

Factsheet: List of derivatives

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Summary

A list of common (and some uncommon) derivatives of functions.

Throughout, a, k are real numbers.

Derivatives of polynomial, exponential and logarithmic functions

function	derivative w.r.t x	notes
c	0	$c \in \mathbb{R}$
$mx + c$	m	$m, c \in \mathbb{R}$
x^α	$\alpha x^{\alpha-1}$	$\alpha \in \mathbb{R}, \alpha \neq 0$
ae^{kx}	ake^{kx}	
$a \ln(kx)$	$\frac{a}{x}$	
ac^{kx}	$akc^{kx} \ln(c)$	$c \in \mathbb{R}, c > 0$ constant
$a \log_c(kx)$	$\frac{a}{x \ln(c)}$	$c \in \mathbb{R}, c > 1$ constant

Derivatives of trigonometric functions

function	derivative w.r.t x
$a \sin(kx)$	$ak \cos(kx)$
$a \cos(kx)$	$-ak \sin(kx)$
$a \tan(kx)$	$ak \sec^2(kx)$
$a \cot(kx)$	$-ak \csc^2(kx)$

function	derivative w.r.t x
$a \sec(kx)$	$ak \sec(kx) \tan(kx)$
$a \csc(kx)$	$-ak \csc(kx) \cot(kx)$

Derivatives of inverse trigonometric functions

function	derivative w.r.t x	notes
$a \sin^{-1}(kx)$	$\frac{ak}{\sqrt{1-k^2x^2}}$	valid for $x \in (-\frac{1}{k}, \frac{1}{k})$
$a \cos^{-1}(kx)$	$\frac{-ak}{\sqrt{1-k^2x^2}}$	valid for $x \in (-\frac{1}{k}, \frac{1}{k})$
$a \tan^{-1}(kx)$	$\frac{ak}{1+k^2x^2}$	valid for $x \in \mathbb{R}$
$a \cot^{-1}(kx)$	$\frac{-ak}{1+k^2x^2}$	valid for $x \in \mathbb{R}$
$a \sec^{-1}(kx)$	$\frac{a}{ x \sqrt{k^2x^2-1}}$	valid for $x \in \mathbb{R} \setminus (-\frac{1}{k}, \frac{1}{k})$
$a \csc^{-1}(kx)$	$\frac{-a}{ x \sqrt{k^2x^2-1}}$	valid for $x \in \mathbb{R} \setminus (-\frac{1}{k}, \frac{1}{k})$

Derivatives of hyperbolic functions

function	derivative w.r.t x
$a \sinh(kx)$	$ak \cosh(kx)$
$a \cosh(kx)$	$ak \sinh(kx)$
$a \tanh(kx)$	$ak \operatorname{sech}^2(kx)$
$a \coth(kx)$	$-ak \operatorname{csch}^2(kx)$
$a \operatorname{sech}(kx)$	$-ak \operatorname{sech}(kx) \tanh(kx)$
$a \operatorname{csch}(kx)$	$-ak \operatorname{csch}(kx) \coth(kx)$

Derivatives of inverse hyperbolic functions

Throughout, a, k are real numbers.

function	derivative w.r.t x	notes
$a \sinh^{-1}(kx)$	$\frac{ak}{\sqrt{1+k^2x^2}}$	
$a \cosh^{-1}(kx)$	$\frac{ak}{\sqrt{k^2x^2-1}}$	a, k, x positive
$a \tanh^{-1}(kx)$	$\frac{ak}{1-k^2x^2}$	
$a \coth^{-1}(kx)$	$\frac{ak}{1-k^2x^2}$	
$a \operatorname{sech}^{-1}(kx)$	$-\frac{ak}{x\sqrt{1-k^2x^2}}$	a, k, x positive
$a \operatorname{csch}^{-1}(kx)$	$-\frac{ak}{ x \sqrt{k^2x^2+1}}$	

Further reading

For more about where these came from, please see [Guide: Introduction to differentiation and the derivative](#) and [Proof sheet: Derivatives of other common functions].

Version history

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