# Math 103 Day 6: Derivative Rules

Ryan Blair

University of Pennsylvania

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# Outline

**Formula 1:** When $c$ is a constant

$$\frac{d}{dx}(c) = 0$$

**Formula 2:**

$$\frac{d}{dx}(x) = 1$$

**Formula 3:** When $n$ is a positive integer,

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

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**fact:** $(x-a)^n = (x-a)(x^{n-1} + ax^{n-2} + a^2x^{n-3} + \ldots + a^{n-2}x + a^{n-1})$

**Formula 4:**(General Power Rule) When $n$ is any real number,

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

**Formula 5:** If $c$ is a constant and $f$ is differentiable, then

$$\frac{d}{dx}(cf(x)) = c\frac{d}{dx}(f(x))$$

**Formula 6:**(Sum Rule)If $g$ and $f$ are differentiable, then

$$\frac{d}{dx}[f(x)+g(x)] = \frac{d}{dx}[f(x)] + \frac{d}{dx}[g(x)]$$

**Formula 7:**(Difference Rule)If $g$ and $f$ are differentiable, then

$$\frac{d}{dx}[f(x) - g(x)] = \frac{d}{dx}[f(x)] - \frac{d}{dx}[g(x)]$$

**Formula 8:**(Product Rule) If $f$ and $g$ are both differentiable, then

$$\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}(g(x)) + g(x)\frac{d}{dx}(f(x))$$

**Formula 9:**(Quotient Rule) If $f$ and $g$ are differentiable, then

$$\frac{d}{dx}[\frac{f(x)}{g(x)}] = \frac{g(x)\frac{d}{dx}(f(x)) - f(x)\frac{d}{dx}(g(x))}{(g(x))^2}$$

**Theorem**

*If* $f(x) = sin(x)$, *then* $f'(x) = cos(x)$.

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**Lemma**

$$lim_{\theta \to 0} \frac{sin(\theta)}{\theta} = 1$$

**Lemma**

$$lim_{\theta \to 0} \frac{(cos(\theta) - 1)}{\theta} = 0$$