

Differentiation Rules (Chapter 3)

1. $\frac{d}{dx}[cf(x)] = cf'(x)$ for any constant c (constants pull out)
2. $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$ and $\frac{d}{dx}[f(x) - g(x)] = f'(x) - g'(x)$
(derivative of a sum or difference = sum or difference of the derivatives)
3. **Product Rule:** $\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + f'(x)g(x)$
4. **Quotient Rule:** $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$ or $\left(\frac{u}{v}\right)' = \frac{v du - u dv}{v^2}$
5. **Chain Rule:** $\frac{d}{dx}f(g(x)) = f'(g(x)) \cdot g'(x)$ or $\frac{dy}{dt} = \frac{dy}{dx} \cdot \frac{dx}{dt}$

Some Specific Derivative Formulas

1. $\frac{d}{dx}(c) = 0$ for any constant c (derivative of a constant is zero)
2. $\frac{d}{dx}(mx + b) = m$ (derivative of a line = slope)
3. **Power Rule:** $\frac{d}{dx}(x^n) = nx^{n-1}$ for any real number n
4. $\frac{d}{dx}(e^x) = e^x$
5. $\frac{d}{dx}(a^x) = \ln a \cdot a^x$ for any real number $a > 0$
6. $\frac{d}{dx} \sin x = \cos x$
7. $\frac{d}{dx} \cos x = -\sin x$
8. $\frac{d}{dx} \tan x = \sec^2 x$
9. $\frac{d}{dx} \sin^{-1} x = \frac{1}{\sqrt{1-x^2}}$
10. $\frac{d}{dx} \cos^{-1} x = -\frac{1}{\sqrt{1-x^2}}$

$$11. \frac{d}{dx} \tan^{-1} x = \frac{1}{1+x^2}$$

$$12. \frac{d}{dx} \ln x = \frac{1}{x}$$

$$13. \frac{d}{dx} \log_a x = \frac{1}{x \ln a}$$