

University of Bahrain
 Department of Mathematics
 MATHS101: Calculus I
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Differentiation Rules

$$(1) \quad (c)' = 0$$

$$(2) \quad (x)' = 1$$

$$(3) \quad (\sqrt{x})' = \frac{1}{2\sqrt{x}}$$

$$(4) \quad \left(\frac{1}{x}\right)' = \frac{-1}{x^2}$$

(5) (Power Rule)

$$(x^n)' = nx^{n-1} \quad \text{---} \quad (\text{variable})^{\text{number}}$$

(6) (Derivative of the Trigonometric function)

$$(\sin x)' = \cos x \quad (\cos x)' = -\sin x$$

$$(\tan x)' = \sec^2 x \quad (\cot x)' = -\csc x$$

$$(\sec x)' = \sec x \tan x \quad (\csc x)' = -\csc x \cot x$$

(7) (Derivative of the exponential function)

$$(e^x)' = e^x$$

$$(a^x)' = a^x \ln a \quad \text{---} \quad (\text{number})^{\text{variable}}$$

(8) (Derivative of the logarithmic function)

$$(\ln x)' = \frac{1}{x}$$

$$(\log_a x)' = \frac{1}{x \ln a}$$

(9) (Derivative of the inverse function)

$$(f^{-1}(x))' = \frac{1}{f'(f^{-1}(x))}$$

(10) (Derivative of the Inverse Trigonometric functions)

$$(\sin^{-1} x)' = \frac{1}{\sqrt{1-x^2}}$$

$$(\cos^{-1} x)' = \frac{-1}{\sqrt{1-x^2}}$$

$$(\tan^{-1} x)' = \frac{1}{1+x^2}$$

$$(\cot^{-1} x)' = \frac{-1}{1+x^2}$$

$$(\sec^{-1} x)' = \frac{1}{|x|\sqrt{x^2-1}}$$

$$(\csc^{-1} x)' = \frac{-1}{|x|\sqrt{x^2-1}}$$

1. Constant Multiple Rule

$$\begin{aligned}(cf(x))' &= c \cdot f'(x) \\ &= c \cdot \text{Derivative of the function}\end{aligned}$$

2. Sum Rule

$$\begin{aligned}(f(x) + g(x))' &= f'(x) + g'(x) \\ &= \text{Derivative of first} + \text{Derivative of second}\end{aligned}$$

3. Product Rule

$$\begin{aligned}(f(x)g(x))' &= f'(x)g(x) + f(x)g'(x) \\ &= (\text{derivative of first})(\text{second}) + (\text{first})(\text{derivative of second})\end{aligned}$$

4. Quotient Rule

$$\begin{aligned}\left(\frac{f(x)}{g(x)}\right)' &= \frac{g(x)f'(x) - f(x)g'(x)}{g(x)^2} \\ &= \frac{(\text{deno})(\text{derivative of numerator}) - (\text{num})(\text{derivative of denominator})}{(\text{denominator})^2}\end{aligned}$$

5. Chain Rule

$$\begin{aligned}(f(g(x)))' &= f'(g(x)) \cdot g'(x) \\ &= \text{derivative of outer}(\text{inner}) \cdot (\text{derivative of inner})\end{aligned}$$