

Bootcamp : Maths

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1 Session 1

1.1 Calculus

Calculus : study of changes.

2 types of calculus : differential and integral calculus.

Differential : distance \rightarrow speed

Integration : speed \rightarrow distance

1.1.1 Derivative

Definition

The derivative is the slope of the tangent line on a point.

Definition : The derivative of f at x_0 is the slope of the line tangent to the graph of f at x_0 .

$$\lim_{\Delta x \rightarrow 0}; \frac{f(x_0 + \Delta x) - f(x_0)}{\Delta x} = f'(x_0)$$

Some derivatives $f(x) = \frac{1}{x} (x > 0)$

$$\frac{\Delta f}{\Delta x} = \frac{\frac{1}{x_0 + \Delta x} - \frac{1}{x_0}}{\Delta x} = -\frac{1}{x_0^2 + x_0 \Delta x}$$

$$f'(x_0) = \lim_{\Delta x \rightarrow 0}; -\frac{1}{x_0^2 + x_0 \Delta x} = -\frac{1}{x_0^2}$$

$$f(x) = x^n$$

$$f'(x) = \lim_{\Delta x \rightarrow 0}; \frac{(x + \Delta x)^n - x^n}{\Delta x} = \lim_{\Delta x \rightarrow 0}; \frac{\left(\binom{n}{0}x^n \Delta x^0 + \binom{n}{1}x^{n-1} \Delta x^1 + \dots\right) - x^n}{\Delta x} = nx^{n-1}$$

$$(f + g)'(x) = f'(x) + g'(x)$$

Continuity

Notations : $f'(x) = \frac{dy}{dx} = \frac{df}{dx} = Df = \frac{d}{dx}f = y'$

Example : 400 ft , $y = 400 - 16t^2$

$$400 - 16t^2 = 0$$

$$t = 5$$

On average, 80 ft per second. But we want to know the instantaneous speed when the pumpkin hits the ground :

$$f'(x) = -32t$$

$$f'(5) = -160 \text{ ft.s}^{-1}$$

Derivatives of composed functions

Chain rules

Higher derivatives

Implicit differentiation

1.2 Differential equations

1.3 Linear Algebra