

● **ACTIVITY 1 A Fifth-Grade Task**

The problem below is adapted from one used by a researcher with a group of fifth grade students.<sup>1</sup> The problem gives a situation in which samples are used because surveying everyone was not feasible. The students were asked to evaluate different sampling methods. In this activity, first decide how you would find an appropriate sample to address the problem, and then discuss and evaluate each of the nine sampling methods. Give reasons why each of the sampling methods is likely to provide valid, or invalid, statistics. (In this case, the numbers of yes and no responses are the statistics.)

► An elementary school with grades 1 through 6 has 100 students in each grade. A fifth-grade class is trying to raise some money to go on a field trip to Disneyland. They are considering several options to raise money and decide to do a survey to help them determine the best way to raise the most money. One option is to sell raffle tickets for a Wii game system. How could they find out whether or not students were interested in buying a raffle ticket to win the game system? ◀

Nine different students each conducted a survey to estimate how many students in the school would buy a raffle ticket to win a Wii. Each survey included 60 students, but the sampling method and the results are different for each survey. The nine surveys and their results are described as follows. (Note: In all cases, yes means that the student agreed to buy a raffle ticket.)

1. Raffi asked 60 friends. (75% yes, 25% no)
2. Marta got the names of all 600 students in the school, put them in a hat, and pulled out 60 of them. (35% yes, 65% no)
3. Spence had blond hair so he asked the first 60 students he found who also had blond hair. (55% yes, 45% no)
4. Jinfa asked 60 students at an after-school meeting of the Games Club. The Games Club met once a week and played different games—especially computerized ones. Anyone who was interested in games could join. (90% yes, 10% no)
5. Abby sent out a questionnaire to every student in the school and then used the first 60 that were returned to her. (50% yes, 50% no)
6. SuLin set up a booth outside the lunchroom, and anyone who wished could stop by and fill out her survey. To advertise her survey, she posted a sign that said WIN A Wii. She stopped collecting surveys when 60 students had completed the survey. (100% yes)
7. Jazmine asked the first 60 students she found whose telephone number ended in a 3 because 3 is her favorite number. (25% yes, 75% no)
8. Dong wanted the same number of boys and girls and some students from each grade. So he asked 5 boys and 5 girls from each grade to get his total of 60 students. (30% yes, 70% no)
9. Paula didn't know many boys, so she decided to ask 60 girls. But she wanted to make sure she got some young girls and some older ones, so she asked 10 girls from each grade. (10% yes, 90% no) ●

(Source: Sowder, Sowder, & Nickerson, 2010, p. 668-669)

**Discussion:** Some sampling methods are better than others. For each sample described above:

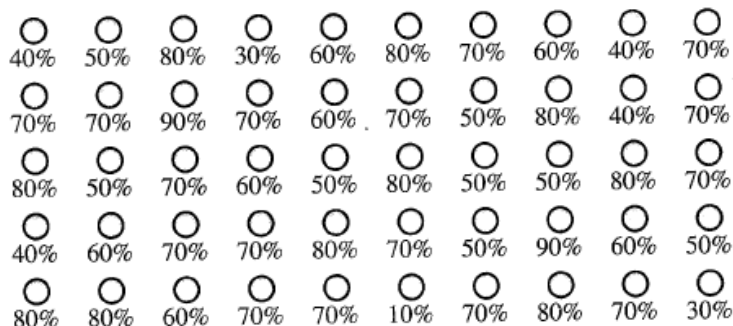
1. Why do you think the percentages came out the way they did?
2. What kinds of **biases** could show up in the students' samples?
3. Is the sampling method likely to provide a **representative sample** that would provide a valid estimate of the **population parameter** of interest?

**Homework:** p. 674 #9, 10, and [#11 for presenters only]. (See end of this packet!)

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**Repeated Samples:** Suppose we have a population that is 63% against Proposition 223. Using an applet like the one at <http://illuminations.nctm.org> (click Activities, then type “Adjustable Spinner”), we may simulate a series of random samples.

The following display gives the results from a *Fathom* simulation of drawing 50 samples, each of size 10, from a population having 63% as the against rate. Each of the 50 balls represents one sample of size 10, with the percent against Proposition 223 for that sample shown underneath the ball.



- What does the first ball and its percent mean?
- Why are all the percents multiples of 10%?
- Complete the following table, summarizing the findings for the percent against Proposition 223 for all 50 samples. (You may wish to make tally marks to the right of the table.)

Percent in the sample that are <i>against</i> Proposition 223	How many of the 50 samples give that percent <i>against</i>
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	

### DISCUSSION 3 What Would Happen If . . . ?

Here is an extremely important question: As the sample size gets larger, what would happen to the spread of the results? Do you think you would be more or less likely to get 20% with a sample size of 10 or with a sample size of 100? Make predictions about what you would expect for sample size 1000, using 100 spins. Would you feel more confident of the result when the sample size is 500 compared to a sample size of 2000? Explain why or why not. ■

Table 1 1000 Samples of Different Sizes from a Population of Which 63% Are Against Proposition 223 (the population parameter is 63%)

