5.4 Lecture Notes
Math 206
04/10/08
Mammenga

FINDING ANTIDERIVATIVES; THE METHOD OF SUBSTITUTION

A. The expression $\int f(x)dx$ is called an *indefinite integral*, while the expression $\int_a^b f(x)dx$ is called a *definite integral*. We say that f is the *integrand* and x is the *variable of integration*.

B. One of the most common techniques of integration is called *u-substitution* and can be thought of an "opposite" of the chain rule that we used when differentiating.

C. Steps for using u-substitution when integrating:
   1. Choose a function to be represented by u.
   2. Calculate du.
   3. Within the original integral, substitute u and du appropriately.
   4. This "new" integral should only have u's. That is, NO x's or dx's!!
   5. Integrate the "new" (easier) integral.
   6. Substitute x back into the expression appropriately.

TEAM ACTIVITIES:

1. Let's practice u-substitution!
   (a) $\int \sin(2-3x)dx$
   (b) $\int (4x+1)^{-2}\,dx$
   (c) $\int \left(3x^2-1\right) e^{x^3-x+1}dx$
   (d) $\int \frac{x^2}{\sqrt{4x^3+5}}dx$
   (e) $\int \cos^3 x \sin x dx$
   (f) $\int \frac{\cos x}{1+\sin^2 x}dx$
   (g) $\int (x+2)\left(x^2+4x-11\right)^8 dx$

2. Now let's practice u-substitution with definite integrals.
   (a) $\int_{-\pi/2}^{\pi} e^{\cos x}\sin x dx$
   (b) $\int_1^e \frac{\sin(\ln x)}{x}dx$
   (c) $\int_1^2 \left(4x-x^2\right)\left(6x^2-x^3\right)^{4/5}$

ASSIGNMENT:

1. Evaluate the following. You must show your work for full credit!
   (a) $\int (3x-1)^{7/3}\, dx$
   (b) $\int \frac{-2x+3}{(-x^2+3x-7)^3}$
   (c) $\int \frac{\ln x}{x} dx$
   (d) $\int \left(\sec^2 x\right) e^{\tan x} dx$
   (e) $\int \cos(6x)\sin^4(6x) dx$
2. Evaluate the following. You must show your work for full credit!
   (a) $\int_e^{2e} \frac{dx}{x\sqrt{\ln x}}$
   (b) $\int_{-5}^{3} \frac{x}{1-x^2} dx$
   (c) $\int_1^4 \frac{1}{x^2}\sqrt{1+\frac{1}{x}} dx$