

## Derivatives

### Basic Differentiation Rules

<i>Constant Function:</i>	$y = c$	$y' = 0$
<i>Linear Function:</i>	$y = cx$	$y' = c$
<i>Power Function:</i>	$y = x^n$	$y' = nx^{n-1}$
<i>Constant Multiple Function:</i>	$y = cf(x)$	$y' = cf'(x)$
<i>Sum of Functions:</i>	$y = f(x) + g(x)$	$y' = f'(x) + g'(x)$
<i>Difference of Functions:</i>	$y = f(x) - g(x)$	$y' = f'(x) - g'(x)$
<i>Product of Functions:</i>	$y = f(x)g(x)$	$y' = f'(x)g(x) + f(x)g'(x)$
<i>Quotient of Functions:</i>	$y = \frac{f(x)}{g(x)}$	$y' = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$
<i>Composite Function: (The chain rule)</i>	$y = f(g(x))$	$y' = \frac{dy}{dg} g'(x)$
<i>Inverse Function:</i>	$x = f^{-1}(y)$ $\Rightarrow y = f(x)$	$\frac{dx}{dy} = \frac{1}{\frac{dy}{dx}}$

### Derivatives of Exponential and Logarithmic Functions

<i>Natural Exponential Function:</i>	$y = e^x$	$y' = e^x$
<i>Exponential Function:</i>	$y = a^x$	$y' = a^x \log_e a$
<i>Natural Logarithmic Function:</i>	$y = \log_e x$	$y' = \frac{1}{x}$
<i>Logarithmic Function:</i>	$y = \log_a x$	$y' = \frac{1}{x \log_e a}$



## Derivatives

### Derivatives of Trigonometric Functions

*Sine Function:*  $y = \sin x \quad y' = \cos x$   
*Cosine Function:*  $y = \cos x \quad y' = -\sin x$   
*Tangent Function:*  $y = \tan x \quad y' = \sec^2 x$   
*Cotangent Function:*  $y = \cot x \quad y' = -\csc^2 x$   
*Secant Function:*  $y = \sec x \quad y' = \sec x \tan x$   
*Cosecant Function:*  $y = \csc x \quad y' = -\csc x \cot x$

### Derivatives of Inverse Trigonometric Functions

*Inverse Sine Function:*  $y = \sin^{-1} x \quad y' = \frac{1}{\sqrt{1-x^2}} \quad \begin{cases} x: -1 < x < 1 \\ y: -\pi/2 < y < \pi/2 \end{cases}$   
*Inverse Cosine Function:*  $y = \cos^{-1} x \quad y' = \frac{-1}{\sqrt{1-x^2}} \quad \begin{cases} x: -1 < x < 1 \\ y: \pi > y > 0 \end{cases}$   
*Inverse Tangent Function:*  $y = \tan^{-1} x \quad y' = \frac{1}{1+x^2} \quad \begin{cases} x: -\infty < x < +\infty \\ y: -\pi/2 < y < \pi/2 \end{cases}$   
*Inverse Cotangent Function:*  $y = \cot^{-1} x \quad y' = \frac{-1}{1+x^2} \quad \begin{cases} \begin{cases} x: -\infty < x < +\infty \\ y: \pi > y > 0 \end{cases} & \text{or} \\ \begin{cases} x: (-\infty < x < 0) \cup (0 < x < +\infty) \\ y: (0 > y > -\pi/2) \cup (\pi/2 > y > 0) \end{cases} \end{cases}$   
*Inverse Secant Function:*  $y = \sec^{-1} x \quad y' = \frac{1}{x\sqrt{x^2-1}} \quad \begin{cases} x: (-\infty < x < -1) \cup (1 < x < +\infty) \\ y: (\pi/2 < y < \pi) \cup (0 < y < \pi/2) \end{cases}$   
*Inverse Cosecant Function:*  $y = \csc^{-1} x \quad y' = \frac{-1}{x\sqrt{x^2-1}} \quad \begin{cases} x: (-\infty < x < -1) \cup (1 < x < +\infty) \\ y: (0 > y > -\pi/2) \cup (\pi/2 > y > 0) \end{cases}$

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**References** - The following work was referenced to during the creation of this handout: [Summary of Rules of Differentiation](#).



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