EXPLORATIONS ™

Activity 10

A Simulation

Introduction

Poll-taking has become a national pastime and pollsters give us statistics on everything from the most popular movie to the favorite restaurant to the leading candidate in any election.

Problem

How do pollsters come up with their statistics? How many people do they survey? How many people should they survey?

In this activity, you will simulate a random survey and compare outcomes from different experiments.

Simulation: A Random Survey for a Political Election

Election for the mayor of Springfield is drawing near. Ms. A is running against Mr. B. The latest poll shows that 45% of the voters favor Ms. A, while 35% favor Mr. B, and 20% are undecided.

You will carry out a survey of random voters in town to see if your results match those of the latest poll.

Exploration

Before beginning, turn the **Automatic Recalculation** feature off. This will allow the graphing handheld to move more quickly.

1. Press [APPS] and select **CelSheet**. Press [ENTER] twice. Select **Menu > File > New**. Name the program **VOTE**.

```
VOTE│  A  │  B  │  C
  1 │█████│     │
  2 │     │     │
  3 │     │     │
  4 │     │     │
  5 │     │     │
  6 │     │     │
A1:              [Menu]
```

2. Select **Menu > File > Format**.

```
FILE
1:Open…
2:Save As…
3:New…
4:Delete…
5█Format…
6:Recalc
```

3. Set **AutoCalc:N**. Press [ENTER] five times.

```
FORMAT
AutoCalc:Y █
Cursor Mvmt:█ →
Init Help:█ N
Show:█████ VALUE
█████
```

*Note: To recalculate at any time while working in the spreadsheet, select **Menu > File > Recalc**.*

```
FILE
1:Open…
2:Save As…
3:New…
4:Delete…
5:Format…
6█Recalc
```

4. In cell B1, enter **24 Voters**. To do so, press [ALPHA] ["] **24** [2nd] [ALPHA] **VOTERS** [ENTER].

```
VOTE│  A  │  B  │  C
  1 │     │24VOTE│RS
  2 │     │     │
  3 │     │     │
  4 │     │     │
  5 │     │     │
  6 │     │     │
B1: "24VOTERS    [Menu]
```

5. The 24 responses will be in B3 through B26. In cell B3, enter the formula **=int(100*rand)**. Press [STO▸] [MATH] **NUM int(100*** [GRAPH] **rand(** [)] [ENTER].

The voter responses are going to be random integers from 0 to 99. These random numbers will be translated to a "vote" using the percentages that were given in the introduction to the problem. If the number is greater than or equal to 55, the voter chose candidate *A*. If the number is less than 35, the voter chose candidate *B*. Otherwise, the voter is undecided. Verify that these decisions reflect the percentages shown in the latest poll.

6. In cell C2 press [ALPHA] ["] to enter the heading **A**. Enter the heading **B** in D2 and **U** in E2.

7. In cell C3 enter the formula **=If(B3≥55,1,0)**. Press [STO▸] [GRAPH] **If(** [ALPHA] **B3** [2nd] [MATH] **≥55** [,] **1** [,] **0** [)] [ENTER].

8. Enter the formula **=If(B3≤35,1,0)** in cell D3.

9. Enter the formula **=1–C3–D3** in cell E3.

In cells C3, D3, and E3, you entered conditional statements (IF statements). In cell C3, the statement gives the condition, *if the value in B3 is greater than or equal to 55,* and directs the application to place a **1** in cell C3, indicating the voter chose candidate *A*. This should happen 45% of the time. In D3, the condition is *if the value in B3 is less than 35*. This would indicate that the voter chose candidate *B*, and a **1** is placed in cell D3. This should happen 35% of the time. The formula in cell E3 will only be 1 if a voter did not choose candidate *A* or *B*.

10. Copy the formula in cell B3 into rows B4 through B26. Press [Y=] [ZOOM] [▼] [Y=] [▼] (through row 26) [TRACE]. Do the same for columns C, D, and E.

The number **1** should appear only once in column C, D, or E for each number in cells B3 to B26. Why is that so?

11. In cell A1 enter the formula **=sum(C3:C26)** to find the sum of the votes for candidate *A* (from column C). Press [STO▶] [GRAPH] **sum(** [ALPHA] **C3** [ALPHA] **:** [ALPHA] **C26** [)] [ENTER].

12. In cell A2, you will enter the sum of the votes for candidate *B* (from column D).

13. In cell A3, enter the sum of the undecided votes (from column E).

These three numbers should add to 24 because there were 24 voters surveyed.

