EC1340 – Fall 2025

Midterm

8:30-9:300am, October 18, 2025

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You will have 60 minutes to complete this exam. No notes or books are allowed but you may use a calculator. Cell phones and any device with a wireless connection must be off. Anyone still working on their exam after time is called will be subject to an automatic 10 point penalty.

When you write up your answers, your goal should be to (1) be correct, and (2) convince your reader that your answer is correct. Answers which do not achieve these goals will not be awarded full credit. To accomplish the second objective, it is helpful if your work is legible and if all steps are presented, possibly with a line of explanation. Total points =100.

This exam has TWO pages.

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) (15) What are the units for each of the following parameters, ρ_1, ρ_5, and P_1.

   (b) (25) Use the numbered constraints to write the change in climate, $T_2 - T_1$, in terms of W and M.

2. Let i index countries and t index years. Dell, Jones and Olken derive the following relationship between the economic growth rate, g_{it}, and temperature, T_{it},

$$g_{it} = g_i + (\beta + \gamma)T_{it} - \beta T_{it-1},$$

   and estimate

$$g_{it} = 0 + (-0.9)T_{it} + (-0.4)T_{it-1} + \epsilon_{it}$$

   for a sample of poor countries (this is from Table 3, Column 2).

   Consider a series of annual temperature shocks, $(T_{i0},T_{i1},T_{i2},T_{i3},T_{i4}) = (0,0,1,0,0)$ and a country for which $g_{i0} = 0$, $Y_{i0} = 1$ and $L_{it} = 1$ for all t.

   (a) (20) Using estimates above, evaluate and plot the path of g_{it} and Y_{it} for $t = 0,...,4$ for i a poor country. Hint: Don't forget that g_{it} is a percentage.

   (b) (5) On the basis of your work above, what do the results above suggest is the effect of this particular path of climate change.

(c) (5) Give one reason to be suspicious of Dell, Jones, and Olken's results.

3. The Trump administration has just cancelled the Esmeralda 7 solar power facility in Nevada. This facility had a nominal capacity of about 6,000MW, or 6,000,000KW. Suppose it runs at 30% capacity (it won't generate power when it is dark or cloudy). With 720 hours per month, we can expect it to generate

$$6{,}000{,}000\text{KW} \times 720\text{Hours} \times 0.3 = 1{,}296{,}000{,}000\text{KWH}$$

per month.

Suppose that households instead get their power from gas fired generators that produce about 1.2 tons of CO_2 per KWH. Suppose the solar plant operates for about 20 years. A typical household in the southwest consumes about 1000KWH per month.

(a) (10) About how much will the atmospheric concentration of carbon increase because of this cancellation?

(b) (15) About how much warmer will the earth be in 100 years because of this cancellation?

You may find the following constants useful for this calculation: Nordhaus rule of thumb, doubling CO_2 concentration from 280ppm to 560ppm causes 3 degrees Celsius of warming by 2100; 1ppm of atmospheric carbon weighs 2.12 Gt; 0.55 of each unit of CO_2 emissions remains in the atmosphere after one year; 44/12 tons of CO_2 contains one ton of carbon.

4. (5) In 'Storms of my Grandchildren', James Hansen makes a policy recommendation about how we should use coal. What is this policy recommendation?

EC1340 MIDTERM SOLUTIONS, OCT 15, 2025
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1. a. $\rho_1 \sim {}^{C^\circ}/_{PPM}$ (5)

$\rho_5 \sim {}^{kg}O/_{\$}$ (5)

$P_1 \sim$ PPM C (5) on CO_2

b. WRITE $(T_2 - T_1)$ IN TERMS OF ω AND M.

