Basic Derivative Rules

1. $\frac{d}{dx}\left[A \text{ (Constant)}\right] = 0$
2. $\frac{d}{dx}\left[A\,f(x)\right] = A \cdot \frac{d}{dx}\left[f(x)\right] = A\,(f'(x))$
3. $\frac{d}{dx}\left[f(x) + g(x)\right] = f'(x) + g'(x)$

The Product Rule

$$\frac{d}{dx}\left[f(x)\cdot g(x)\right] = \left(f'(x)\cdot g(x)\right) + \left(f(x)\cdot g'(x)\right)$$

The Quotient Rule

$$F(x) = \frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{(f'(x)\cdot g(x)) - (g'(x)\cdot f(x))}{(g(x))^2} = F'(x)$$

Chain Rule (use with Compositions)

$$\frac{d}{dx}\left[f(g(x))\right] = f'(g(x)) \cdot g'(x)$$

More Chain Rule...

1. $\frac{d}{dx}\left[a^x\right] = a^x \cdot \ln(a)$ $\quad$ * a = constant
2. $\frac{d}{dx}\left[\log_a x\right] = \frac{1}{\ln(a)\cdot x}$ $\longrightarrow$

Derivatives of an Inverse Function

$f(x)$, $g(x) = f^{-1}(x)$, $g(f(x)) = x$

$$\frac{d}{dx}\left[g(f(x))\right] = \frac{d}{dx}\left[x\right] = g'(f(x)) \cdot f'(x) = 1$$

$$f'(x) = \frac{1}{g'(f(x))}$$

Inverse Trig Functions

1. $y = \sin^{-1}(x) = y' = \frac{1}{\sqrt{1-x^2}}$
2. $y = \cos^{-1}(x) = y' = \frac{-1}{\sqrt{1-x^2}}$
3. $y = \tan^{-1}(x) = y' = \frac{1}{x^2+1}$

Derivatives of Sin(x) / Cos(x)

$$\frac{d}{dx}\left[\sin(x)\right] = \cos(x)$$

$$\frac{d}{dx}\left[\cos(x)\right] = -\sin(x)$$

Derivatives of e^x / ln(x)

$f(x) = e^x \rightarrow f'(x) = e^x$

$f(x) = \ln(x) \rightarrow f'(x) = \frac{1}{x}$

Trig. Derivatives

$$\frac{d}{dx}\left[\tan(x)\right] = \sec^2(x)$$

$$\frac{d}{dx}\left[\cot(x)\right] = -\csc^2(x)$$

$$\frac{d}{dx}\left[\csc(x)\right] = -\cot(x)\cdot\csc(x)$$

$$\frac{d}{dx}\left[\sec(x)\right] = \tan(x)\cdot\sec(x)$$

Changing Log Base.

$$\log_a b = \frac{\log_c b}{\log_c a} = \frac{\ln b}{\ln a}$$

Pythagorean Identities

(In case you forget)

1. $\sin^2(x) + \cos^2(x) = 1$
2. $1 + \cot^2(x) = \csc^2(x)$
3. $\tan^2(x) + 1 = \sec^2(x)$

General Derivative by Limit

$$f'(x) = \lim_{c \to 0} \frac{f(x+c) - f(x)}{c}$$