EXPLORATIONS

Activity 9

You're Probably Right, It's Wrong

Objectives

- To use technology to find experimental and theoretical probabilities
- To use technology to find measures of central tendencies
- To use technology to explore simulation
- To use technology to generate random numbers
- To use technology to plot a histogram
- To use technology to plot a pie chart
- To use technology to plot a pictograph
- To use technology to plot a bar graph

Materials

- TI-73 graphing device

Introduction

Nathan had a choice between studying for a mathematics test and going to the movies with a friend. He knew going to the movies was the wrong choice, but he decided to go anyway. When the math test was handed out the next day, he knew he should have studied. After seeing the test, it was clear that he was not prepared to take it. Nathan was somewhat relieved when he saw that the test had 20 multiple-choice questions. He knew that if he guessed the answers, he would have a 25% chance of getting the correct answer for each question, since each question had four choices. Nathan remembered that his TI-73 had a random number generator. He used this feature to help him guess the answers on the test. Nathan is now nervous about the results of the math test. If he fails this test, he will be grounded for a month. Nathan thinks that he did not pass the test. Is he right?

You will find the *experimental probability* to determine the likelihood that Nathan has passed this test. You will perform a *simulation* to determine the experimental probability. *Probability* is a number between 0 and 1 that measures the likelihood that an event will or will not occur. If the probability is *0*, then the probability that the event will occur is impossible. If the probability is *1*, then the probability that the event will occur is certain. *Experimental probability* is determined by performing experiments and observing outcomes to determine what might happen in a given situation. A *simulation* is a method for finding experimental probability using a device to model the event.

You will also find the *theoretical probability* of Nathan passing the test. If *P(E)* represents the probability of the event occurring, *m* represents successful outcomes, and *n* represents possible equally likely outcomes (both successful and unsuccessful), then

$P(E) = \frac{m}{n}$ is the *theoretical probability* of the event occurring.

Problem

Was Nathan's idea of generating random numbers to answer the questions on the test a good idea? Should Nathan prepare to clean his room since he might be spending a good deal of time in there?

Collecting the data – Part I

Use the TI-73's random number generator to perform a simulation to guess answers on the test. The choices of answers are ***A***, ***B***, ***C***, or ***D***. An ***A*** will be represented by a **1**, a ***B*** by a **2**, a ***C*** by a **3**, and a ***D*** by a **4**. The correct answers for the test are listed below along with the corresponding number for the letter.

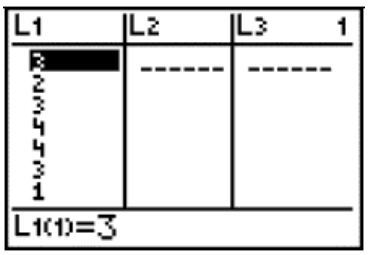
1.	C – 3	**6.**	C – 3	**11.**	B – 2	**16.**	C – 3
2.	B – 2	**7.**	A – 1	**12.**	A – 1	**17.**	D – 4
3.	C – 3	**8.**	B – 2	**13.**	A – 1	**18.**	D – 4
4.	D – 4	**9.**	D – 4	**14.**	D – 4	**19.**	C – 3
5.	D – 4	**10.**	C – 3	**15.**	D – 4	**20.**	A – 1

Setting up the TI-73

Before starting your data collection, make sure that the TI-73 has the STAT PLOTS turned OFF, Y= functions turned OFF or cleared, the MODE and FORMAT set to their defaults, and the lists cleared. See the Appendix for a detailed description of the general setup steps.

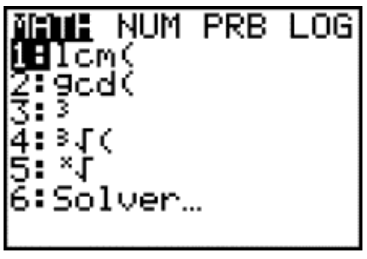
Entering the data in the TI-73

1. Press [LIST] and enter the data for the answers to the test in **L1.** When finished, press [2nd] [QUIT] to exit the list editor.

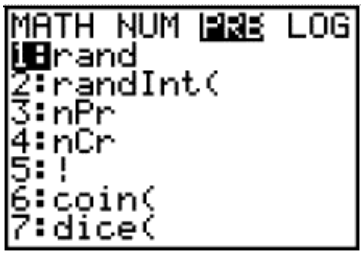


The following steps will generate a list of random numbers between 1 and 4 and store them in **L2**.

