

## PreCalculus Sinusoidal Model Project 2008

### READ EVERYTHING FIRST!

Group project: two or three members in a group. If you have three members, then you have to do the extra credit model.

Computer lab: check to see if you have access to the HS Drop folder, if not let me know on the first class! At the end of each lab session, group members should all save a copy of the work in case a key member is absent for the next computer lab period.

Many interesting behaviors are periodic. If you can model periodic data, you can analyze it. In this project, your group of two students will model at least two types of periodic data (with a third as extra credit.)

- a) **Basic Sine Model:** Use the web site for the US Naval Observatory, <http://aa.usno.navy.mil/AA/data>, to find the duration of daylight for one location in the world (not Canton.) Choose a major city within 60 degrees of the equator. [The Land of the Midnight Sun does not fit a sine curve well.] Ignore the time zone since it doesn't impact the number of daylight hours. <http://www.bcca.org/misc/qiblib/latlong.html> has latitude and longitude for a lot of world cities. Convert the daylight hours and minutes into decimal hours on a calculator or put hours and minutes into separate attributes in Fathom and make a new attribute, DecimalHours. Use Fathom to model your data, similar to the class model of sunrise time except you are modeling the numbers of daylight hours! Explain what the parameters of your model mean and determine when the number of daylight hours is changing the fastest and the slowest. How do these values compare with what you know about daylight, latitude and the calendar?
- b) **Slant Translation of Sine Model:** CO<sub>2</sub> data from Mauna Loa (more info, <http://mathforum.org/tpow/index2.ehtml?puzzle=210>). Find the MaunaLoa2003 Fathom document by File>Open Sample Document >Teaching Math with Fathom>Algebra 2. Use Save As to copy this document into your own documents folder. DO NOT change the original. Use the Mauna Loa, Continuous collection. You will need a new attribute to merge the Years and Months into a single YearMonth attribute that represents years with months included as a decimal amount of years (use an equation to get this.) Model CarbonDioxide as a function of YearMonth. You need to determine what parameters to use and what model is vertically translating your sine curve. Explain the parameters of your model and what their values mean.
- c) Extra credit: **Dampened Sine Model:** Use a CBR to collect data on the motion of a spring. See me to transfer the calculator data to a text file. Import the text file into Fathom. Use Fathom to model your data. You need to determine what parameters to use and what model is dampening your sine curve. Explain the periodic parameters of your model and what their values mean. Show at least two different models (linear and exponential) as dampening functions. Explain the parameters you use in your dampening functions and what their values mean. Choose the best model and justify your response (use residual values, here!)

For each model, the report will show part of the data table with at least 15 data values shown for all attributes, a graph of the data with the model function plotted, residual plot for the function, and copies of the sliders with values readable.

Hand in a group report. All members will receive the same grade.

## PreCalculus Quarter 3 Project Rubric

Names \_\_\_\_\_

Score \_\_\_\_\_

Not done	Major error or missed concept	Minor error(s)	Meets standard	Better than standard	I'm impressed
0	-	$\sqrt{-}$	$\sqrt{}$	$\sqrt{+}$	+
-10	-7	-2	+0	+1	+3
<b>Criteria</b>					
<b>Daylight Hours Model</b>					
Data: decimal hours accurate, daylight computed accurately, identify location, part of data table with at least 15 cases shown in report					
Sine Model: accurate with best chosen parameters, small residual values, good eyeball fit to data					
Fathom Graph: scatter plot with curve and residual plot, sliders for parameters readable					
Explanation of parameters (amplitude, period, vertical and phase shifts): use correct values, units, explanation is about context of daylight hours for location, comparison to general knowledge about relationship between latitude, daylight and the calendar					
Analysis of change: accurate dates of when daylight is changing the most and the least, justification of dates chosen, comparison to calendar					
<b>Mauna Loa CO2 Model</b>					
Data: part of data table with at least 15 cases shown in report, computation of decimal years, continuous data used					
Slanted Sine Model: accurate with best chosen parameters, small residual values, good eyeball fit to data					
Fathom Graph: scatter plot with curve and residual plot, sliders for parameters readable					
Explanation of periodic parameters (amplitude, period, and phase shift): use correct values, units, explanation is in context					
Explanation of vertical translation model: explanation of the type of model you used and why					
Report: <b>typed</b> , images neatly included in report, watch spelling!					
Timeliness: you will lose points if your report is late.					
<b>Extra credit:</b> Spring Motion Model, equation, graphs and explanation of parameters for dampening model. (up to 10 extra points)					

