

MAT 142 – Calculus II
Lab 1: Modeling and Analysis with Trigonometry

Due Friday, February 11th

You may work in teams of two or three and submit one report. Your report must be typed using Microsoft WORD. In each problem, show all mathematical work that is pertinent to the solution. Please include any graphs or worksheets that you used in the problem. Make sure all of your graphs are clearly labeled. Your written responses must be made with complete sentences.

Overview

Trigonometric functions are particularly useful in modeling real-world phenomena that fluctuate in a regular pattern. In this lab, you will investigate several features of the sine graph and use it to model a real-world data set. You will also explain how calculus can be used to analyze the resulting model.

1. Go to the website

<http://www.ies.co.jp/math/products/trig/applets/ABCsinX/ABCsinX.html>

This is a Java applet that shows the graph of $y = \sin x$ (in blue) and three sliders to its left. The sliders allow you to adjust the values of the constants a , b , and c . The resulting graph (in red) is the graph of

$$y = a \sin(b(x - c)).$$

By experimenting with this applet, give clear and precise responses to the following questions.

- a) What effect does the parameter a have on the shape or position of the graph?
 - b) What effect does the parameter b have on the shape or position of the graph?
 - c) What effect does the parameter c have on the shape or position of the graph?
2. Go to the website

<http://www.worldclimate.com/>

Select a city and record the average temperature of the city in the following table:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Avg. Temp												

3. Using Excel or Minitab, enter your temperature data into a spreadsheet and make a computer-generated graph of the average temperature over the course of one year. Make sure your axes are labeled (hint: It may help to use Jan. = 1, Feb. = 2, ...).

4. The graph shows the average temperature over one year. Is it reasonable to assume the graph repeats itself? Why? What do you think is the period?
5. Assuming that the temperature is periodic, come up with a formula using a trigonometric function that reasonably models the data that you found. What are the units of the dependent and independent variables? Briefly explain how you arrived at your particular model.
6. Use MAPLE to plot both the graph of your function and the graph of your data on the same set of axes. Explain why you believe that your model is reasonable. What might account for any significant deviations between the data and the graph of your function?
7. By looking at your graph from problem 6, determine the times of the year at which the temperature is changing most rapidly. Explain (step-by-step) how you would use calculus to analytically determine the times at which the temperature is changing most rapidly. What are the units of the rate of change of your function?