These numbers, which are probably different from yours, are the result of one survey, or experiment. If you recalculate, you will perform another survey and will most likely get different results.

14. Select **Menu > File > Recalc**. Here are the new results.

What do you notice about the new results? How different are the percentages from the first set of results? How can you explain these two sets of results?

Recalculate a third time and compare these results with the two previous sets. What do you notice?

Pie charts are often used by the media to show the results of a vote. Next you will display the data in a pie chart.

```
VOTE   A       B       C
 1        11 24 VOTERS
 2        11           A
 3         2    93      1
 4              16      0
 5              34      0
 6               7      0
A3: =sum(E3:E26)        [Menu]
```

15. Select **Menu > Charts > Pie.**

The **Categories** are the three different sectors of the pie chart. Enter **C2:E2**, and press ENTER. At **Series:** enter **A1:A3**. These give the data for each category. Press ENTER. Select **Percent**, and then press ENTER three times to see the graph.

This gives you the percentage rather than the number of votes for each candidate. Why would the percentage be more useful information?

```
PIE CHART
Categories:C2:E2
Series:A1:A3
Number  Percent
Title:0
Draw
```

```
1:45.833
2:45.833
3:8.3333
```
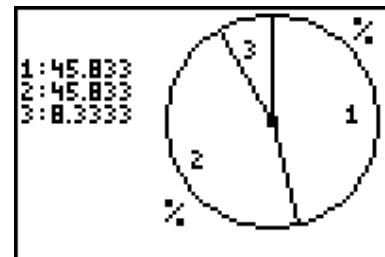
16. Press 2nd [QUIT] to return to the spreadsheet. Recalculate to perform another experiment (survey).

```
VOTE   A       B       C
 1         8 24 VOTERS
 2         9           A
 3         7    21      0
 4              42      0
 5              59      1
 6              78      1
C1:                    [Menu]
```

17. Return to the pie chart.
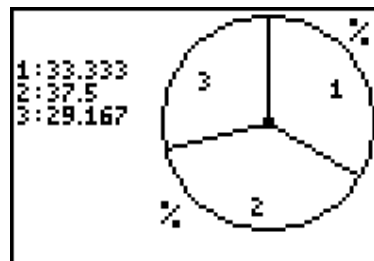
Questions for Discussion

1. Are the percentages of the third experiment the same as they were for the second experiment?

2. Explain the results.

3. How do these results compare to the percentages that the latest polls found?

4. The latest poll indicates the results from a sample of voters. Since the poll does not include all voters, you do not expect the percentages for each candidate from the sample to match the percentages if all voters were queried or if the election were held the same day the poll was taken. How do you make the results of a poll more closely model the feelings of the entire population?

Student Worksheet

Name _____

Date _____

Analyzing the Data

As you have noticed, your survey results do not always match those of the polls. You probably also noticed that your survey results change from one sample to the next. What happens when you average the findings of these different samples?

Using the spreadsheet constructed in this activity, recalculate to find four more samples. Fill out the table below with the results from each sample. Place the corresponding percentage in parentheses.

1. In the column marked "Average," show the average of all four samples as a percent rounded to one decimal place. In the column marked "Error," show the greatest error of any one sample. (To find the error, subtract the percentage points for the sample from the average percent.)

	Sample 1	Sample 2	Sample 3	Sample 4	Average (shown as a %)	Error
Ms. A						
Mr. B						
Undecided						

2. Next, form groups of 3 or 4. Compare your "Average" columns and the "Error" columns. What do you observe?

3. Make a large table of the sample results from all the members of the group. Find the average (count and percentage) and the error of the sample results from all the members of the group. What do you notice? How close are the average results from those of the poll on page 1?

Group Work

Polls may be used to sample a smaller part of a larger population in order to find out how an entire population is thinking. We take a sample because either we cannot afford to or it is not feasible to ask the entire population. The sample gives us some indication of what the population may think, but only if the sample is unbiased and large enough.

In this group activity, each group will define a population and come up with an issue or question that can be answered in three ways.

Half of the group will decide on the position of the population regarding the issue or question. They will reprogram the spreadsheet used in the simulation to match their projections.

The other half of the group will run the simulation and make an educated guess about the stance of the population on the issue. The entire group will present their findings to the rest of the class giving reasons for the percentages they used and commenting on the accuracy of the sample.

