EXPLORATIONS

Activity 1

The Candy Caper

Objective

- To use estimation to determine the number of candies in various size cylinders. You will compare the estimated numbers to the actual numbers and investigate the relationship between the two numbers.

Materials

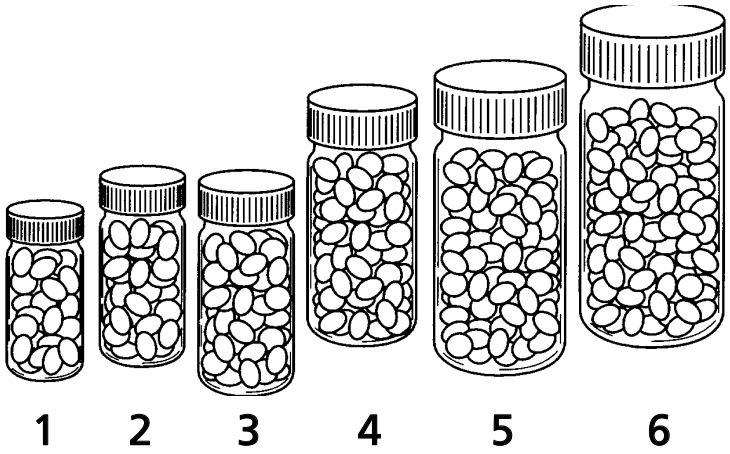
- TI-73 calculator
- Student Worksheet

In this activity you will:

- estimate the number of candies in each container
- find measures of central tendency, the mean, median and mode
- compare your estimate with the actual number and investigate the relationship

You will need to know this math vocabulary:

- absolute value
- mean
- median
- mode
- box-and-whiskers plot or box plot
- scatterplot



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Introduction

You are probably familiar with Skittles™ candy. A pharmacist would probably be a good estimator of how many Skittles™ candies a medicine vial could hold, since pharmacists deal with filling different sized containers with pills of various sizes all the time in their occupation. How good are you at estimating the number of Skittles™ different-sized medicine vials can hold?

Problem

In this activity, you will estimate the number of candies contained in each vial. Record your estimates on the table on the Student Worksheet.

Your teacher will give your team a vial of candies. Find the actual number of candies in the vial. Divide the candy between the members in your group. Sort in groups of 10. Count the candies and tell your teacher this number. After all bottles have been counted, record the actual numbers on the table on the Student Worksheet.

Activity

1. The List editor ([LIST]) will be very helpful in determining how well you estimated. Before using the List editor, go to the Home screen and execute the SetUp Editor by pressing [2nd] [CATALOG], selecting **SetUpEditor**, and pressing [ENTER] [ENTER].

a. Enter your estimates in a list named **GUESS** and the actual numbers in a list named **EXACT**.

✎ Answer Question 1 on the Student Worksheet.

b. To find the difference in the two lists, highlight **L1** and press [2nd] [STAT]. Select **GUESS** and press [ENTER], then press [−] [2nd] [STAT] **EXACT** [ENTER].

✎ Record this data in the fourth column of the table on the Student Worksheet. Answer question 2 on the Student Worksheet.

c. **Absolute value** is the positive number that you were off on each estimate. To obtain the absolute value of **L1** and store in **L2**, highlight **L2**, press [2nd][CATALOG], select **abs(** [ENTER], then press [2nd] [STAT] **L1** [ENTER] [)] [ENTER]. Scroll down **L2**. These numbers are the positive difference of your guess and the exact number, or how many you were off. Calculate the **mean** of **L2** to determine the average number by which you were off. To do this, go to the Home screen and press [2nd] [STAT] [▸] [▸] **MATH**, then select **mean(** [2nd] [STAT] **L2** [ENTER] [)] [ENTER].

✎ Answer question 3 on the Student Worksheet and copy the data from **L2** in the calculator into the fifth column of the table on the Student Worksheet.

d. Find the percentage you were off on each estimate and put this in **L3**. To do this, highlight **L3** and use the formula **L2** [÷] **EXACT** [×] 100. Then find the mean of **L3**.

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✎ Answer question 4 on the Student Worksheet.

