Chapter 6

Data Analysis

In this chapter

This chapter summarizes NCTM's ***Principles and Standards for School Mathematics*** *for data analysis and applies those principles in some activity overviews. You will learn how to:*

- *Design data investigations, describe data, and draw conclusions.*
- *Choose the best type of graph, graph and interpret the data, and look for patterns and trends.*
- *Use the calculator to investigate and communicate results.*

Overview of data analysis

The NCTM Principles and Standards for School Mathematics (NCTM, 2000) propose an increased curricular emphasis on data analysis. The document recommends that data analysis span the grades rather than be reserved for the middle grades and secondary school, as is common in many countries. The Data Analysis and Probability Standard states that "Students should learn how to collect data, organize their own or others' data, and display the data in graphs and charts that will be useful in answering their questions" (p. 48).

Goals for students

The Data Analysis and Probability Standard states:

> Instructional programs from pre-kindergarten through grade 12 should enable all students to--
>
> - formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;
> - select and use appropriate statistical methods to analyze data;
> - develop and evaluate inferences and predictions that are based on data;
> - understand and apply basic concepts of probability. (p. 48)

When students work directly with data, they can connect mathematics with other school subjects and with experiences in their daily lives. Ideas and procedures from the number, algebra, measurement, and geometry content strands can be connected while collecting and analyzing data.

Through the process of reasoning about data analysis and statistics, students should come to realize that “solutions to some problems depend on assumptions and have some degree of uncertainty” (p. 48).

Activities involving analysis and probability should build upon the natural curiosity of children. Such activities should allow children to generate investigations that are based upon their own interests and daily experiences. In the elementary grades, this can begin with simple data-gathering plans and move to more time spent on “planning the data collection and evaluating how well their methods worked in getting information about their questions” (p. 49). In prekindergarten through grade 2, the primary focus should be developing the fundamental idea that data can be organized and ordered so that the information can be more readily used to answer the questions that were posed. In grades 3 - 5, students should develop skill in representing their data, often using bar graphs, tables or line plots. They should learn what different numbers, symbols, and points mean. Recognizing that some numbers represent the frequency with which those values occur is a big step. As students begin to understand ways of representing data, they will be ready to compare two or more data sets (p. 49). Beginning in grades 3 - 5 and continuing in the middle grades, the emphasis should shift from analyzing and describing one set of data to comparing two or more sets (p. 50).

With the use of technology such as the TI-73 graphing calculator, students can reorder data and represent the data with various types of graphs so they can focus on analyzing the data and understanding what the data mean.

Goals for teachers

In order for teachers to provide the curriculum the NCTM Principles and Standards recommends, the CBMS states:

> Teachers need to develop skill in the design and conduct of data investigations: to pose questions that can be addressed by data; design data collection procedures; collect and analyze those data; consider whether their initial questions have, indeed, been addressed; or, if necessary, revise both questions and data collection procedures and analyze the new data; and, finally, draw conclusions and communicate findings (CBMS, 23).

The use of calculators can be very valuable in the study of some of the specific content for teachers in the area of statistics that are summarized in the CBMS document, such as:

- Designing data investigations: understanding the kinds of question that can be addressed by data, creating data sets, moving back and forth between the question (the purpose of the study) and its design.
- Describing data: understanding shape, spread, and center; using different forms of representation; comparing two sets of data.
- Drawing conclusions: choosing among representations and summary statistics to communicate conclusions, understanding variability,

understanding some of the difficulties that arise in sampling and inference (CBMS, 23).

By designing data projects that extend over several class periods or even weeks, preservice teachers can ask questions that can be answered, at least in part, through data collection and analysis. At the same time students can grapple with any difficulties with the data collection procedures such as incomplete data sets, inaccuracies in measurements, or data that do not fit predetermined categories. When examining a set of numerical data, questions should be asked about how the data are spread and what is typical in the set. It is important to explore the same data sets with multiple representations to consider how different views communicate various aspects of the data for interpretation and analysis. A graphing calculator such as the TI-73 can explore different representations of data such as lists, tables, and graphs.

Sample Activities

The following activities focus on posing and clarifying questions, estimation and measurement to collect data, tabulating and finding descriptive data for the data set, choosing the best type of graph, graphing and interpreting the data, and looking for patterns and trends while using calculators to investigate and communicate results. Each of the four data collection activities that are described in this section are adapted from the activities **Break Your Own Record**, **The 30 Second Walk, Estimating Lengths,** and **The Phone Book Game** from *Chance and Data Investigations* by Charles Lovitt and Ian Lowe (1993). These activities serve as models for similar situations where students use calculators and their personal performance data to create and interpret graphs. In these activities, students determine if there has been an improvement in their performance by engaging in various tasks from which measurements can be taken.

Activity 1: Can You Improve Your Record?

