EC1340-Fall 2021
Midterm solutions
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1. Idiosyncratic

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3. Let

$$C \sim \text{Tons of Carbon mitigation}$$
$$p_c \sim \text{unit cost of mitigation}$$
$$p_c C \sim \text{Total cost of mitigation}$$

The first two problems should have resulted in an estimate of C and $p_c C$ for your policy. Use C to calculate the implied change in climate from your policy.

1ppm C is 2.12 GtC and of each ton of emissions, 0.55 stays in the atmosphere. Thus 1 ton of emissions results in $\frac{0.55}{2.12 \times 10^9} \approx \frac{1}{3.8 \times 10^9}$ ppm. Thus, C tons results in a change in concentration of $\approx \frac{C}{3.8 \times 10^9}$ ppm.

Using Nordhaus' estimate of climate sensitivity, doubling atmospheric concentration from 280 to 560ppm give 3 degrees Celsius of warming by 2100.

Thus, C tons of emissions gives $\frac{C}{3.8 \times 10^9} \times \frac{3}{280}$ degrees of warming by 2100. Call this change ΔT^*

4. Calculate the flow of damages from this ΔT^*. You can either use Nordhaus' damage function, given in slides #4 slide 43, or $\gamma = 0.01$ from slide 43 of slides #5. The second way is easier.

From the equation 6 of BDICE

$$c_2 = [(1+r) - (\delta T^*)]I$$
$$= [1 + r - \gamma(\delta T^*)]I$$

so ΔT^* causes a $0.01\Delta T^*$ percent decrease in future consumption.

Let W_1 denote future consumption. This should be a value calculated from current GDP. For example, if $g = 1.03$ and we are thinking about W_1 happening in 80 years, then $W_1 \approx 1.03^{80} \times$ Current GDP.

Let the annual cost/benefit of your policy starting in 2100 be $0.01 \times \Delta T^* \times W_1 \equiv \Delta W_1^*$.

5. Suppose we experience the benefit ΔW_1^* every year from 2100 on. Then the discount present value of this flow of benefits is

$$V^* = \sum_{t=78}^{\infty} \delta^t \Delta W_1^*$$
$$= \delta^{78} \sum_{t=0}^{\infty} \delta^t \Delta W_1^*$$
$$= \frac{\delta^{78}}{1-\delta} \Delta W_1^*$$

You should evaluate this last expression for $r = 0.03$, or $\delta = 1/(1.03)$

Thus, $V^* \approx (0.97)^{78} \frac{1}{1-1.03} \Delta W_1^*$

6. A policy is a good idea if the discount present value of benefits, V^* is large compared to the total value of the policy, $p_c C$ that you calculated in part 2.