Math 103, Fall 2014
Week 15

In Class Work, Tuesday, December 2nd

Warm Up

(i) Find $\int x \sec^2(2x^2+1)dx$

(ii) There are two ways to perform substitution on a definite integral: transform the limits as well as the integrand (the inside of the integral), or find the indefinite integral, change it back to the original value, and use the original limits. Use one of these methods for the first problem and the other for the second.

(a) Find $\int_0^{\pi/4} \tan x dx$

(b) Find $\int_0^{\ln 2} \frac{e^x}{1+e^x} dx$

Exercise 1

Find $\int x^2 + e^{1-x} dx$.

Exercise 2

(a) Find $\int_1^{e^2} \frac{2}{t(1+\ln^2 t)} dt$.

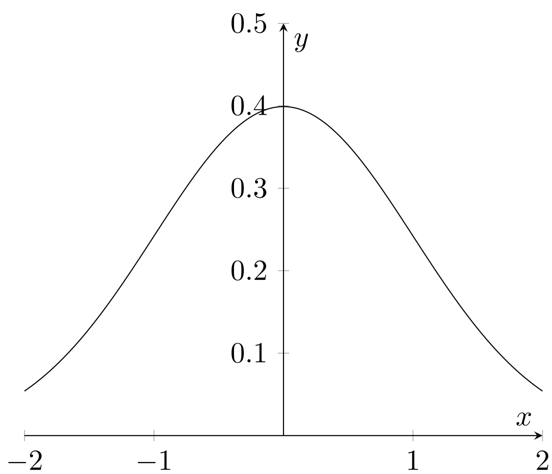
(b) Find $\int_1^{e^2} \frac{2\ln t}{t(1+\ln^2 t)} dt$.

Exercise 3

(a) What goes wrong if you try to use substitution to find $\int e^{-x^2} dx$?

(b) Write down a function which is an antiderivative of e^{-x^2}. (Hint: you'll need to use use an integral.)

The function $\frac{1}{\sqrt{2\pi}} e^{-x^2/2}$ is actually quite important—it's the equation of the *bell curve* or *normal distribution* which describes many natural phenomena (often including exam grades!)



For example, the average height of a European man born in 1980 is about 177cm, and the standard deviation is 7cm. Because heights are distributed according to the normal distribution, that means the probability a European man born in 1980 has height between 120cm and 150cm is given by the definite integral

$$\int_{\frac{120-177}{7}}^{\frac{150-177}{7}} \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx.$$

Exercise 4

Find $\int \tan x \, dx$ using a substitution.

Exercise 5

An experimental drug raises a patient's temperature. The rate of change, in degrees per milligram, is $\frac{3x^2}{x^3+1}$, where x is the number of milligrams the patient has already had. If the patients starting temperture is 95 degrees, find a function $T(x)$ which is the patients temperature after taking x milligrams of the drug.

Exercise 6

(a) Find $\int e^{t+e^t}\,dt$

(b) Find $\int \frac{e^t}{1+e^{2t}}\,dt$

(c) Find $\int x\sqrt{x+2}\,dx$

- For Exercise 1, you should get $F(x) + C$ where $F(1) = \frac{-2}{3}$.
- For 2a, about 2.2143
- For 2b, about 1.6094
- For 4, it's $-\ln|\cos x|$
- For each of the parts of 6, you get functions $F_a(x) + C$, $F_b(x) + C$, and $F_c(x) + C$. You should get $F_a(1) = e^e$, $F_b(1) = \tan^{-1}(e)$, and $F_c(1) = \frac{-2}{15}3^{3/2}$.