2. Press [MATH].

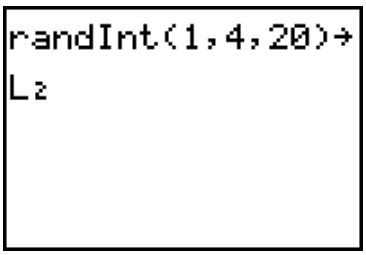


3. Press ▶ ▶ to move the cursor to the **PRB** menu.

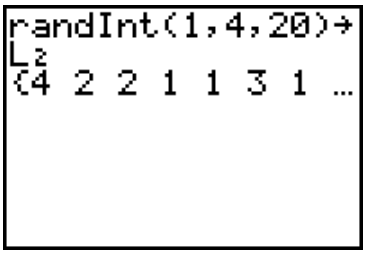


4. Select **2:randInt(** by pressing **2**.

5. Press **1** , **4** , **20**) STO▶ 2nd [STAT] **2:L2**.

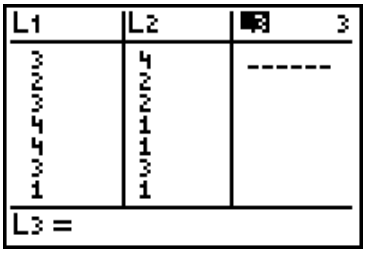


6. Press ENTER to generate the list of numbers and store them in **L2**.

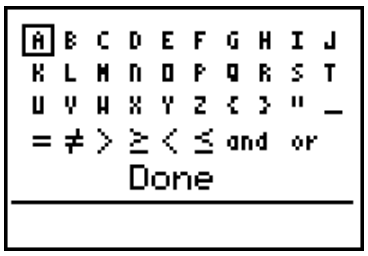


Compare your answers with the correct answers for the test. Using the equal sign, compare the number in **L1** to the corresponding number in **L2**. If the two values are *equal*, the TI-73 returns a *1*, which indicates that the statement is *true*. If the values are *not equal*, the TI-73 returns a *0*, which indicates that the statement is *false*. Use the following steps to perform this operation. Since this simulation will be repeated, you will save the formula that performs the operation.

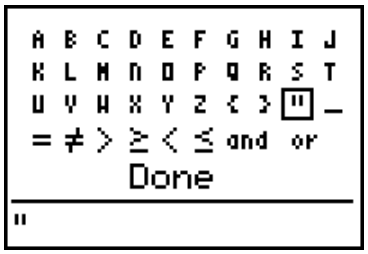
7. Press LIST. Press ▶ ▶ ▲ to move the cursor to highlight **L3**.



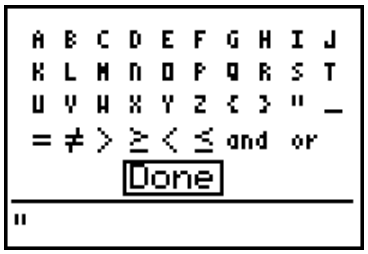
8. Press 2nd [TEXT].



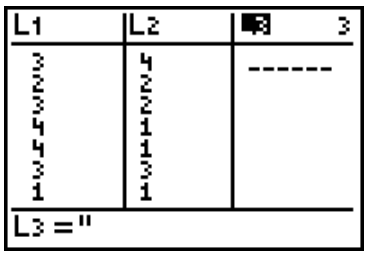
9. Press ◀ ◀ ▼ ▼ ENTER to select the quotation mark (").



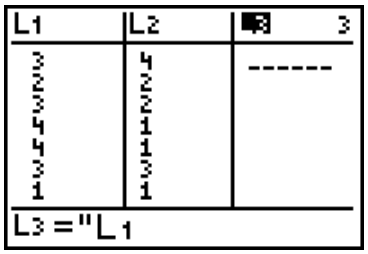
10. Press ▼ ▼ to move the cursor to **Done**.



11. Press ENTER to exit the Text editor and paste the quotation mark in **L3**.

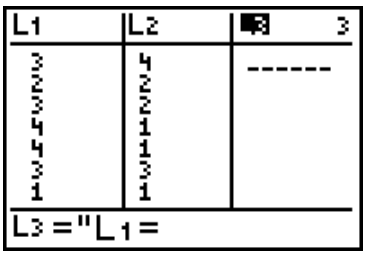


12. Press 2nd [STAT]. Select **1:L1** by pressing **1** or ENTER.

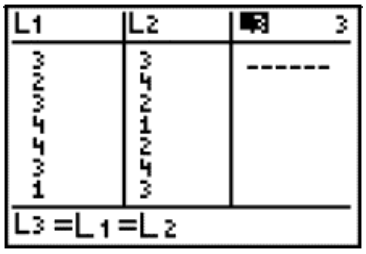


13. Press 2nd [TEXT]. Press ▲ ▲ ENTER to select the equal sign (=).

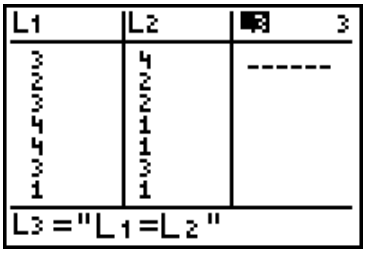
14. Press ▼ ENTER to exit the Text editor and paste the equal sign next to **L1**.



15. Press 2nd [STAT]. Select **2:L2** by pressing **2**.

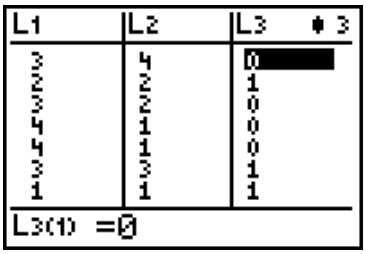


16. Press 2nd [TEXT] ◄ ◄ ▼ ▼ ENTER to select the quotation mark ("). Press ▼ ▼ ENTER to exit the Text editor and paste the quotation mark next to **L2**.



