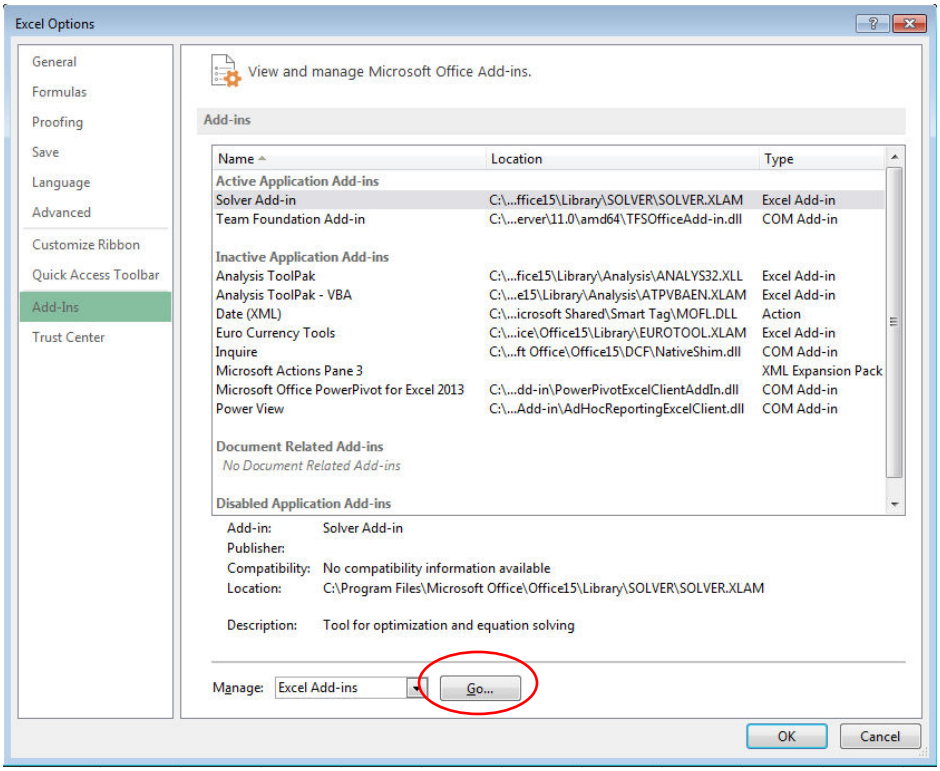
Solution to math 3210 programing assignment
Desktop
Protect Workbook
Protect Workbook
Control what types of changes people can make to this workbook.
Check for Issues
Inspect Workbook
Before publishing this file, be aware that it contains:
Document properties, printer path, author's name and absolute path
Hidden rows
Content that people with disabilities find difficult to read
Manage Versions
Versions
Today, 7:55 PM (autosave)


Excel Options
General
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Language
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Quick Access Toolbar
Add-Ins
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Add-ins
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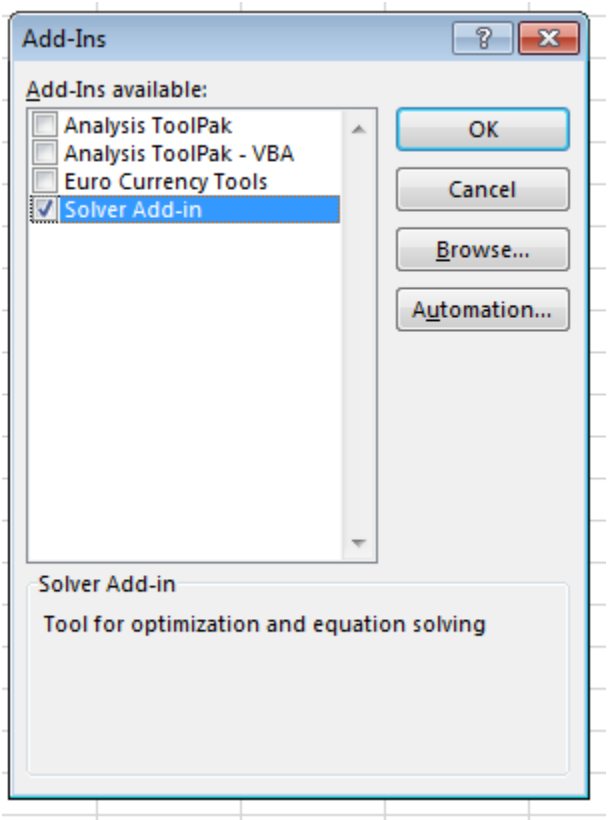
Microsoft Office PowerPivot for Excel 2013 C:\...dd-in\PowerPivotExcelClientAddIn.dll COM Add-in
Power View C:\...Add-in\AdHocReportingExcelClient.dll COM Add-in
Document Related Add-ins
No Document Related Add-ins
Disabled Application Add-ins
Add-in: Solver Add-in
Publisher:
Compatibility: No compatibility information available
Location: C:\Program Files\Microsoft Office\Office15\Library\SOLVER\SOLVER.XLAM
Description: Tool for optimization and equation solving
Manage: Excel Add-ins
Go...
OK
Cancel


