Math 120 BASIC CALCULUS II Spring 1998

Class 9

Monday February 12

Fundamental Theorem of Calculus (Part 2)

From the first part of the Fundamental Theorem of Calculus, we know that if $F(x) = \int_c^x f(t)dt$, then $F'(x) = f(x)$. Another way of saying this is that the accumulation function $F(x)$ is an *antiderivative* of f.

Definition:

The function $F(x)$ is an antiderivative of $f(x)$ if $F'(x) = f(x)$.

Now suppose that $c \leq a < b$. Then by the additivity property of integrals,

$$\int_a^b f(t)dt = \int_c^b f(t)dt - \int_c^a f(t)dt = F(b) - F(a).$$

We have proven:

Theorem: The Fundamental Theorem of Calculus - Part 2

If f is integrable on $[a, b]$ and F is an antiderivative of f, then

$$\int_a^b f(t)dt = F(b) - F(a).$$

1. Use the Fundamental Theorem of Calculus to find an antiderivative of $f(x) = x^3$.

2. Use the Fundamental Theorem of Calculus to find *another* antiderivative of $f(x) = x^3$.

Using Antiderivatives to Evaluate Definite Integrals

3. Use the Fundamental Theorem of Calculus to evaluate $\int_1^3 x^3 dx$

4. Use the Fundamental Theorem of Calculus to evaluate $\int_0^{\pi} \cos(2x) dx$

5. Use the Fundamental Theorem of Calculus to evaluate $\int_{-1}^1 e^{x^2} dx$