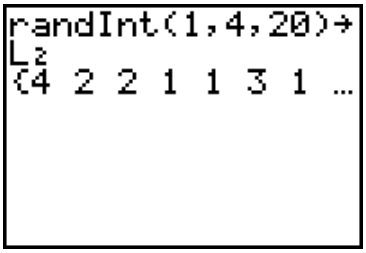
17. Press ENTER to see the comparison with the correct answers.

Note: *The symbol next to* ***L3*** *indicates a formula has been stored in* ***L3****.*



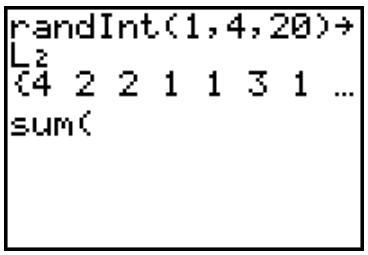
To find the number of correct answers in the simulation, calculate the sum of the numbers in **L3**.

18. Press 2nd [QUIT] to exit the List editor.

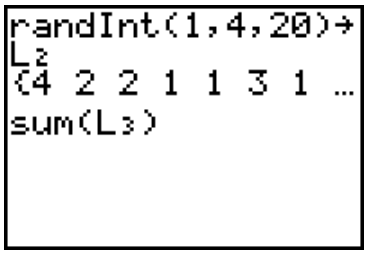


19. Press 2nd [STAT] ► ► to move the cursor to the **MATH** menu.

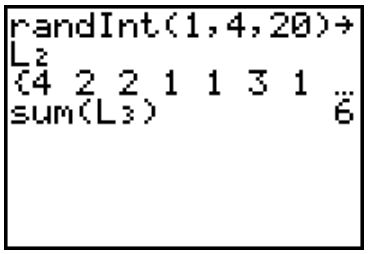
20. Select **7:sum(** by pressing **7**.



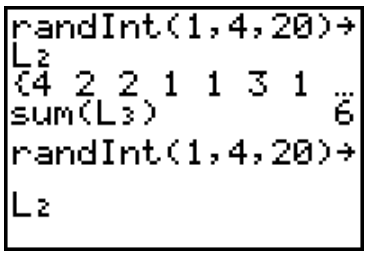
21. Press [2nd] [STAT] **3:L3** [)].



22. Press [ENTER] to see how many were correct. Record the data for this simulation in the table on the **Data Collection and Analysis** page.

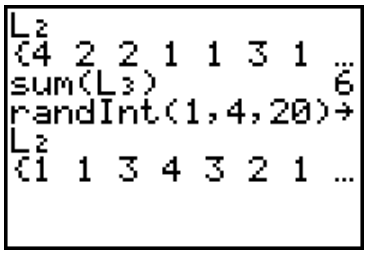


23. Run the simulation again. Press [▲] [▲] [▲] [▲] until **randInt(1,4,20)→L2** is highlighted.

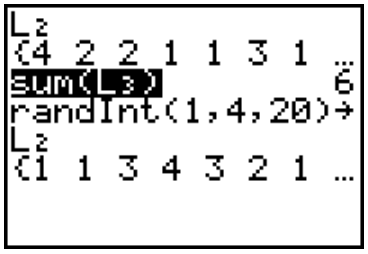


24. Press [ENTER] to copy the **randInt(** command, the press [ENTER] to run the simulation again.

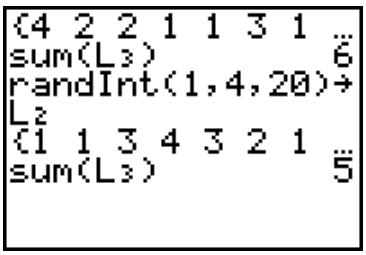
***Note**: You can view the results of the new simulation by pressing [LIST]. When finished, press [2nd] [QUIT] to exit the List editor.*



25. To calculate how many are correct, press [▲] [▲] [▲] [▲] until **sum(L3)** is highlighted.



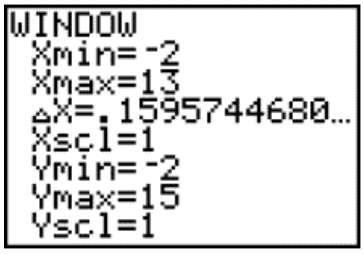
26. Press [ENTER] to copy the **sum(L3)** command, then press [ENTER] to calculate the number correct. Record the data for this simulation in the table on the **Data Collection and Analysis** page.



27. Run the simulation 40 to 50 more times (Steps 23-26). Record each of the trials on the **Data Collection and Analysis** page.

Setting up the window for the Histogram

1. Press [WINDOW] to set up the proper scale for the axes.



2. Set the **Xmin** value by identifying the minimum number of correct answers from the **Data Collection and Analysis** page. Choose a number that is less than the minimum.

3. Set the **Xmax** value by identifying the maximum number of correct answers from the **Data Collection and Analysis** page. Choose a number that is greater than the maximum. **Do Not Change the ΔX Value.** Set the **Xscl** to **1**.

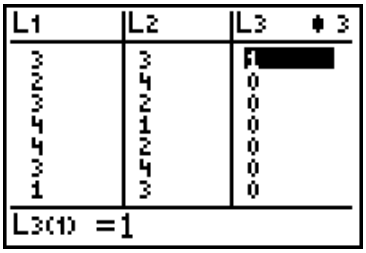
4. Set the **Ymin** value by identifying the minimum in the frequency column from the **Data Collection and Analysis** page. Choose a number that is less than the minimum.