Add-Ins
Add-Ins available:
Analysis ToolPak
Analysis ToolPak - VBA
Euro Currency Tools
Solver Add-in
OK
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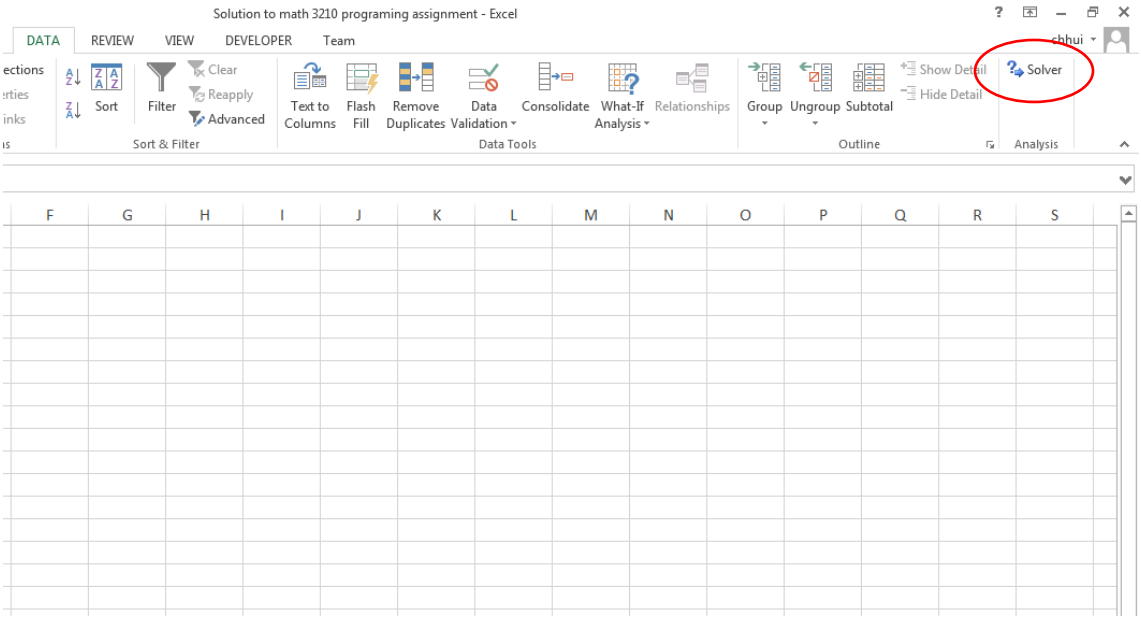
Solver Add-in
Tool for optimization and equation solving


Solution to math 3210 programing assignment - Excel
DATA
REVIEW
VIEW
DEVELOPER
Team
Sort
Filter
Clear
Reapply
Advanced
Text to Columns
Flash Fill
Remove Duplicates
Data Validation
Consolidate
What-If Analysis
Relationships
Group
Ungroup
Subtotal
Show Detail
Hide Detail
Solver
Sort & Filter
Data Tools
Outline
Analysis
F
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Demonstration of solving a linear programing problem:

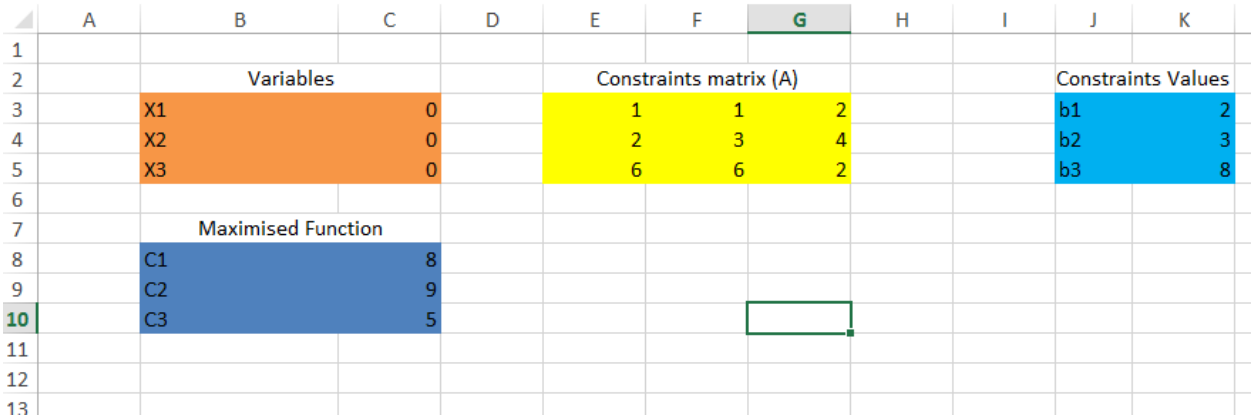
Assume we want to solve the following linear programing problem:

$$Maximised\ z = 8x_1 + 9x_2 + 5x_3$$

$$Subject\ to \begin{cases} x_1 + x_2 + 2x_3 \leq 2 \\ 2x_1 + 3x_2 + 4x_3 \leq 3 \\ 6x_1 + 6x_2 + 2x_3 \leq 8 \end{cases}$$

Entering the variables:

The most straight forward way is to reference each variable to a particular cell, enter the variables, the numbers that correspond to matrix A, vector C and the vector b separately.



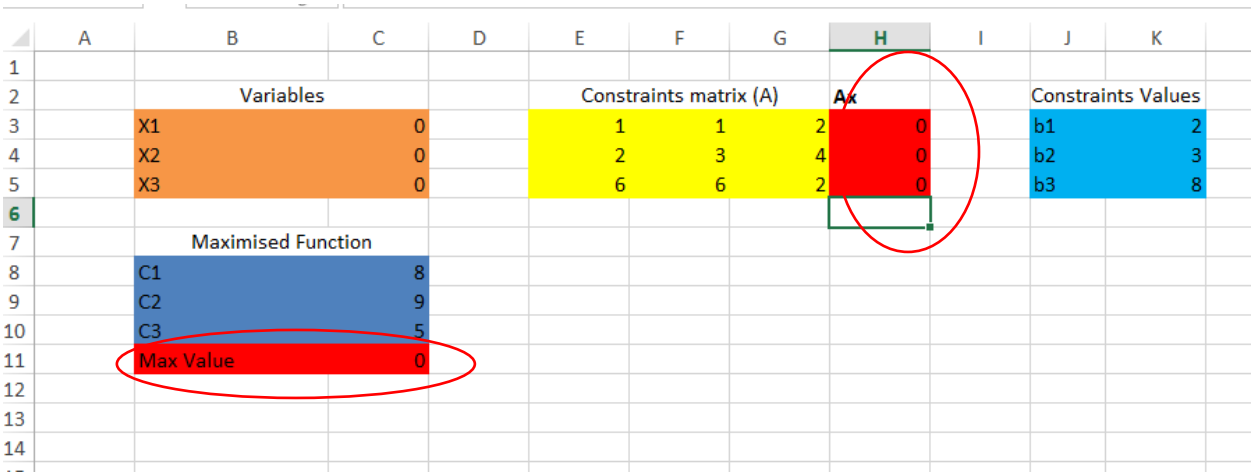
	A	B	C	D	E	F	G	H	I	J	K
1											
2		Variables			Constraints matrix (A)					Constraints Values	
3		X1	0		1	1	2			b1	2
4		X2	0		2	3	4			b2	3
5		X3	0		6	6	2			b3	8
6											
7		Maximised Function									
8		C1	8								
9		C2	9								
10		C3	5								
11											
12											
13											

Here for clarity I suggest that you name your range in the following manners

Range	Names
C3:C5	Variables
K3:K5	Constraints
E3:G6	Amatrix

Setting up the equations for the constraints:

Here we introduce the column **Ax** and the Cell max Value.



