Activity
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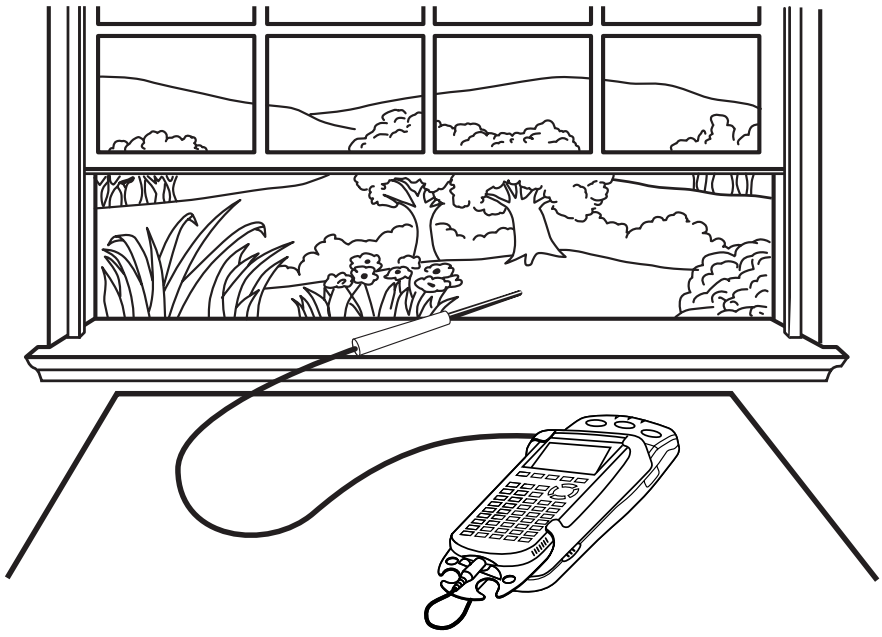
And Now, the Weather… Describing Data with Statistics

Meteorologists use mathematics to interpret weather patterns and make predictions. Part of the job involves collecting and analyzing temperature data. Once the meteorologists have collected a large number of measurements, they have a problem: How do they make sense of a long list of numbers? What is needed is a way of describing the set of data with just a few numbers. We call those numbers *descriptive statistics*. One important need is to be able to represent the set of measurements with a single number. There are several ways to do this:

- The *mean* temperature is what we usually think of when we hear the word "average." It is the sum of the temperature values in the data set divided by the number of elements in the set.
- The *median* temperature represents the center data point of the set after all the elements have been placed in order from lowest to highest.

Almost any weather report includes a summary of the day's high temperature, called the *maximum* value, and the day's low temperature, called the *minimum* value. The difference between these two statistics, called the *range*, shows the variability or *spread* of the data.

In this activity you will collect outdoor temperature readings over a day-long period using a temperature probe. After this data has been transferred to the calculator, you will use its statistical analysis tools to create your own temperature report.



OBJECTIVES

- Record temperature data over a day-long period.
- Describe the temperature data using statistical concepts.

MATERIALS

TI-83 Plus or TI-84 Plus graphing calculator
EasyData application
Temperature Probe and data-collection interface
fresh batteries or AC adapter

PROCEDURE

1. In order to collect weather data for a 24-hour period, you need to change the data collection rate and time. EasyData uses seconds as a time unit. How many seconds are there in a 24-hour period? Determine this number and record it on the *Data Collection and Analysis* sheet.

   If you want to record the temperature every 600 seconds, how many points do you want recorded? Subtract one from the value you get to be sure your run is done tomorrow at the start of your class, and to have an odd number of measurements. Record this value on the *Data Collection and Analysis* sheet. You will need it during setup.

2. Turn on the calculator. Connect the Temperature Probe to the calculator. (This may require the use of a data-collection interface.)

3. Set up EasyData for data collection.

   a. Start the EasyData application, if it is not already running.
   b. Select [File] from the Main screen, and then select **New** to reset the application.
   c. Select [Setup] from the Main screen, then select **Time Graph…**
   d. Select [Edit] on the Time Graph Settings screen.
   e. Enter **600** as the time between samples in seconds and select [Next]. In other words, the data-collection interface will record the temperature every 10 minutes
   f. Enter the number of samples you want to take and select [Next]. (This is the number you determined in Step 1.)

4. Set up EasyData for remote data collection.

   a. In order to collect data with the data-collection interface and probe alone, you need to set up EasyData for remote data collection. Select [Adv] from the TIME GRAPH SETTINGS screen.
   b. Select MANUAL as your Trigger type and then select [Next].
   c. Select [OK] to return to the Main screen.
   d. Select [Start] from the Main screen and then select [OK] to quit EasyData and prepare for data collection. Note that on the data-collection interface a yellow and green light are now lit. Data collection will not begin until you press the START/STOP key on the data-collection interface.
   e. Disconnect the data-collection interface from the calculator, taking care not to press the START/STOP button on the data-collection interface. The two lights on the data-collection interface must remain on.

5. Place the temperature probe outside a window, with the cable running through the window to the data-collection interface inside. Take care that the cable is not pinched tightly in the window.

   Press the START/STOP key on the data-collection interface. The data-collection interface will beep, and the yellow light will go off. Leave the data-collection interface in place for 24 hours. Make a note of the time you started data collection and write it on the *Data Collection and Analysis* sheet.

6. The next day, retrieve the data stored in the data-collection interface.

   a. Reconnect the calculator to the data-collection interface, and start EasyData.
   b. EasyData will display a screen confirming that data collection is complete. Select [OK] to retrieve the collected data.
   c. After the data is transferred to the calculator, EasyData will display a graph of temperature versus time.
   d. Examine the temperature versus time plot that appears on the screen.
   e. Select [Main] to return to the Main screen. Select [Quit] and then [OK] to exit EasyData.