5. Set the **Ymax** value by identifying the maximum value in the frequency column from the **Data Collection and Analysis** page. Choose a number that is greater than the maximum. Set the **Yscl** to **1**.

Graphing the data: Plotting a histogram

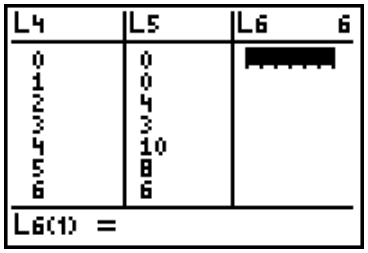
Use the data in the table on the **Data Collection and Analysis** page, Part I, to plot a histogram.

1. Press [LIST].

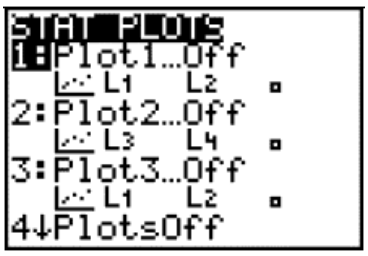


2. Enter the number of correct answers in **L4**.

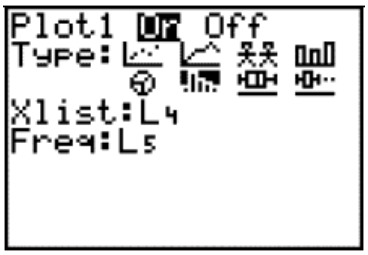
3. Enter the frequencies in **L5**.



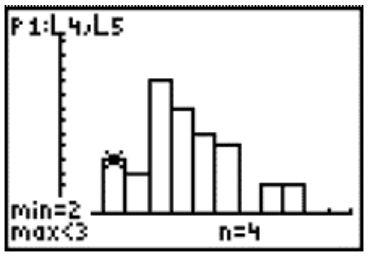
4. Press [2nd] [PLOT]. Select **1:Plot1** by pressing **1** or [ENTER].



5. Set up the plot as shown by pressing [ENTER] [▼] [▶] [▶] [▶] [▶] [▶] [ENTER] [▼] [2nd] [STAT] **4:L4** [▼] [2nd] [STAT] **5:L5.**



6. Press [TRACE] to see the plot. Use [◀] and [▶] to see the frequencies.



Answer Part I questions 1 – 9 on the **Data Collection and Analysis** page.

Collecting the data – Part II

Nathan noticed that the correct answers on the test contained more C's and D's than A's and B's. He decided to run a simulation on his calculator to see if the calculator would produce a distribution of A – D's similar to that on the test. Nathan decided to run three practice tests for his simulation and look at the number of A's, B's, C's, and D's.

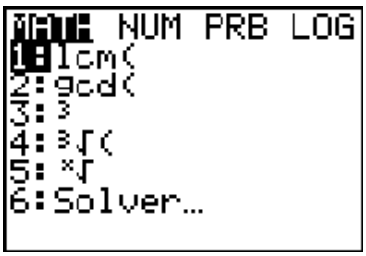
Use the TI-73 and the random number generator to simulate the answers on three practice tests. You will plot a pie graph, a pictograph, and a bar graph to determine the distribution of letters on the test.

Setting up the TI-73

Before starting your data collection, make sure that the TI-73 has the STAT PLOTS turned OFF, Y= functions turned OFF or cleared, the MODE and FORMAT set to

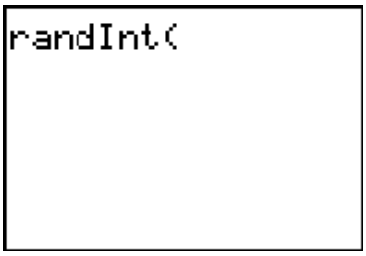
their defaults, and the lists cleared. See the Appendix for a detailed description of the general setup steps.

1. Press MATH.

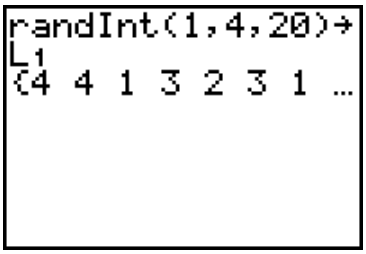


2. Press ▶ ▶ to move the cursor to the **PRB** menu.

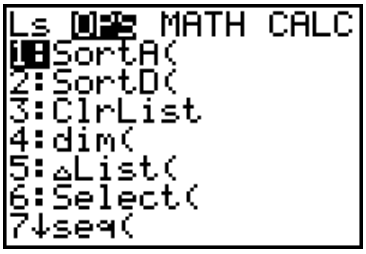
3. Select **2:randInt(** by pressing **2**.



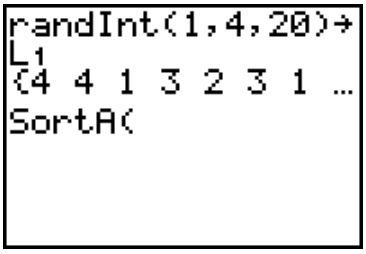
4. Press **1** , **4** , **20**) STO▶ 2nd [STAT] **1:L1**. Press ENTER to generate a list of numbers that represent the answers to a practice test 1.