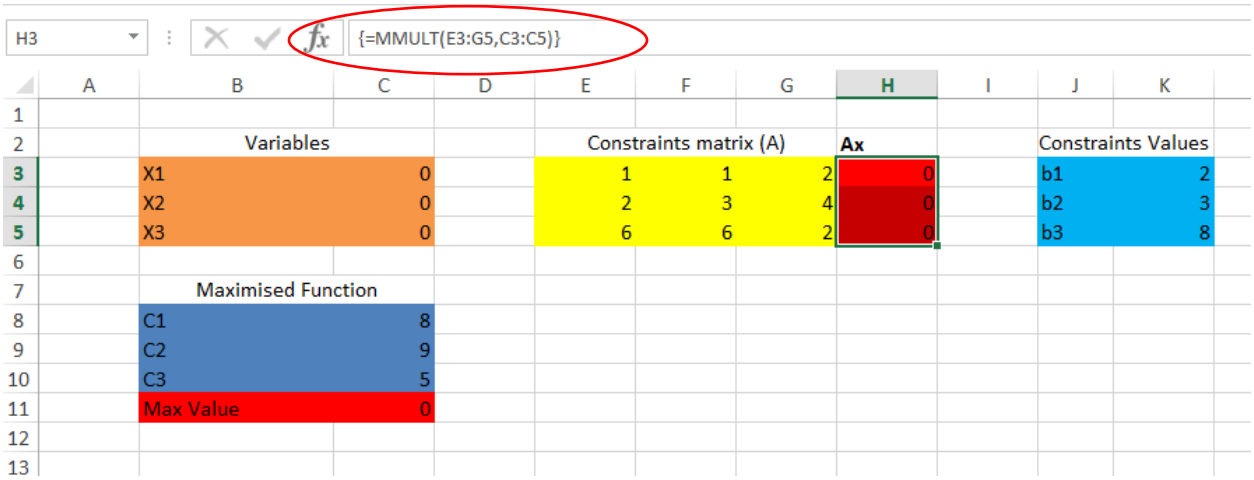
	A	B	C	D	E	F	G	H	I	J	K
1											
2		Variables			Constraints matrix (A)			Ax		Constraints Values	
3		X1	0		1	1	2	0		b1	2
4		X2	0		2	3	4	0		b2	3
5		X3	0		6	6	2	0		b3	8
6											
7		Maximised Function									
8		C1	8								
9		C2	9								
10		C3	5								
11		Max Value	0								
12											
13											
14											

Here we get used of the **sum product equation** and the **matrix multiplication** equation

Explanation:

AX is calculated by the Excel formula **MMULT(E3:G5,C3:C5)** .

1) Select (H3:H5)
2) type in **MMULT (** “then you select **E3:G5** “,”then you select **C3:C5**”) Press **enter**
3) Then press “**Ctrl**” + “**Shift**” + “**Enter**”

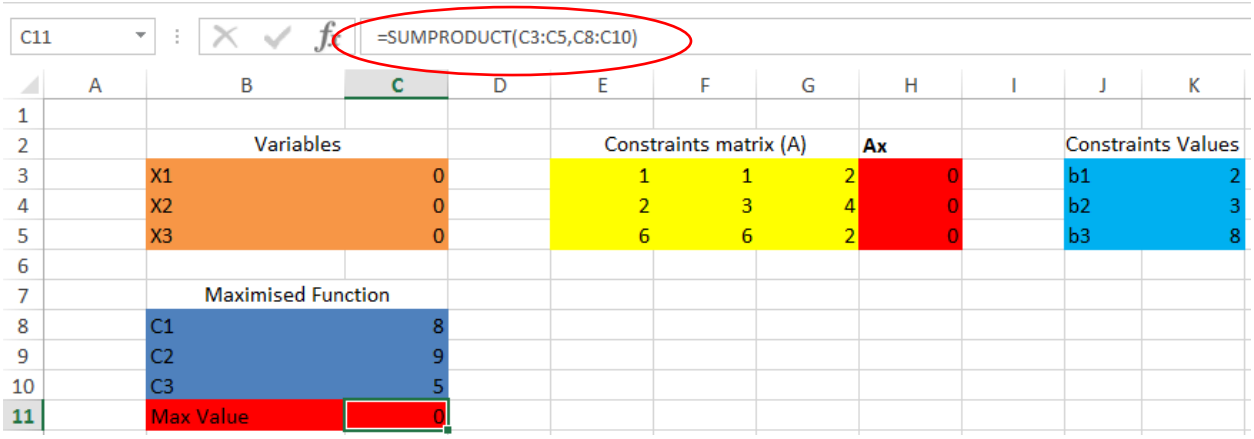


	A	B	C	D	E	F	G	H	I	J	K
1											
2		Variables			Constraints matrix (A)			Ax		Constraints Values	
3		X1	0		1	1	2	0		b1	2
4		X2	0		2	3	4	0		b2	3
5		X3	0		6	6	2	0		b3	8
6											
7		Maximised Function									
8		C1	8								
9		C2	9								
10		C3	5								
11		Max Value	0								
12											
13											

Max value is the value that we need to maximized and you can set max variable = **B11**.

Then you the value of $\mathbf{11} = \mathbf{C3} * \mathbf{C8} + \mathbf{C4} * \mathbf{C9} + \mathbf{C5} * \mathbf{C10}$ **,** or you can set

B11 = sumproduct (C3:C5, C8:C10).