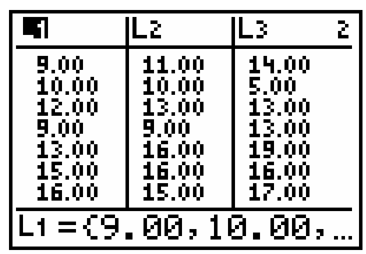
Because elementary school students regularly engage in physical activities, they have an opportunity to gather data on how practice affects performance by recording counts or measurements. Students choose their own physical task such as bouncing a ball, jumping over a skipping rope, dropping a coin onto a target, snapping fingers for a given time segment, or other similar types of activities that can be counted and recorded to measure performance. Data should be gathered over a period of 5 days with 7 trials each day. Working with a partner for recording purposes, each day students tabulate and analyze their performance scores, look for patterns or improvement, and graph the results using paper and pencil and the calculator.

Younger students can find their lowest and highest scores and use a calculator to find the range and their total score each day. The most common score or mode should also be easily identifiable. With seven trials, the median or middle score can be located when all the scores are put into ascending or descending order.

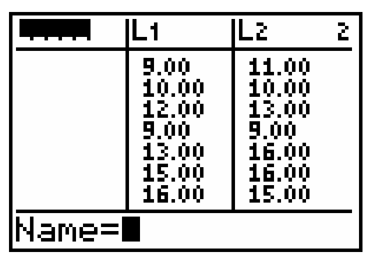
After data has been collected and recorded, it can be entered into lists on the TI-73. It would be advisable to use the overhead view screen so students and the teacher can enter the data together. Since the TI-73 allows you to enter 20 lists in the List editor, the scores from the seven trials from each of the five days can be easily entered. The example that follows represents sample data for the number of times a student might jump rope without faltering. The example uses seven trials over a five-day period.

To list trial scores for each of five days, insert a list in front of **L_1** and name it **TRIAL**.

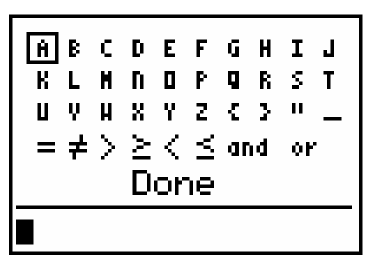
1. Press [LIST] to display the List editor. Position the cursor on the heading **L_1**.



2. Press [2nd] [INS].

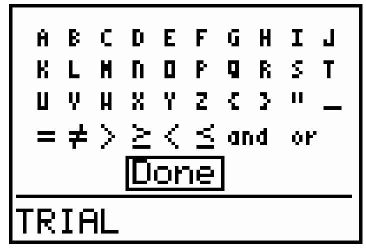


3. Press [2nd] [TEXT] to display the Text editor.

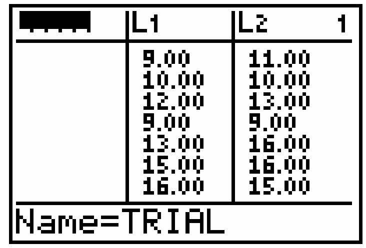


4. Press [◄] and [►] to select **T**, and then press [ENTER].

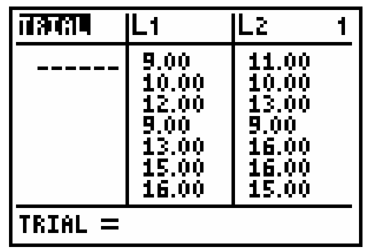
5. Continue selecting the letters in **TRIAL**. When you are finished, select **Done**, and then press [ENTER].



6. The List editor is displayed with a new, blank column.

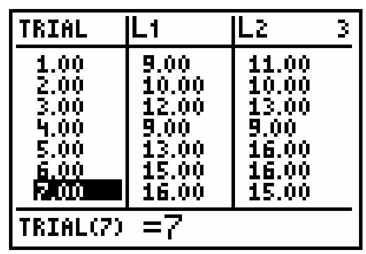


7. Press [ENTER] to confirm **TRIAL** as the name of your new list.



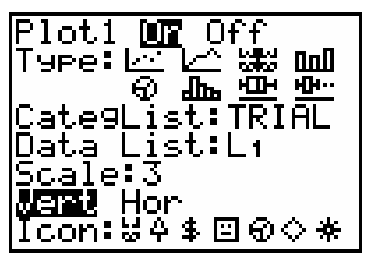
8. Enter **1** through **7** in this list to serve as the number of trials.

List **TRIAL** will serve as the categorical list.



Graph the trials for each of the five days.

1. Press [2nd] [PLOT].
2. Press [ENTER] to select **1:Plot1**.
3. Press [▶] to select **On**, and then press [ENTER]. Set your TI-73 as shown at the right, and described below.



   a. Press [▼] to select **Type.** To set the plot **Type**, press [▶] [▶] to highlight (pictograph), and then press [ENTER].

   b. Press [▼] to select **CategList**. To set **CategList**, press [2nd] [STAT]. Press [▼] to highlight **TRIAL**, and then press [ENTER].

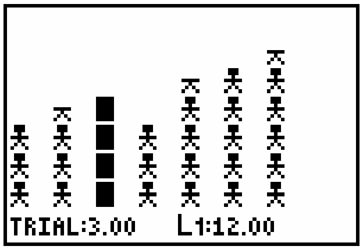
   c. Follow the same procedure to set **L1** for **Data List**.

   d. Press [▼] to select **Scale.** Press **3** to allocate each icon to represent 3 bounces.