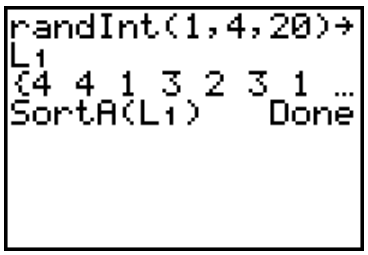
5. Sort the list. Press 2nd [STAT] ▶ to move the cursor to the **OPS** menu.



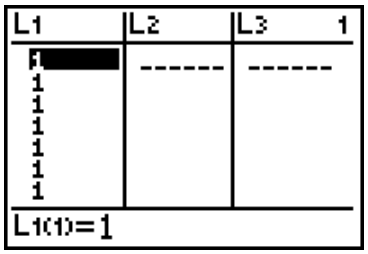
6. Select **1:SortA(** by pressing **1** or ENTER.



7. Press [2nd] [STAT] **1:L1** [)] [ENTER].

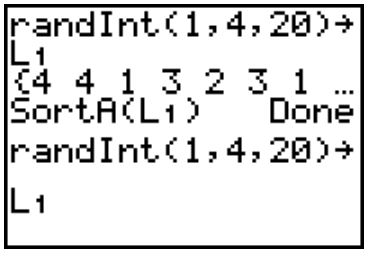


8. Press [LIST]. Count the number of A's, B's, C's, and D's. (Remember that A = 1, B = 2, C = 3, and D = 4.)

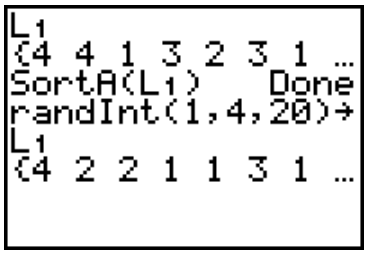


Enter the data in the table for Part II on the **Data Collection and Analysis** page.

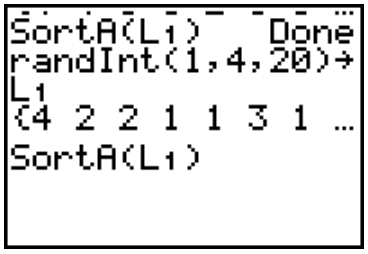
9. Press [2nd] [QUIT] to return to the Home screen. Press [2nd] [ENTRY] twice until you get the **randInt(1,4,20)→L1** statement on the screen.



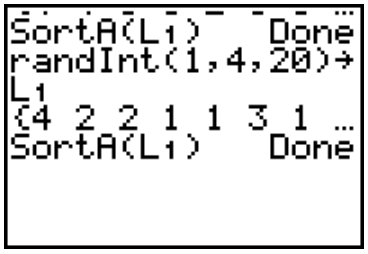
10. Press [ENTER] to generate a second list of numbers that represent the answers to a practice test 2.



11. Press [2nd] [ENTRY] twice until you get the **SortA(L1)** statement.



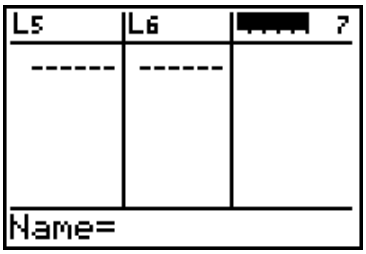
12. Press [ENTER] to sort the data. Repeat Step 8 and record your results in the table on the **Data Collection and Analysis** page.



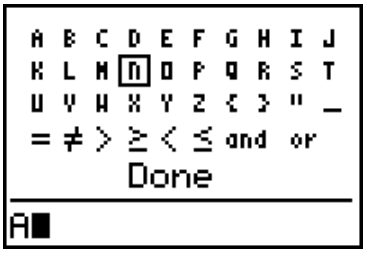
13. Repeat Steps 9 - 12 to generate the answers to a practice test 3. Record your results in the table on the **Data Collection and Analysis** page.

Entering the data in the TI-73

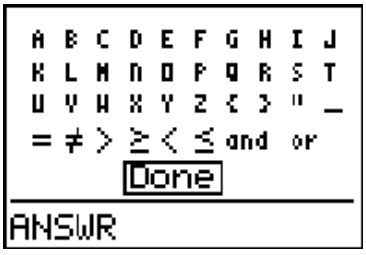
1. Press [LIST] and press [◄] to place the cursor at the top of the 7th list.



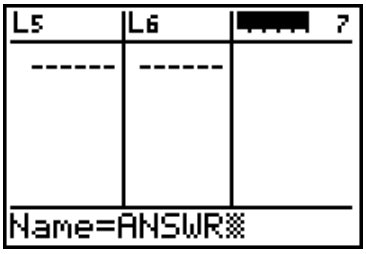
2. Name the list **ANSWR** by pressing [2nd] [TEXT], moving the cursor to each letter of the name **A N S W R,** and pressing [ENTER].



