# Derivative Tools

| |
|---|
| **Limit Definition of Derivative**<br>$f'(x) = \lim\limits_{h \to 0} \frac{f(x+h)-f(x)}{h}$ or $\lim\limits_{x \to a} \frac{f(x)-f(a)}{x-a}$ |
| **Power Rule**<br>$f(x) = a \bullet x^{n}$<br>$f'(x) = a \bullet n \bullet x^{n-1}$ |
| **Sum Rule**<br>$h(x) = f(x) + g(x)$<br>$h'(x) = f'(x) + g'(x)$ |
| **Product Rule**<br>$h(x) = f(x) \bullet g(x)$<br>$h'(x) = (f'(x) \bullet g(x)) + (f(x) \bullet g'(x))$ |
| **Quotient Rule**<br>$h(x) = \frac{f(x)}{g(x)}$<br>$h'(x) = \frac{(f'(x) \bullet g(x)) - (f(x) \bullet g'(x))}{(g(x))^{2}}$ |
| **Chain Rule**<br>$h(x) = f(g(x))$<br>$h'(x) = f'(g(x)) \bullet g'(x)$ |
| **Exponential**<br>$f(x) = a^{g(x)}$<br>$f'(x) = a^{g(x)} \bullet ln(a) \bullet g'(x)$ |
| **Logarithm**<br>$f(x) = log_{a}(x)$<br>$f'(x) = \frac{1}{x \bullet ln(a)}$ or $\frac{log_{a}(e)}{x}$ |

# Derivative Tools

## Trigonometric

| | |
|---|---|
| $f(x) = sin(x), f'(x) = cos(x)$ | $f(x) = cos(x), f'(x) =- sin(x)$ |
| $f(x) = tan(x), f'(x) = sec^2(x)$ | $f(x) = cot(x), f'(x) =- cot^2(x)$ |
| $f(x) = sec(x),$<br>$f'(x) = sec(x) \bullet tan(x)$ | $f(x) = csc(x),$<br>$f'(x) =- csc(x) \bullet cot(x)$ |

## Inverse Trigonometric

| | |
|---|---|
| $f(x) = sin^{-1}(g(x)),$<br>$f'(x) = \frac{g'(x)}{\sqrt{1-g^2(x)}}$ | $f(x) = cos^{-1}(g(x)),$<br>$f'(x) =- \frac{g'(x)}{\sqrt{1-g^2(x)}}$ |
| $f(x) = tan^{-1}(g(x)),$<br>$f'(x) = \frac{g'(x)}{1+g^2(x)}$ | $f(x) = cot^{-1}(x), f'(x) =- \frac{g'(x)}{1+g^2(x)}$ |
| $f(x) = sec^{-1}(g(x)),$<br>$f'(x) = \frac{g'(x)}{\lvert g(x)\rvert \bullet \sqrt{g^2(x)-1}}$ | $f(x) = csc^{-1}(g(x)),$<br>$f'(x) =- \frac{g'(x)}{\lvert g(x)\rvert \bullet \sqrt{g^2(x)-1}}$ |

## Implicit Differentiation (Chain Rule)

Example: If $x + f(x) = 10$, then $1 + f'(x) = 0$