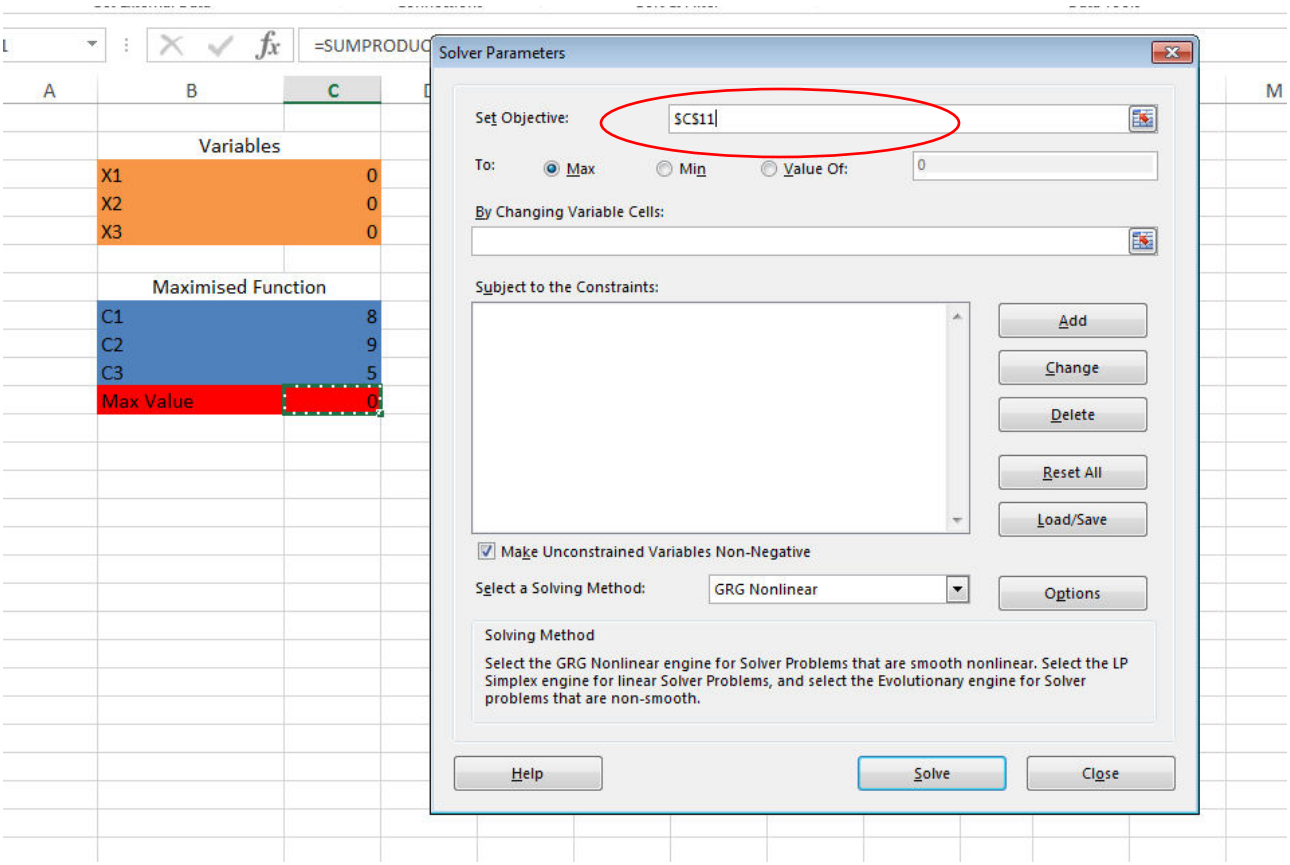
Now we are ready to apply our Solver application:

Go to the Data part and select Solver

Set Objective column:

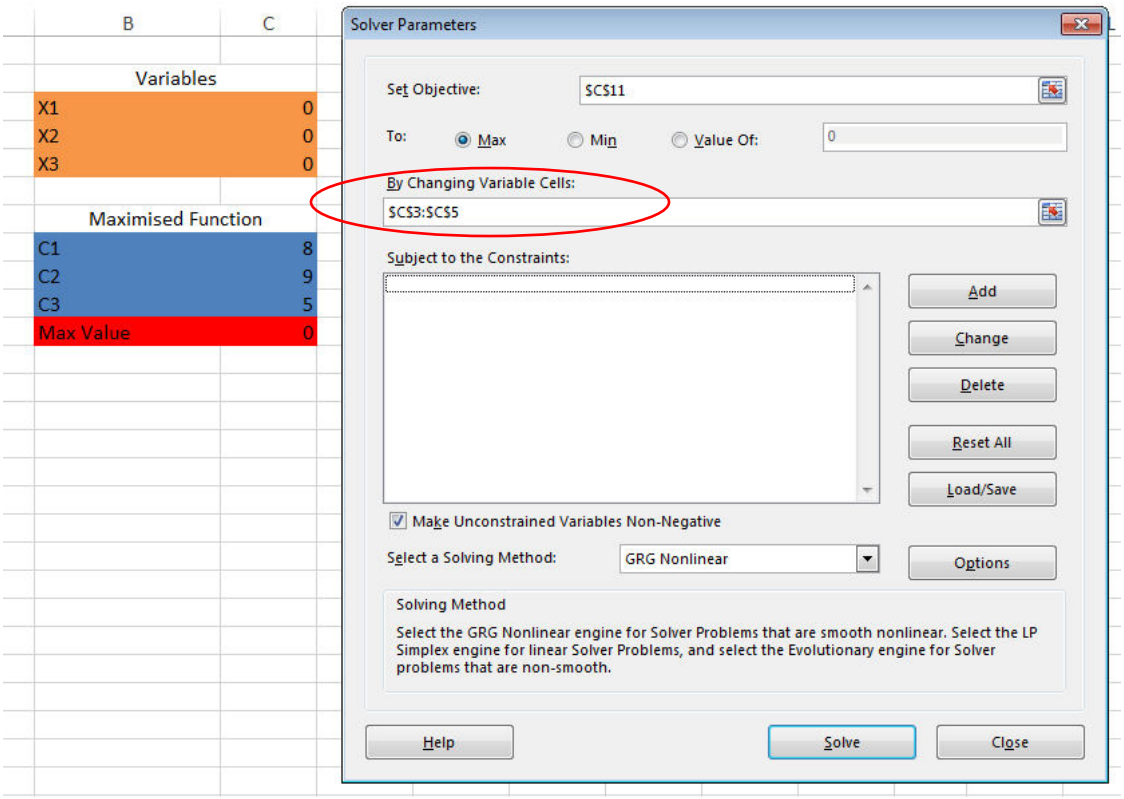
For the **Set objective** column, select the cell that you need to maximized:

And of cause you need to **Max**:



By Changing Variable Cell Column:

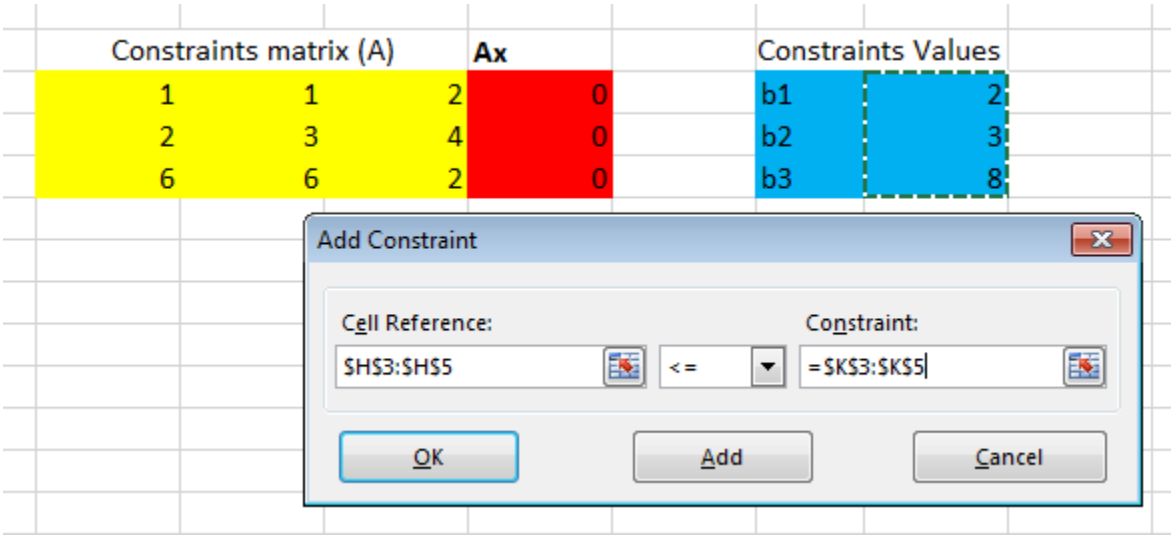
Press the red button and select the section that you have defined as variables, hence select C3 to C5 in our case.



Adding in the constraints $AX \leq b$.