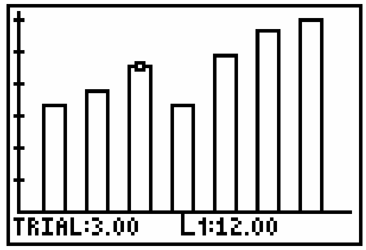
4. Press [GRAPH] to display the graph.

A pictograph and bar graph (shown below) provide visualizations for the changes in the seven trials as shown for day one, which is recorded in **L1**. In the pictograph, each person represents 3 bounces, as set in the **Scale** above.

Pressing [TRACE] allows you to follow the data on the screen as 12 bounces are highlighted for the third trial on day one (or **L1**) below. As various representations of the data are created through graphs and lists, it is very important to discuss observations and interpretations of the data.

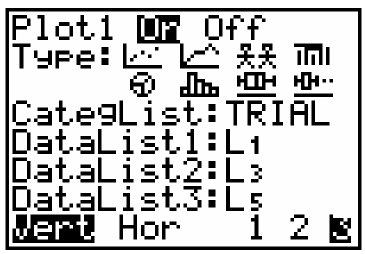


Pictograph

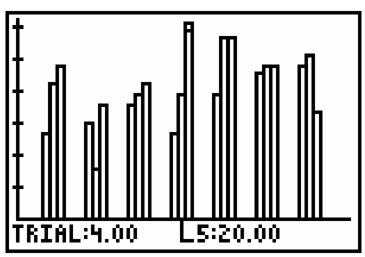


Bar Graph

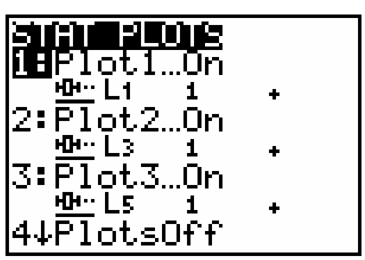
By using a triple bar graph, comparisons can be made over a three-day period such as Day 1, Day 3 and Day 5.



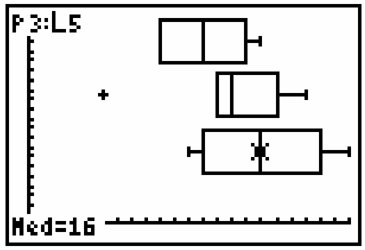
Using [TRACE] allows the data to be explored from a visual representation. The graph below shows **TRIAL** 4 of Day 5 with 20 bounces.



Another graph to use for analyzing and interpreting data is the Box plot. The TI-73 displays three Box plots on the screen at one time if Plot 1, 2, and 3 are turned on simultaneously.

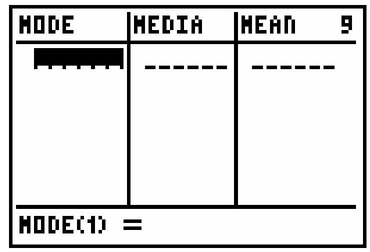


Days 1, 3, and 5 are chosen for graphing Box plots in the graph below.



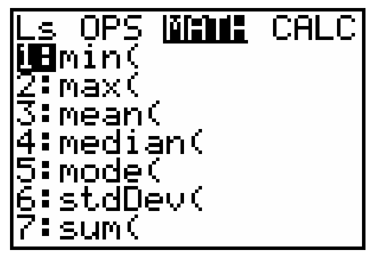
By examining the Box plots, you can gain information about the distribution of the data, where clusters occur, note outliers as in Day 3, and identify the maximum, minimum, and median, along with the first and third quartiles.

1. New lists can be named using the Text editor for the total, range, median, and mean scores from each day to enter measures of central tendency.



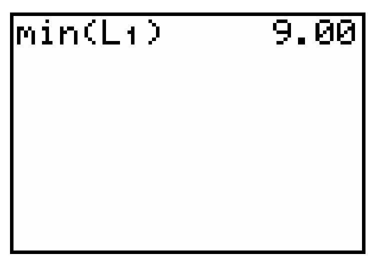
2. To find the measures of central tendency, press [2nd] [STAT]. Press [▶] [▶] to highlight **MATH**.

   a. To find the minimum of **L1**, select **1:min(** and press [ENTER].



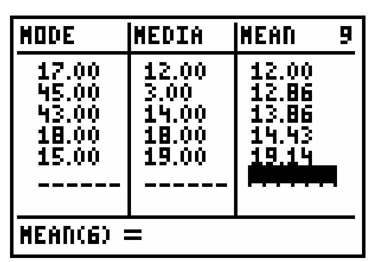
   b. Press [2nd] [STAT]. Highlight **1:L1** and then press [ENTER].

   c. Press [)] [ENTER] to display the minimum of **L1**.

