EC1340-Fall 2025
Problem Set 7 solutions

(Updated 19 November 2025)

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1. To make this problem easier to handle, define $\delta_1 = \frac{1.015}{1+r}$ and $\delta_2 = \frac{1.005}{1+r}$. With this notation in place, we have

$$\begin{aligned}
W_1 &= \sum_{t=0}^{\infty} \delta_1^t Y_0 \\
&= \frac{1}{1-\delta_1} Y_0 \\
W_2 &= \sum_{t=0}^{49} \delta_1^t Y_0 + \delta_1^{50} \sum_{t=0}^{\infty} \delta_2^t Y_0 \\
&= \frac{1-\delta_1^{50}}{1-\delta_1} Y_0 + \delta_1^{50} \frac{1}{1-\delta_2} Y_0 \\
W_3 &= \sum_{t=0}^{99} \delta_1^t Y_0 + \delta_1^{100} \sum_{t=0}^{\infty} \delta_1^t (0.95 Y_0) \\
&= \frac{1-\delta_1^{100}}{1-\delta_1} Y_0 + \delta_1^{100} \frac{1}{1-\delta_1} (0.95 Y_0)
\end{aligned}$$

   (a) We evaluate $W_1 - W_2$ using the formulas above, to get

$$\begin{aligned}
W_1 - W_2|_{r=.02} &= 6700 \text{ trillion} \\
W_1 - W_2|_{r=.055} &= 48.11 \text{ trillion}
\end{aligned}$$

   (b) We evaluate $W_1 - W_3$ using the formulas above, to get

$$\begin{aligned}
W_1 - W_3|_{r=.02} &= 393.12 \text{ trillion} \\
W_1 - W_3|_{r=.055} &= 1.74 \text{ trillion}
\end{aligned}$$

   (c) From figure 5-1 the value of the backstop policy is about 17 trillion dollars.

   (d) The discount rate is very important in determining the value of climate change policy. However, since the growth rate also enters in to our calculations exponentially, it too is very important. In particular, even if we use Stern's discount rate, it's hard to conclude that global warming is a catastrophe if it just causes a 5% drop in GDP in 100 years. When we start to consider impacts on the growth rate, however, it becomes much easier to generate catastrophic impacts on welfare. That is, global warming starts to look like an important problem.

2. This table shows all of the data and calculations you need to answer this question. The 2000 data is pre-entered in the spreadsheet.

Cell	Description	2000	205	2020
b4	World GDP, Trillions USD2015/year https://data.worldbank.org/indicator/NY.GDP.MKTP.CD(August 2022)	33.8	47.8	85.0
.	Gt Fossil CO_2 per year from IPCC (lecture 1)	24	26	40*
b5	Base year emissions Gt C Convert CO_2 to C	6.6	7.1	10.9
.	Base year concentration (ppm) https://gml.noaa.gov/webdata/ccgg/trends/co2/co2_annmean_mlo.txt (August 2022)	370	380	414
b7	Base year concentration Gt C $(ppm \times 2.12)$	784.4	805.6	877.7
b8	World population in billions https://data.worldbank.org/indicator/SP.POP.TOTL(August 2022)	6.11	6.51	7.76
b54	[PVT Damages + PVT Abatement Costs] (tril. 2015USD)	26.7	38.1	72.9
b56	Social Cost of Carbon	203.1	267.1	309.3
b58	Social Cost of CO_2	55.4	72.8	84.4
	Social Cost of CO_2 2005USD Nordhaus, Table 5-4	.	27.3	47.6**
	Social Cost of CO_2 2015USD Nordhaus	.	36.3	63.3
b56	[PVT Damages + PVT Abatement Costs] (tril. 2015USD) (2020, pure time preference = 0.1%)	.	.	146.2
b58	[PVT Damages + PVT Abatement Costs] (tril. 2015USD) (2020, 0.7 CO_2 in atmosphere)	.	.	80.5

* I just estimated fossil emissions from the figure in lecture #1, and rounded up to go from 2019 to 2020.** Average of 2015 and 2025 table entries.