

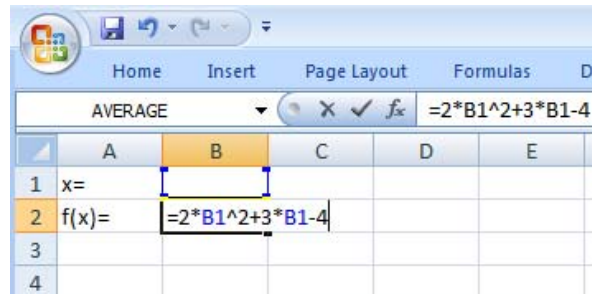
SOLVING EQUATIONS WITH EXCEL

Excel and Lotus software are equipped with functions that allow the user to identify the root of an equation. By root, we mean the values of x such that a given equation cancels itself out.

Let us consider the case where we wish to obtain the root of the function

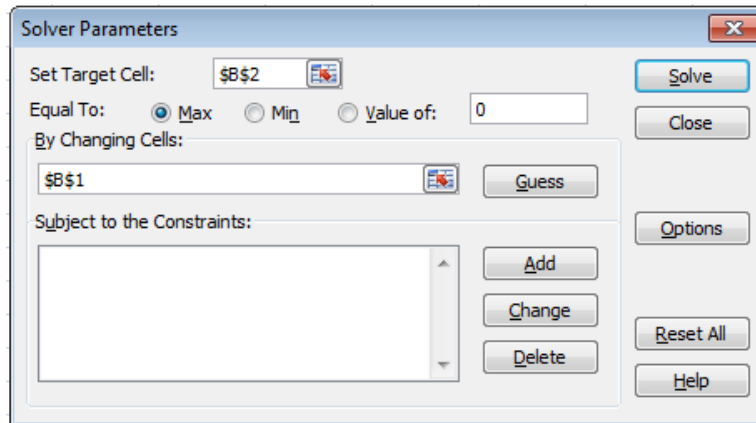
$$y = 2x^2 + 3x - 4,$$

i.e., solve the equation $2x^2 + 3x - 4 = 0$. You will see in the following illustration, that the first step of all Excel solutions is to correctly define the function we want to find the root of, and to assign the variable to one specific cell.



We assigned the cell B1 to contain the value of variable x . In cell B2, we define the function. Note that B1 *plays the part of* x in the formula. By inserting values in cell B1, you will notice that the result of the function will change. Therefore, finding the root of a function implies finding the value of x such that the function is zero. Our goal is to have cell B1 vary (the value of x) until the cell B2 (that contains the value of the function) is 0.

It would be too long to find an answer by trial and error. Select in Excel the function Solver (Tools menu). The following dialog box will appear.

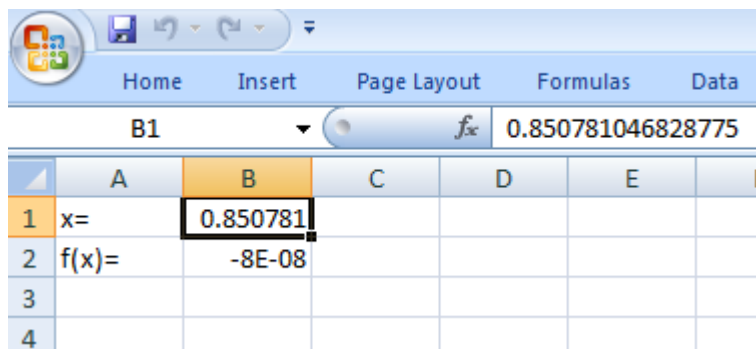


Set Target Cell: we ask you to identify the position of the function you wish to carry out an operation on. In our example, the function was placed in cell B2.

Equal to: To identify the operation you wish to carry out with the function located at B2 (max ? min ? value ?). We want the function to take on the value 0.

By Changing Cells: To identify cells that contain the variables of the function. In our example, B1 is the cell containing the value of x .

By clicking on **Solve**, Excel will execute the operation you asked it to and will give you the solution $x = 0,85078105$.



One of the limits of the Excel Solver is that it will only give one root even though we know there is a second one. For now, we use the discriminant

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

That gives the second root ($x = -2,35078108$).

	A	B	C	D	E	F
1	x=	-2.35078				
2	f(x)=	0				
3						
4						
5						

Unfortunately, the discriminant will be of no use with other types of functions and we will not be able to count on it to help us.