3. Move the cursor to highlight **DONE**.

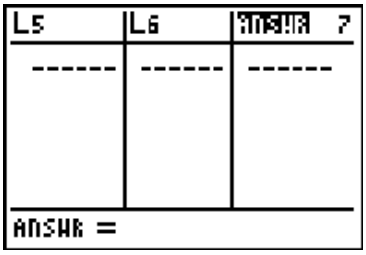


4. Press [ENTER] to exit the Text editor.

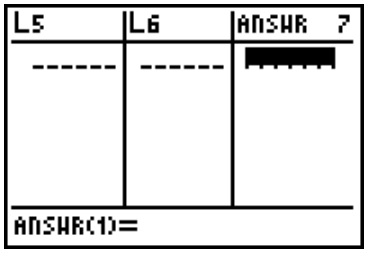


5. Press [ENTER] to paste **ANSWR** at the top of the list.

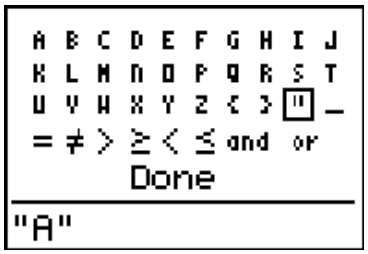
Create a category list (a list that contains text) by having the first element entered in quotation marks.



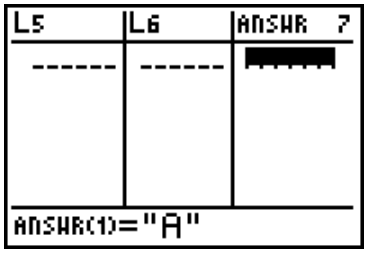
6. Press ▼ to move the cursor to the first element.



7. Enter **"A"**. Press 2nd [TEXT]. Move the cursor to each character of the entry **"A"** and press ENTER.

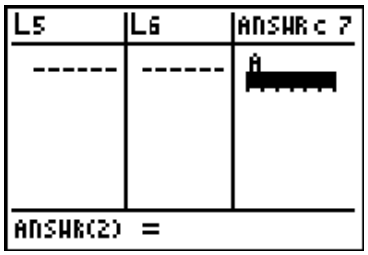


8. Move the cursor to highlight **DONE.** Press ENTER to exit the Text editor.

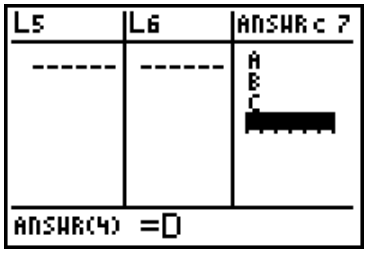


9. Press ENTER to paste **A** in the list.

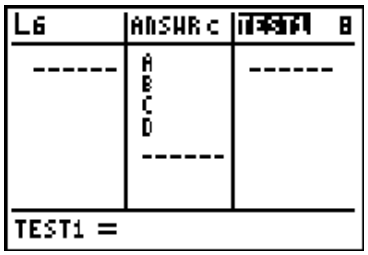
***Note**: A **c** should appear at the top of the list indicating that this is a category list.*



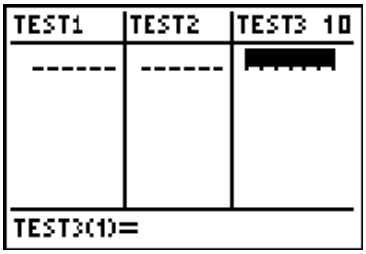
10. Enter the letters **B**, **C**, and **D** in the list by repeating Steps 7-9. You DO NOT have to enclose the remaining letters in quotation marks.



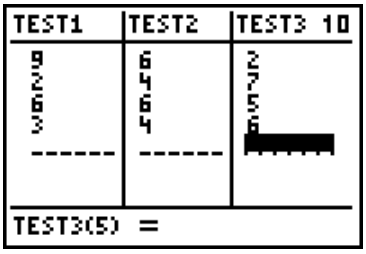
11. Press ▶ to move the cursor to the top of the 8th list. Repeat Steps 1-5 using the list name,**TEST1**.



12. Repeat Step 11 for the list names **TEST2** (9th list) and **TEST3** (10th list.)



13. Enter the data from the table in Part II of the **Data Collection and Analysis** page in the appropriate lists.



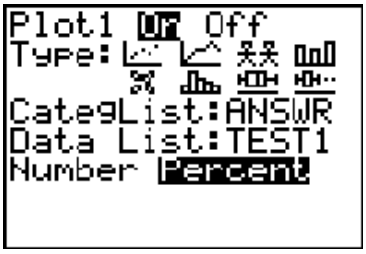
Graphing the data: Setting up a pie chart

Use the data in the table on the **Data Collection and Analysis** page Part II to plot a pie chart.

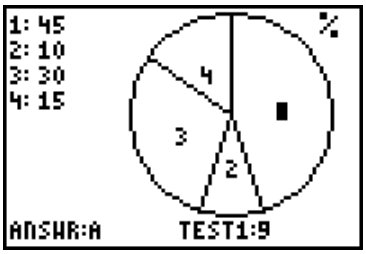
1. To set up the plot, press 2nd [PLOT]. Select **Plot1** by pressing **1** or ENTER.

Press ENTER ▼ ▶ ▶ ▶ ▶ ENTER ▼ 2nd [STAT] **7:ANSWR** ▼ 2nd [STAT] **8:TEST1** ▼ ▶ ENTER.

