

THE CHAIN RULE

If $y = f(u)$ and $u = g(x)$ then

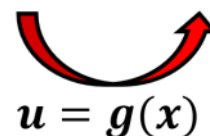
$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$



Consider a function, y , that is actually a combination of 2 functions.

We say that y is a function of u , $f(u)$, where in this case u is a function of x , $g(x)$.

$$y = f(u) = f(g(x))$$



Scenario: Consider the function $y = (2x + 4)^5$

- ❖ We can see that $y = (u)^5$, where $u = 2x + 4$
- ❖ From this we can say that $y = f(u)$, where $u = g(x)$; $f(u) = u^5$, $g(x) = 2x + 4$
- ❖ We can check this by substituting these back into $y = f(g(x))$ to get $y = (2x + 4)^5$

Understanding the Formula: The formula for the chain rule is as follows

If $y = f(u)$ and $u = g(x)$ then

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

We say that $\frac{dy}{du} = f'(u)$ and $\frac{du}{dx} = g'(x)$

Example: Find the derivative of the function $y = (2x + 4)^5$

1. Let $y = f(u)$, $u = g(x)$ such that; $f(u) = u^5$ and $g(x) = 2x + 4$

$$2. \frac{dy}{du} = f'(u) = 5u^4 \quad \text{and} \quad \frac{du}{dx} = g'(x) = 2$$

$$3. \frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx} = 5u^4 \cdot 2 \\ = 10u^4$$

$$= 10(2x + 4)^4$$

Remembering that $u = g(x) = 2x + 4$



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