

Calculus

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Contents

1	Derivatives	2
1.1	Definition	2
1.2	Properties	2
1.3	Common Derivatives	2

1 Derivatives

1.1 Definition

If the derivative is defined to be $y = f(x)$, then its derivative is $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$.

Equivalent notations for the derivative of $y = f(x)$ are:

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

Equivalent notations for the the derivative of $y = f(x)$ evaluated at $x = a$ are:

$$f'(a) = y' \Big|_{x=a} = \frac{df}{dx} \Big|_{x=a} = \frac{dy}{dx} \Big|_{x=a} = Df(a)$$

1.2 Properties

The following properties hold where $f(x)$ and $g(x)$ are differential functions and c and n are any real numbers.

1. $(cf)' = cf'(x)$

5. $\frac{d}{dx}(c) = 0$

2. $(f \pm g)' = f'(x) \pm g'(x)$

6. $\frac{d}{dx}(x^n) = nx^{n-1}$

3. $(fg)' = f'g + fg'$

4. $\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$

7. $\frac{d}{dx}(f(g(x))) = f'(g(x))g'(x)$

1.3 Common Derivatives

$$\frac{d}{dx}(x) = 1$$