Texas Instruments Activity #4
Title: Sands of Time
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Estimated Time: 40-50 Minutes

NCTM Standards:

Connections Standard – Recognize and apply mathematics in contexts outside of mathematics. Use representations to model and interpret physical, social and mathematical phenomena.

Problem Solving Standard – Solve problems that arise in mathematics and other contexts.

Algebra Standard – Understand patterns, relations, and functions. Approximate and interpret rates of change from graphical and numerical data. Understand and compare the properties of classes of functions.

Topics in Calculus:

Integration, Applications of Integration, Regressions

Overview:

In this activity, the students will use the TI-89 graphing calculator to find a regression equation and then to interpolate the data from the equation using integration. The students will explore the length of day during the winter and summer solstice at various locations.

Supplies: TI-89 Graphing Calculator

Name: _____ Date: _____

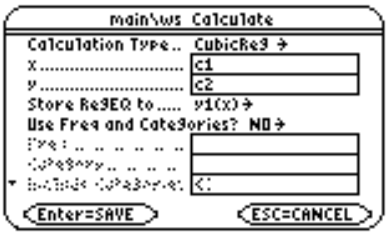
SANDS OF TIME

In this activity, you will determine the length of the day where you live. To do this, we will create a data list and find a regression equation.

Latitude	***Length of Daylight***			
	Winter Solstice (Dec 21-22)	*March Equinox (March 21-22)*	*Summer Solstice (June 20-21)*	*Autumnal Equinox (Sept. 22-23)*
0°	12 hours	12 hours	12 hours	12 hours
30°	10 hours	12 hours	14 hours	12 hours
40°	9 hours	12 hours	15 hours	12 hours
50°	8 hours	12 hours	16 hours	12 hours
60°	5.5 hours	12 hours	18.5 hours	12 hours
90°	0 hours	Sunrise*	24 hours	Sunset*

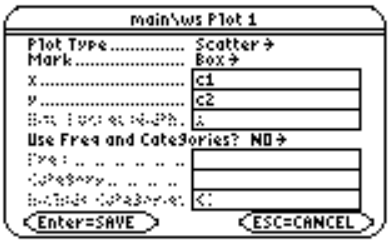
*Sunrise and sunset mean that the sun rises on March 21 and stays in the sky until it sets on Sept. 22-23. Use .5 hour for these.

STEP ONE: Create a list with the latitude and the number of hours in the Winter Solstice. Then, create another list for the latitude and the Summer Solstice. Name the Winter Solstice's list *WS* and the Summer Solstice's list *SS*. To create the list, press [APPS] [6] [3] and a dialog box will appear. Select Data and type the name of the list. Press [ENTER]. Then enter the latitude in the first column (C1) and the hours in the second column (C2). Repeat STEP ONE for the second list.



STEP TWO: While you are viewing the data, press [F5] and select a regression type. Enter c1 for x and c2 for y. Store the regression equation in y1(x). Then press [ENTER]. The regression will be saved in the Y= Editor.

STEP THREE: Now, press the [◆][Y=][▲][ENTER] to plot the data. Make the changes that appear on the screen to the right. Then, press [◆][F2][F2][9] and the graph and data plots will appear. Determine whether or not the regression you chose fits the data. If the data does fit, continue to step four, however, if it does not, repeat STEP TWO and STEP THREE.



STEP FOUR: Now, you will need to repeat STEP TWO and STEP THREE for the second data set. Use y2(x) for the second regression and Plot 2 for the second. Also, turn off Plot 1 and y1(x) so you can clearly view the second plot. Once you have both of the regression equations, write them on the lines below.

Winter Solstice: _____

Summer Solstice: _____

STEP FIVE: Using a map, write the names of the following places and the latitudes of these places.

Your Home Town: _____ Latitude: _____

Your Favorite Vacation Place: _____ Latitude: _____

Dream House Location: _____ Latitude: _____

Least Favorite Place: _____ Latitude: _____

STEP SIX: Using the TI-89 graphing calculator, find the amount of daylight for each of the places listed above during the winter solstice. Use the equation for the winter solstice from STEP FOUR. Press [2nd][∫] *equation* [,][X][,] *lower bound* [,] *upper bound* [)][ENTER]. The lower bound should be slightly lower than the latitude and the upper bound should be slightly higher than the latitude of the place for which you are finding the amount of daylight.

Before you find the amount of daylight, find the length of day for the latitude 30°. Integrate the function using 29.5 as the lower bound and 30.5 as the upper bound. Then, repeat this step with 29.99 as the lower bound and 30.99 as the upper bound. Try at least three different upper and lower values. What do you notice about the answer? What set of bounds seem to work the best? Why? Use the best method for finding the amount of daylight. Finally, compare the solution from the your calculations to the table on page one. Explain why these answers are different.

_____

_____

_____

_____

_____

_____

Below, write the amount of daylight for each of the locations for the winter solstice.

Your Home Town: _____

Your Favorite Vacation Place: _____

Dream House Location: _____

Least Favorite Place: _____

STEP SEVEN: Find the length of day at the locations you chose for the summer solstice. Write the answers in the spaces below.

Your Home Town: _____

Your Favorite Vacation Place: _____

Dream House Location: _____

Least Favorite Place: _____

Answer the following questions.

1. What functions would represent the data for the equinoxes? What problems would you encounter with these functions? Why?

2. When does each of your locations have the most amount of daylight? What is the pattern of the amount of daylight?

3. How does this method compare to using only a regression equation to find the amount of daylight?