

MATH 101

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2020

Learning Goals 1

(1) Approximate the area between a curve and x -axis by using **left**, **right**, or **midpoint** sums. Interpret a definite integral in terms of the area between a curve and x -axis. Compute definite integral by using the **Riemann Sum**, the definition of definite integral.

Examples,

- ▶ Estimate the area under the graph $y = \sqrt{x}$ from $x = 0$ to $x = 4$ using N approximating rectangles and right endpoints. Sketch the graph and rectangles. Is your estimate an underestimate or overestimate?
- ▶ Write an integral that is defined by the expression

$$\lim_{n \rightarrow \infty} \sum_{i=1}^n \frac{\pi}{n} \sin\left(\frac{i}{4n}\right).$$

- ▶ Use the definition of a definite integral to show that

$$\int_a^b x^2 dx = \frac{b^3 - a^3}{3}.$$

Learning Goals 2

Compute definite integrals by using the **fundamental theorem of calculus**. Be able to recognize functions that are given as definite integrals with variable upper and lower limits and find their derivatives, relate antiderivatives to definite and indefinite integrals, and the **net change** as the definite integral of a rate of change. Examples:

1. Evaluate $\int_0^4 \left(\frac{x^2}{4} + \sqrt{x} + e^x \right) dx$.
2. Differentiate $\int_{\ln x}^{e^x} \frac{1}{\sqrt{1+t^4}} dt$.

Learning Goal 3

Compute the following integrals using **substitution**.

1. $\int (2x - 1)e^{x^2 - x} dx.$

2. $\int \tan^3(\theta) d\theta.$

3. $\int_e^{e^2} \frac{1}{x \ln x} dx.$

4. $\int_2^3 \frac{1}{e^x + e^{-x}} dx.$