ANALYSIS

1. (Optional). Since the EasyData application uses only time units of seconds, convert the times to hours to make interpreting the graph a little easier. To do this, determine a scale factor by which you will divide the times in seconds to convert to hours, as in (time in seconds) / scale factor → (time in hours).

   Your time values are in L1. To do the conversion you just planned, perform these steps.

   a. Press [2nd] [L1].
   b. Press [÷].
   c. Enter the numerical scale factor you determined.
   d. Press [STO▸], and enter L1 a second time to complete the expression L1 / 12345→ L1. Press [ENTER] to perform the calculation. (Your scale factor should be different.)

2. Redisplay the graph.

   a. Press [2nd] [STAT PLOT].
   b. Press [ENTER] to select Plot1 and press [ENTER] again to select On.
   c. Press [ZOOM].
   d. Press [▼] until ZoomStat is highlighted; press [ENTER] to display a graph with the *x* and *y* ranges set to fill the screen with data.
   e. Press [TRACE] to determine the coordinates of a point on the graph using the cursor keys.

3. Use the cursor keys to move along the temperature plot. The *x*-values that appear at the bottom of the screen represent the time since data collection began. Identify at least two time intervals during the 24-hour collection period during which there was a significant change in the temperature, and record this information in the Data Table on the *Data Collection and Analysis* sheet.

4. Can you relate these times to specific weather events that occurred during the day such as rain showers, periods of cloudiness, sunrise or sunset? Record your answers in the Data Table.

5. The mean temperature is the sum of all the readings divided by the number of readings. For example, the mean of {23, 25, 30} is (23 + 25 + 30)/3 = 26. During data collection you obtained a series of temperature measurements. To calculate the mean temperature, add the values in the list of temperature measurements and divide by the number of measurements, which you set earlier.

   a. To enter the sum(function press 2nd [LIST] and press ▶ twice to open the MATH menu. Press the number in front of sum(to paste it to the home screen.
   b. Press 2nd [L2].
   c. Press) to close the sum function.
   d. Press ÷ and enter the number of temperature measurements in the list.
   e. Press ENTER to complete the calculation.
   f. Round and record the mean temperature in the second column of the Data Table on the *Data Collection and Analysis* sheet. Use three significant digits for this and all following entries.

6. The median temperature is the element exactly in the middle of the ordered list; for example, it would be the 50^{th} out of 99 elements. To find the median temperature, you need to sort your temperatures so they are in ascending order, and then find the middle reading.

   a. To sort the values in L2, your temperature values, press 2nd [LIST].
   b. Press ▶ to reveal the OPS menu. Press ENTER to paste SortA(to the home screen.
   c. Press 2nd [L2].
   d. Press) to close the SortA function, and press ENTER. The calculator will sort the values in ascending order and then show Done.
   e. To show the middle data value, press 2nd [L2]. Press (, and enter the place of the middle element in the list. For example, enter 50 if you have 99 elements.
   f. Press) to close the argument as L2(50), and press ENTER.
   g. Record the median temperature in second column of the Data Table.

7. You have calculated the mean and the median temperatures in a very direct way – by finding the sum of the elements, or by sorting the list elements and looking for the middle one. The calculator can perform the same kind of calculations, and more.

   The following steps will have the calculator find a set of descriptive statistics, including the mean, median, minimum, and maximum values of the temperature measurements.

   a. To enter the 1-Var Stats function press STAT and press ▶ to open the CALC menu. Press ENTER to paste the 1-Var Stats function to the home screen.
   b. Press 2nd [L2].
   c. Press ENTER to complete the calculation.
   d. The 1-Variable Statistics command calculates a number of statistics all at once. Use the ▼ key to scroll down to reveal values of the mean (shown as $\bar{x}$), minX, Med, and maxX.

      Record the mean, minimum, median, and maximum temperatures in the third column of the Data Table on the *Data Collection and Analysis* sheet.
   e. Press 2nd [QUIT] CLEAR to return to the calculator's home screen.

⇒ Answer Questions 1–4 on the *Data Collection and Analysis* sheet.

EXTENSIONS

1. What differences would you expect if this activity were repeated three months from today? Indicate how each statistic you found would change, if at all. Make a rough graph of temperature versus time corresponding to these projections. Be sure to include scale markings and axis labels on your graph.

2. Suppose you are designing a travel brochure for your city. Assume that the mean and median temperatures for the tourist season matched the values you found during the 24-hour collection period for this activity. Which of these statistics would you advertise as the average temperature for your city and why? Explain how your choice might depend on regional tourist attractions.

3. Write a weather report for your local newspaper summarizing the 24-hour period during which you collected data for this activity. Use your own words, together with the statistical information you gathered during this activity, to write the report.

DATA COLLECTION AND ANALYSIS

Name _____

Date _____

DATA TABLE

Seconds in a day	
Number of data collection points	
Time data collection started	

	by direct calculation	from calculator stats
mean		
median		
maximum		
minimum		

Time Interval of Rise/Fall	Corresponding Weather Event
to	
to	
to	
to	

QUESTIONS

1. How do the mean and median values determined by the calculator compare with the ones you found earlier?

2. Compare the maximum and minimum temperature values with high and low temperature results printed in the local newspaper or quoted on the local weather report. Are the results in close agreement with the local meteorologist's reported values? Justify any discrepancies.

3. Determine the *range* (high temperature minus low temperature) and record it below:

   Range = _____

4. People often listen to a local weather forecast before choosing what they will wear for the day. Would knowing the predicted temperature range for a given day provide enough information for this decision? What other statistic(s) would you need to know?

