

Lesson 10: Summarizing Bivariate Categorical Data with Relative Frequencies

Classwork

This lesson expands on your work with two-way frequency tables from Lesson 9.

Exploratory Challenge 1: Extending the Frequency Table to a Relative Frequency Table

Determining the number of students in each cell presents the first step in organizing bivariate categorical data. Another way of analyzing the data in the table is to calculate the *relative frequency* for each cell. Relative frequencies relate each frequency count to the total number of observations. For each cell in this table, the *relative frequency* of a cell is found by dividing the frequency of that cell by the total number of responses.

Consider the two-way frequency table from the previous lesson.

Two-Way Frequency Table:

	To Fly	Freeze Time	Invisibility	Super Strength	Telepathy	Total
Females	49	60	48	1	70	228
Males	51	71	27	25	48	222
Total	100	131	75	26	118	450

The relative frequency table would be found by dividing each of the above cell values by 450. For example, the relative frequency of females selecting “To Fly” is $\frac{49}{450}$, or approximately 0.109, to the nearest thousandth. A few of the other relative frequencies to the nearest thousandth are shown in the following relative frequency table:

	To Fly	Freeze Time	Invisibility	Super Strength	Telepathy	Total
Females	$\frac{49}{450} \approx 0.109$					$\frac{228}{450} \approx 0.507$
Males			$\frac{27}{450} \approx 0.060$			
Total		$\frac{131}{450} \approx 0.291$			$\frac{118}{450} \approx 0.262$	

Exercises 1–7

- Calculate the remaining relative frequencies in the table below. Write the value in the table as a decimal rounded to the nearest thousandth or as a percent.

Two-Way Frequency Table:

	To Fly	Freeze Time	Invisibility	Super Strength	Telepathy	Total
Females						
Males						
Total						

- Based on previous work with frequency tables, which cells in this table would represent the joint relative frequencies?
- Which cells in the relative frequency table would represent the marginal relative frequencies?
- What is the joint relative frequency for females who selected “invisibility” as their favorite superpower?
- What is the marginal relative frequency for “freeze time”? Interpret the meaning of this value.

6. What is the difference in the joint relative frequencies for males and for females who selected “to fly” as their favorite superpower?

7. Is there a noticeable difference between the genders and their favorite superpowers?

Exploratory Challenge 2: Interpreting Data

Interest in superheroes continues at Rufus King High School. The students who analyzed the data in the previous lesson decided to create a comic strip for the school website that involves a superhero. They thought the summaries developed from the data would be helpful in designing the comic strip.

Only one power will be given to the superhero. A debate arose as to what power the school’s superhero would possess. Students used the two-way frequency table and the relative frequency table to continue the discussion. Take another look at those tables.

Scott initially indicated that the character created should have “super strength” as the special power. This suggestion was not well received by the other students planning this project. In particular, Jill argued, “Well, if you don’t want to ignore more than half of the readers, then I suggest ‘telepathy’ is the better power for our character.”

Exercises 8–10

Scott acknowledged that “super strength” was probably not the best choice based on the data. “The data indicate that “freeze time” is the most popular power for a superhero,” continued Scott. Jill, however, still did not agree with Scott that this was a good choice. She argued that “telepathy” was a better choice.

8. How do the data support Scott’s claim? Why do you think he selected “freeze time” as the special power for the comic strip superhero?

9. How do the data support Jill's claim? Why do you think she selected "telepathy" as the special power for the comic strip superhero?
10. Of the two special powers "freeze time" and "telepathy," select one and justify why you think it is a better choice based on the data.

Lesson Summary

- *Categorical data* are data that take on values that are categories rather than numbers. Examples include male or female for the categorical variable of gender or the five superpower categories for the categorical variable of superpower qualities.
- A *two-way frequency table* is used to summarize bivariate categorical data.
- A *relative frequency* compares a frequency count to the total number of observations. It can be written as a decimal or percent. A two-way table summarizing the relative frequencies of each cell is called a *relative frequency table*.
- The marginal cells in a two-way relative frequency table are called the *marginal relative frequencies*, while the joint cells are called the *joint relative frequencies*.

Problem Set

1. Consider the Rufus King High School data from the previous lesson regarding after-school activities:

	Intramural Basketball	Chess Club	Jazz Band	Not Involved	Total
Males	20	2	8	10	40
Females	20	10	10	20	60
Total	40	12	18	30	100

Calculate the relative frequencies for each of the cells to the nearest thousandth. Place the relative frequencies in the cells of the following table. (The first cell has been completed as an example.)

	Intramural Basketball	Chess Club	Jazz Band	Not Involved	Total
Males	$\frac{20}{100} = 0.200$				
Females					
Total					

2. Based on your relative frequency table, what is the relative frequency of students who indicated they play basketball?
3. Based on your table, what is the relative frequency of males who play basketball?
4. If a student were randomly selected from the students at the school, do you think the student selected would be a male or a female?
5. If a student were selected at random from school, do you think this student would be involved in an after-school program? Explain your answer.
6. Why might someone question whether or not the students who completed the survey were randomly selected? If the students completing the survey were randomly selected, what do the marginal relative frequencies possibly tell you about the school? Explain your answer.
7. Why might females think they are more involved in after-school activities than males? Explain your answer.