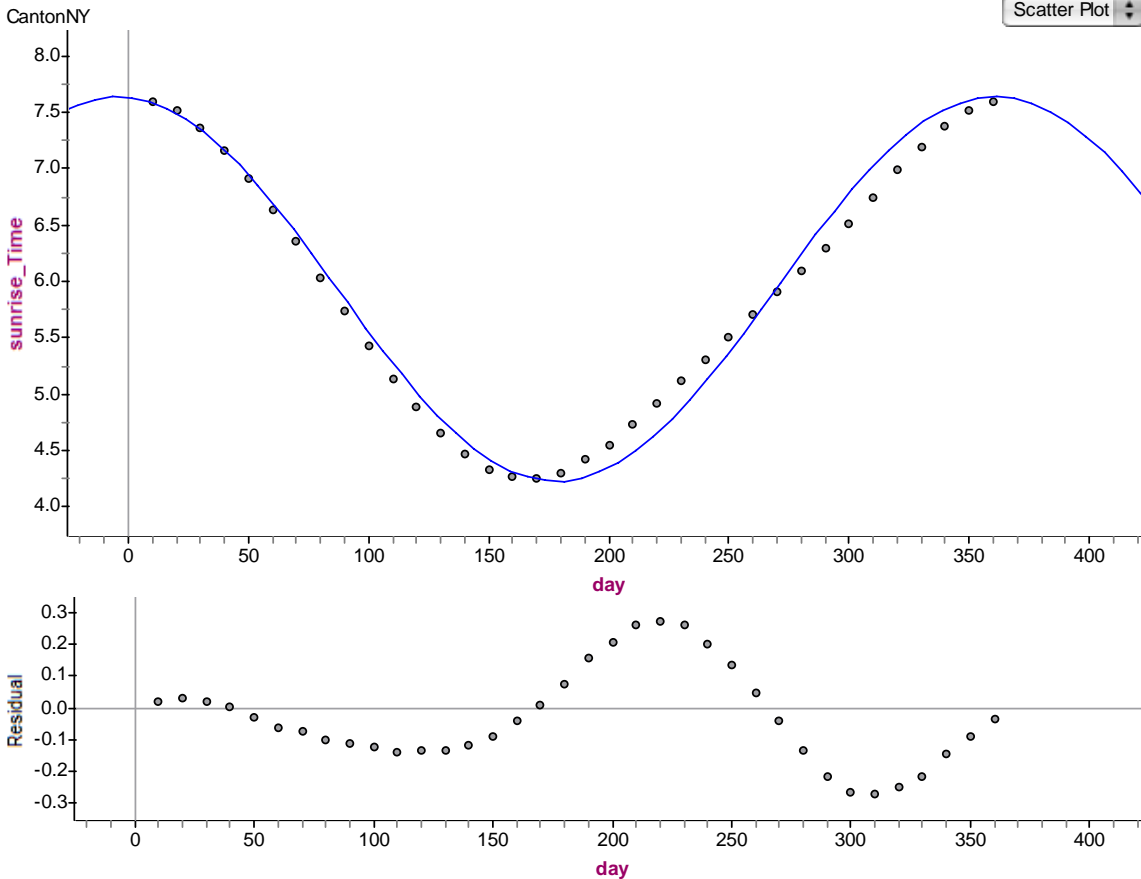
95 is the baseline score—meets the standard in each category. If you want a higher score, be prepared to impress me!

## Class Model: Modeling the Sunrise Times for Canton NY

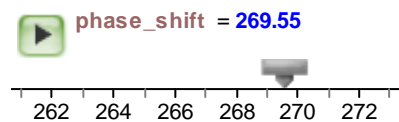
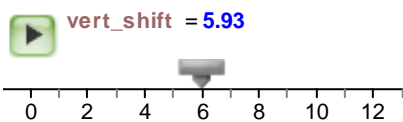
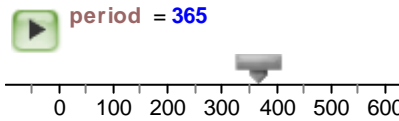
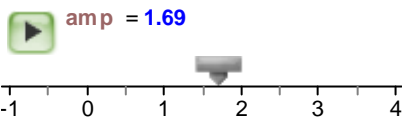
- 1) Find the web site for the US Naval Observatory: <http://aa.usno.navy.mil/AA/data>
- 2) Find the sunrise times for Canton NY for one year. Ignore Daylight Savings Time. Print in landscape orientation, with Shrink to Fit selected. (Data provided.)
- 3) Use every ten days for data in Fathom, changing hours, minutes to decimal hours.
- 4) Graph in Fathom, use sliders to adjust graph. Use residual plot to judge the best setting for sliders. Tips: Sometimes sliders need to be enlarged to read clearly. Reselect Scatter Plot to automatically refit the graph and residual plot.

CantonNY

	day	sunrise...
1	10	7.6
2	20	7.517
3	30	7.367
4	40	7.167
5	50	6.917
6	60	6.633
7	70	6.35
8	80	6.033
9	90	5.733
10	100	5.433
11	110	5.133
12	120	4.883
13	130	4.65
14	140	4.467
15	150	4.333
16	160	4.267
17	170	4.25



— sunrise\_Time = amp sin  $\left( \frac{(2\pi)}{\text{period}} (\text{day} - \text{phase\_shift}) \right) + \text{vert\_shift}$



- 5) Turn in for homework:
  - a) Explain the meaning of the amplitude, period, vertical and phase shift (parameters) for this model. Use numbers, units and context in your explanations.
  - b) When does the sunrise time change the most? When does it change the least? Justify your answers.
- 6) Before the next project class, print out your city's duration of daylight hours, circle every 10 days for the year and convert the hours-minutes to decimal hours.