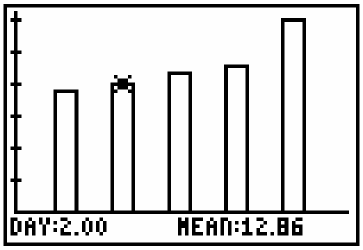


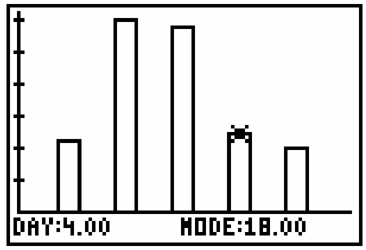
3. Repeat these steps to find the other values in the MATH menu, such as the sum, median, and mean. The **min(** can be subtracted from the **max(** to find the range.

4. Enter each of these values in the new lists you made above.



Choose features of your data to plot over the five-day period. Interesting and unusual aspects of the data are more evident as multiple representations are used in a variety of ways to view and explore the data.





Answer questions 1 - 11 as a *learner* of mathematics.

1. What trends did you see in the data you collected on your performance? Did any patterns emerge?

2. Can you make any conclusions from analyzing the data and graphs of each day's seven trials? What did the different graphs tell you about the data? Which graphs were most helpful in analyzing this data?

3. In what ways do the mode, median, mean and range help you interpret the data?

4. What conclusions can you draw from looking at the data and graphs for all five days?

5. Were there any unusual aspects of the data that stood out as you examined the graphs that you produced?

6. How did you use mathematics and the calculator to help you understand your performance on the task you selected?

7. In what ways did you use the calculator to compare the seven trials over a five-day period?

8. What predictions might you make about your performance on a sixth day by looking at your numerical scores and from examining your graphs? Choose one aspect of your results to predict for Day 6. What type of score is easiest to predict?

9. How accurate do you think your prediction will be? What variables might affect your results?

10. Without engineering your results, how close was your prediction?

11. Write a story about the investigation that was conducted emphasizing the mathematical ideas that you learned and used.

Answer questions 12 - 17 as a *teacher* of mathematics.

12. Did you have the students graph their data with paper and pencil as well as the calculator? How did each method benefit the students' understanding, interpretation and analysis of their data?

13. What did you find most useful about using the TI-73 in this activity?

14. In what ways did using the TI-73 encourage students to use mathematics vocabulary?

15. What aspects of the data did the students use to make predictions for the sixth day? What reasons did they give for their choices?

16. What were you able to learn about the students' understanding of data analysis from the stories they wrote about this investigation?

17. Discuss the ways the graphing capabilities of the TI-73 allowed students to explore and examine various aspects of their data and to make more accurate predictions of their performance.

Two other examples of performance activities follow in which students gather data and use the functions of the TI-73 to help with their analysis.

Answers and Comments

In this activity, students can see how they progress by recording counts or measurements. Through the use of graphs and the graphing capabilities of the TI-73, students can visualize the changes from day to day and interpret what has occurred while making predictions about the future. They can then test these predictions and make comparisons.

Questions **1 – 5**

As students examine data trends, look for patterns, and make conclusions, there will likely be some debates because results can be interpreted in so many ways. Some students will focus on the highest score to determine improvement while others will determine improvement by looking at the mean score. Discussions about using the mode, median, mean, and range to show distribution of the data should help students examine the value of these measures of central distribution. By using the **TRACE** feature of the TI-73, students can examine the data visually while having numerical values displayed as well. This feature will be especially valuable when displaying data with Box plots and examining unusual aspects of the data.

Questions **6 & 7**

It is important to discuss in what ways the TI-73 can be used to examine data both numerically and visually to interpret data and draw conclusions. Pictographs, bar graphs, triple bar graphs, and box plots provide multiple representations of the data.

Questions **8 – 10**

When making predictions, emphasize that they are not certainties, but they are closer than guesses. The concept of using previous results to predict your next result is difficult for students and they will often just pull numbers out of the air. Carefully observe what strategies students used to make their predictions. Encourage students to look closely at the data in the tables and the graphs they made to help them make the predictions. There will likely be discussions that center around the role of fatigue, improvement in skills and concentration affecting the results, and the accuracy of their predictions.

Question **11**

Asking students to put into their own words what they have learned is an excellent way to summarize an activity such as this. It is important to stress what mathematics was used to help understand what occurred as the trials were continued.

Question **12**

It is important for students to gain experience in representing their data in various forms. They should use paper and pencil to record their trials in table form prior to entering the data into lists on the TI-73. In this way, the students can double-check the lists in the List editor with their paper and pencil tables for accuracy. Students should graph a pictograph and some of the simple bar graphs with paper and pencil to help them see the distribution and trends of their data over five days for the seven trials. This will also give them additional practice with making bar graphs with appropriate scales and labels. The triple bar graphs and the box plots are more efficiently and effective produced, interpreted, and analyzed using the calculator. By using the [TRACE] feature on the TI-73, students can explore and examine aspects of the data not easily accomplished using only paper and pencil.

Question **13**

Probably the most useful aspect of using the TI-73 in this activity is for multiple representations of the data. Students should be able to explore the data in various graphical forms as well as examine the distribution of the data through bar graphs, box plots, and measure of central tendency.

