# Goal 3: Data Analysis & Probability

## Making Informed Decisions & Predictions Based on Survey Results

| OBJECTIVE | CORE LEARNING GOALS |
|---|---|
| • Students will make predictions based upon survey results. | 3.2.1 The student will make informed decisions and predictions based upon the results of simulations and data from research. |
| DRILL<br>You live in a district with 37,500 voters. Suppose you select a random sample of 1500 voters and find that 900 prefer the democratic candidate running in an upcoming election.<br>1. What is the sample proportion?<br>*(sample proportion:* $900/1500 = 0.60$ *)*<br>2. Estimate the number of voters in your district preferring the democratic candidate using your sample results.<br>*(estimate of population:* $37{,}500(0.60) = 22{,}500$ *)* | MATERIALS<br>Activities: "Understanding Probability," "Predicting from Survey Results," and "Practice Predicting from Survey Results"<br>Answer Keys |
| CALCULATOR SKILLS<br>None | |
| ACTIVITIES<br>**1. Drill.** The drill provides a review of sample proportions and making predictions.<br>**2. Exploration.** When analyzing sample results and estimating population percentages, we are, in fact, making predictions from data. The following activities will enable students to relate rules of probability to estimating from sample results. These exercises provide students with data from random samples from which they can apply rules of probability to make predictions about a population.<br>**3. Class Discussion.** It is important to note that in statistics we generally take **one** sample and make predictions based on these results. Because we take a single sample, it is vital that the procedures used to gather the data rely on simple random sampling techniques. In the real world, there is no way to verify that sample results are good estimates of the true population percentage. If we knew the true percentage in the first place, there would be no reason to sample.<br>**4. Formative Assessment.** These questions summarize concepts from several activities and will help the teacher determine if students are grasping the idea of statistical inference.<br>**5. Additional Problems.** "Practice Predicting from Survey Results" is an activity that can be used as individual or additional practice if needed. | |

## ASSESSMENT

Formative Assessment:

Andrew wants to know the number of hours students spend studying outside of school during the week. He asks thirty students in his calculus class to complete a survey. The results are shown below.

| # Hours studying in a week | 0 – 5 | 6 – 10 | 11 – 15 | over 16 |
|---|---|---|---|---|
| # Students | 4 | 12 | 9 | 5 |

1. Identify the population this sample is intended to describe.
   *(The population is all students in Andrew's school.)*
2. What is the sample?
   *(The sample contains thirty students in Andrew's calculus class.)*
3. According to the survey, what proportion of students study between 6 and 10 hours outside of school in a week?
   ( $12/30 = 0.40$ or about 40% of students)
4. There are 1500 students in Andrew's school. Use the survey results to estimate the number of students in the school who study for less than 5 hours per week.
   *(According to the sample, about 200 students study for less than 5 hours a week.)*
5. Do you think that Andrew's sample results are good estimates for the population you identified in #1? Use principles of simple random sampling to justify your answer.
   *(No. Although Andrew's sample is probably large enough, he selects only calculus students. The sample is biased because calculus students may have study habits that differ significantly from those of other students.)*

## HOMEWORK

"Practice Predicting from Survey Results"

# Understanding Probability

Consider the following events and estimate how likely each is to occur. Use the following scale to help you. A "0" means that the event will never happen, and a "1" means that the event is certain to happen.

| Impossible | | | | Certain |
|---|---|---|---|---|
| 0 | 0.25 | 0.50 | 0.75 | 1 |

1. You will get an *A* on your next math quiz.

2. You will have chicken for dinner tonight.

3. The sun will set this evening.

4. It will rain sometime this week.

5. It will snow in Maryland this July.

6. A dog can live without water for one month.

7. The next baby born at Union Memorial Hospital will be a girl.

8. You will have scrambled eggs for lunch one day this week.

9. You will be absent from school at least one day during this school year.

10. A Republican will win the next presidential election.

# Predicting from Survey Results

The Student Government of Central High School wants to determine which activity students would enjoy most: a dance, an ice cream social, a carnival, or a movie night. They agreed on an appropriate sampling technique and conducted a survey of 400 students. The table below gives the results of the survey broken down by class.

| | Dance | Ice Cream | Carnival | Movie | Total |
|---|---|---|---|---|---|
| Freshmen | 9 | 14 | 40 | 37 | 100 |
| Sophomores | 27 | 12 | 57 | 4 | 100 |
| Juniors | 13 | 24 | 44 | 19 | 100 |
| Seniors | 19 | 11 | 59 | 11 | 100 |

Answer the following questions using the survey results.

