Lynx in the Yukon

The Hudson's Bay Company collected data on the number of lynx pelts brought in by trappers between 1821 and 1934. This set of data gives us valuable information about lynx populations over many years in northern Canada. You will use the spreadsheet data provided by your instructor to answer questions on this worksheet.

1. Let Model 1 for the number of lynx pelts brought in every year be a sinusoidal model,

$$L(t) = -1,460 \cos\left(\frac{2\pi(t-1821)}{10}\right) + 1,540,$$

   where t is the year and $L(t)$ is in thousands. What is the derivative $L'(t)$?

2. In which years does the population reach its peak, according to this model (Model 1)? Use appropriate mathematical notation to write your answer.

3. Graph your model and the actual data on the same axes. This will involve writing a formula so that the spreadsheet will fill in the column for Model 1, and then creating a chart.

4. Identify two ways in which the model seems to be working well and two ways in which you think it is not very good. (Play with the scale of your chart; does scale matter in your evaluation of the model?)

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5. Estimate the derivative each year by looking at change in number of lynx pelts over change in year and fill in a column in the spreadsheet for estimated derivative. Ask questions of peers and the instructor if you're stuck!

6. Graph the data you generated in the previous question. Does this look like the function you found in question 1? Does it look like any functions you know? Discuss.

7. A better model, Model 2, can be found by looking at the *logarithmic transform* of the data. Create a column filled with the natural logarithm of the lynx data, graph it, and find parameters that to your eye create a good model for the transformed data:

$$ln(\text{data}) \approx f(t) = \underline{\hspace{2em}} \cos\left(\frac{2\pi(t-1821)}{10}\right) + \underline{\hspace{2em}}$$

8. Model 2 for the original data would thus be $e^{f(t)}$. What is the derivative of $e^{f(t)}$?

9. Graph the original data and Model 2 output on the same axes, and the derivative of the original data and the derivative of Model 2 on the same axes. Evaluate: does your new model address the issues you identified in question 4? Are the good aspects of the model maintained?