

CLIMATE CHANGE AND POPULATION GROWTH

EXTRA CREDIT FOR MATH 122-01
DUE FEBRUARY 14, 2008

The answers to the problems below should be presented neatly, (either typed or written **very** neatly).

You may discuss the problems with other students. However each student is responsible for the final preparation of his or her own paper.

Before completing this project you should read Section 7.6: Exponential Growth and Decay.

One important factor when studying climate change models is the impact of population growth.

A simple model for population growth is the exponential growth model. The idea is that the more people there are, the more they will reproduce. More specifically, if out of every 100 people b of them produce a child and d of them die in a year, the annual population growth rate is $(b - d)\%$.

If we let r be this population growth rate and P be the size of the population, then we can express this in a **differential equation** as follows:

$$\frac{dP}{dt} = rP.$$

By Theorem 7.6.1, it follows that there is a constant C such that:

$$P(t) = Ce^{rt}.$$

According to the United States Census Bureau, the size of the U.S. population in 1990 was roughly 250 million. It is estimated that the size of the U.S. population reached 300 million in 2006.

Problem 1. *Using the above data, find values of C and r in order to create an exponential growth model for the size of the U.S. population. (It will probably be helpful to let t be the number of years since 1990.)*

Problem 2. *Use the model that you created to estimate the current U.S. population, the U.S. population twenty years from now (in 2028) and fifty years from now (in 2058).*

According to the United Nations Framework Convention on Climate Change-Carbon Dioxide Information Analysis Center (UNFCC-CDIAC), the annual amount of carbon dioxide emissions in the United States is roughly 20 metric tons per capita.

Problem 3. *Using your estimate of the current U.S. population, calculate the total annual amount of carbon dioxide emissions in the United States. Assuming that the annual per capita carbon dioxide emissions remains the same, estimate the annual amount of carbon dioxide emissions in the United States twenty years from now and fifty years from now.*

Problem 4. *Determine the percentage decrease in the annual per capita carbon dioxide emissions that would be necessary to keep the total annual carbon dioxide emissions in the U.S. at the same level in twenty years as it is currently. What percentage decrease is needed for fifty years?*

Problem 5. *Find data about the size of the global population and the global annual per capita carbon dioxide emissions in order to recalculate all of the above estimates for the global population.*