Note: *Your lists, ANSWR and TEST1 may not be in positions 7 and 8 on the TI-73. Use ▼ and ▲ to move the cursor to the desired list and press ENTER to select that list.*

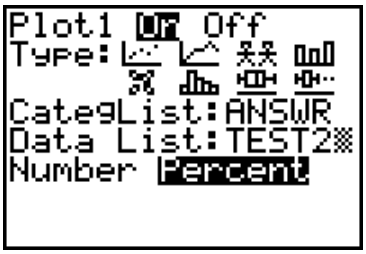


2. Press TRACE to see the pie chart.



3. Use ◀ and ▶ to see the number of items in each section of the graph. The numbers displayed in the left hand corner represent the percent (%) for each letter.

4. To view the pie chart for the data in **TEST2,** press 2nd [PLOT]. Select **Plot1** by pressing **1** or ENTER. Press ▼ ▼ ▼ ▶ ▶ ▶ ▼ **2**.



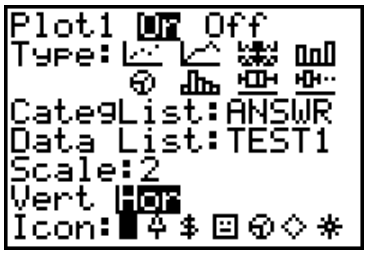
5. Repeat Steps 2-3 using the data from **TEST2.**
6. Repeat Steps 4-5 using the data from **TEST3.**

Answer Part II question 1 on the **Data Collection and Analysis** page.

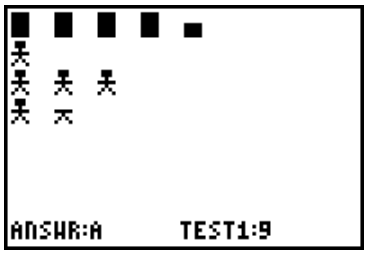
Graphing the data: Setting up a pictograph

1. Press [2nd] [PLOT]. Select **Plot1** by pressing **1** or [ENTER]. Press [ENTER] [▼] [▶] [▶] [ENTER] [▼] [2nd] [STAT] **7:ANSWR** [▼] [2nd] [STAT] **8:TEST1** [▼] 2 [▼] [▶] [ENTER] [▼] [ENTER].

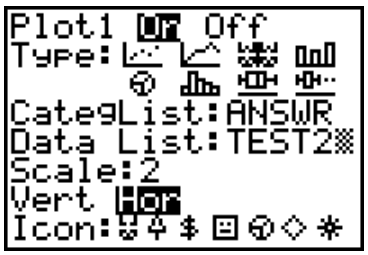
   Note: *Your lists,* ***ANSWR*** *and* ***TEST1,*** *may not be in positions 7 and 8 on the TI-73. Use [▼] and [▲] to move the cursor to the desired list and press [ENTER] to select that list.*



2. Press [TRACE] [▶] to see the pictograph.



3. Use [▶] and [◀] to see the number of items represented by each row of data.
4. To view the pictographs for the data in **TEST2,** press [2nd] [PLOT]. Select **Plot1** by pressing **1** or [ENTER]. Press [▼] [▼] [▼] [▶] [▶] [▶] [▼] **2**.

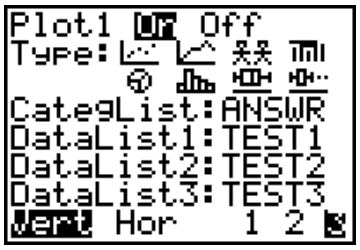


5. Repeat Steps 2-3 using the data from **TEST2.**
6. Repeat Steps 4-5 using the data from **TEST3.**

Answer Pat II question 2 on the **Data Collection and Analysis** page.

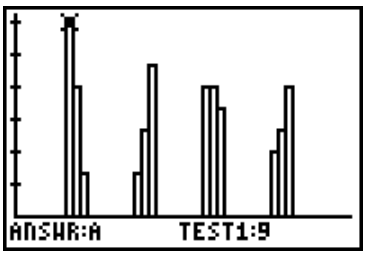
Graphing the data: Setting up a bar graph

1. To set up the plot, press 2nd [PLOT]. Select **Plot1** by pressing **1** or ENTER. Press ENTER ▼ ▶ ▶ ▶ ENTER ▼ 2nd [STAT] **7:ANSWR** ▼ 2nd [STAT] **8:TEST1** ▼ **9:TEST2** ▼ **0:TEST3** ▼ ENTER ▶ ▶ ▶ ▶ ENTER.



***Note**: Your lists, **ANSWR**, **TEST1**, **TEST2**, and **TEST3**, may not be in positions 7, 8, 9, and 0 (10) on the TI-73. Use ▼ and ▲ to move the cursor to the desired list and press ENTER to select that list.*

2. Press TRACE to see the bar graph.



3. Use ▶ and ◀ to see the number of items represented by each bar of data.

Answer Part II questions 3 and 4 on the **Data Collection and Analysis** page.

Data Collection and Analysis

Name_____

Date _____

Activity 9: You're Probably Right, It's Wrong

Collecting the data – Part I

Record your data in the table below.

