Section Week 1

TA: Dante Buhl

UCSC AM-11B

April 1, 2024

Plan for Today

Topics to Cover

- Introduction
- Differentiation Review
- Antiderivatives and Integrals

Learning Outcomes

- Connecting the ideas of differentiation and integration
- Understanding the notation used for anti-derivatives and integrals.

Derivative Practice!

1. Power Rule

$$\frac{d}{dx}x^9 + 2x^2 + 4200000x$$

2. Chain Rule

$$\frac{d}{dx}\ln(x^9 + 2x^2 + 4200000x)$$

3. Product Rule

$$\frac{d}{dx}4x^3e^x$$

4. Quotient Rule

$$\frac{d}{dx}\frac{x+2}{\sqrt{x}}$$

5. Chain Rule

$$\frac{d}{dx}\sqrt[3]{4x + x^3}$$

Antiderivatives / Integrals

Lets dissect the basic notation!

$$\int f(x)dx, \quad \int_a^b f(x)dx$$

The example can be read as, "the integral of $f(x)$ with respect to x from a to b".

- $f(x)$ is denoted the "integrand"
- $dx \sim$ "infinitesimal", indicates which variable to integrate with
- a, b are the lower and upper "limits of integration"

Note: the left is an indefinite integral, and the right is a definite integral.

Antiderivatives?????

There is a basic relationship between derivatives and integrals. This is summarized by the Fundamental Theorem of Calculus. We have,

$$\frac{d}{dx}F(x) = f(x), \quad \text{f is the derivative of F}$$

$$\int f(x)dx = F(x) + C, \quad \text{F is the antiderivative of f}$$

Lets Practice

1. $$\int 9x^8 + 4x + 4200000dx$$
2. $$\int \frac{9x^8 + 4x + 4200000}{x^9 + 2x^2 + 4200000x}dx$$
3. $$\int e^x \left(12x^2 + 4x^3\right) dx$$
4. $$\int \frac{1}{2}x^{-\frac{1}{2}} - x^{-\frac{3}{2}}$$
5. $$\int \frac{4 + 3x^2}{3\left(4x + x^3\right)^{2/3}}$$