

EC1340-Fall 2023

Problem Set 2

(Updated 31 July 2023)

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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 you have two climate models that predict future temperature from CO₂ concentration,

$$T_1 = 1\text{CO}_2 + \epsilon_1$$

$$T_2 = 2 + 3\text{CO}_2 + \epsilon_2,$$

with $\epsilon_1 = \epsilon_2 = (-1, 1; \frac{1}{2}, \frac{1}{2})$ and independent. Suppose that we would like to predict temperature under a future scenario where CO₂ = 1.

- (a) Evaluate the mean and variance of predicted temperature for each model.
 - (b) Suppose that you must decide which prediction to rely on, and you have no information about which one is likely to be correct. That is, you think each is equally likely. If you choose models with a coin-toss,
 - i. Describe the compound lottery that describes the resulting climate prediction.
 - ii. What is the mean and standard deviation of this prediction?
 - (c) Suppose that instead of choosing one of the two models at random you average them. That is, you base your prediction on the hybrid model $T^* = \frac{T_1 + T_2}{2}$.
 - i. What is the lottery for T^* .
 - ii. Calculate the mean and variance of T^*
 - (d) What does this analysis suggest to you is the best strategy to pursue when confronted with more than one predictive model?
 - (e) Given your answers above, and that the IPCC reports I-IV summarized many climate models, does this example suggest an explanation for the IPCC's failure to predict the warming hiatus from 1998-2015?
2. Each of the following numbers is an important constant that is either part of the BDICE model, or is helps to understand some other important aspect of the climate change problem. For each number, give the appropriate units and a brief description. For example, '240' would be something like '240 W/m². This is the baseline amount of energy that the earth receives from the sun.'

- (a) $\frac{44}{12}$
- (b) $\frac{3}{280}$
- (c) 55%

(d) 2.12

(e) 0.17

(f) 0.77

(g) 77×10^{12}

(h) 13×10^9