EC1340-Fall 2025
Problem Set 7

(Updated 19 November 2025)

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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.

Problems

1. Suppose that current world income is about 63 trillion dollars. Consider the following three possible growth paths.

   (a) World income grows at 1.5% forever. This path is the mitigation path – we magically solve the problem of warming at time 0 and live happily ever after. The discounted present value of world income on this path is

   $$W_1 = \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t (1.015)^t Y_0$$

   (b) World income grows at 1.5% a year for $t = 1,..,49$ and at 0.5% per year thereafter. This is a stylized description of the path suggested by Dell et al.'s analysis in which warming stops growth in half the world. The discounted present value of world income on this path is

   $$W_2 = \sum_{t=0}^{49} \left(\frac{1}{1+r}\right)^t (1.015)^t Y_0 + \left(\frac{1}{1+r}\right)^{50} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t (1.005)^t [(1.015)^{50} Y_0]$$

   (c) World income grows at 1.5% a year forever, but in 100 years is subject to a 5% decrease. This corresponds (approximately) to the case Nordhaus analyzes: after it warms up, productivity drops, but growth continues largely unharmed. The discounted present value of world income on this path is

   $$W_3 = \sum_{t=0}^{99} \left(\frac{1}{1+r}\right)^t (1.015)^t Y_0 + \left(\frac{1}{1+r}\right)^{100} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t (1.015)^t [0.95(1.015)^{100} Y_0]$$

   The value of magical solution to the mitigation problem in W_1 is the difference between W_1 and W_2 or W_3. (Hint: recall that $\delta^t \gamma^t = (\delta\gamma)^t$)

   (a) Evaluate $W_1 - W_2$ for $r = 2\%$ and $r = 5.5\%$.

   (b) Evaluate $W_1 - W_3$ for $r = 2\%$ and $r = 5.5\%$.

   (c) What is Nordhaus' estimate of the value of the carbon free energy? To which of the calculations above does this value most closely correspond?

   (d) What do the calculations you performed here suggest about the role of the discount rate and the effect of climate on growth in evaluating mitigation policy?

2. The question asks you to use the 'Simple IAM' presented in `Simple_IAM.xlsx`.

   (a) The baseline data in the spreadsheet describe a policy based on year 2000 data. Update cells `b4` , `b5`, `b7`, and `b8`, to 2005 values (the trick here is getting the units right). What total NPV of damages (`b54`) and Social Cost of Carbon (`b56`) does the Simple IAM lead to?

   (b) How does this compare to Nordhaus? To do this comparison, you will need to adjust Nordhaus' from 2005 to 2015 dollars, and convert the price of `C` from the simple IAM. One 2005 dollar is about 1.33 2015 dollars.

   (c) Update the data to 2020. What total NPV of damages (`b54`) and Social Cost of Carbon (`b56`) does the Simple IAM lead to? Compare this to the forecast that Nordhaus made (in 2007) for the business as usual trajectory in 2020.

   (d) Using the 2020 data, what happens to What total NPV of damages do we have in 2020 if the share of carbon that stays in the atmosphere increases to 0.7? What if the subjective rate of time preference drops to 0.1%?