

# 9.4 Two-Way Tables

Sometimes we need to compare two sets of data where the data is a yes/no type answer. In this case a scatter plot doesn't make sense since we don't have numerical data. We use what is called a two-way table to analyze this type of data.

## Constructing a Two-Way Table

To construct a two-way table, we first need some data. Let's look at the following fictional table where we asked a class of 22 students a series of questions:

	Anne	Brad	Cathy	Devin	Edith	Frank	Gabby	Hannah	Ignus	Jake	Koty
Democrat/ Republican?	D	R	R	R	D	D	R	R	R	D	D
Do you eat McDonald's weekly?	Y	Y	Y	N	N	Y	Y	Y	Y	N	N
Want higher taxes?	Y	N	N	N	N	Y	N	N	N	Y	N
Do you own smartphone?	N	Y	Y	N	Y	Y	N	Y	Y	N	N

	Lisa	Mo	Nancy	Opy	Peggy	Quira	Ron	Shela	Toni	Ula	Vanna
Democrat/ Republican?	D	D	D	R	R	D	R	D	R	D	D
Do you eat McDonald's weekly?	N	Y	N	Y	N	N	N	N	Y	N	N
Want higher taxes?	N	Y	Y	N	N	N	Y	N	N	Y	Y
Do you own smartphone?	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y

Now that we have our data, we will consolidate some of it into a two-way table. Let's first compare the students' political view to their eating habits at McDonald's. A two-way table for this comparison would look like this:

	Democrat	Republican
Eat McD's weekly	3	7
Don't eat McD's weekly	9	3

How did we fill this out? We counted the number of Democrats that eat at McDonald's weekly, the number of Republicans that eat at McDonald's weekly, the number of Democrats that don't eat at McDonald's weekly, and the number of Republicans that don't eat at McDonald's weekly. Each of

those numbers we filled in the table in the appropriate place. Obviously one of the advantages of the two-way table is the fact that it takes up so much less space than the original data. We could make a similar two-way table comparing political affiliation with tax views or comparing tax views with owning a smart phone.

## Analyzing a Two-Way Table

There are many things that a two-way table can tell us. Let's look at another example of how the U.S. House of Representatives voted on a recent bill that would force the national budget to be balanced.

	Democrat	Republican
In favor	25	236
Against	161	4

How many Democrats voted on this bill? If 25 voted in favor of the bill and 161 voted against, that means that a total of 186 Democrats voted on this bill. In essence we are finding the frequency of being a Democrat by adding the numbers in the Democrat column. **Frequency** is how often something occurs.

Similarly we can see how many Republicans voted on this bill, which is 240. How many total representatives voted on this bill? We can find this by adding all the numbers together. This means that 426 representatives in total voted on this bill. Since there are 435 representatives (we know this from our social studies class), we can then ask why the remaining 9 representatives didn't vote. Call them and ask.

We can also see that 261 voted in favor of the bill and 165 voted against the bill by adding the numbers in the rows. While this is a majority vote, it is not the required 290 votes needed to pass, so ultimately this bill failed.

At times it may be more useful to look at the relative frequency instead of the frequency. **Relative frequency** is the ratio of the frequency to the total number of data entries. So while the frequency of in favor votes was 261, it might be more useful to know that the relative frequency is  $\frac{261}{426} \approx 0.61$ . So about 61% of the House voted in favor of this bill and a vote of  $\frac{2}{3}$  or 66. $\bar{6}$ % was needed for the bill to pass.

Are there any other conclusions we can make based on the information in the two-way table? For example, is there evidence that one party supported the bill over the other? It appears from the data table that there is a positive association between being a Republican and being in favor of the balanced budget bill. It appears that there is a negative association between being a Democrat and being in favor of the balanced budget bill. Notice that this doesn't mean that the Republicans are positive (or correct) and Democrats are negative (or wrong). Instead the positive and negative refer to the association or correlation in the data.

## Lesson 9.4

Use the data set to answer the following questions. For this data set a class of middle school students was asked what they thought was most important in school: good grades or popularity.

Boy or Girl	B	B	G	G	G	B	G	B	B	G	G	B	G	B	G	B	B	G	G	B
Grades or Popularity	P	G	G	P	G	P	G	G	P	G	G	P	G	P	P	P	G	G	G	P

Boy or Girl	B	B	G	G	G	B	G	B	B	G	G	B	G	B	G	B	B	G	G	B
Grades or Popularity	P	G	P	G	G	P	G	P	P	G	G	G	G	P	P	P	G	P	G	G

1. Construct a two-way table of the data.

	Grades	Popularity
Boys		
Girls		

- What is the frequency of students who believe grades are more important?
- What is the *relative* frequency of students who believe grades are more important?
- What is the frequency of students who believe popularity is more important?
- What is the *relative* frequency of students who believe popularity is more important?
- What is the frequency of girls who believe grades are more important?
- What is the *relative* frequency of girls who believe grades are more important?
- What is the frequency of boys who believe popularity is more important?
- What is the *relative* frequency of boys who believe popularity is more important?
- Based on this data, do you feel there is relationship between a student's gender and what they think is most important in school? What is that relationship and what evidence do you have that it exists?

Use the data set to answer the following questions. For this data set a class of middle school students was asked what hand was their dominant hand.

Boy or Girl	B	B	G	G	G	B	G	B	B	G	G	B	G	B	G	B	B	G	G	B
Right or Left	L	R	R	L	R	L	R	R	R	R	L	R	R	R	R	R	L	R	L	R

Boy or Girl	B	B	G	G	G	B	G	B	B	G	G	B	G	B	G	B	B	G	G	B
Right or Left	R	R	L	R	R	R	L	R	L	R	R	R	L	R	R	L	R	R	L	L

11. Construct a two-way table of the data.

	Right-handed	Left-handed
Boys		
Girls		

- 12. What is the frequency of students who are right-handed?
- 13. What is the *relative* frequency of students who are right-handed?
- 14. What is the frequency of students who are left-handed?
- 15. What is the *relative* frequency of students who are left-handed?
- 16. What is the frequency of girls who are right-handed?
- 17. What is the *relative* frequency of girls who are right-handed?
- 18. What is the frequency of boys who are right-handed?
- 19. What is the *relative* frequency of boys who are right-handed?
- 20. Based on this data, do you feel there is relationship between a student's gender and whether or not they are right-handed? What is that relationship and what evidence do you have that it exists?

Use the two-way tables representing surveys middle school students took to answer the following questions.

Survey 1:	Prefer Spicy Salsa	Prefer Mild Salsa
Boys	255	45
Girls	68	132

Survey 2:	Prefer Spicy Salsa	Prefer Mild Salsa
Right-handed	280	170
Left-handed	43	7

21. How many students were surveyed?
22. What is the *relative* frequency of students who prefer spicy salsa? Is it the same on both two-way tables?
23. How many boys were surveyed?
24. How many girls were surveyed?
25. What is the *relative* frequency of boys who prefer spicy salsa?
26. What is the *relative* frequency of girls who prefer spicy salsa?
27. Do you think there is a relationship between gender and salsa preference? What is that relationship and what evidence do you have that it exists?
28. How many right-handed students were surveyed?
29. How many left-handed students were surveyed?
30. What is the *relative* frequency of right-handed students who prefer mild salsa?
31. What is the *relative* frequency of left-handed students who prefer mild salsa?
32. Do you think there is a relationship between a student's dominant hand and salsa preference? What is that relationship and what evidence do you have that it exists?