2. Tell your teacher the average number of "candies off" you were. (This was the answer to question 3 on the Student Worksheet.) You will enter the averages of your class members in **L4** on the calculator. Listen as your teacher calls out the numbers and explains how to do this.

a. Go to the Home screen and sort **L4** in ascending order by pressing 2nd [STAT] ▶ **OPS**, selecting **1: SortA(** ENTER, and pressing 2nd [STAT] **L4** ENTER) ENTER. Press LIST and scroll down **L4** to see the averages in order.

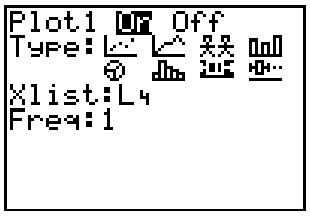
✎ Answer question 5 on the Student Worksheet.

b. Find the mean of the class' "candies off." Press 2nd [STAT], press ▶ ▶ to move to **MATH**, then select **3:mean(** ENTER 2nd [STAT] **L4** ENTER) ENTER.

c. Find two other measures of central tendency: the **median** and **mode**. Press 2nd [STAT] ▶ ▶ **MATH**, select **4:median(** ENTER 2nd [STAT] select **L4** ENTER) ENTER. You may follow the same procedure to find the mode, but select **5:mode(** from the **Math** menu. If there is no mode, the calculator will display **ERR:NO MODE**. Select the **Quit** option.

✎ Record these results in question 6 on the Student Worksheet.

3. Set up a statistics plot and create a **box-and-whiskers plot**.



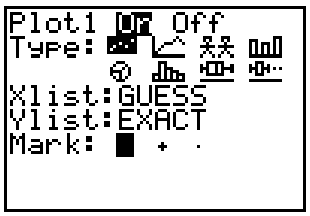
a. Before doing so, make sure equations are turned off or cleared out of the Y= editor. Press 2nd [PLOT] **4:PlotsOff** ENTER, 2nd [PLOT] **1:Plot 1** ENTER.
Change settings to match those shown at the right. Use ▶ and ▼ to move to the box-and-whiskers symbol, then press ENTER to select it. Select **Xlist** by pressing 2nd [STAT] and selecting **4:L4**.

b. Set the window by pressing ZOOM **7:ZoomStat**. Press TRACE.

✎ Answer question 7 on the Student Worksheet.

4. Compare your estimated numbers to the actual numbers using a **scatterplot**. When data is displayed in a scatterplot, usually the purpose is to determine if there is an association between the two variables on the graph. If the points seem to fall on or close to a line then there is a relationship. If the points are all scattered out then there is no relationship.

a. Turn plots off by pressing 2nd [PLOT] **4:PlotsOff** ENTER. Set up plot 1 by pressing 2nd [PLOT] **2:Plot 1** ENTER and entering the settings shown at the right.



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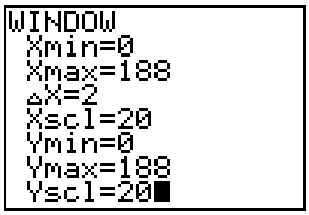
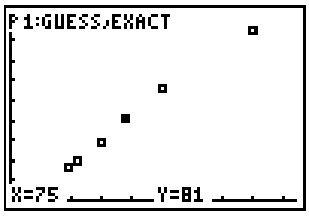
b. Press [WINDOW] and set an appropriate first quadrant window, as shown at the right.



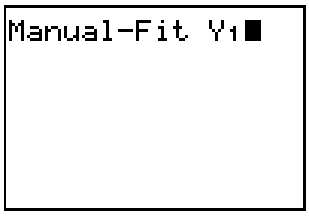
✎ Answer question 8 on the Student Worksheet.

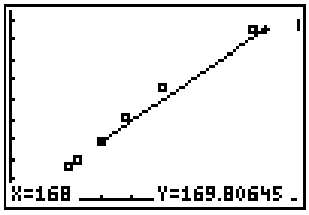
c. Press [GRAPH] [TRACE].