Question **14**

As students use the List editor and plot feature of the TI-73, they will need to use mathematically correct vocabulary such as category list, scale, horizontal, vertical, pictograph, bar graph, box plot, mean, median, and mode. In discussing what features of the calculator they are using for interpretation and analysis of the data, students will become more comfortable with using mathematics vocabulary.

Questions **15 - 16**

Although various groups will choose different aspects of the data to make predictions for the sixth day, it is essential that they give their reasons for the choices they made. This will allow you, as the teacher, to assess the depth of their understanding. The stories the students write about this investigation will provide another excellent alternative method for assessing students' understanding of data analysis.

Question **17**

Each group of students you work with will provide you with additional information as to how students interacted with the TI-73 as they explored and examined the various aspects of their data. As you work with different groups of students, note how the accuracy of the predictions of their performance differs. How closely are the accuracy of predictions related to the amount and depth of exploration and examination students engaged in throughout the activity?

Activity 2: The Timed Walk

This activity should provide some informal discussion of speed, distance, and time as the students physically experience the relationships. Students will be developing conceptual understanding of measurement concepts of speed, distance, and time while using statistics to monitor the event.

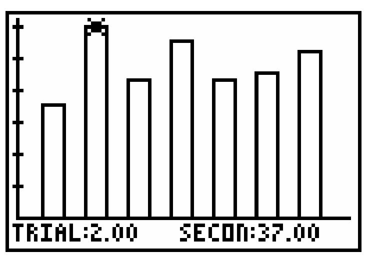
This activity would be conducted best outside, in a gymnasium, or in a room where students can walk between 25 to 60 meters without any obstacles in the path. Mark off a 40-meter long path to an object. Ask students if they can walk there and back in exactly 30 seconds. Let the students each have five attempts to try to accomplish this, as they record the time it took as well as the time greater or less than the goal of 30 seconds. One condition is that as soon as the first step is taken, students should not speed up or slow down.

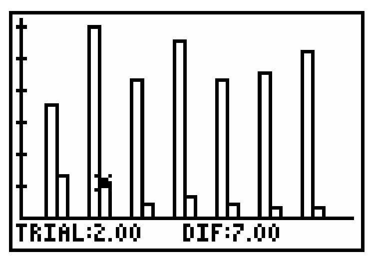
Have students work in groups to decide how to conduct their measurements, record the data, and share tasks within the group. It is important that all students understand that this is not a race, especially if the concepts of time and distance have never been explored or discussed previously, even at an intuitive level. This is an excellent activity to develop the conceptual understanding of measurement concepts of speed, distance, and time while using data analysis to monitor performance. By using the list and plot functions of the TI-73, students can represent their results to show any improvements in estimating their speed.

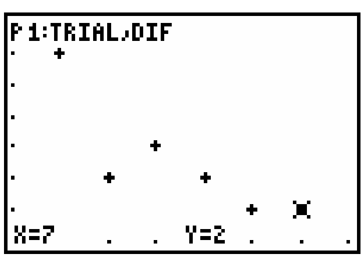
The plots below show some possible results for the number of seconds of each trial (**SECON**) and the difference of each trial from the goal of 30 seconds (**DIF**). Plotting these each separately and then graphing them together on one graph helps in interpreting the data. The *x*-axis represents seven trials, and the *y*-axis shows the number of seconds.

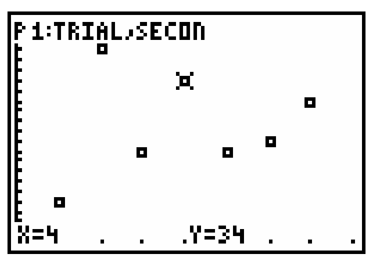
TRIAL	SECON	DIF 1
1.00	22.00	8.00
2.00	37.00	7.00
3.00	27.00	3.00
4.00	34.00	4.00
5.00	27.00	3.00
6.00	28.00	2.00
7.00	32.00	2.00

TRIAL(1)=1









Answer questions 1 - 8 as a *learner* of mathematics.

1. What information does each plot provide?
2. What does the difference plot tell us about the speed of the walker?

3. Are we able to tell whether the walker was increasing or decreasing speed from the difference plot? Explain.

4. How can the information in the list help with the interpretation?

5. On which trial did the walker walk the fastest? How can you tell?

6. Does shorter time mean going faster or slower?

7. How was using the calculator as a tool for interpreting and analyzing this data more effective than using only paper and pencil?

8. The data and graphs tell what story? Be sure to use mathematical ideas and vocabulary as you explain what you have done.

Answer questions 9 - 14 as a *teacher* of mathematics.

9. What relationships were students able to see among speed, distance, and time?

10. How did students approach changing their speed when their time was too low or too high?

11. What kinds of graphs did students make to visually display their results?

12. What mathematical vocabulary were students able to use when discussing their results and graphs?

13. In what ways did the graphing capabilities of the TI-73 help students explain their results?

14. What accommodations were you able to make for students who saw this as a race or were not able to see that a shorter time means going faster?