$(1) \Rightarrow \quad c_1 + s = \omega - M \quad (1')$

$(1') \to (2) \Rightarrow \quad E = (1 - \rho_4 \frac{M}{\omega}) \rho_5 (\omega - M) \quad (2')$

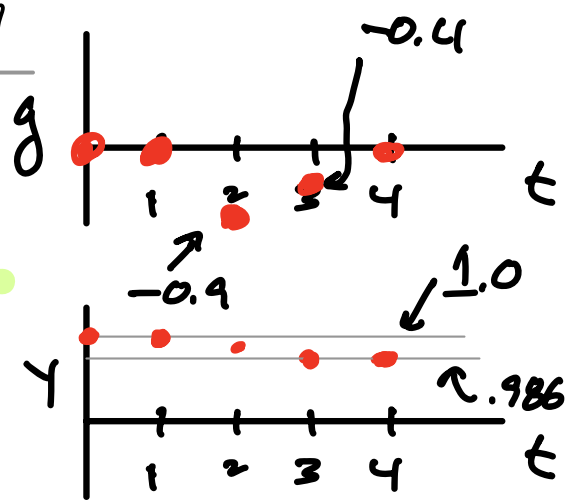
$(2') \to (3) \Rightarrow (P_2 - P_1) = \rho_0 E$

$= \rho_0 (1 - \rho_4 \frac{M}{\omega}) \rho_5 (\omega - M) \quad (3')$

$(3') \to (4) \Rightarrow T_2 - T_1 = \rho_1 \left[\rho_0 (1 - \rho_4 \frac{M}{\omega}) \rho_5 (\omega - M) \right]$ (25)

2. a. (20)

t	T	g	$Y \left[Y_{t+1} = (1 + \frac{g}{100}) Y_t \right]$
0	0	0	1
1	0	0	1
2	1	-0.9	$1(0.991) = 0.991$
3	0	-0.4	$1(0.991)(0.995) = 0.986$
4	0	0	0.986



b. (5) ALONG THIS PATH, THE GROWTH RATE DROPS FROM 0 TO -0.9% BEFORE RECOVERING TO ZERO. INCOME STARTS AT 1, DROPS DURING THE TWO PERIODS WITH NEGATIVE GROWTH RATE, AND THEN STABILIZES.

c. (1) DELL, JONES, CLERGY BASES THEIR ESTIMATES ON ANNUAL DATA, AND SO THESE ESTIMATES DON'T GIVE PEOPLE TIME TO ADAPT. (5)

(2) THESE ESTIMATES CONSIDER THE EFFECT OF CHANGING TEMPERATURE IN A SINGLE COUNTRY. THIS MEANS THEY DON'T ALLOW FOR GENERAL EQUIL. EFFECTS. FOR EXAMPLE, IF CORN WON'T GROW ANYWHERE.

(1) CLEARLY MEANS THEY OVERESTIMATE DAMAGES. I THINK (2) IS AMBIGUOUS.

3. (a) WE HAVE 1.296×10^9 KWH PER MONTH.
PLANT RUNS FOR 20 YEARS = 240 MONTHS
1.2 TONS CO_2 PER KWH

$$\Rightarrow \frac{1.2 \times 1.296 \times 10^9 \times 240}{1.2} = 312 \times 10^9 \text{ TONS } CO_2$$

$$= \frac{12}{44} \cdot 312 \times 10^9 \quad (10)$$

$$= 86 \times 10^9 \text{ TONS C.}$$

86×10^9 TONS C IS
86 BILLION TONS OF C
= 86 OF C.

86 Gt C $\Rightarrow$ $0.55 \cdot \frac{1}{2.12} \cdot 86$ PPM C

$= \quad 22 \text{ ppm } C$

(b) From Neuschaus,

$560 - 280 \text{ ppm} \Rightarrow 3^\circ C$

$\Rightarrow 280 \text{ ppm increase} \Rightarrow 3^\circ C$

This $22 \text{ ppm } C \Rightarrow$

$\frac{3}{280} \times 22 = 0.236^\circ C$ of warming (15)

M.B. It's actually 1.2 tons C for 1000 kcal so this is 1000 times too big!! (5)

(4) Stop burning coal right away.