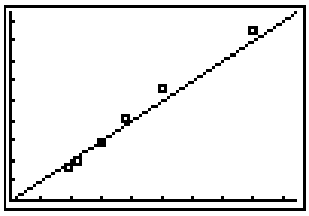
5. You can use **Manual-Fit** to best fit a line on the plotted data. Press [MODE] and set as shown at the right to round the values to the nearest whole number.

a. On the Home screen, press [2nd] [STAT] [◄] **CALC 3:Manual-Fit**, then [2nd] [VARS] **2:Y-Vars 1:Y1** [ENTER]. Position the cursor at the beginning of the line segment that you want to draw, and press [ENTER]. As you press the cursor keys, the line is drawn and the slope or steepness is adjusted. When you have matched the plotted points as desired, press [ENTER]. You can use the cursor keys to adjust the line. When you find the best fit, press [ENTER] again.



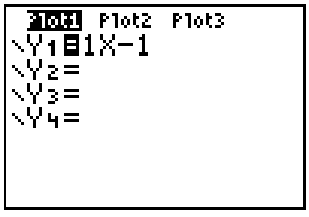


b. The equation of this line has now been pasted in the [Y=] editor. This is an approximate equation that describes the relationship between your estimates and the actual numbers. What would the relationship be between **X** and **Y** if you had guessed the exact amounts in every container?

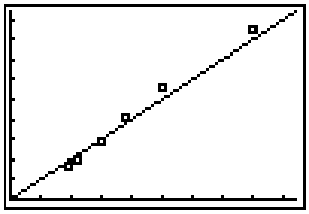


✎ Answer question 9 on the Student Worksheet.

c. Press [Y=] and turn **Y1** off by highlighting the = sign and pressing [ENTER]. In **Y2**, type **X** (to create the equation **Y=X**) and press [GRAPH].



6. The students with the "lowest number of candies off" average and the "highest number of candies off" average will show their scatterplots to the class.



✎ Answer questions 10 and 11 on the Student Worksheet.

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Student Worksheet

Name _____

Date _____

Activity 1

The Candy Caper

Record your results on the table below. Then answer the questions about the activity.

Part 1 - One-Variable Statistics

Vial #	Estimate LGUESS	Actual LEXACT	L1=LGUESS − LEXACT	L2=abs(L1)	% off L3=L2 ÷ LEXACT × 100
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

1. How can you determine how close you guessed to the actual number?

_____

2. Suppose you guessed 30 candies but there were only 25; you were _____ over. On a second vial, you guessed 50 but there were 59, so you were _____ under. How could you find the your average error in this situation?

_____

_____

3. The mean number I was off is _____. This means on average I was off _____ candies per bottle. Explain how you find this average without a calculator.

_____

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4. The mean percent I was off was _____. Relate this to your estimate.

_____

_____

_____

5. List all class members' averages in order from least to greatest.

_____

_____

_____

_____

_____

6. The median of the data set in **#5** is _____.

The mean is _____.

The mode is _____.

7. Box Plots can often be described as evenly distributed, positively skewed or negatively skewed. Which description best describes the data in the class' box plot? Explain.

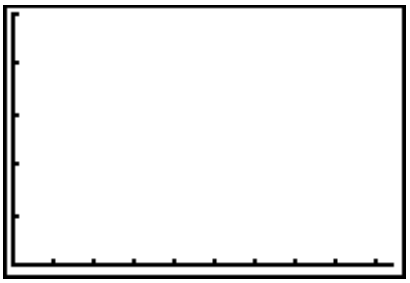
_____

_____

_____

_____

Sketch the box plot on this screen.



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Part 2 - Two-Variable Statistics

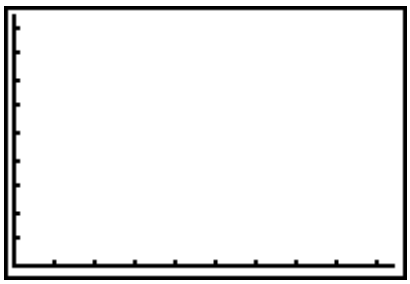
8. Describe the data points on the scatterplot.

_____

_____

_____

Sketch the plot on this screen.



9. Write an equation to describe the relationship between the estimate (**X**) and the exact number (**Y**) if you had guessed the exact amounts in every container.

_____

How does this equation compare to the manual-fit equation?