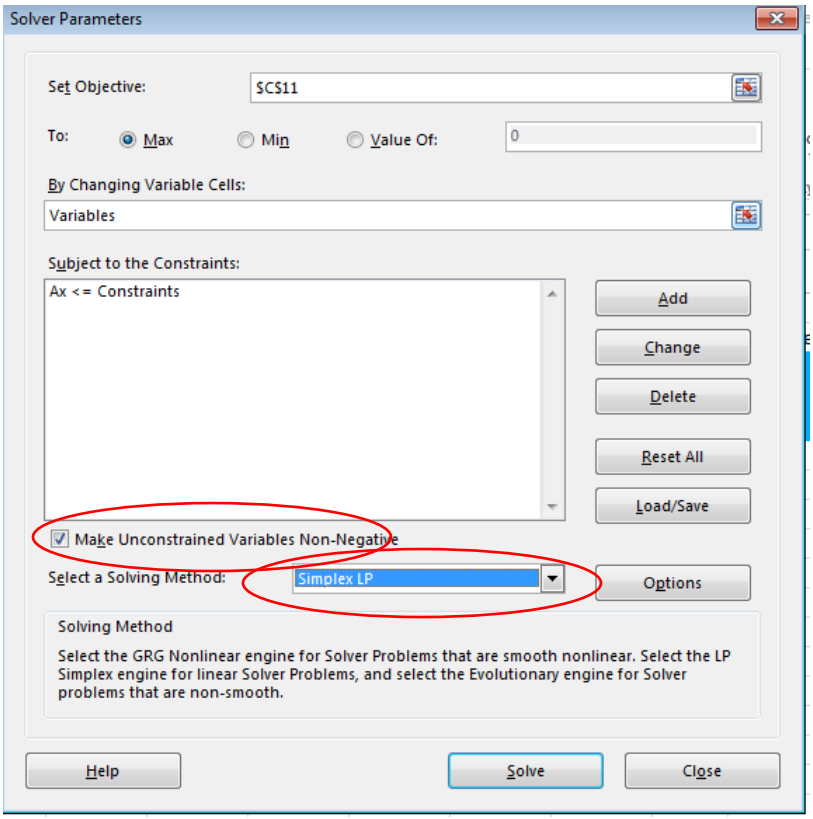
For the Subject to the constraints section, press **ADD**.

Since we need $AX \leq b$



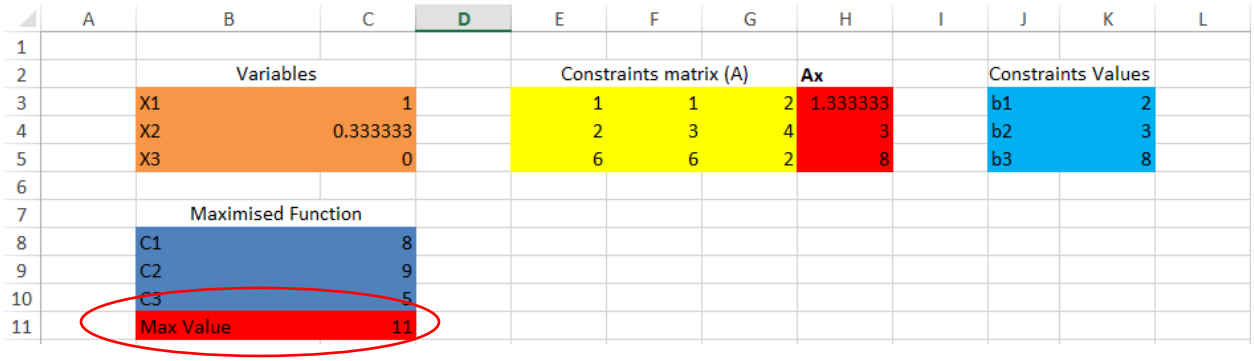
Select **(H3:H5)** $\leq$ (**k3:k5**), then press **OK**.

Making sure that the variables are non-negative and telling the solver to use the Simplex methods.



