MONT 104N – Modeling the Environment
Information on Midterm Exam
October 23, 2019

General Information and Groundrules

As announced in class and on the revised course schedule online, the midterm exam for our Montserrat seminar will be given in class on Friday, November 1.

- This will be a full period, individual exam. No sharing of information with others in any form will be permitted during the exam.
- You may use a calculator during the exam, but *no other electronic devices.*
- There will be three or four mathematical problems (each possibly with a few separate parts). These questions will be similar to things you have seen on the first three problem sets (material up to and including the discussion of exponential models from Chapter 5) and the group projects from Chapters 1 - 3 of our text. Some sample exam questions are given later in this document.
- The exam will also include an essay question on a set topic given below. As you will see, part of this consists of several factual questions. *You will need to look up some information before coming to the exam to write this part of the essay. Online sources will be the best way to gather this information.* Then, the rest of the essay topic asks you to take a stand one way or another on the issues raised. There's no one right or wrong answer for that part; the point is to get you to think about the issues and try to formulate a position of your own. This section of the exam should take you about 15 minutes or so, so it will be necessary to spend some of your preparation time on deciding what you want to say.

Essay Prompt

There is an ongoing movement at this point in history (i.e. 2019) that is especially strong in Sweden, where it known as *flygskam.* What does this Swedish word mean in English? What actions are proponents of *flygskam* urging other people not to continue doing, and what are their reasons for doing this? Part of the underlying reason for the existence of this movement is concern about how the actions are influencing greenhouse gas levels in the atmosphere. What proportion of current CO_2 emissions can be attributed to these actions and which people are contributing most to this? While the recommendations of proponents of *flygskam* might make a lot of sense from the environmental point of view, there are also certainly aspects of modern life that would be drastically changed if those recommendations were adopted by everyone. [Note: The opinion part starts here.] What would we be losing by following those recommendations? Are the environmental benefits great enough to justify the costs to individuals and society of adopting those recommendations?

Something to think about in conjunction with this essay topic

Travel is fatal to prejudice, bigotry, and narrow-mindedness, and many of our people need it sorely on these accounts. Broad, wholesome, charitable views of men and things cannot be acquired by vegetating in one little corner of the earth all one's lifetime. Mark Twain (1835-1910)

Sample Mathematical Questions

Disclaimer: The actual exam questions will cover the same mathematical topics and will be at approximately the same level of difficulty. However the organization and the content may be completely different.

I. The following table gives estimates of the amounts of carbon (in units of 10^{15} kilograms) contained in the major "reservoirs" of this element on planet Earth:

Reservoir	**Carbon Content**
Atmosphere	.59
Crust (as fossil fuels)	3.7
Vegetation	2.3
Shallow Ocean	.9
Deep Ocean	37.3

A. What percent of the total carbon present on Earth is contained in each of these reservoirs?

Reservoir	**Percent of Total Carbon**
Atmosphere	_____
Crust (as fossil fuels)	_____
Vegetation	_____
Shallow Ocean	_____
Deep Ocean	_____

B. Construct and draw a chart (your choice of type) showing how the total carbon breaks down into these categories.

II. Burning coal provides between 9500 and 14000 BTUs of heat energy per pound. Using the information below, answer questions A and B:

- 1 lb $\doteq$ .454 kg
- 1 BTU $\doteq$ .252 Kilocalorie

A. Express the heat energy from burning one pound of coal as a range of values in Kilocalories. Give the endpoints of your range in scientific notation.

B. What is the range of heat energy values provided by burning 1 kilogram of coal, expressed in BTUs?
C. If the 9500 BTU figure comes from bituminous coal and the 14000 BTU comes from anthracite coal, what is the percentage difference in heat energy between anthracite and bituminous?

III. The Honda Civic comes in a standard (gasoline engine) version and a hybrid (gasoline-electric) version. The standard version has a fuel efficiency of about 34 miles per gallon, while the hybrid version gets about 44 miles per gallon. The hybrid version has a "sticker price" (that is, the nominal cost to buy the car new) about $4000 more than the standard. You drive about 10000 miles per year. Assume that gasoline will average $3.00 per gallon over the life of your vehicle.

A. How many gallons of gasoline would you use to drive the 10000 miles with each version?
B. What is the difference between your costs for gasoline with the two versions?
C. If you bought the hybrid version, about how many years would it take for your savings in gasoline costs to make up for the difference in sticker price?

IV. The link next to the one where you downloaded this review sheet shows a spreadsheet scatter plot. Place a check next to the best responses to the questions below.

A. (5) The least squares regression line for this data set would have a slope m about:
$m = -.1$ _____
$m = .3$ _____
$m = 1$ _____

B. (5) Based on the scatter plot, the R^2 statistic is probably:
between .8 and 1 _____
between .4 and .6 _____
between .2 and .4 _____
between .0 and .2 _____

V. Wind power has emerged as one of the faster-growing methods of electricity generation in recent years. In 2016, the generating power of wind turbines installed around the world was about 301 gigawatts and it was increasing at about 33.2% per year.

A. The typical English unit of power is the horsepower. 1 horsepower $= 7.457 \times 10^{-7}$ gigawatts. Convert 301 gigawatts to the equivalent number of horsepower.
B. Construct an exponential model for WP = wind power generation as a function of t = years after 2016. *Use units of* 10^2 *gigawatts for* WP – see the entry for 2016 in the table below.
C. Compute the values of WP predicted by your model for the years $2017-2022$. Round to 2 decimal places. About how many years will it take for WP to reach approximately double the 2016 level?
D. How many years will it take for wind power generation to reach 2.0×10^3 gigawatts according to your model?