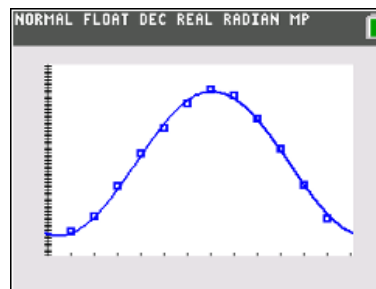




# Find That Sine Student Activity

Name \_\_\_\_\_  
Class \_\_\_\_\_

In this activity, you will use the data in the file *KANSTEMP.8xp*, which contains the temperatures and hours of sunlight in Kansas City, and the heights of tides in the Bay of Fundy. You will find the equations of Sine curves that model the given data and answer several questions about what you have found.



\*\*Note: Make sure that your handheld is in Radian mode.

## Problem 1 – Temperature

In this problem, you will graph data and find a sinusoidal function.

The temperature in Kansas City fluctuates from cold in the winter to hot in the summer. The average, monthly temperature (°F) will be loaded into **L<sub>1</sub>** and **L<sub>2</sub>** when you run the program. After your teacher has transferred the file to your handheld, press **prgm** to access the Program menu. Choose the **KANSTEMP** program and press **enter**. This will load the six lists with the data for all three problems.

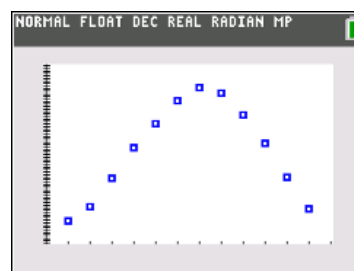
Press **stat**, **1 Edit...** to see the data in the lists. The number of the month is in **L<sub>1</sub>** and the temperature is in **L<sub>2</sub>**. Note: The data that appears in **L<sub>3</sub>** through **L<sub>6</sub>** will be used later in the activity.

To graph the data, press **2nd y =** and **enter** to access **Plot1**. Make sure that the **Plot1** settings are the same as shown below. Press **zoom** and select **9:ZoomStat**. You will get a graph similar to the one below.

L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	L <sub>6</sub>
1	25.7	1	9.21	0	
2	31.2	16	9.46	3	
3	42.7	32	9.92	6	
4	54.5	47	10.48	9	
5	64.1	60	11.02	12	
6	73.2	75	11.68	15	
7	78.5	91	12.41	18	
8	76.1	106	13.07		
9	67.5	121	13.68		
10	56.6	136	14.21		
11	43.1	152	14.63		

L<sub>5</sub>(8)=

Plot1 Plot2 Plot3  
 On Off  
 Type:   
 Xlist:L1  
 Ylist:L2  
 Mark: + \* .  
 Color: BLUE



- (a) Find the sine equation that models the data. Press **stat**, arrow over to **CALC**, and select **C:SinReg**. Fill in the information with the following:  
 XList: L      YList: L<sub>2</sub>      Store EQ: Y<sub>1</sub>      **enter** to calculate

Rounding to the nearest hundredth, write down the sine equation in the form  
 $y = a \cdot \sin[bx + c] + d$ .



Press **graph** to see the sine regression with the data.

(b) Discuss with a classmate how well the sine curve of regression models the data. Share your thoughts with the class.

(c) Find the approximate temperature in Kansas City on March 15. Explain if this is a reliable temperature you found.

(d) Using your sine curve of regression, estimate when your temperature will reach  $85^\circ$  in Kansas City and give an explanation of your results.

### **Problem 2 – Hours of Sunlight**

The amount of light a location on the Earth receives from the Sun changes each day depending upon the time of year and latitude of that location. The amount of daily sunshine Kansas City experiences has been recorded in the lists where the calendar day is in **L<sub>3</sub>**, and the hours of sunlight is **L<sub>4</sub>**.

Create the scatter plot and sine equation that models the data as outlined in **Problem 1**. To create the scatter plot, make sure to change the **XList** to **L<sub>3</sub>** and the **YList** to **L<sub>4</sub>**.

In early cultures, certain days of the year had significant importance because of the planting cycle. These days were the winter and summer solstices, and the spring and fall equinoxes. The equinoxes are the days with equal amounts of light and dark. The summer solstice has the greatest amount of sunlight, while the winter solstice has the fewest amount of sunlight.

(a) Rounding to the nearest hundredth, write down the sine equation.



- (b) Discuss with a classmate how well the sine curve of regression models the data. Share your thoughts with the class.
- (c) Find the solstice and equinox dates using your sine curve of regression. Make sure that after you find your regression curve that you turn off **Plot1** so you can see your curve and not the data points.
- Winter Solstice \_\_\_\_\_ Summer Solstice \_\_\_\_\_
- Fall Equinox \_\_\_\_\_ Spring Equinox \_\_\_\_\_

**Problem 3 – Tides**

The Bay of Fundy has the highest tides in the world. If a tape measure were attached at the water line of a pier, and the water level height were recorded over a period of eighteen hours, data like that in  $L_5$  and  $L_6$  would be generated.

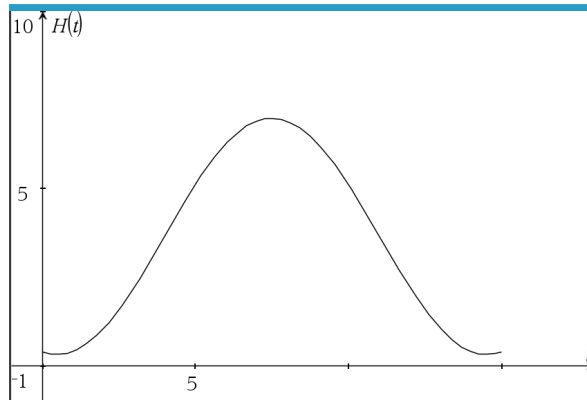
Create the scatter plot and sine equation that models the data as outlined in **Problems 1 and 2**. To create the scatter plot, make sure to change the **XList** to  $L_5$  and the **YList** to  $L_6$ .

- (a) Rounding to the nearest hundredth, write down the sine equation.
- (b) Discuss with a classmate how well the sine curve of regression models the data. Share your thoughts with the class.
- (c) Using the sine curve of regression for the data, predict the water level when the time is 49 hours after the readings were started. Share one or more ways you can attain this answer by using your TI-84 Plus CE handheld.



**Further IB Applications**

The height of the tides off the coast of Fripp Island, SC is modelled by the function  $H(t) = a \sin(b(t - c)) + d$ , where  $t$  is the number of hours after midnight, and  $a$ ,  $b$ ,  $c$ , and  $d$  are constants, where  $a > 0$ ,  $b > 0$ , and  $c > 0$ . The following graph shows the water for 15 hours, starting at midnight.



The first high tide occurs at 7:10 am and the next occurs 12 hours later. Throughout the day, the height of the water fluctuates between 6.9 ft. and 0.4 ft. All heights are given correct to one decimal place.

- (a) Show that  $b = \frac{\pi}{6}$ .
- (b) Find the value of  $a$ .
- (c) Find the value of  $d$ .
- (d) Find the smallest possible value for  $c$ .
- (e) Find the height of the tide at 12:00 pm.
- (f) Determine the number of hours, over a 24 hour period, that the tide is over 4 ft.