MONT 100N – Modeling the Environment
Information on Final Exam
November 29, 2017

General Information and Groundrules

As announced in the course syllabus, the final exam for our Montserrat seminar will be given at the announced time for MWF 9:00am classes:

Friday, December 15, 8:00am to 10:30am

The exam will be held in O'Neil 123, *not our regular class room.*

- This will be an individual exam. No sharing of information in any form will be permitted during the exam.
- You may use (and should use) a calculator during the exam, but no other electronic devices. *Know how to compute logarithm and exponential values* using your calculator in addition to basic arithmetic.
- If you are well-prepared and work steadily, I expect the exam will take about 1 1/2 hours (90 minutes) to complete. However, you will have the full 2 1/2 hour period (150 minutes) to work if you need that much time.
- This will be a *comprehensive* exam. The exam questions may cover concepts and techniques from any section of the course (Chapters 1,2,3,4,5,7,8 in the Modeling the World textbook – we did not cover the topics in Chapter 6 yet). But I will only ask about topics we have actively discussed in class, the problem sets, or the projects.
- There will be four or five mathematical problems (each possibly with a few separate parts). These questions will be similar to things you have seen on the problem sets or the group projects. Some sample exam questions are given later in this document. I will post solutions for those in a few days – my recommendation is to try working out solutions first on your own, then use the solutions to check your work.
- The exam will also include an essay question (worth about 1/3 of the total points) on one of the set topics below. It should take you between 30 and 45 minutes to produce a good, detailed answer for that question. So it will be necessary to spend a sufficient portion of your preparation time on deciding what you want to say.
- I will be available during the reading period at the following times for "last minute" questions:

- Monday, December 11, 3:00pm - 4:45pm
- Tuesday, December 12, 8:00am - 12:00noon
- Thursday, December 14, 8:00am - 10:00am

Essay Topics – You will have the choice of answering either one of the following prompts – I will include both in the exam sheets; you choose which one you want to address.

Topic A In general terms, what is a mathematical model? Describe in general terms what they are, how they are constructed, and how they are used. Give examples of two different

types of mathematical models we have studied in this course. Even if mathematical models don't capture every feature of a real world situation, why is it still important to develop them and understand the information we get from them? As an example, why is it important to understand how radioactive substances decay? What types of models that we discussed would apply to describe that process? What are three of the main issues discussed in the film *Containment* that we saw with the rest of the Natural World Cluster? How do those issues connect with other topics we discussed semester like the properties of different sources of energy used in the U.S. and their effects on the environment? How are mathematical models important in understanding our choices of which energy sources to use?

Topic B What does Jared Diamond mean by a "collapse" in his book with that name? Discuss the five-point framework for understanding causes of collapses that Diamond lays out in the Prologue. Which of those factors does he say are *always* present? Discuss how the framework applies to *either* the collapse of the Easter Island civilization or the Classic Maya civilization in Central America. "The past is a foreign country; they do things differently there," is the famous opening line of a novel called *The Go-Between* by L. P. Hartley. How does Diamond's point of view in *Collapse* relate to that attitude about the past? For instance, would he say the past is not really that foreign after all, or would he argue that there is some key difference that sets us apart from previous civilizations and lessens the causes for concern about our ultimate fate? What do *you* think about this question, after having read several sections of *Collapse*?

Sample Mathematical Questions

Full solutions for all of these will be posted later so you can check your work.

1) Chapter 1/5, 11, 14 (Note: the conversion factors you need are given in the text. I will supply any information like that you would need for questions like these ones.)
2) Chapter 2/2, 7
3) Chapter 4/6, 8, 9
4) Chapter 5/2, 4, 6, 7, 8, 9
5) Chapter 7/1, 4 (know the general solution for affine first-order difference equations and how to determine equilibrium solutions algebraically; I will not give you that formula), 13 – sketch the solutions by hand in rough, qualitative terms for (ii)
6) Chapter 8/6, 8 (only parts (a) and (b) would be suitable for an exam question, though!), 11

Note: I could also ask you "qualitative" questions relative to the process of fitting a linear or exponential model to data like one of the questions from the midterm, including questions about the process of transforming the data via logarithms for the exponential cases. I *can't really* ask you to compute a regression equation for fitting a linear or exponential model to data, of course, since apart from one simple linear example, we only did those computations with Excel.) I could give you the equation of a regression line, though, and ask you to give a model prediction for an x-value not occurring in the data.