2.3 The Product Rule

Theorem

Given $f(x)$, and $g(x)$, both differentiable, **then** the **PRODUCT FUNCTION**

$$F(x) = f(x) \cdot g(x)$$

is differentiable, and

$$F'(x) = f'(x) \cdot g(x) + f(x) \cdot g'(x)$$

Proof

Example 2.3.1

Differentiate $f(x)=\left(3x^2-5x+2\right)\left(3\sqrt{x}-5x^{-2}\right)$

Note: The Product Rule says "(deriv. of 1st times 2nd) + (first times deriv. of 2nd)"

Triple Product Rule

Given three differentiable functions $f(x)$, $g(x)$, and $h(x)$, **then** the function

$$H(x)=f(x)\cdot g(x)\cdot h(x)$$

is also differentiable, and

$$H'(x)=f'(x)\cdot g(x)\cdot h(x)+f(x)\cdot g'(x)\cdot h(x)+f(x)\cdot g(x)\cdot h'(x)$$

Proof

Example 2.3.2

Differentiate $f(x)=\left(3x^2-2x\right)^3$

The Power of a Function Rule

Given a differentiable function $f(x)$, then the power function

$$F(x)=\left(f(x)\right)^n$$

is also differentiable and

$$\frac{dF}{dx}(x)=\left[n\cdot\left(f(x)\right)^{n-1}\right]\cdot\left(\frac{df}{dx}(x)\right)$$

Example 2.3.3

Differentiate $\left(3x^2-2x\right)^3$

Example 2.3.4

Differentiate $\left(x^{\frac{2}{3}} - 5x^2 + 3x - 5 \right)^{52}$

Class/Homework for Section 2.3

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