Number of correct answers	Tally marks	Frequency
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Analyzing the data – Part I

1. Find the *mean* for the number of correct answers. _____

(Press 2nd [QUIT] CLEAR 2nd [STAT] ▶ ▶ **3:mean(** 2nd [STAT] **4:L4** , 2nd [STAT] **5:L5**) ENTER)

2. Find the *median* for the number of correct answers. _____

(Press 2nd [STAT] ▶ ▶ **4:median(** 2nd [STAT] **4:L4** , 2nd [STAT] **5:L5**) ENTER)

3. Find the *mode* for the number of correct answers. _____

(Press 2nd [STAT] ▶ ▶ **5:mode(** 2nd [STAT] **4:L4** , 2nd [STAT] **5:L5**) ENTER)

4. Which measure of central tendency do you think gives a better indication of what might happen if you use this method to answer the questions on a multiple-choice test? Explain your answer.

_____

_____

5. Using your answer from number 4, find the *experimental probability*.

_____

6. Find the *theoretical probability*. _____

7. How do your answers in number 5 and number 6 compare?

_____

_____

8. Do you think it is a good idea to use a random number generator to answer the multiple-choice questions on a test? Explain.

_____

_____

9. Write a random number statement to answer 20 True / False questions.

randInt(_____ **)**

Collecting the data – Part II

Answer	Test 1 Amount	Test 2 Amount	Test 3 Amount
A			
B			
C			
D			

Analyzing the data – Part II

1. Compare the percentage of A's from the pie charts. Are the percentages the same or different for each test? Would you expect them to be the same or different? Explain.

_____

_____

_____

2. Compare the number of B's for each practice test using the pictograph. Are the number of B's the same or different for each test? Do you think the pictograph is a good way of comparing the data? Explain.

_____

_____

_____

_____

3. Compare the number of D's for each practice test using the bar graph. Are the number of D's the same or different for each test? Explain.

_____

_____

_____

4. Which graph, pie chart, pictograph, or bar graph is best for comparing the number of A's, B's, C's, and D's in each test? Explain.

_____

_____

_____

Teacher Notes

Activity 9

You're Probably Right, It's Wrong

Objectives

- To use technology to find experimental and theoretical probabilities
- To use technology to find measures of central tendencies
- To use technology to explore simulation
- To use technology to generate random numbers
- To use technology to plot a histogram
- To use technology to plot a pie chart
- To use technology to plot a pictograph
- To use technology to plot a bar graph

Materials

- TI-73 graphing device

Preparation – Part I

- Make sure students run enough trials to produce at least 40 to 50 data items.
- Find the *mean, median, and mode* by using the 2nd [STAT] MATH menu on the TI-73. Check students' results for finding the mean.
- For a histogram, discuss the values at the bottom of the screen for the plot (that is, the values of *n*, *min*, and *max*).

Preparation – Part II

- After the activity, to remove the list that has an equation stored in it, press 2nd [STAT] ▶ **3:ClrList** 2nd [STAT] **3:L3** ENTER.

Answers to Data Collection and Analysis questions

Collecting the data – Part I

Sample data:

Number of correct answers	Tally marks	Frequency
0	-	0
1	-	0
2	////	4
3	///	3
4	~~////~~ ~~////~~	10
5	~~////~~ ///	8
6	~~////~~ /	6
7	~~////~~	5
8	-	0
9	//	2
10	//	2
11		
12		
13		

Analyzing the data – Part I

1. Find the *mean* for the number of correct answers.

Per the sample data, mean = 5.15

2. Find the *median* for the number of correct answers.

Per the sample data, median = 5

3. Find the *mode* for the number of correct answers.

Per the sample data, mode = 4

4. Which measure of central tendency do you think gives a better indication of what might happen if you use this method to answer the questions on a multiple-choice test? Explain your answer.

The median or mean gives a better indication of the results of using this method to answer questions on a multiple-choice test. Answers may vary.

5. Using your answer from number 4, find the *experimental probability*.

5 / 20 or .25

6. Find the *theoretical probability*.

5 / 20 or .25

7. How do your answers in number 5 and number 6 compare?

They are the same. Answers may vary.

8. Do you think it is a good idea to use a random number generator to answer multiple-choice questions on a test? Explain.

No. The TI-73 simulates the theoretical probability, which means that the score will most likely be around 25%.

9. Write a random number statement to answer 20 True/ False questions.

randInt(*1,2,20*)

Collecting the data – Part II

Answer	Test 1 Amount	Test 2 Amount	Test 3 Amount
A	9	6	2
B	2	4	7
C	6	6	5
D	3	4	6

Analyzing the data – Part II

1. Compare the percentage of A's from the pie charts. Are the percentages the same or different for each test? Would you expect them to be the same or different? Explain.

The percentages are different. You would expect the percentages to be approximately the same. Since each answer has an equally likely chance of occurring, you would expect 25% of the answers to be A for each trial.

2. Compare the number of B's for each practice test using the pictograph. Are the number of B's the same or different for each test? Do you think the pictograph is a good way of comparing the data? Explain.

The number of B's is different. Answers will vary.

3. Compare the number of D's for each practice test using the bar graph. Are the number of D's the same or different for each test? Explain.

The number of D's is different. Answers will vary.

4. Which graph on the TI-73, pie chart, pictograph, or bar graph, is best for comparing the number of A's, B's, C's, and D's in each test? Explain.

The bar graph is the best graph for comparison because it is the only one on the TI-73 that allows you to clearly see the results of all three tests, side-by-side.