11 Patinkin Way
First National Park of Florin
March 21, 2011

Math 111 Students
Kenyon College
Gambier, OH 43022

Dear Calculus Students:

I'm writing to you as the head of the First National Park of Florin. As you may know, a large portion of the Park consists of a Fire Swamp. When I went looking for help with our long range planning, your enterprising and resourceful professor naturally referred me to you.

We have two species that have me really worried about the future of the Park: the indigenous R.O.U.S.s (Rodents of Unusual Size) and the brown tree snake which entered the Park about 50 years ago as a stowaway on a pirate ship. Fortunately, R.O.U.S.s eat brown tree snakes. Unfortunately, brown tree snakes reproduce very rapidly.

My predecessor at the Park was a meticulous census taker (who used statistical sampling, by the way, to get more accurate counts), so I have approximate populations for each species for the last 30 years.

Year	Tree Snakes	R.O.U.S.s
1981	15300	415
1983	9890	910
1985	2860	950
1987	3340	525
1989	9340	250
1991	12290	460
1993	9050	830
1995	4840	855
1997	5130	545
1999	8720	340
2001	10490	500
2003	8550	770
2005	6030	790
2007	6200	560
2009	8350	410
2011	9410	525

It looks like the populations are following some sort of pattern, but I'm not sure what it is. My real problem is that when either population gets very large, I will need additional employees to make sure that both species stay within the park and don't escape in the neighboring farmland. This is where I need your expert help (which your enterprising and resourceful professor assures me you can deliver). Specifically, I need a prediction for how large the populations will be in each of the next 20 years.

In addition, I believe the populations are fluctuating less and less, and may eventually stabilize. I would like your expert opinion on whether or not the populations do stabilize, and if they do, I need to know how long it will take and what the eventual populations will be.

Once the populations stop fluctuating so drastically, we will be able to dramatically improve access to the Park by offering summer camps, establishing permanent camp grounds, and perhaps even adding a logride, although there are still some flame-retardant issues to be worked out. This should all be possible when the R.O.U.S. population is fluctuating by less than 75 per year and the brown tree snake population is fluctuating by less than 500 per year. As usual, I need your expert recommendation on when this will occur.

In addition to these details, I would like to see some informative graphs. If possible, for each population, I'd like to see a graph of the population over time as well as a graph of the rate of change of the population over time.

I have a meeting with the Budget Advisory Committee at the end of the month to propose our budget for the next two decades, so I would greatly appreciate your report by April 1st.

Gratefully yours,

Will Power

Project 1 Expectations
Fire Swamps, Rodents and Snakes (Oh My)[1]

Work in groups of two or three people. Each group should turn in one typed report containing the following. The paper should be a single **narrative** that includes all relevant information. All equations and figures should be labeled and explained (There should not be any stand-alone equations!). Maple code should be included when appropriate.

- Introduction – Restate the problem as you interpret it and the motivation for your work.
- Model Description – Give your equations and plot the data together with your models.
- Results – Give the results of your analysis for each model. All statements made in your conclusions section should be made here first.
- Conclusion – Summarize your general, important, and/or surprising findings. Discuss how your work could be improved upon and/or what questions remain to be investigated.
- Bibliography – Cite all sources (textbook, Maple, friends,...?).

A Few Notes from Your Professor

- To see the general trend of the populations, I would suggest plotting the points for each population separately, with time on the horizontal axis and population on the vertical axis. It may make things a little easier if you let time $t = 0$ be 1981.
- You should justify that the fluctuations are as small as you claim they are by using calculus to find the maxima and minima in your models. This includes taking the derivative of your model equations **by hand**. You may use Maple to solve the necessary equations to find the locations of the maxima and minima.
- Some Maple commands that you might find useful can be found in the Maple worksheet *Project1Maple.mw* on the P drive (P:/Class/Math/Smith/Math111Sp11). As always, if you don't understand how to use a particular command, check out the help menu.

[1] Adapted from a project in *Writing Projects for Mathematics Courses*, by Crannell, LaRose, Ratliff, and Rykken.