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## 10.3 Making Inferences from Sample Surveys
For use with Exploration 10.3

Essential Question How can you use a sample survey to infer a conclusion about a population?
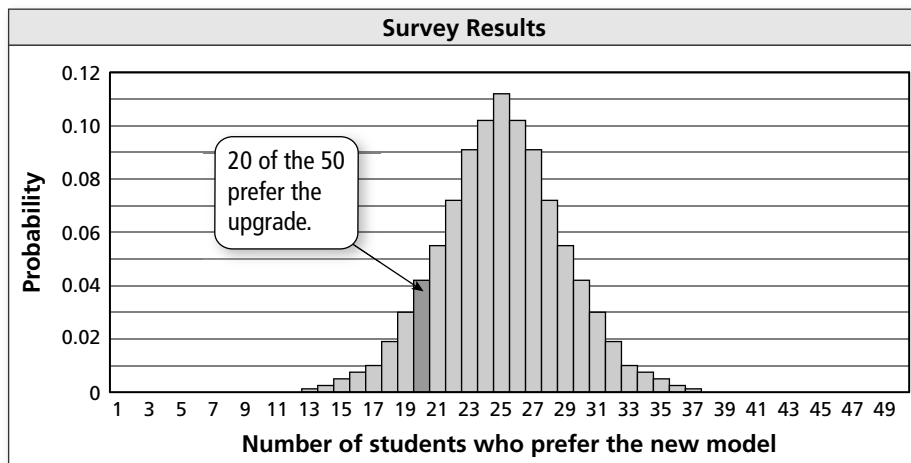
1 **EXPLORATION:** Making an Inference from a Sample

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. You conduct a study to determine what percent of the high school students in your city would prefer an upgraded model of their current cell phone. Based on your intuition and talking with a few acquaintances, you think that 50% of high school students would prefer an upgrade. You survey 50 randomly chosen high school students and find that 20 of them prefer an upgraded model.

> **50,000 High School Students**
>
> **50 Sampled**
>
> **20 Prefer Upgrade**
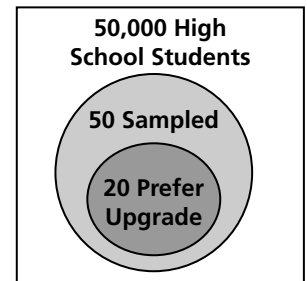
a. Based on your sample survey, what percent of the high school students in your city would prefer an upgraded model? Explain your reasoning.

b. In spite of your sample survey, is it still possible that 50% of the high school students in your city prefer an upgraded model? Explain your reasoning.

c. To investigate the likelihood that you could have selected a sample of 50 from a population in which 50% of the population does prefer an upgraded model, you create a binomial distribution as shown below. From the distribution, estimate the probability that exactly 20 students surveyed prefer an upgraded model. Is this event likely to occur? Explain your reasoning.

Survey Results

20 of the 50 prefer the upgrade.

Probability (y-axis): 0, 0.02, 0.04, 0.06, 0.08, 0.10, 0.12

Number of students who prefer the new model (x-axis): 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49

10.3 **Making Inferences from Sample Surveys** (continued)

1 **EXPLORATION:** Making an Inference from a Sample (continued)

    d. When making inferences from sample surveys, the sample must be random. In the situation described on the previous page, describe how you could design and conduct a survey using a random sample of 50 high school students who live in a large city.

Communicate Your Answer

    2. How can you use a sample survey to infer a conclusion about a population?

    3. In Exploration 1(c), what is the probability that exactly 25 students you survey prefer an upgraded model?

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10.3 Practice
For use after Lesson 10.3

Core Concepts

Margin of Error Formula

When a random sample of size n is taken from a large population, the margin of error is approximated by

$$\text{Margin of error} = \pm\frac{1}{\sqrt{n}}.$$

This means that if the percent of the sample responding a certain way is p (expressed as a decimal), then the percent of the population who would respond the same way is likely to be between $p - \frac{1}{\sqrt{n}}$ and $p + \frac{1}{\sqrt{n}}$.

Notes:

Worked-Out Examples

Example #1

DRAWING CONCLUSIONS   When the President of the United States vetoes a bill, the Congress can override the veto by a two-thirds majority vote in each House. Five news organizations conduct individual random surveys of U.S. Senators. The senators are asked whether they will vote to override the veto. The results are shown in the table.

a. Based on the results of the first two surveys, do you think the Senate will vote to override the veto? Explain.

b. Based on the results in the table, do you think the Senate will vote override the veto? Explain.