Answers and comments

Question **1**

Plotting the number of seconds tells the time it took to walk the distance. Plotting the difference between the 30-second goal and the actual time the student took to walk tells how far away the walker is from the goal. It would be better for each point to be plotted immediately after each trial so the meaning of the graph emerges during the course of the trials. This strategy makes collecting data more vivid and the meaning of the graphs evident for your students.

Questions **2 - 5**

The difference plot is useful for showing how close to the goal the walker is getting; however, it is not helpful to know whether the speed is increasing or decreasing. Referring to the information in the list and the graphs will be more valuable.

Question **6**

It may take some students longer to recognize that the shorter the time, the faster they are going.

Question **7**

It should be evident throughout this activity that the calculator is a valuable and essential tool for comparing and interpreting data.

Question **8**

Asking students to write a story opens up possibilities for creative expression and a means for understanding student thinking.

Questions **9 – 10**

Students may vary considerable in the relationships they see among speed, distance, and time according to their prior experiences with these concepts. Since conceptual understanding develops over a period of time, this activity will add to their understanding of speed, distance, and time although they will likely need many additional experiences to have a solid understanding. Observing if students are able to adjust their speed to affect the desired change in time will give you information as to their understanding of the relationships among speed, distance, and time.

Question **11**

As students conduct the activity, it is important that they have a plan for recording their data. Although they could enter their data directly into the List editor, it would be advisable to have them record in a table with paper and pencil initially. To help students build an understanding of the relationships among speed, distance, and time, it would also be useful to plot points or form bars on a paper and pencil graph immediately after each trial. This experience along with the dynamical display of the data in multiple graphs on the TI-73 should provide a meaningful visual representation of the relationships among speed, distance, and time.

Questions 12 – 13

Students need to use mathematically correct vocabulary as they enter the data into the List editor and then choose an appropriate graph for displaying the data. The use of mathematical vocabulary when working with the TI-73 should carry over into discussions of the results and interpretations of the graphs produced, both with paper and pencil and on the calculator. The graphing capabilities of the calculator will allow students to use several graphical representations of their data to explain the results as well as use the [TRACE] feature to emphasize certain points in the graphs.

Question **14**

This activity takes some creative grouping of students if the concepts of speed, distance and time have never been previously discussed and explored. If there are students who continue to view this as a race or are not able to recognize that the faster they go, the shorter the time will be, you may want to pair them with student mentors who can help them pace their steps more appropriately.

Activity 3: How Many Pages?

Using a large book with several hundreds of pages, pick a number and have students open the book as close as they can to the page corresponding to the number chosen. Students can play in pairs where one player creates a challenge for the other. Each player records the page number, their guess and their error, or number of pages they are away from the given number. After seven games, have students analyze their data to answer two main questions: 1) Are you improving? and 2) How do the results support this?

Answer questions 1 - 5 as a *learner* of mathematics.

1. What picture can you describe from the results, either in the table or from graphs?

2. Are you improving? Using your statistics and graphs, justify any claim you make about whether you are improving or not.

3. Do you make more mistakes when the number given is larger? How does your data support your answer?

4. What trends do you notice?

5. Using your results, can you predict what improvement you will make in the next five games? Enter your predictions into a list on the TI-73 prior to playing the second set of games. Then use double bar graphs to make comparisons between your prediction and your collected data.

Repeat this activity several days later to see if improvement is maintained over time.

Answer questions 6 - 9 as a *learner* of mathematics.

6. How did students proceed to answer the two questions?

7. What statistics or graphs did students use to justify their responses? Did they use primarily visual representations or did they use the average error in explaining what improvement was or was not made?

8. What did you observe from students' predictions for five more games? Were they more confident discussing their results?

9. Did students use the vocabulary of data analysis in describing their picture of the results?

Answers and comments

Even though the main questions of "Are you improving?" and "How do the results support this?" are posed, there are likely to be many different questions that arise from this activity.

Questions **1 & 2**

Encourage students to use tables from which they enter their information into the calculator to graph the data. It is important that students use the statistics and graphs when justifying their claims.

Question **3**

Certainly the size of the book and the number used will lend themselves to debate.

Questions **4 & 5**

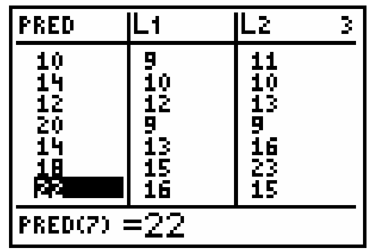
Students should have experiences recognizing trends in data to help them make predictions. This is an activity in which their predictions can be easily tested.

To make a double bar graph on the TI-73, follow the steps below.

1. In the List editor, insert a new list and name it **PRED** for your predictions.

__Note:__ (See page 66 for instructions on inserting and naming new lists.)

2. Enter your predictions in list **PRED** for the next seven trials. After you perform each trial, enter the page difference between the prediction and the actual trial for the first game in **L1**, and the difference for the second game in **L2**.



