

# Could You Participate in Our Survey?

## Interpreting Frequency Distributions

### 10.1

#### LEARNING GOALS

In this lesson, you will:

- Construct and interpret frequency and frequency marginal distributions displayed in two-way tables for two-variable categorical data.
- Create and interpret graphs of frequency distributions displayed in two-way tables.

#### KEY TERMS

- categorical data
- two-way frequency table
- frequency distribution
- joint frequency
- frequency marginal distribution

In order for many businesses to be successful they need one thing: money. If they do not have money, they have two choices—make more money or cut back on spending. While businesses have the opportunity to make more money, government-funded programs, such as schools or public libraries, do not have this option. In turn, these programs must figure out ways to cut back on their spending. So what do they do? These places must first prioritize and determine what areas need the most funding. For example, a school might desperately need new computers. Once these decisions are made, they must look at their budget and figure out where they can cut costs so that they have the money needed for these priorities. Oftentimes in schools this may mean getting rid of extra-curricular activities or limiting the school lunch menu.

Have you noticed any changes in your school? Do you think these changes are the result of school budget cuts? Do you have any ideas on how schools could cut costs without eliminating any programs?

**PROBLEM 1 Hot Lunch!**



Ms. Seymour is the school cafeteria supervisor at Williams High School. She has been asked to cut her food budget for the upcoming school year. One idea she has is to cut the number of meal choices during the week. However, determining which meal to cut will not be an easy decision. Ms. Seymour wonders if there is a difference in students' favorite cafeteria meals by grade level. She decides to survey the students in Mr. Kolbe's gym class, which consists of 9th and 10th graders. She recorded the results of her survey in the table shown.

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Grade	Favorite Meal
9	Salad bar
10	Burgers
10	Pizza
10	Chicken nuggets
10	Chicken nuggets
9	Burgers
10	Salad bar
9	Salad bar
10	Chicken nuggets
9	Burgers
10	Pizza
9	Salad bar
9	Burgers
10	Burgers
9	Chicken nuggets
9	Salad bar
10	Chicken nuggets
10	Chicken nuggets
10	Salad bar
10	Burgers
10	Salad bar
9	Burgers
9	Pizza
10	Chicken nuggets
10	Salad bar
9	Salad bar
10	Pizza
9	Pizza
10	Chicken nuggets
9	Pizza

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1. Analyze Ms. Seymour's data table.
  - a. Can you summarize her findings just by looking at her data table? Explain why or why not.
  - b. Identify the variables of the data from Ms. Seymour's survey. Are the variables in the table numerical? Explain your reasoning.

Categorical data can also be called qualitative data.



Previously, you explored the relationship between two variables that had data values that were quantitative, or numerical. Data that can be grouped into categories, such as favorite meals, are called **categorical data**.

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One method of organizing categorical data is to use a *two-way frequency table*. A **two-way frequency table** displays categorical data by representing the number of occurrences that fall into each group for two variables. On the table, one variable is divided into rows and the other is divided into columns.

2. Identify the groups for the variable, grade level. How many groups are there for this variable?

3. Identify the groups for the variable, favorite meal. How many groups are there for this variable?

Remember, there is a difference between the variables in a data set and the groups in a data set.





4. Create a two-way frequency table of the data.
  - a. Enter the name of each group.
  - b. Record the favorite meal for each student in the appropriate row using tally marks. Then, write the frequency of each meal for each grade level.



Favorite Meals of Students

Grade Level				

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5. What observations can you make from the data about the students' favorite meals?



The table you created is a *frequency distribution*. A **frequency distribution** displays the frequencies for categorical data in a two-way table. Each time you determined the frequency of one favorite meal of one of the grade levels, you recorded a *joint frequency*. Any frequency you record within the body of a two-way frequency table is known as a **joint frequency**.

