EC1340-Fall 2019
Problem Set 1

(Updated 21 August 2019)

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When you write up your answers, your goals should be to (1) be correct, and (2) convince your reader that your answer is correct. It is always helpful if your work is legible and if all steps are presented, possibly with a line of explanation.

In the case of empirical exercises, your goal should be to provide enough information to allow a reader to replicate your answer. This requires a description of data and data sources as well as a description of your analysis of the data.

Answers which do not achieve these goals will not be awarded full credit.

To assist us in complying with the University's privacy policy, the first page of each problem set should be blank except for your name and the problem set number. This will allow us to write your score inside your problem set. Failure to include such a page will be understood as permission to write your score on the front of your problem set where others might accidentally see it.

Problems

1. Consider the BDICE model introduced in class,

$$
\begin{aligned}
&\max_{s,M} u(c_1,c_2) \\
&\text{s.t. } W = c_1 + s + M && (1)\\
&\quad c_2 = (1+r)s - \gamma(T_2 - T_1)s \\
&\quad E = (1 - \rho_4 \frac{M}{W})(\rho_5(c_1 + s)) && (2)\\
&\quad P_2 = \rho_0 E + P_1 && (3)\\
&\quad T_2 = \rho_1(P_2 - P_1) + T_1 && (4)
\end{aligned}
$$

   (a) Use the numbered constraints to write the change in climate, $T_2 - T_1$, in terms of W and M.

   (b) Using the expression you just found, together with the values of W,ρ_0,ρ_1 and ρ_5 given in lecture to calculate the change in temperature we should expect from production of W today. For the purposes of this calculation, let $P_1 = 400$ and suppose that zero resources are devoted to mitigation. (Hint: the trick here is to get the units to be consistent for all of the quantities involved).

   (c) Consider a program of technology transfer from the developed world to the developing world that simultaneously (1) doubled world output, and (2) reduced ρ_5 to US levels, about one third of the world average level. What would be the resulting counterfactual climate change?

   (d) You have just used the BDICE model to predict climate change under two hypothetical scenarios. How do these scenarios compare to the various RCPs that the IPCC 2013 report presents. Can you say anything about how well the BDICE model matches IPCC predictions?

2. These questions ask you to do some elementary calculations to relate the weight of fuel, emissions,CO_2 concentrations and climate change. You will probably need to refer to numbers given in lecture.

   (a) From Hansen figure 22, estimate the change in atmospheric CO_2 concentrations that would result from burning all coal reserves.

   (b) Using Nordhaus' rule of thumb for the relationship between atmospheric CO_2 and climate change, estimate the change in world average temperature in 100 years that would result from burning the world's coal supply tomorrow.

   (c) Using figure 25 in Hansen, estimate how much coal we will burn over the next 100 years if the rate of consumption stays constant at about 2010 levels.

   (d) Again using Nordhaus' rule of thumb, what is the likely impact on climate in 100 years of this consumption of coal? (To do this calculation, you can suppose that the impact on climate in 2111 of emissions in 2011 is the same as for emissions in 2110.)

3. In table 2 of their paper 'Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the U.S.', (at `http://www.jstor.org/stable/41288654`), O. Deschenes and M. Greenstone find that an increase of daily average temperature of about 4 degrees Fahrenheit causes about 6 extra deaths per day in the United States. Suppose that in 100 years, the rest of the world's death rate responds to changes in climate in just the same way as does the US today. Also suppose that the world population and US population are the same as they are today.

   Use this information, together with the discussion from lecture, to calculate the increase in the daily death rate in 100 years that results from burning one 50 liter tank of gasoline.