To reprogram the spreadsheet, change the **IF** statements in columns C, D, and E. (The questions shown here are only suggestions. You may use current issues, actual candidates, or issues more appropriate for your class.) Some groups may choose to increase the sample size as they reprogram the simulation.

Samples

Population: High school students in <your state or city>

Question: What is your favorite lunch?

> **a.** Pizza
>
> **b.** Burger and Fries
>
> **c.** Salad

Population: Parents of students at <your school>

Question: Do you believe the voting age should be changed to 21?

    a. Yes

    b. No

    c. Undecided

Group 1A determines the way they believe the population feels.

    a. Yes - 50%

    b. No - 30%

    c. Undecided - 20%

Group 1A reprograms the simulation.

VOTE	C	D	E
1			
2	A	B	U
3	0	1	0
4	1	0	0
5	1	0	0
6	0	1	0

C3: =If(B3≥50,1,0) [Menu]

Group 1A observes the collection of data.

VOTE	C	D	E
1			
2	A	B	U
3	1	0	0
4	0	0	1
5	0	0	1
6	0	1	0

D3: =If(B3<30,1,0) [Menu]

Group 1B is not present for these discussions.

Group 1B takes a sample:

VOTE	A	B	C
1	13		
2	6		A
3	5	74	1
4		67	1
5		17	0
6		3	0

A1: =sum(C3:C26) [Menu]

Grade 1B makes an educated guess based on the sample.

    54.2% say, "Yes."

    25% say, "No."

    20.8% are undecided.

Teacher Notes

Activity 10

A Simulation

Objective

- Use the CellSheet™ App to simulate a probability event

Materials

- TI-84 Plus/TI-83 Plus

Time

- 60 minutes

Preparation

This activity simulates an experiment: performing a survey. In the Exploration, students can see that the results of a random survey can vary widely if a small sample size is used. The discussion questions are designed to help students think through the variation in the experimental outcomes and the relationship to sample size. The student worksheet continues exploration of these concepts as students average their results of four experiments and then join with other students to average the averages. Students are introduced to the concept of sampling error.

The proposed group activity has students apply these concepts. Assign students into two groups. Assign each group the task of working the experiment and then completing the corresponding part of the student worksheets. Groups can report their findings to the rest of the class. Ask each group to plan its oral presentation so that some students are involved in the oral part and others are involved in using the technology, handing out reports, and so on. Before the presentation, give students a rubric that identifies your expectations and your assessment plan. (A rubric is included as an example.)

The activity can be done in one class and the presentation in a subsequent class, giving the students time to plan their presentation.

Elicit Questions

Bring up the topic of polls and ask students how those who take polls get their information. (If election time is near, you may want to ask students who is leading in the polls.) How many people do students think the poll-takers ask? How many people do students think they should ask to get a valid answer to the question? Ask students to explain their answers to find out what they already know about poll-taking.

Management

Provide time for the groups to work through the project and plan their presentations. Require some of their work to be done outside class, so that students can communicate, plan, and coordinate activities.

Answers to the Student Worksheet

Student results will vary, but should approach the reported percentages as more results are aggregated.

	Sample 1	Sample 2	Sample 3	Sample 4	Average (shown as a %)	Error
Ms. A	11(45.8%)	11(45.8%)	13(54.2%)	8(33.3%)	44.8%	11.5%(44.8 – 33.3)
Mr. B	10(41.7%)	10(41.7%)	8(33.3%)	11(45.8%)	40.6%	7.3%(40.6 – 33.3)
Undecided	3(12.5%)	3(12.5%)	3(12.5%)	5(20.8%)	14.6%	6.2%(20.8 – 14.6)

Rubric

1. **Content**	**/56**
a. The opening remarks got the attention of the audience.	/8
b. The problem was clearly stated.	/8
c. The process the group used to collect the data was generally defined.	/8
d. The results were clearly displayed (histogram or pie chart).	/8
e. Observations about the results were logical and showed that the group had thought critically about the experiment and the results.	/8
f. The results were accurate.	/8
g. The conclusion was clear and concise.	/8
2. **Preparation**	**/21**
a. The presentation plan was carried out well with no lapses between speakers and no material left out.	/7
b. All members of the group assisted with the presentation.	/7
c. The visual display or handouts were clear and well done.	/7
3. **Presentation**	**/23**
a. The speakers spoke clearly and distinctly.	/6
b. The remarks were free of grammatical errors.	/6
c. The group received questions and answered them well.	/6
d. The individuals were appropriately dressed.	/5