MONT 103N – Analyzing Environmental Data
Information on Midterm Exam
March 22, 2012

General Information and Groundrules

As announced in class and on the course schedule online, the midterm exam for our Montserrat seminar will be given in class on Friday, March 30.

- This will be a full period, individual exam. No sharing of information 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 problem sets or the group projects. Some sample exam questions are given later in this document. The material to be covered is basically everything in chapters 9, 11, 12, 13 of our textbook.
- I will provide copies of the normal curve area table from page 308 and the t-table from page 316.
- The exam will also include an essay question on a set topic chosen from the topics listed below. This part of the exam should take you about 15 minutes, so it will be necessary to spend some of your preparation time on deciding what you want to say for each topic.
- I will see if the small classroom Swords 330 is available so that you can have a better space for taking this test than our regular classroom.

Possible Essay Topics

1. How did early Americans consume apples? When and why did that change? How were notions of the apple's healthfulness popularized? Explain Pollan's assertion that both Chapman (the real-world figure behind the "Johnny Appleseed" legend) and the apple "have been sweetened beyond recognition. Figures of tart wildness, both have been thoroughly domesticated ... in both cases a cheap, fake sweetness has been substituted for the real thing." To whom or what else have we done this? Why?
2. Pollan observes that companies that have developed [genetically modified organisms] essentially want to have it both ways: "... the new plants are novel enough to be patented, yet not so novel as to warrant a label telling us what we're eating." Can both be true? Pollan writes, "Monsanto likes to depict genetic engineering as just one more chapter in the ancient history of human modifications in nature, a story going back to fermentation." What do you think of Monsanto's comparison? How does the example of the NewLeaf potato factor into this?
3. Explain Pollan's statements "the tulip is that rare figure of Apollonian beauty in a horticultural pantheon mainly presided over by Dionysus," and "color breaks ... can perhaps best be understood as an explosive outbreak of the Dionysian in the too-strict Apollonian world of the tulip–and the Dutch bourgeoisie." Who (or what) are Apollo

and Dionysus? What do they represent? How did the figure of Dionysus appear in Chapter 1 as well?

Sample Mathematical Questions

Note: There are more questions and more parts to these questions than I could reasonably ask you to do in the actual exam (because of the limited time available). This should give you an idea of the range of possible topics and styles of questions I might include in the exam, though.

A. The changing total mass of Pacific halibut in units of 10^6 kg without fishing is modeled by the logistic difference equation

$$u(n) = 1.71u(n-1) - \frac{.71}{80}u(n-1)^2.$$

1. What are the values of r_{max} (the maximum growth rate) and K (the carrying capacity)?
2. If the initial population is $u(0) = 4$, find $u(3)$. What would happen in the long run (i.e. if you computed $u(n)$ for a large range of years n)?
3. If the initial population is $u(0) = 100$, find $u(3)$. What would happen in the long run (i.e. if you computed $u(n)$ for a large range of years n)?
4. Suppose the effects of fishing are taken into account. How would the model be changed to reflect a *constant* fishing level of 1×10^6 kg per year? What does that do to the long-term equilibrium population level?
5. How would the model be changed to reflect a *proportional* fishing level of 10% of whatever the total mass of fish that were present? What would that do to the long-term equilibrium population level?

B. The following data set has $n = 9$: $23, 28, 40, 44, 47, 50, 51, 54, 55$

1. Find the "5-number" summary for this data set.
2. Draw the corresponding box plot.
3. Compute the (Bowley) measure of skewness. Does this seem reasonable from the box plot?
4. Compute the SD of the data set. How many of the points lie within two SD's of the mean? Is Chebyshev's Rule satisfied here? (Say what that rule says, and determine whether or not it is satisfied.)

C. (Short answer) Suppose that a researcher collects 80 individuals of the Atlantic surf clam. These clams can be found at levels down to about a meter in the sand, and larger clams tend to live at deeper levels. The researcher finds an average shell width 10.2 cm. Think of this as a sampling process.

1. What is the population? What is the sample?
2. Is the 10.2 a statistic or a parameter of the population?

3. Would the researcher *know* the population mean in this circumstance?
4. What additional information would the researcher need in order to find a *confidence interval* for the population mean? Describe how that would be determined and how that would be interpreted.
5. If you knew that reasearcher was being lazy about digging and the clams he collected were all taken from sand levels no deeper than 10cm, would that be a *simple random sample*?

D. Suppose that a large data set of air temperature readings is normally distributed with $\overline{x} = 18.6°$C and $SD = .2°$ C.

1. What would be the z-score of a reading of 17.9°?
2. What temperature reading would correspond to a z-score of 1.4?
3. Based on this information, if a temperature reading T is selected at random from the data set, what is the probability that $18.2° \leq T \leq 18.9°$?
4. Based on this information, if a temperature reading T is selected at random from the data set, what is the probability that $T > 19.0°$?

E. Physicians measured the blood lead levels in 373 bridge workers employed by painting contractors in eight states. The lead levels had $\overline{x} = 27.2$ micrograms per liter of blood, with an SD of 16.1 micrograms per liter.

1. Determine a 95% confidence interval for the average lead level in bridge workers.
2. A health objective of a federal regulatory agency was the elimination of blood lead levels of 28 micrograms per liter or higher for these workers. From the evidence given by your confidence interval, does it seem that that objective was being met? Explain, by describing the way we interpret the meaning of a confidence interval of this sort.

F. A study shows that a 95% confidence interval for the average amount X of hazardous waste generated by a single hospital is $210 \leq X \leq 260$ (in units of kg/day). This interval was computed using the formulas we have discussed.

1. What was the sample mean $\overline{x}$ used to generate this confidence interval? What was the margin of error?
2. If the sample size was $n = 100$, what was the SD of the waste amounts in the sample?
3. If the sample size was $n = 16$, what was the SD of the waste amounts in the sample?