1. If a high school junior is selected at random, what is the probability that he would favor a school dance? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

2. If a high school freshman is selected at random, what is the probability that he would favor movie night? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

3. If any high school student is selected at random, what is the probability that he would favor an ice cream social? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

4. What percent of those who favor the carnival are seniors? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

5. According to the data, what prediction should the Student Government make with respect to the school activity the students would enjoy the most? Use mathematics to justify your answer.

6. A student from Central High School is randomly selected and asked which social activity he prefers. Based on this data, what is the probability that he favors the school dance? Use mathematics to justify your answer.

7. Suppose the 400 students in the sample were not selected randomly. Would it be reasonable to conclude that 50% of all students favor a carnival? Use mathematics to justify your answer.

The diagram below shows the results of a two-question survey administered to 80 randomly selected students at Highcrest Middle School.

| | | Do you play a musical instrument? | |
|---|---|---|---|
| | | Yes | No |
| Do you play on a sports team? | Yes | 12 | 34 |
| | No | 20 | 14 |

8. Based on the data, what is the probability that a student selected at random plays on a sports team and plays a musical instrument? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

9. Based on the data, what is the probability that a student who plays on a sports team also plays a musical instrument? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

10. a. Based on the data, what is the probability that a student, chosen at random, plays a musical instrument?

b. Of the 2100 students in the school, how many would you expect to play a musical instrument? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation

# Practice Predicting from Survey Results

A random sample of forty students at your school was selected, and students were asked whether or not they have a family pet. The table below gives the results of the survey

| | Girls | Boys | Total |
|---|---|---|---|
| Has a family pet | 15 | 14 | 29 |
| Does not have a family pet | 7 | 4 | 11 |
| | 22 | 18 | 40 |

Suppose another student is randomly selected from the student body. Use the results of the survey to estimate the following probabilities.

1. What is the probability that the student is a boy?

2. What is the probability that the student does not have a family pet?

3. What is the probability that the student has a cat?

4. If the randomly selected student is a girl, what is the probability that she has a family pet? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

5. Suppose there are 1,600 students in the school. How many would you expect to have a family pet? Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

6. Would it be reasonable to use the sample results to make predictions about the student population at a different school? Use mathematics to justify your answer.

7. Suppose the students selected for the original survey were not a simple random sample of the student body. Would it be reasonable to make predictions about the entire student population based on the sample results? Use the principals of simple random sampling to justify your answer.

# Understanding Probability
## Answer Key

1. Answers will vary.
2. Answers will vary.
3. 1
4. Answers will vary.
5. 0
6. 0
7. 0.5
8. Answers will vary, probably close to 0.
9. Answers will vary, probably close to 1.
10. Answers will vary, probably close to 0.5.

# Predicting from Survey Results
## Answer Key

1. $13/100 = 0.13$
2. $37/100 = 0.37$
3. $(14+12+24+11)/400 = 0.1525$
4. $40/(40+57+44+59) = 0.20 = 20\%$
5. Look at the following table.

| Activity | Dance | Ice Cream | Carnival | Movie |
|---|---|---|---|---|
| Total # in Survey | 68 | 61 | 200 | 71 |
| Proportion | 0.17 | 0.1525 | 0.50 | 0.1775 |

Half of the students in the survey favor the Carnival, so this is what the SGA should plan for.

6. Since 17% of those surveyed prefer a school dance, the probability that a student selected randomly from the population favors a dance is also 17%. Note: this is only true for results from simple random samples.
7. No. If the sample was not selected randomly, it may not reflect the true proportions of opinions of students in the school. It would not be reasonable to draw conclusions about a population from a sample *not* selected randomly.
8. $\frac{12}{80} = 0.15$
9. $\frac{12}{12+34} = 0.261$
10. a. $\frac{12+20}{80} = 0.40$

    b. $0.40(2100) = 840$

# Practice Predicting from Survey Results
# Answer Key

1. $\frac{18}{40} = 0.45$
2. $\frac{11}{40} = 0.275$
3. Cannot estimate this probability because there is not enough information.
4. $\frac{15}{22} = 0.6818$
5. $\frac{29}{40}(1600) = 1160$
6. No. The sample represents the population of the particular school and would not necessarily be representative of students at a different school.
7. No. Without randomness in the sample selection, we cannot be sure that each member in the population has the same chance of being chosen or the members of the population were selected independently from each other. The sample will most likely *under*represent particular groups, so the results from the sample would not reflect the views of these groups.