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 |
| --- | --- | --- |
| $c$ | $0$ | $c\in R$ |
| $mx+c$ | $m$ | $m,c\in R$ |
| $x^{α}$ | $αx^{α−1}$ | $α\in R,α\ne 0$ |
| $ae^{kx}$ | $ake^{kx}$ |  |
| $aln\left(kx\right)$ | $\frac{a}{x}$ |  |
| $ac^{kx}$ | $akc^{kx}ln\left(b\right)$ | $c\in R,c>0$ constant |
| $alog\_{c}\left(kx\right)$ | $\frac{a}{xln\left(c\right)}$ | $c\in R,c>1$ constant |

## Derivatives of trigonometric functions

| function | derivative w.r.t $x$ |
| --- | --- |
| $asin\left(kx\right)$ | $akcos\left(kx\right)$ |
| $acos\left(kx\right)$ | $−aksin\left(kx\right)$ |
| $atan\left(kx\right)$ | $aksec^{2}\left(kx\right)$ |
| $acot\left(kx\right)$ | $−akcsc^{2}\left(kx\right)$ |
| $asec\left(kx\right)$ | $aksec\left(kx\right)tan\left(kx\right)$ |
| $acsc\left(kx\right)$ | $−akcsc\left(kx\right)cot\left(kx\right)$ |

## Derivatives of inverse trigonometric functions

| function | derivative w.r.t $x$ | notes |
| --- | --- | --- |
| $asin^{−1}\left(kx\right)$ | $\frac{ak}{\sqrt{1−k^{2}x^{2}}}$ | valid for $x\in \left(−\frac{1}{k},\frac{1}{k}\right)$ |
| $acos^{−1}\left(kx\right)$ | $\frac{−ak}{\sqrt{1−k^{2}x^{2}}}$ | valid for $x\in \left(−\frac{1}{k},\frac{1}{k}\right)$ |
| $atan^{−1}\left(kx\right)$ | $\frac{ak}{1+k^{2}x^{2}}$ | valid for $x\in R$ |
| $acot^{−1}\left(kx\right)$ | $\frac{−ak}{1+k^{2}x^{2}}$ | valid for $x\in R$ |
| $asec^{−1}\left(kx\right)$ | $\frac{a}{\left|x\right|\sqrt{k^{2}x^{2}−1}}$ | valid for $x\in R∖\left(−\frac{1}{k},\frac{1}{k}\right)$ |
| $acsc^{−1}\left(kx\right)$ | $\frac{−a}{\left|x\right|\sqrt{k^{2}x^{2}−1}}$ | valid for $x\in R∖\left(−\frac{1}{k},\frac{1}{k}\right)$ |

## Derivatives of hyperbolic functions

| function | derivative w.r.t $x$ |
| --- | --- |
| $asinh\left(kx\right)$ | $akcosh\left(kx\right)$ |
| $acosh\left(kx\right)$ | $aksinh\left(kx\right)$ |
| $atanh\left(kx\right)$ | $ak sech^{2}\left(kx\right)$ |
| $a coth\left(kx\right)$ | $−ak csch^{2}\left(kx\right)$ |
| $a sech\left(kx\right)$ | $−ak sech\left(kx\right) tanh\left(kx\right)$ |
| $a csch\left(kx\right)$ | $−ak csch\left(kx\right) coth\left(kx\right)$ |

## Derivatives of inverse hyperbolic functions

Throughout, $a,k$ are real numbers.

| function | derivative w.r.t $x$ | notes |
| --- | --- | --- |
| $asinh^{−1}\left(kx\right)$ | $\frac{ak}{\sqrt{1+k^{2}x^{2}}}$ |  |
| $acosh^{−1}\left(kx\right)$ | $\frac{ak}{\sqrt{k^{2}x^{2}−1}}$ | $a,k,x$ positive |
| $atanh^{−1}\left(kx\right)$ | $\frac{ak}{1−k^{2}x^{2}}$ |  |
| $a coth^{−1}\left(kx\right)$ | $\frac{ak}{1−k^{2}x^{2}}$ |  |
| $a sech^{−1}\left(kx\right)$ | $−\frac{ak}{x\sqrt{1−k^{2}x^{2}}}$ | $a,k,x$ positive |
| $a csch^{−1}\left(kx\right)$ | $−\frac{ak}{\left|x\right|\sqrt{k^{2}x^{2}+1}}$ |  |

# Further reading

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

## Version history

v1.0: created in 08/25 by tdhc.

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