3. Press [2nd] [PLOT].

4. Press [ENTER] to select **1:Plot1**.

5. Press [▶] to select **On**, and then press [ENTER]. Set your TI-73 as shown at the right, and described below.

a. Press [▼] to select **Type.** To set the plot **Type**, press [▶] [▶] to highlight (bar graph), and then press [ENTER].

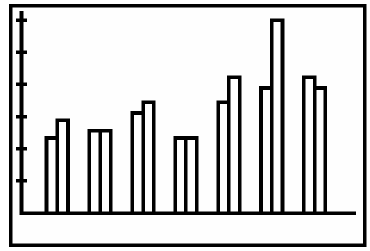
b. Press [▼] to select **CategList**. Press [2nd] [STAT]. Press [▼] to highlight **PRED**, and then press [ENTER].

c. Follow the same procedure to set **L1** for **DataList1**, and **L2** for **DataList2**. **DataList3** can be left at the default value.

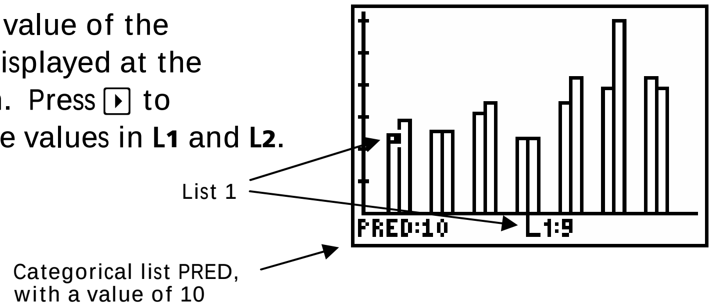
d. Press [▼] to highlight **Vert**, and then press [ENTER].

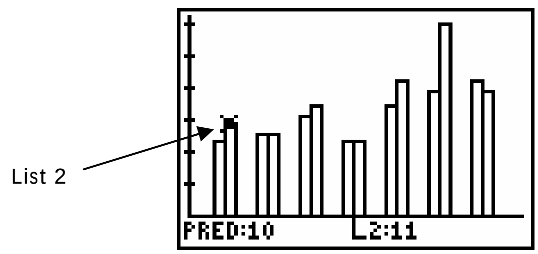
e. Press [▶] [▶] to highlight **2**, and then press [ENTER].

6. Press [GRAPH] to display the graph.



7. Press [TRACE]. Observe the value of the categorical list, **PRED**, is displayed at the bottom left of the screen. Press [▸] to compare that value to the values in **L1** and **L2**.





Questions **6 – 7**

Students will vary in their approaches for answering the two questions: 1) Are you improving? and 2) How do the results support this? However, they should be reminded that they must use the statistics and graphs generated from their games to support their answers to the questions. Much can be learned about an individual student's learning style through observations of his or her use of statistics and graphs. Visual learners may primarily rely on visual representations to support their answers while more analytical learners may refer to numerical statistical values in their explanations. Students should be encouraged to incorporate both methods to justify their responses.

Questions **8 – 9**

Hopefully, students will become more confident discussing results and using the vocabulary of data analysis as they gain more experience working with the data and using the data analysis features of the TI-73. This activity is just one example of posing interesting questions that engage students in data collection and analysis. Students should be encouraged to generate other questions of their interest that could lead to collection of data, using graphs to interpret the data, and analyzing the results to answer the questions that were posed.

Using calculators to assess data analysis

The calculator is equipped to handle data in ways that students using paper and pencil graphing cannot do efficiently. Assessment will usually involve a performance task to find out if students can collect, organize, graph, and interpret data in appropriate ways. The performance task below includes all these elements and can be done relatively easily by students individually. It also provides an opportunity to make predictions and then test them.

Assessment 1: Snap Your Fingers

*Adapted from **Exploring Statistics in the Elementary Grades Book Two** by C. Bereska, C.H. Bolster, L.C. Bolster and Dr. R. Scheaffter © 1999 by Dale Seymour Publications. Used by permission of Pearson Education, Inc.*

A student snapped her fingers for 30 seconds, rested for 5 seconds, and then snapped again for 30 seconds. She did this every day for a week, and the following data were generated:

First Set of Snaps	Second Set of Snaps
66	64
73	62
70	55
73	58
78	62
68	45
64	72

1. In what ways can you organize and graphically display the data to help you interpret it?
2. What conclusions can you draw from examining the data?
3. What mathematical terms can you use to summarize the sets of data? Write a summary statement using mathematical terms.
4. What factors could affect the number of times the student was able to snap her fingers during each 30-second period?
5. Make a prediction as to how many times *you* can snap your fingers for 60 seconds with a 5-second rest period after 30 seconds.
6. Add to the data sets by snapping your fingers for 60 seconds with a 5-second rest period after 30 seconds.
7. Graph the new data sets and compare your results.

Answers and comments

Question **1**

Double stem-and-leaf plots could be used to organize the data. Box plots would be a good way to examine the distribution of the two sets of data. Students may use double bar graphs for a visual representation of the data points.

