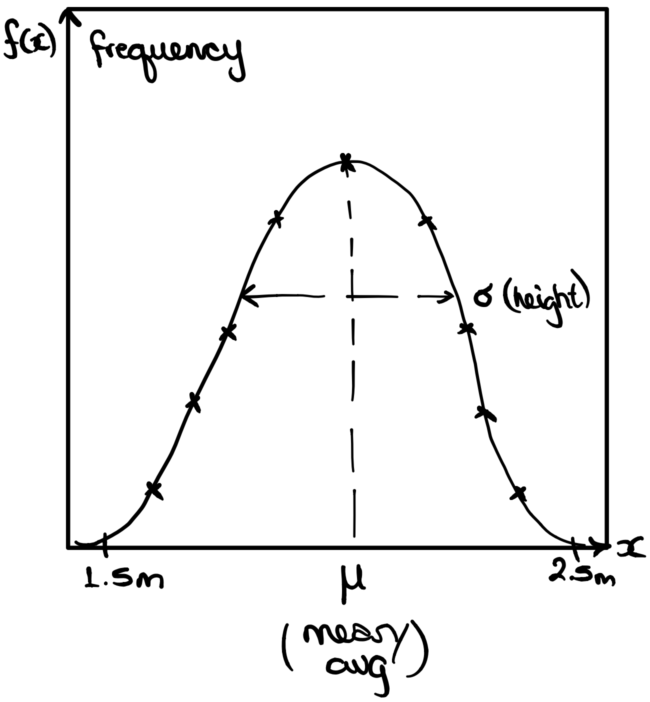
The Newton-Raphoon method can be used to solve equations.



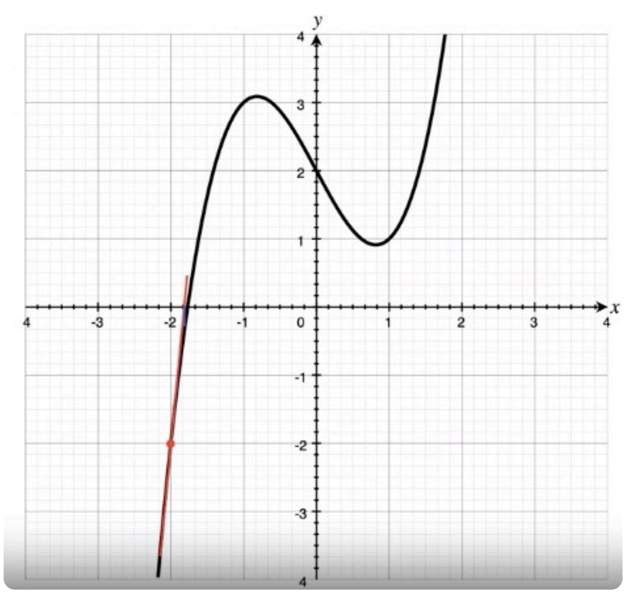

By solving the equation - a model for the distribution can be produced; often working with a model is more desirable than working with the raw data points.

Newton-Raphson produces a degree of error; and the parameter values are subject to a goodness of fit.

$$f(x) = x^3 - 2x + 2.$$

NEWTON-RAPHSON ITERATION TABLE.

| $i$ | $x_i$ | $y(x_i)$ | $\frac{\partial y(x_i)}{\partial x}$ |
|---|---|---|---|
| 0 | -2 | -2 | 10 |
| 1 | -1.8 | -0.23 | 7.7 |
| 2 | -1.77 | -0.005 | 7.4 |
| 3 | -1.769 | -2.3E-6 | |




$$f(x) = x^3 - 2x + 2.$$

Example: solving for y=0 in

$$f(x) = x^3 - 2x + 2.$$

① $\frac{\partial f}{\partial x} = 3x^2 - 2$, linearise the function

② $g_1(-2) = 10$, compute the gradient

③ $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$, estimate the parameters which will solve the equation.

$$-1.8 = -2 - \frac{(-2)}{10}$$

④ $-0.23 = f(-1.8)$, evaluate the new function.

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(*) The key requirements of the Newton-Raphson method for solving an equation is: (1) the ability to evaluate the function, and (2) the ability to derivate the func.

Complex functions with massive datasets are often too complex to be solved analytically - or be graphed out.

An Algorthimic corner case in Newton-Raphson.

