SCIE1000, Tutorial Week 4, Semester 1, 2011.

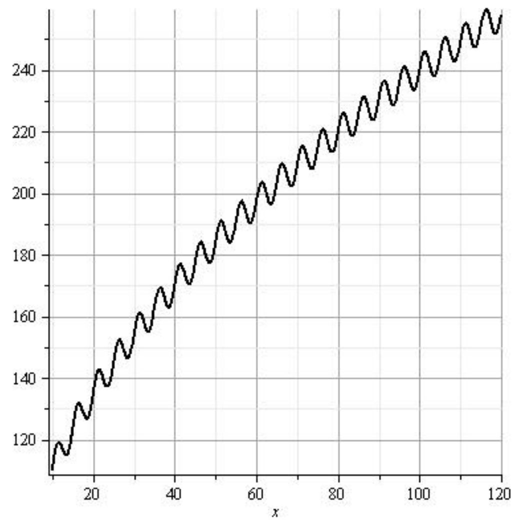
Aims

- This week you will work through some general calculation and discussion questions. As usual, the broad concepts and techniques are more important than the specific examples. Do not try to commit lots of facts to memory; instead, know **how** to do things, and **when** certain models and approaches are appropriate.
- The initial submission of your project is due the week after next. You should know what topic you are going to do, and be making progress on it. **The requirements for submission, including the due date and time, are very strict.** Do not leave it until the last minute!

1 Questions

1. (Final exam, 2009. Worth 5 marks, so about 5 minutes to work.) In a particular region, the number of species $S_1(a)$ that occur in an area of size a in km^2 is
$$S_1(a) = 10a^{0.5}.$$
   (a) A national park in this region covers 25 km^2. Find the predicted **average rate of change** in the number of species per km^2 if the size of the park is increased to 100 km^2.
   (b) The species diversity in a different region is given by $S_2(a) = 15a^{0.8}$. List two possible features of the second region that could explain the differences in the equation for S_2 as compared with S_1. Briefly justify your answer.

2. (Special final exam, 2008. Worth 9 marks, so about 9 minutes to work.)
   (a) The following graph shows the values of some phenomenon compared to time. Find an approximate mathematical model of this graph, as a function of the time x; include the periodic fluctuation and the underlying, long-term trend. (Show work.)



   (b) How would your mathematical model change if each periodic fluctuation took twice as long, but instead had three times the amplitude? Explain your answer briefly.

3. (Final special exam, 2010. Worth 6 marks, so about 6 minutes to work.)

(a) If the wind velocity is 76.1 km/h, show that the apparent wind chill temperature W in °C is approximately given by $W = -9.62 + 1.41t$ where t is the ambient air temperature in °C. (Hint: $W = 13.12 + 0.6215t - 11.37v^{0.16} + 0.3965tv^{0.16}$.)

(b) Using the result from Part (a), if the wind velocity is 76.1 km/h, find the ambient air temperature T for which a 5 °C rise in ambient temperature would result in the value of W doubling.

4. Earlier in semester we modelled the time taken for blood alcohol concentration (BAC) for males to return to zero, using the model $t = 240n/W$, where n is the number of standard drinks consumed and W is the total weight in pounds. We also saw the Widmark formula, which says that the BAC % B at any time t in hours after drinking is

$$B = \frac{A}{rW} \times 100 - 0.015t,$$

where here A is the amount of alcohol consumed in g, the *Widmark factor* r is the percentage of body weight that is water and W is the total weight in g. In this question we will compare these two models.

(a) Rewrite the equation $t = 240n/W$ to instead include the weight of the person in g, and the weight in g of alcohol consumed. (Hint: use 2.2 pounds per kilogram, and 10 g of alcohol per standard drink.)

(b) Rewrite the Widmark formula to estimate the time for BAC to return to 0.

(c) Using your answer to Part (b), find an equation for the time taken for the BAC of a male to return to 0. (Hint: an approximate value of r for males is $r = 0.7$.) Use this answer and your answer to Part (a) to find two estimates for the time taken for BAC to return to 0 for a male weighing 107 kg, consuming 4 standard drinks.

(d) Compare your equations in Parts (a) and (c), describing and explaining similarities and variations. Which formula appears to be more 'conservative' when estimating time for BAC to return to 0?

5. In 1954, the band *Bill Haley and his Comets* released the song *Rock around the clock*, which commences:

1, 2, 3 o'clock, 4 o'clock, rock,
5, 6, 7 o'clock, 8 o'clock, rock,
9, 10, 11 o'clock, 12 o'clock, rock,
We're gonna rock around the clock tonight.

Answer each of the following questions "by hand". You can type your code into Python later if you want to check the output. (In each case, don't worry about getting 'newlines' correct in your output.)

(a) What output is produced by the following piece of Python code.

```
i=1
while i <= 12:
    print i," o'clock"
    i=i+1
print "We're gonna rock around the clock tonight."
```

(b) Use one or more `if` statements to only print the word *o'clock* in the correct places for the song.

(c) Show how to modify the code from Part (b) using one or more `if` statements to print the word *rock* in the correct places for the song.

(d) Modify the code from Part (c) so that the user is prompted to input the number of hours (which can be more than 12), and the program prints a version of the song using that many hours. You may assume that the number is divisible by 4. (Hint: the Python command `a % b` gives the remainder when `a` is divided by `b`. For example, if the value of i is divisible by 4 then `i % 4` will equal 0.)

The end