_____

10. How does the scatterplot of the person whose mean average was the "lowest number of candies off" compare to the line **Y=X**?

_____

_____

_____

_____

11. How does the scatterplot of the person whose mean average was the "greatest number of candies off" compare to the line **Y=X**?

_____

_____

_____

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Teacher Notes

Activity 1

The Candy Caper

Math Strand

- Algebraic reasoning
- Number sense
- Statistics

Materials

- TI-73 calculator for each student
- Student Worksheets (page 5)
- ViewScreen
- 6 to 10 clean medicine vials of different sizes, labeled with numbers. (A local pharmacy would probably be willing to donate these.)
- 1 to 2 large bags of candies (Skittles™ candies work well) or beans
- Wet wipes for students to clean their hands (or give them an opportunity to wash their hands, since they will be touching the candy).

Students will use estimation to determine the number of candies in various size cylinders. They will compare their estimated numbers to the actual numbers and investigate the relationship between the two numbers. One- and two-variable statistics will be analyzed.

Vocabulary

absolute value	The number of units the number is from zero on the number line.
mean	The sum of the elements in the set, divided by the number of elements in the set.
median	The middle number of a set of data when the numbers are arranged in numerical order.
mode	The number that occurs the most often in a set of data.

(Vocabulary continued on the next page)

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box-and-whisker plot (box plot)	A graph that shows the minimum value, lower quartile, median, upper quartile and maximum value. It graphically displays the quartiles using the 5 values above as boundary points. If the segments that join the minimum value to lower quartile, lower quartile to median, median to upper quartile, and upper quartile to maximum value are about the same length then the data set is evenly dispersed. If the right whisker is shorter than the left whisker the data is positively skewed. If the left whisker is shorter than the right then the data is negatively skewed.

Classroom Management

The activity is divided into two parts. Part 1 investigates one-variable statistical topics such as the mean, median and mode and concludes with the analysis of a box plot. Part 2 compares the students' estimate to the actual number using a scatterplot, manual fit, and the Y= editor. You may need to divide the activity into two days depending on length of class and ability of students.

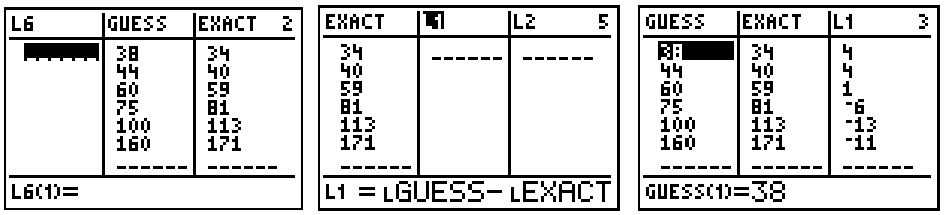
Problem

Display the vials of candy on a table in numerical order. Have the students bring a pencil and Student Worksheet and walk by the vials of candy in a single file line, writing down their estimates as they inspect the vials. Do not permit them to touch or pick up the vials. Monitor the line so that each student gets approximately the same amount of inspection time.

Send the students back to their groups, where they will work together to complete most of the activity. Some of the activity will be class-oriented and teacher-directed or the whole activity could be teacher-led. Give each group a vial to count and find the actual number. Tell the students to sort the candy in groups of 10. They may not eat the candy until given permission to do so. Have a member from each group come up to the board and record the exact number of candies contained in their vial. Have the students record this number on the table on the Student Worksheet.

Activity

1. To access lists, name lists, and use formulas in lists, see Appendix A, B, and C, respectively. Sample screen shots are shown below.



