

MAT 136, Prof. Swift

Differentiation Shortcuts

Rules:

$$\frac{d}{dx} [c \cdot f(x)] = c \cdot f'(x) \quad \text{The Constant Multiple Rule (} c \text{ is any constant).}$$

$$\frac{d}{dx} [f(x) \pm g(x)] = f'(x) \pm g'(x) \quad \text{The Sum and Difference Rules.}$$

$$\frac{d}{dx} [f(g(x))] = f'(g(x)) \cdot g'(x) \quad \text{The all-important Chain Rule.}$$

$$\frac{d}{dx} [f(x) \cdot g(x)] = f'(x) \cdot g(x) + f(x) \cdot g'(x) \quad \text{The Product Rule.}$$

$$\frac{d}{dx} \left[\frac{f(x)}{g(x)} \right] = \frac{f'(x) \cdot g(x) - f(x) \cdot g'(x)}{g(x)^2} \quad \text{The Quotient Rule.}$$

Derivatives of specific functions:

$$\frac{d}{dx} [m \cdot x + b] = m \quad \text{for any constants } m \text{ and } b.$$

$$\frac{d}{dx} x^a = a \cdot x^{a-1} \quad \text{for any constant } a. \text{ (Drag and drop.)}$$

$$\frac{d}{dx} |x| = \frac{x}{|x|}. \quad \text{This can also be written as } \frac{d}{dx} |x| = \frac{|x|}{x}$$

$$\frac{d}{dx} e^x = e^x \quad \text{and more generally } \frac{d}{dx} a^x = \ln(a) \cdot a^x \text{ for any positive constant } a.$$

$$\frac{d}{dx} \ln(x) = \frac{1}{x} \quad \text{with domain } x > 0 \qquad \frac{d}{dx} \ln|x| = \frac{1}{x} \quad \text{with domain } x \neq 0$$

$$\frac{d}{dx} \sin(x) = \cos(x) \qquad \frac{d}{dx} \cos(x) = -\sin(x) \qquad \frac{d}{dx} \tan(x) = \frac{1}{\cos^2(x)} = \sec^2(x)$$

$$\frac{d}{dx} \arcsin(x) = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx} \arccos(x) = \frac{-1}{\sqrt{1-x^2}} \qquad \frac{d}{dx} \arctan(x) = \frac{1}{1+x^2}$$

Trigonometric Identities:

$$\sin^2(x) + \cos^2(x) = 1 \qquad \tan(x) = \frac{\sin(x)}{\cos(x)}$$

$$\csc(x) = \frac{1}{\sin(x)} \qquad \sec(x) = \frac{1}{\cos(x)} \qquad \cot(x) = \frac{1}{\tan(x)} = \frac{\cos(x)}{\sin(x)}$$

All there is to know about Logarithms:

$\ln(a) = b \Leftrightarrow e^b = a$, so $\ln(1) = 0$ (since $e^0 = 1$), and $\ln(e) = 1$ (since $e^1 = e$), etc.

$$e^{\ln(x)} = x \text{ for all } x > 0 \qquad \ln(e^x) = x \text{ for all } x \qquad \log_a(x) = \ln(x)/\ln(a)$$

$$\ln(ab) = \ln(a) + \ln(b) \qquad \ln(a/b) = \ln(a) - \ln(b) \qquad \ln(a^b) = b \ln(a)$$