

**Information and Tutorial for** 

Newton's Method with Mathcad



## **General Information for these Pages**

This is an active page, so you may practice some of the procedures. Just enter your trial in a blank area. *If you print out this page, first make sure all computations have been completed.* 

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## Newton's Method

Let's say, for example, that we wish to calculate the root of the following equation:

$$f(x) = e^x - 5$$

The first thing we need to do is define the function and its derivative:

$$f(x) := e^{x} - 5$$
 df  $(x) := \frac{d}{dx}f(x)$  \* We must also calculate the derivative  $f'(x)$ .

Next, we need to determine the number of iterations we wish to perform. Usually 10 iterations is sufficient to obtain a good approximation of the root, but remember that Newton's method is sensitive to the initial guess as well, so changing this variable may be necessary.

Now, we must determine our initial guess value for Newton's method. You can use graphical techniques to guess the root. The closer the initial guess, the fewer the number of iterations that will be needed to obain a good approximation of the root. We will use graphical estimation in this case. Our graph looks like convergence should be between 1 and 2, so we can set our initial guess to be 1.



newtpop2\_8.mcd

 $x_0 := 1$  This is our initial guess entered as: x [0:1].

Notice the subscript is 0 for the first iteration.

The next step is to enter the equation for Newton's formula as a subscripted array. A recursive formula can be input into Mathcad by using subscripts. Newton's equation looks like the following:

$$x_{i+1} \coloneqq x_i - \frac{f(x_i)}{df(x_i)}$$
 Newton's Formula

Now that Newton's formula is entered, we have several ways of displaying the convergence. We can either do this graphically, or in table form. The simplest is table form, where we simply print out the results of our calculations. As you can see, the data seems to converge to approximately 1.609. You can change the precision of your digits by double clicking on the table.



Results Format

**Exercise:** Try to plot several of the tangent lines along with the original equation on a graph.