Newton-Raphson Method - Part 3

Select RUN mode from the main menu by using the arrow keys to highlight the RUN icon or pressing 1.

Finding the solution to an equation such as f(x) = 0, using the derivative and tangent to achieve better and better approximations to the solution of f(x) = 0.

Formula used is: $x_{n+1} = x_n - f(x_n) / f'(x_n)$

N.B. The Newton-Raphson method fails when $f'(x_n) = 0$, or when a vertical asymptote value is calculated from the iteration method and then $f(x_n)$ cannot be calculated, or when there is NO solution at all.

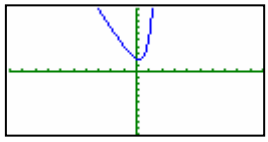
Tools needed are ? and : , these can be accessed via the PRGM menu by pressing **SHIFT** **VARS** then **F4** for the **?** and F6 then F5 for the **:**

Example 1: Attempt to find the solution to $e^{2x} - 3x + 1 = 0$, with the initial value of $x = 0$

Note here that $f(x) = e^{2x} - 3x + 1$ and that $f'(x) = 2e^{2x} - 3$

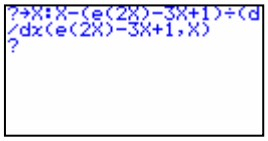
[N.B. There is NO solution to this equation and the N-R iteration method will illustrate this by not converging to an answer.]

Solution: A graph illustrates that there is **NO** solution to this equation and N-R will show an oscillation in predictions and will not 'settle' on an answer.

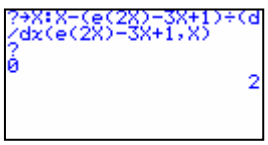


Enter the following into the calculator:

? → x : x – $(e^{2x} - 3x + 1)/(d/dx(e^{2x} - 3x + 1, x))$ then press **EXE**

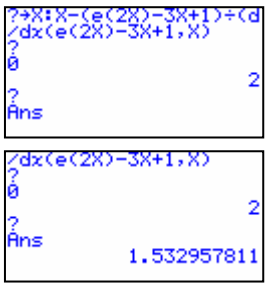


This sets up an algorithm for the calculator to have a value for x inputted. Then the N-R calculation is initiated with the first iteration value (the next best estimate) made. Enter the number: 0 then press **EXE** the answer 2 appears, this is

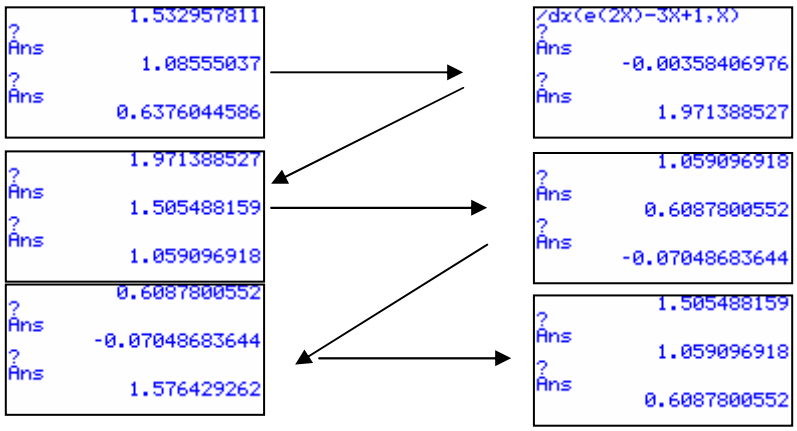


the next best answer from the N-R algorithm.

Press **EXE** again and the ? reappears.
This is where the calculator is to do another iteration of N-R. This time we want to use the revised answer from the first iteration.
Ans needs to be entered. Press **SHIFT** then **(-)**, to get ANS on the screen.



Repeat the process EXE , then Ans until the entries that are appearing on the calculator are the same.



You can see that the iteration method ‘osculates about and does not settle onto a solution.

Don’t forget to record your results as you progress through each iteration: An example of way to set out your answer is shown below.

Number of iterations: n	**x_n**	**$x_n - f(x_n)/f'(x_n)$**	**Decision / Comment**
0	**0**	**2**	
1	**2**	**1.532957811**	
2	**1.532957811**	**1.085550377**	
3	**1.085550377**	**0.6376044586**	
4	**0.6376044586**	**-0.00358406976**	
5	**-0.00358406976**	**1.971388527**	
6	**1.971388527**	**1.059096918**	
7	**1.059096918**	**Etc, etc**	**Not converging to an answer**

The recording of the iteration process is an important aspect of approximation and iterative methods used in mathematics.