Homework Assignment 21: Due at the beginning of class 4/26/02.

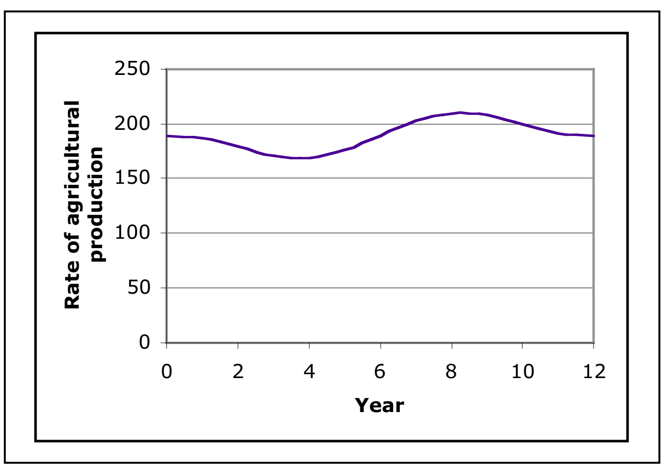
This homework assignment is intended to be short and reasonably straight forward. If you find that you can solve the problems easily and with little fuss, then that's a good sign rather than a sign that you have missed the point.

In Questions 1, 2 and 3 of this assignment you will be working with the data on the agricultural production of the United States. The figures for annual agricultural production can be found in Table 1[1] (below).

Year	*T*	Agricultural production (millions of metric tons)
1989	0	186.2
1990	1	184.7
1991	2	194.0
1992	3	178.2
1993	4	175.4
1994	5	171.2
1995	6	174.6
1996	7	202.3
1997	8	203.6
1998	9	208.6
1999	10	199.9
2000	11	212.7

Table 1: Annual U.S. Agricultural Production, 1989-2000.

1. Use the data given in Table 1 to estimate the total amount of agricultural produce grown in the United States from the beginning of 1989 to the end of 2000. Your answer should be expressed in units of millions of metric tons. (This number will give you an indication as to whether your answer to Question 3 is correct or not.)



2. In Homework #20, you found an equation for a function, $A(T)$. The diagram included here shows a graph of $A(T)$ versus T. One interpretation of $A(T)$ is that it gives the **rate** at which American farmers produce agricultural goods. With this interpretation, the units of $A(T)$ are millions of metric tons of agricultural produce per year. Give a detailed, practical interpretation of the area under the given graph from $T = 0$ to $T = 12$.

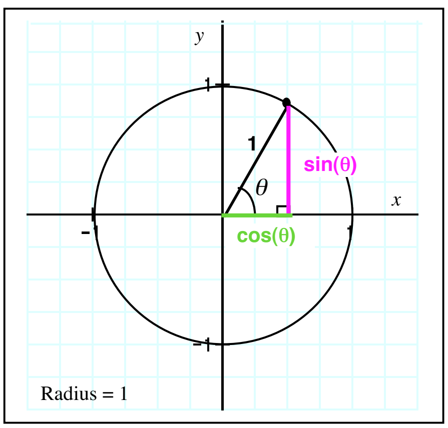
[1] Source: U.S. Department of Agriculture, Foreign Agricultural Service. *Grain: World Markets and Trade*. October, 2000. Available on-line from: http://www.fas.usda.gov/grain_arc.html

3. Although you may have obtained a slightly different equation when you completed Homework #20, the equation that you should use for $A(T)$ in this assignment is:

$$A(T) = 173.5245 + 2.592 \cdot T + 15.2895 \cdot \cos\left(\tfrac{2\pi}{8} \cdot T\right).$$

Find an equation for an antiderivative of $A(T)$ and use this antiderivative to calculate the numerical value of the area under the graph in Figure 1 from $T = 0$ to $T = 12$. Show full details of the u-substitution that you perform when calculating the antiderivative $\int A(T) \cdot dT$.

In Questions 4 and 5 all that you have to do is to find equations for the antiderivatives. You do not have to show any work if you don't want to. However, if your answer is incorrect, partial credit may be awarded if you show your work. In any case, don't forget to add the "+*C*" to the end!



4. Find and equation for the antiderivative:

$$\int \frac{\sin(\theta)}{\sqrt{1-\sin^2(\theta)}} \cdot d\theta.$$

NOTE: One consequence of combining the Pythagorean Theorem with the unit circle definition of the sine and cosine is the useful relationship:

$$\sin^2(\theta) + \cos^2(\theta) = 1.$$

5. Find an equation for the antiderivative: $\int \tan(\theta) \cdot \cos(\theta) \cdot d\theta$

NOTE: The last problem has a definite "trick" to it. One calculus fact that might help you is: $\tan(\theta) = \dfrac{\sin(\theta)}{\cos(\theta)}$. Using this expression, the antiderivative of $\tan(\theta)$ is given by a u-substitution with $u = \cos(\theta)$.

$$\int \tan(\theta) \cdot d\theta = \int \tfrac{\sin(\theta)}{\cos(\theta)} \cdot d\theta = \int \tfrac{-1}{u} \cdot du = -\ln(u) + C = -\ln(\cos(\theta)) + C.$$