Solving the system:

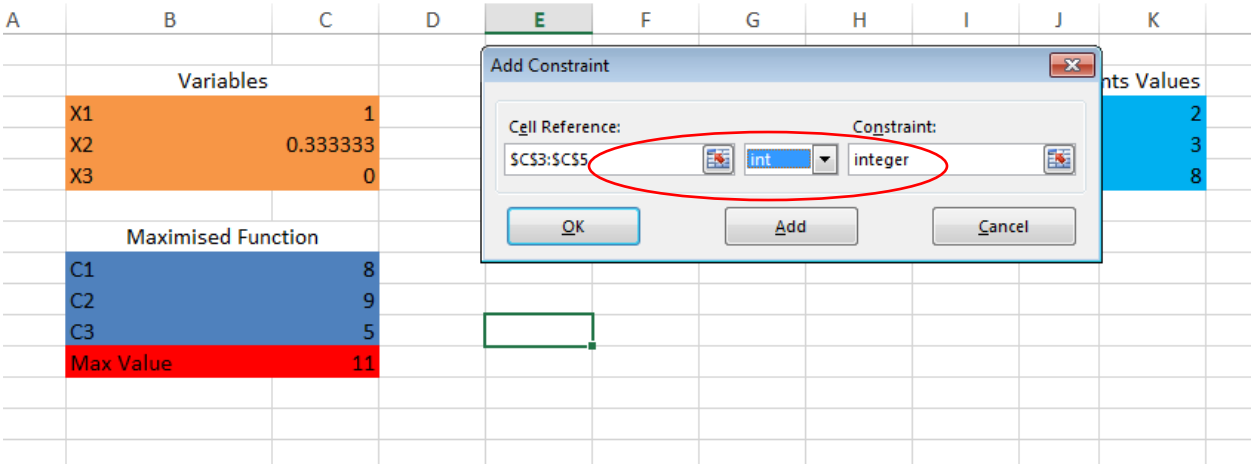
Press **“Solve”.** Select **“keep Solver solution”** and press **“OK”.**



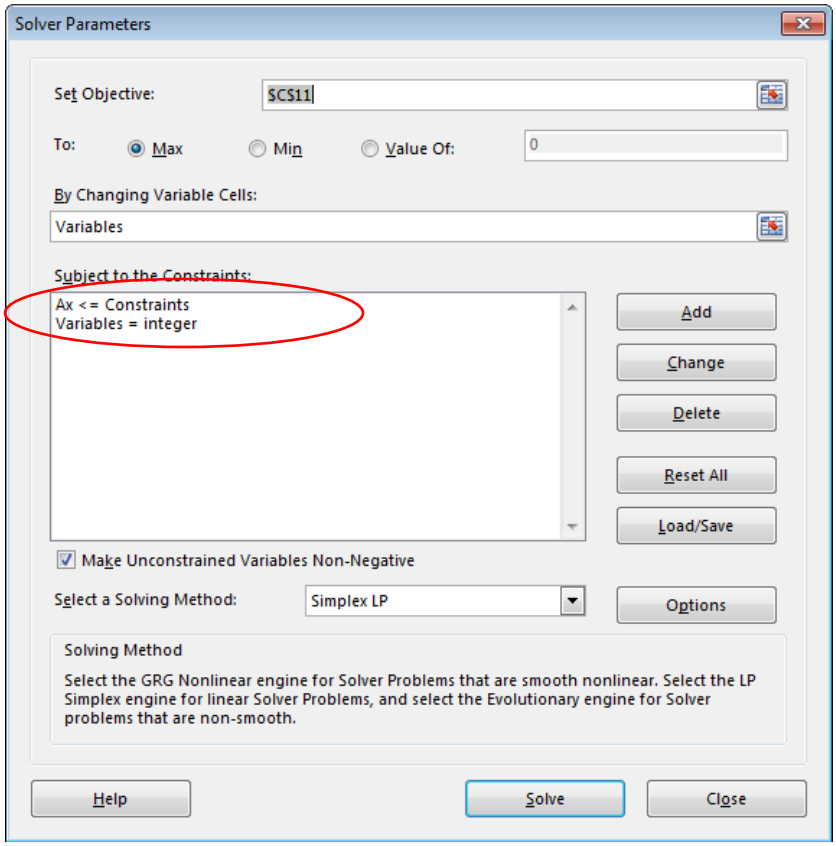
	Variables		Constraints matrix (A)			Ax	Constraints Values	
X1	1		1	1	2	1.333333	b1	2
X2	0.333333		2	3	4	3	b2	3
X3	0		6	6	2	8	b3	8
	Maximised Function							
C1	8							
C2	9							
C3	5							
Max Value	11							

More function of the constraints:

When you set the variables as “**Integer**”, the Solver will try to maximize the objective function while keeping the Xs as integer from.



	Variables	
X1	1	
X2	0.333333	
X3	0	
	Maximised Function	
C1	8	
C2	9	
C3	5	
Max Value	11	



Variables		Constraints matrix (A)			Ax	Constraints Values	
X1	0	1	1	2	1	b1	2
X2	1	2	3	4	3	b2	3
X3	0	6	6	2	6	b3	8

Maximised Function	
C1	8
C2	9
C3	5
Max Value	9

The same logic follows when you set the variables to be **binary**