A two-way frequency table is helpful in organizing each group's frequency in an efficient way. However, it is common to determine the total number of people surveyed just to ensure that a good survey was taken. Determining this total is also helpful to ensure that you recorded the data accurately within the table. For example, if you know 50 people took part in the survey, and the sum of the joint frequencies is 47, then you know that you are missing three data points from the data set.

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6. Use the data from your frequency distribution to determine the total number of 9th graders and 10th graders, and to determine the total number of frequencies for each favorite meal category.

**Favorite Meals of Students**

		Burgers	Chicken Nuggets	Pizza	Salad Bar	Total
Grade Level	9th grade					
	10th grade					
	Total					

You just created a *frequency marginal distribution* of the data by determining the totals for each group. A **frequency marginal distribution** displays the total of the frequencies of the rows or columns of a frequency distribution.



7. Analyze the frequency marginal distribution to answer each question.
- How many 9th graders participated in the survey?
  - How many students prefer burgers?
  - How many students prefer chicken nuggets?
  - How many 10th graders participated in the survey?
  - How many students prefer salad bar?
8. What do you notice about the total number of students who prefer burgers, chicken nuggets, pizza, and salad bar; and the total number of 9th and 10th graders? Can you use this observation to determine if you correctly determined the frequency distribution?

9. Use the frequency marginal distribution to answer each question.

- a. Which meal is the least favorite of all students?
- b. Which meal is the least favorite of 9th graders?
- c. Which meal is the most favorite of all students?



- d. Which meal is the most favorite of the 10th graders?

**10** **PROBLEM 2** **Representing Data**



While a two-way table shows a numerical summary of the data, a graph can help relay information about a survey in a visual way. Remember, every graph tells a story.

Recall that Ms. Seymour is trying to determine ways to cut the cafeteria budget for the upcoming school year. She has already gathered her data and organized it in a frequency distribution table. Ms. Seymour has a couple of ideas, but she would like to use a graph to visually display the ideas she has for cutting the cafeteria budget.

Ms. Seymour's data are displayed in the frequency distribution table shown.

		Burgers	Chicken Nuggets	Pizza	Salad Bar
Grade Level	9th grade	4	1	3	5
	10th grade	3	7	3	4

- 1. Analyze the frequency distribution table.
  - a. Determine which graphs would be appropriate to display Ms. Seymour's data. Justify your response.
  - b. Determine which graphs would not be appropriate to display Ms. Seymour's data. Explain why these graphs would not be appropriate for displaying this data.

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2. Construct a double bar graph of the frequencies. Let the  $x$ -axis represent the favorite meals, and let the  $y$ -axis represent the number of students.

Remember to create a key so you can identify what each bar represents!



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3. What conclusions can you draw by examining the graph?

4. Use the graph to determine if you represented the data from the frequency distribution table accurately. Explain how you verified that the data in the graph matches the data in the frequency distribution table.

5. Construct a bar graph of the frequencies. This time, let the  $x$ -axis represent grade level.



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6. What conclusions can you draw by examining the graph?



7. Does it matter which graph Ms. Seymour's uses to display her survey data? Why or why not.

**PROBLEM 3** Putting It All Together



Ms. Seymour must decide on a plan for the upcoming school year. The principal of the school would like Ms. Seymour to present her data and a graph to justify her decision to cut costs.

1. Which meal choice would you cut according to the data? Explain why you would discontinue that meal choice. Then explain which graph you would recommend Ms. Seymour use when she presents her plan.

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2. Ms. Seymour just thought of an idea, and she thinks it will help cut the cafeteria costs. She is recommending that two lunch periods be created: one for the 9th graders and one for the 10th graders. She thinks that if two lunch periods exist, she can keep all four meal choices, but just cook a lesser amount of certain choices; thus cutting costs.
- a. Do you think Ms. Seymour should present this idea to the principal? Use the data to justify your reasoning.

- b. Which graph would you recommend Ms. Seymour use to justify her solution? Explain your reasoning.

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Be prepared to share your solutions and methods.