Question **2**

Students should compare the medians and modes in the two sets of data and see the change and shifting in the two sets of data.

Question **3**

Summary statements should include ideas of range, cluster, gaps, outliers, and medians.

Question **4**

Fatigue may set in after the first 30 seconds; therefore, the numbers for the first set of snaps will likely be higher than the numbers for the second set.

Questions **5 - 7**

This is another activity in which students are close to the physical data so making predictions should be something they engage in readily with some accuracy in their prediction. It is important that they follow-up their predictions with collecting new data and making comparisons.

Activity overviews for K-6: data analysis

The following list contains brief descriptions of elementary school activities that incorporate the use of the calculator as a recording or exploring device for developing understanding of geometry and measurement. The activities can be found on the CD that accompanies this text.

A Foot is a Foot – Or Is It? (Curry, Brenda, ed. "Which Brand is Best?," *Using the TI-73: A Guide for Teachers*, Texas Instruments, 1998.)

Because measurement is an area of mathematics that still stirs controversy in the U.S. about whether and when to teach the metric system, students should be engaged in activities from which measurement concepts can be meaningfully constructed. In this activity students work with the customary measurement of a foot (12 inches) to investigate how their own foot measurements compare. They will conduct a survey to find the measurement of the average human foot and will also convert fractions to decimals.

An Average Lunch? (Schielack, Jane F. and Chancellor, Dinah, "An Average Lunch," *Uncovering Mathematics with Manipulatives and Calculators Levels 2 & 3,* Texas Instruments, 1995.)

Students are introduced to the Wayside School in *Sideways Stories from Wayside School* by Louis Sachar. They are told that it does not matter how much a lunch costs at Wayside School, just as long as the average price per lunch sold is $1.85 each day. Calculators are used as a tool to investigate ways to create data sets that give deeper meaning for *average*.

A Tall Story (Johnston, Ellen C. and Young, David A. "A Tall Story," *Data Collection Activities for the Middle Grades with the TI-73, CBL, and CBR*, Texas Instruments, 1998.)

In the course of the activity, students use a CBR to gather measurements of heights, which are used in the analysis of growth rates. Students will measure data, convert units, examine data statistically, graph data, and produce mathematical models that reflect patterns in the data.

Come Fly With Me (Mankus, Margo Lynn and Klespis, Mark, eds., *Come Fly With Me, Data Analysis, Math Teacher Educator Short Course for College Professors Teaching Pre-service Teachers with an Elementary School Focus*, Technology Short Course Program, 1999.)

In this activity students create and fly paper airplanes to generate, organize, analyze and interpret data. Working with one-variable data of distanced traveled, students use stem-and-leaf-plots and box-and-whisker plots to understand statistical ideas of the center and spread of a set of data. By examining a second variable such as the weight of the plane, scatter plots are used to examine independent and dependent variables. The TI-73 graphing capabilities, including the manual line of best fit, provide for a rich mathematical experience in data analysis.

Gemini Candy (Nast, Melissa, ed., "Gemini Candy," *Discovering Mathematics with the TI-73: Activities for Grades 5 and 6*, Texas Instruments, 1998.)

Students will design an experiment to collect data and draw conclusions from random samples simulated by drawing tiles from a bag. This activity will allow students to compare data using fractions, decimals and percents. The data will be interpreted through graphical representation using triple bar graphs on the TI-73.

Making Money (Nast, Melissa, ed., "Making Money," *Discovering Mathematics with the TI-73: Activities for Grades 5 and 6*, Texas Instruments, 1998.)

Students are presented with real-world data from a concession stand showing workers' hours and productivity. They will decide which vendors to rehire by choosing appropriate methods to analyze the data, providing summary statistics, writing a report, and making a presentation to support their findings.

Taste Test (Johnston, Ellen C., ed., "Taste Test," *Discovering Mathematics with the TI-73: Activities for Grades 7 and 8*, Texas Instruments, 1998.)

Students use a sample to make a decision and then use this sample and data analysis to make a convincing recommendation about the best brand of soft drink to buy. They use the TI-73 to create pictographs, bar graphs, and pie graphs to represent their data.

Which Brand is Best? (Curry, Brenda, ed., "Which Brand is Best?," *Using the TI-73: A Guide for Teachers*, Texas Instruments, 1998.)

In this real-world activity, students comparison shop and produce consumer reports to share their findings. With the help of the TI-73, the students' reports show the measures of central tendency (mean, median, mode) and the various graphs (Box plot, Pictograph, Bar graph, and Pie chart).

Why Aren't There More Reds in my Bag? (Nast, Melissa, ed., "Why Aren't There More Reds in My Bag?," *Discovering Mathematics with the TI-73: Activities for Grades 5 and 6*, Texas Instruments, 1998.)

M&M's® are used to engage students in making predictions, gathering data, finding ratios, creating circle graphs, and understanding sample size. Students make a circle graph by arranging like colors of M&M's® in a circle, with their sides touching. Then they draw a line from the center to the point where the color changes on the circle. Data is also entered into the TI-73 calculator on which a circle graph is plotted and compared to the M&M's® graph.