Sample Size	Number of Votes to Override Veto	Percent of Votes to Override Veto
7	6	85.7%
22	16	72.7%
28	21	75%
31	17	54.8%
49	27	55.1%

a. yes; The first two surveys show more than the 66.7% of votes needed to override the veto.

b. no; As the sample size increases, the percent of votes approaches 55.1%, which is not enough to override the veto.

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Example #2

MODELING WITH MATHEMATICS Employee engagement is the level of commitment and involvement an employee has toward the company and its values. A national polling company claims that only 29% of U.S. employees feel engaged at work. You survey a random sample of 50 U.S. employees.

a. What can you conclude about the accuracy of the claim that the population proportion is 0.29 when 16 employees feel engaged at work?

b. What can you conclude about the accuracy of the claim that the population proportion in 0.29 when 23 employees feel engaged at work?

c. Assume that the true population proportion is 0.29. Estimate the variation among sample proportions for sample of size 50.

a. Note that 16 out of 50 corresponds to a sample proportion of $\frac{16}{50} = 0.32$. It is likely that 16 out of 50 U.S. employees are engaged at work when the company claims 29% of U.S. employees are engaged at work. So, you can conclude that the company's claim is probably accurate.

b. Note that 23 out of 50 corresponds to a sample proportion of $\frac{23}{50} = 0.46$. It is unlikely that 23 out of 50 U.S. employees are engaged at work when the company claims 29% of U.S. employees are engaged at work. So, you can conclude that the company's claim is probably not accurate.

c. Check students' work. Students should perform a simulation as described in Example 3. *Sample answer:* 0.15 to 0.43

Practice A

1. The numbers of minutes spent each day on a social networking website by a random sample of people between the ages of 18 and 64 are shown in the table. Estimate the population mean μ.

Number of Minutes				
175	15	190	180	45
100	210	240	190	60
102	165	253	192	102
12	180	189	193	230
300	185	190	395	186
183	200	165	195	409

10.3 Practice (continued)

2. Use the data in Exercise 1 to answer each question.

   a. Estimate the population proportion ρ of social network users between the ages of 18 and 64 who spend more than 120 minutes each day on a social networking website.

   b. Estimate the population proportion ρ of social network users between the ages of 18 and 64 who spend fewer than 60 minutes each day on a social networking website.

3. Two candidates, A and B, are running for the student council president position. The table shows the results from four surveys of randomly selected students in the school. The students are asked whether they will vote for candidate A. The results are shown in the table.

Sample Size	Number of Votes for Candidate A	Percent of Votes for Candidate A
10	6	60%
20	11	55%
50	20	40%
150	64	42.7%

   a. Based on the results of the first two surveys, do you think Candidate A will win the election? Explain.

   b. Based on the results in the table, do you think Candidate A will win the election? Explain.

4. A national polling company claims that 39% of Americans rate the overall quality of the environment in the nation as "good." You survey a random sample of 50 people. What can you conclude about the accuracy of the claim that the population proportion is 0.39 when 19 Americans say the quality of the environment is good?

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5. In a survey of 2680 people in the U.S., 60% said that their diet is somewhat healthy.

    a. What is the margin of error for the survey?

    b. Give an interval that is likely to contain the exact percent of all people in the U.S. who think their diet is somewhat healthy.

Practice B

1. The numbers of bait fish caught in a random sample of 40 cast net throws are shown in the table.

Number of Bait Fish Per Cast Net Throw									
4	8	6	15	1	6	8	0	1	14
9	6	8	7	3	10	4	11	2	4
15	2	0	5	1	2	7	5	6	6
9	11	8	9	5	1	4	7	2	1

    a. Estimate the population mean μ.

    b. Estimate the population proportion ρ of cast net throws that produce at least eight bait fish.

    c. Estimate the population proportion ρ of cast net throws that produce fewer than three bait fish.

2. A survey asks a random sample of U.S. voters how many times they have gone to the polls unknowledgeable about who they are voting for. The survey reveals that the sample mean is 5.8 times. How confident are you that the average number of times all U. S. voters have gone to the polls unknowledgeable is exactly 5.8 times? Explain your reasoning.

3. A national polling company claims that 45% of U.S. drivers do not adhere to the speed limits in construction areas. You survey a random sample of 50 households.

    a. What can you conclude about the accuracy of the claim that the population proportion is 0.45 when 15 drivers do not adhere to the speed limits in construction areas?

    b. What can you conclude about the accuracy of the claim that the population proportion is 0.45 when 23 drivers do not adhere to the speed limits in construction areas?

    c. Assume that the true proportion is 0.45. Estimate the variation among sample proportions for samples of size 50.