EVSS 650 Problem Set #1
due... 24 January 2013

<u>Show your work</u>. State and justify any assumptions you make. Try to do these on your own first. Let me know if/when you run into problems (i.e. don't work together yet).

1) Suppose you start off the summer in Charleston with a pair of amorous cockroaches (sorry, that should read "Palmetto bugs") under your kitchen sink. (a) How many cockroaches will you have at the end of the summer? I read somewhere that the doubling time for cockroaches is 1 week (it's not correct, thank goodness, but we'll assume 1 week for now and evaluate that assumption later). Assume the lifetime of a cockroach is as long as or longer than a summer in Charleston, and assume (optimistically) that a summer in Charleston lasts 20 weeks. Do this long-hand, brute-force first (write out the number of cockroaches you have each week). Then show how to use the doubling formula to get the same result.

2) Suppose you start with a box that is only 1% filled with cockroaches, 99% open space yearning for development. How many times would the population have to double until the box is completely full? How long would it take for that to happen (using the same assumptions as in problem #1)?

3) Assuming that cockroaches have an average mass of 15 grams, and also assuming no constraints on the increase in the number of cockroaches, (a) how many doubling times would it take the total mass of cockroaches to equal the mass of the Earth ($6x10^{24}$ kilograms). (b) How long is this in years? (c) Comment on the factors that will keep this from happening (a paragraph or so).

4) Electrical power plants in the US can generate about 900 GigaWatts (900 billion!) altogether. (a) If the electrical energy consumption continues to rise at the rate of 1% per year, how many 500 MegaWatt (500 million watts; a large, but not huge facility) power plants will **have to be built** in the next 70 years (i.e. your lifetime) just to meet the **increase** in demand? (b) If each plant costs $500 million to build, what is the total investment required?

5) The world's population passed 7 billion in 2012. It is growing at a rate of about 1.25% per year (it is slightly less now, but it was higher than this when you were born). Use these numbers to calculate: (a) How many people were there on Earth when you were born? (b) How many people will be added to the world's population this year? (c) The equivalent of how many new New York City's must we build **every year (!)** to accommodate these people? (d) If this growth rate continues, when will the world population reach 10 billion?