Percent that are against Prop 223, in a sample	Number of the 1000 samples of size $n$ having the given percent against Prop 223 (from the first column)				
	Sample Size				
	$n = 100$	$n = 500$	$n = 1000$	$n = 2000$	$n = 3000$
48	1				
49	1				
50	1				
51	6				
52	6				
53	10				
54	14				
55	18	1			
56	29	3			
57	30	2			
58	55	6	2		
59	36	25	6	1	
60	72	73	50	12	6
61	76	105	116	64	41
62	84	189	226	229	226
63	85	179	240	335	421
64	77	163	204	273	251
65	99	135	99	73	52
66	68	74	50	13	3
67	68	26	6		
68	55	12	1		
69	34	5			
70	28	2			
71	14				
72	15				
73	8				
74	6				
75	0				
76	0				
77	1				
78	1				
79	1				
80	0				
81	0				
82	0				
83	1				

**DISCUSSION 4** What Does a Large Sample Size Buy?

Use Table 1 on the following page for this discussion.

- In the column  $n = 500$  what exactly does the 25 mean?
- What is the sum of the numbers in each column? Why would you expect to get this sum?
- What exactly does a sample size of 3000 give you that a sample size of 2000 does not?
- Compare the results for a sample size of 1000 with those for sample sizes of 2000 and 3000.
- How close to 63% are all the statistics from all the samples when the sample size is  $n = 1000$ ?
- Is your answer in part (e) close enough for most practical purposes? Why or why not?

**Discussion 5** (Sowder et al, p. 767)

- What does Table 1 tell you about sample size? Notice that the population could have been very large.
- What general patterns do you see in this table? What does your pattern tell you about the effect of sample size?
- Complete this statement: "The larger the sample size, . . ."

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**Rule of Thumb about the Margin of Error:** The expression  $1/\sqrt{n}$  will give an estimate of the **margin of error** with a sample of size  $n$  if the population proportion is close to 50%.

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**Example:** If 100 adult males were surveyed and 55% preferred Pepsi and 45% preferred Coke, is the following statement supported by the evidence? *“Men are more likely to prefer Pepsi than Coke.”*

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**TAKE-AWAY MESSAGE . . .** If samples are unbiased, a statistic derived from a large sample is more likely to be closer to the corresponding parameter of the population than when the statistic is derived from a small sample. But just how large does the sample have to be? Surprisingly, the sample does not have to be extremely large, no matter what size the population. The sample size required will depend on how confident one wants to be about the sample statistic's proximity to the population parameter. In some circumstances, there is a rule of thumb for relating sample size to the exactness of the sample statistic.

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**Homework from p. 674 (#11 needs to be completed by presenters only)**

9. The National Assessment of Education Progress tests mathematical knowledge in Grades 4, 8, and 12 across the nation. (Information about the test and test items that have been used may be found at <http://nces.ed.gov/nationsreportcard/>.) Here is one of the test items, first used in eighth grade. Answer it and justify your choice.

► A poll is being taken at Baker Junior High School to determine whether to change the school mascot. Which of the following would be the best place to find a sample of students to interview that would be most representative of the entire student body?

- a. an algebra class
- b. the cafeteria
- c. the guidance office
- d. a French class
- e. the faculty room ◀

10. The *San Diego Union Tribune* chooses a question each week and asks readers to call in their responses. During the presidential campaign in 2008, readers were asked to predict who would win the Republican primary in New Hampshire. Of the 2831 responses, 78% chose Ron Paul, 8% John McCain, 6% Mike Huckabee, 5% Mitt Romney, 2% Rudy Giuliani, and 1% Fred Thompson. John McCain actually won the primary. What might have caused these numbers to be so different from those recorded in national polls?

11. Find an example in newspaper, news magazine, or news program of a sample used to make predictions about the population. Bring it to class.

(#11 is required of presenters only)

**Homework: p. 768 (#1, 2, 5, 6, 7, 11)**

- .....
1. A polling company increased its sample size from 1000 people to 4000 people before a big election. Why would they do this?
  2. Using Table 1 on page 766, complete this table, which tells the number of samples with statistics that would be within a specific percent from the population parameter. Two entries in the table are provided for you.

1000 samples of size $n$	Number of samples in which the sample statistic is within this % of parameter:		
	$\leq 10\%$	$\leq 5\%$	$\leq 2\%$
$n = 100$			421
$n = 500$			
$n = 1000$			
$n = 2000$			
$n = 3000$			991

5. Which of the following samples would you want? Tell why.
  - a. a sample with low bias and low precision
  - b. a sample with high bias and low precision
  - c. a sample with low bias and high precision
  - d. a sample with high bias and high precision
6. Suppose we asked a random sample of 400 people if they preferred Coke or Pepsi and found that 54% of the people preferred Pepsi. What could we say about the true population proportion?
7. In a poll of 1631 people in a city of a million people, 53% said they would vote against funding a new library.
  - a. Might funding for a new library still be approved? Tell how you know.
  - b. Would you feel as you did in part (a) if only 100 people had been polled?
  - c. Suppose that after polling 100 people, you found that 75% of the sample said they would vote against funding a new library. Do you think the measure will pass?
11. You suspect that the population parameter is about 50%. What sample size would you use if you want the margin of error to be
  - a.  $\pm 5\%$
  - b.  $\pm 1\%$
  - c.  $\pm 0.5\%$