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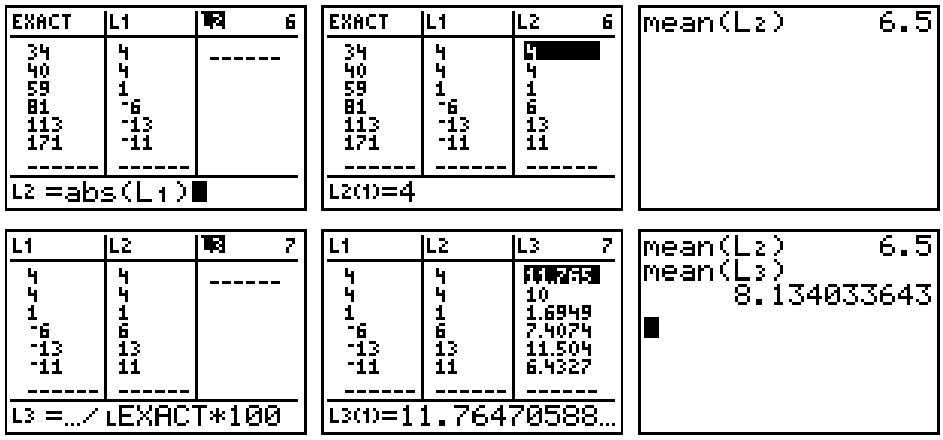
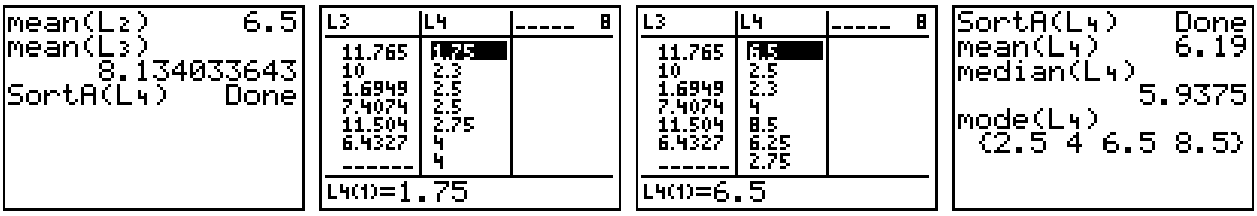


2. This part of the activity will involve the whole class and will be directed by you. Go around the class and have the students tell you their "average off." Enter the data in **L4** on a calculator with a ViewScreen display, and have the students enter these numbers in **L4** on their calculators. The rest of number 2 can be directed by you, or the students may work in groups. Sample screen shots are shown below. A prize may be given to the student who did the best job estimating if they can verify their estimates. In the second screenshot below, 1.75 was the best estimator.



3. For more information about setting up statistical plots see Appendix D. If the students are experienced in setting up plots and are familiar with box-and-whisker plots, they may work through this part of the activity with their group. Otherwise, you may lead them through this part of the activity.

4. If the students are experienced in setting up scatterplots, they may work through this part of the activity with their group. If you lead them through you will need to use a student's data as a sample.

5. You may choose whether to lead them through the manual fit and analysis of data or not depending on your students level and calculator experience. Have the groups with the highest and lowest "number of candies off" display their scatterplots so they can be compared. The lists could be sent to a calculator and displayed on a ViewScreen. (See Appendix E for more information on linking.) One of the lists named **Guess** would have to be renamed so both groups' **Guess** lists could be used. In the [Y=] editor, graph the equation **Y=X** and in plot 1 display the "worst" estimators scatterplot and in plot 2 display the "best" estimators scatterplot. Use a different mark in plot 2.

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Answers to Student Worksheet

1. Find the difference in the number you guessed and the exact number
2. You would just look at the positive values. Add 5 and 9 and then divide by 2.
3. Answers will vary. Add the numbers in **L2** and divide by the number of numbers.
4. Answers will vary. (On average, my guess was ___ percent too high or too low.)
5. Answers will vary but should be the same for the entire class. Make sure the data is in ascending order
6. Answers will vary, but should be the same for the entire class.
7. Answers will vary. See **box plot** in vocabulary for a description.
8. Answers will vary. The better the estimates, the more linear the scatterplot will be.
9. **Y=X**. Answers will vary.
10. Answers will vary. The closer the points are to the line, the better the guess.
11. Answers will vary. These points will be scattered more and not as linear.

Going Further

You can make a variation of this activity by estimating ages of famous or well-known people, investigating the relationship between a guess and the person's actual age. To do this, simply make up a list of 10 to 20 people of various ages and find out their actual ages. Good sources are newspapers, magazines, or the Internet. This is a fun and interesting activity to do with parents and children on Family Math Nights.

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