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

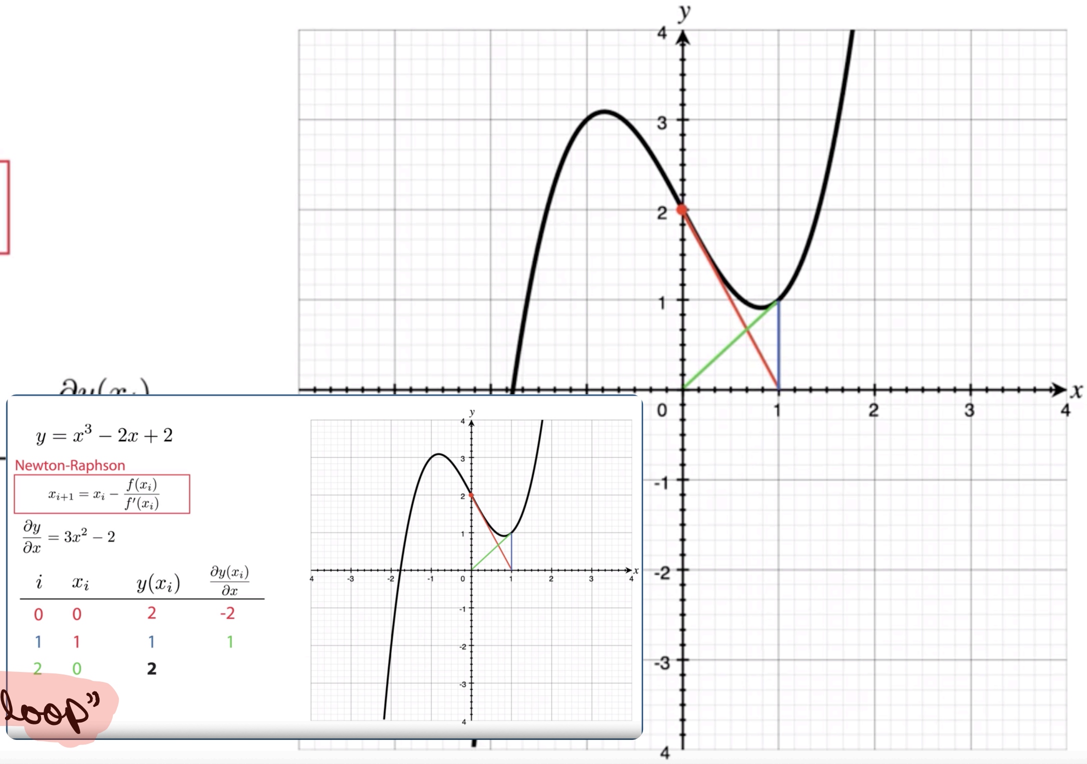
Newton-Raphson

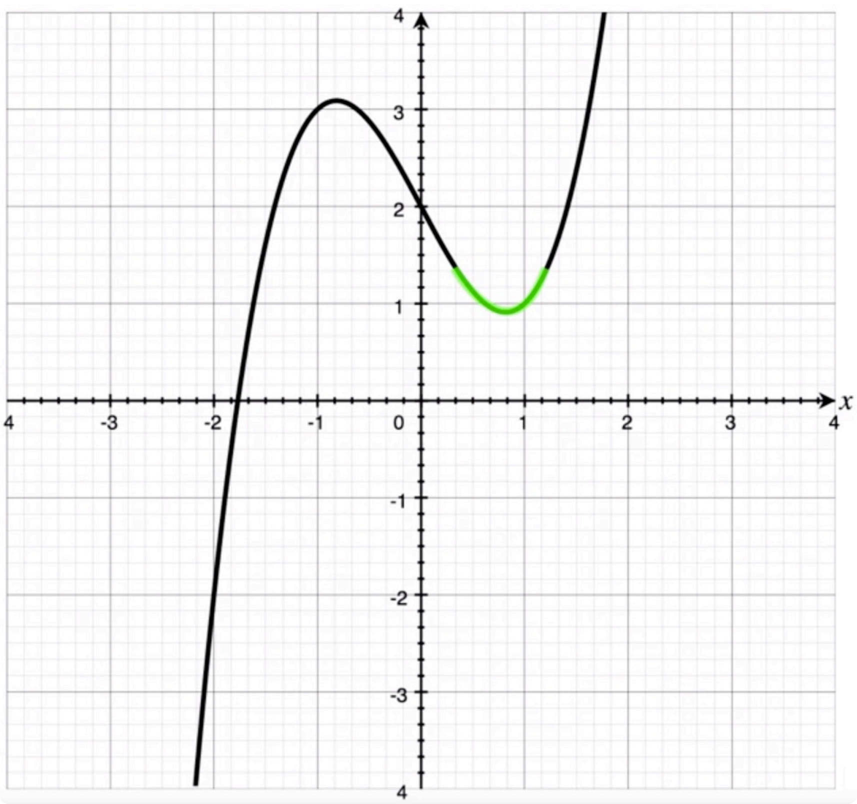
$$\boxed{x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}}$$

$$\frac{\partial y}{\partial x} = 3x^2 - 2$$

| $i$ | $x_i$ | $y(x_i)$ |
|---|---|---|
| 0 | 0 | 2 |
| 1 | 1 | 1 |
| 2 | 0 | **2** |

Some points can "loop"




Secondly, when estimating/iterating with Newton-Raphson near a minima/maxima the division by the gradient will produce an inflated jump to the next estimate. Zero also is problematic.

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

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In a multivariate context newton-raphson requires a contour plot.

Newton-Raphson works by linearisation.

Assuming the root is nearby a certain point – like $(x_0 + \delta x)$.

$$f(x_0+\delta x) = f(x_0) + f'(x_0)\delta x$$

$= 0$, the jump slightly over will be the root.

By rearranging this equation; and assuming $f(x_0+\delta x)$ is 0.

$$f(x_0+\delta x) = f(x_0) + f'(x_0)\delta x$$
$$0 = f(x_0) + f'(x_0)\delta x$$
$$f'(x_0)\delta x = -f(x_0)$$
$$\delta x = -\frac{f(x_0)}{f'(x_0)}$$

• the delta to shift for the next Newton-Raphson estimation.

Hence, $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$.