Exponential and logarithmic equations using Excel

Besides for finding the root of polynomial equations, the Excel Solver can solve equations containing exponential or logarithmic functions. The software will be all the more useful in this case since solving this type of algebraic equations is often impossible. For example, there are no solution methods that will find the value of x such that the equation $e^x = 4x$ is solved. The method to follow will be identical to the one presented in the case of roots, except for the following detail : the equation must be rewritten so that all terms are regrouped on the left side of the equality. For example, instead of resolving the equation $e^x = 4x$, we want the solution of $e^x - 4x = 0$.

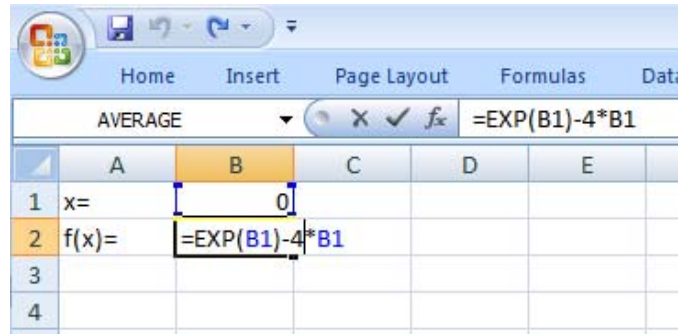
Example

Solve the following equation with the help of the solver: $e^x = 4x$.

Solution

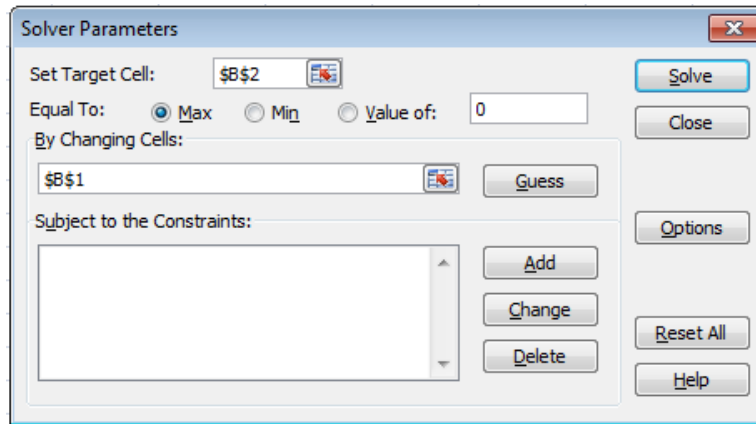
Firstly, we need to rewrite the equality so that the terms are regrouped on the left side :

$e^x - 4x = 0$. Then, it is important to correctly define the equation we want to resolve, as well as attributing the variable to a specific cell.



Once again, we have designated the cell B1 to contain the value of the variable x . The cell B2 contains the expression equal to 0. It is defined in function to B1, which substitutes the variable x .

Select in Excel the function Solver (Tools menu). A dialog box will appear in which you need to fill in information.



Equal to: To identify the operation you wish to carry out with (max ? min ? value ?).

Variable cells: To identify cells that contain the variables of the function. In our example, B1 is the cell containing the value of x .

- Target cell to define: the function was placed in cell B2.
- Equal to: We want the function located in B2 to take on the value 0.
- Variable cells: B1 is the cell that will contain the value of x .

By clicking on **Solve**, Excel will execute the operation you asked it to and will give you the following answer:

	A	B	C	D	E
1	x=	0.357403			
2	f(x)=	-2.7E-07			
3					
4					
5					

The value of $x = 0,35740306$ makes the equations $e^x = 4x$ true. Let us recall though that Excel only gives one solution to any given equation, even though it may have more than one. A second solution exists when $x = 2,15329217$, as is indicated in the following image:

	A	B	C	D	E
1	x=	2.153292			
2	f(x)=	-1.9E-08			
3					
4					
5					
6					
7					

The techniques allowing us to find these other solutions will be the subject of future discussions.

Exercise

With the help of Excel, find at least one value of x such that the following equations are satisfied.

a) $\ln x + x^2 = 2x$

b) $\ln(1 + x^2) = e^{-x}$

c) $e^x = \sqrt{x + 2}$

d) $\ln x - e^x = 3x$

Solution

a. 1,68957994

b. 0,76822112

c. 0,44754188

d. 0,82461277