Teacher Notes

Activity 10

Climate and Temperature: Sinusoidal Models

Objective

- Students will develop an understanding of the sine and cosine functions and use them to model real world data

Applicable TI InterActive! Functions

- Define — function_name := function
- Spreadsheet 
- Graph 
- Max — max (first_cell: last_cell)
- Min — min (first_cell: last_cell)
- Mean — mean (first_cell: last_cell)
- Browser 

Problem

Students will collect temperature data from the Internet and find a sinusoidal model for the data. Students should also make a connection between the values of *a*, *b*, *c*, *d* and the relationship of these parameters to the temperature of the location.

Pre-Activity

Investigate the parameters *a*, *b*, *c*, and *d* of the functions
f(x): = a cos(b*(x − c)) + d and f(x): = a sin(b*(x − c)) + d.

1. Students should open a new TI InterActive! document. The students should open a math box and use the Math Palette to define **f(x): = a * cos(b * (x − c)) + d**. Students should then define each of the parameters of this function as follows: **a: = 1**, **b: = 1**, **c: = 0**, and **d: = 0**.

2. Students should click on Graph  and enter **cos(x) as** $y1(x)$ and **f(x)** as $y2(x)$ and then Save to Document  . Students should then double-click on a: = 1 and adjust *a*'s value. For example, let a: = 3. Click out of the Math Box and note the change in the graph. Students should continue adjusting the value of *a* (positive and negative numbers) until they can make a statement about the effect *a* has on this graph. Students can enter a list of *a* values to see multiple graphs by changing $a: = \{L5, L3, L1, 1, 3, 5\}$.

3. Students should double-click on b: = 1 and adjust *b*'s value. For example, let b: = 1/2. Click out of the Math Box and note the change in the graph. Students

should continue adjusting the value of *b* (positive and negative numbers) until they can make a statement about the effect *b* has on this graph.

4. Students should double-click on c: = 0 and adjust its value. For example, let c: = 3. Click out of the Math Box and note the change in the graph. Students should continue adjusting the value of *c* (positive and negative numbers) until they can make a statement about the effect *c* has on this graph.

5. Students should double-click on d: = 0 and adjust *d*'s value. For example, let d: = 3. Click out of the Math Box and note the change in the graph. Students should continue adjusting the value of *d* (positive and negative numbers) until they can make a statement about the effect *d* has on this graph.

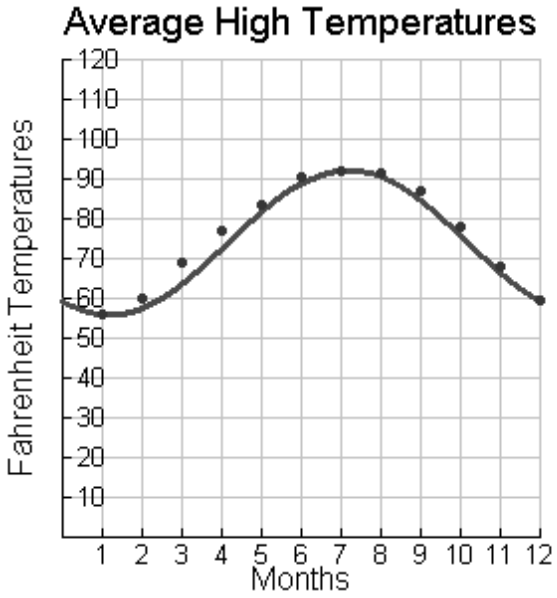
Exploration

***Note**: Students could record their graphs on the grids found in Appendix A.*

Steps 1 through 10 are details for the students to set up the problem and extract the data from the Internet. The Jackson, MS (30°N 90°W) data used in the solutions was collected from **www.climate.com** on September 1, 1999. Other websites may post the data in columns rather than rows. If the data is in columns, the data should be extracted into the list editor instead of the spreadsheet.

Month	1	2	3	4	5	6	7	8	9	10	11	12	
Temp	55.8	60.1	68.9	77.2	83.5	90.3	92.1	91.6	86.9	77.9	68	59.4	75.9

1. through 10.



Analysis

1. tempmax: = 92.1 tempmin: = 55.8 tempavg: = 75.975
2. d: = 73.95
3. The change in *d* shifts the graphs of *f*(*x*) and *g*(*x*) up to the middle of the data.
4. a: = 18.15
5. The change in *a* vertically stretches the graphs of *f*(*x*) and *g*(*x*).
6. The period of this graph is 12 months.
7. b: = $\frac{2\pi}{12}$
8. The change in *b* horizontally stretches the graphs of *f*(*x*) and *g*(*x*).
9. c1: = 4
10. Answers will vary. One sine function that fits this data is

    f(x): = 18 sin($\frac{2\pi}{12}$(x − 4)) + 75.
11. c2: = 7
12. Answers will vary. One cosine function that fits this data is

    f(x): = 18 cos($\frac{2\pi}{12}$(x − 7)) + 75. The graphs of *f*(*x*) and *g*(*x*) should coincide.

    If students need to verify that *f*(*x*) passes through the data set, have them open the graph and click on Animate.
13. The value of *d* is approximately the average of the monthly temperatures.
14. The value of *a* is the temperature flux from the average.
15. The value of *b* is the number of months per year.
16. *c*1 is the month that the temperature first reaches the average temperature for the year. *c*2 is the month that the temperature reaches the maximum temperature for the year.