

# Bar Graphs and Pie Charts

by Sophia



## WHAT'S COVERED

This tutorial will cover how to display qualitative data utilizing bar graphs and pie charts. We will explore how to create and interpret bar graphs and pie charts, discussing the following:

1. Bar Graphs
2. Bar Graphs: Relative Frequency
3. Multiple Bar Graphs
3. Pie Charts

## 1. Bar Graphs

Categorical data is qualitative data, and it can be displayed visually in a **bar graph**, which will compare the number of values in each category. A bar graph is not the only way to display categorical data, but it is a common way.

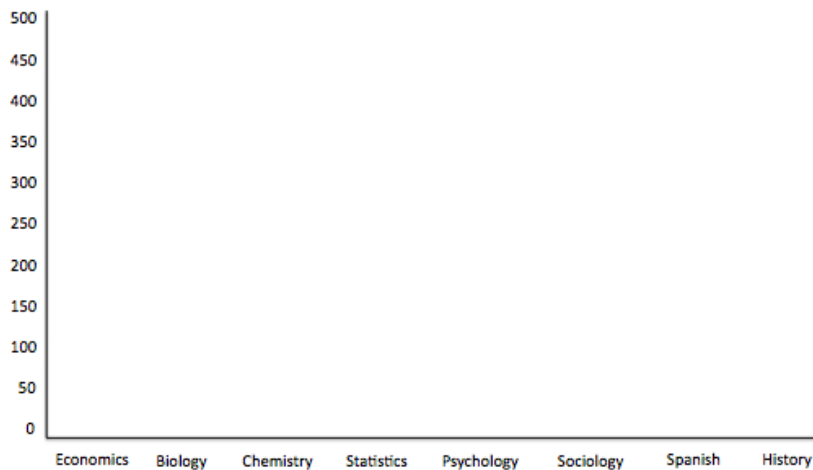
Suppose there are 2070 students enrolled in the following college courses, which are taken by different majors. At this particular college, there are 331 economics majors, 435 biology majors, 124 chemistry majors, etc.

Course	Frequency
Economics	331
Biology	435
Chemistry	124
Statistics	248
Psychology	311
Sociology	248
Spanish	207

You begin by drawing a horizontal axis and labeling the categories beneath it. You could also label it on the vertical axis and label the categories from top to bottom if you want. So, you wrote economics, biology, chemistry, and visually separated them.

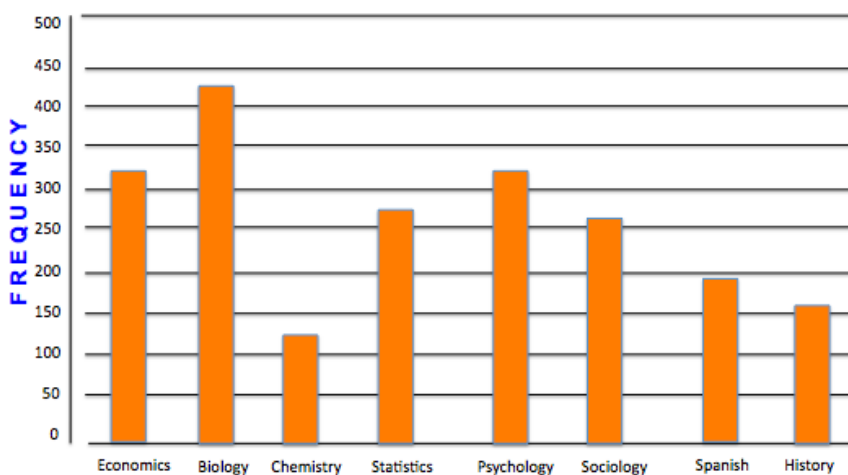
Economics   Biology   Chemistry   Statistics   Psychology   Sociology   Spanish   History

Then, you need to create a vertical axis with frequency on it. The highest number in the data set is 435, so a smart choice would be to have the vertical axis frequencies go up to 450, or even 500. This way, all values will be represented.



Finally, you set up a bar that goes up to the number that corresponds to that category. Therefore, economics will have a bar that goes up to 331, biology will go all the way up to almost 450, etc.

The full bar graph looks like this:



#### TERM TO KNOW

### Bar Graph

A distribution of qualitative data that displays bars that are proportional in length to the frequency or relative frequency of a particular data value

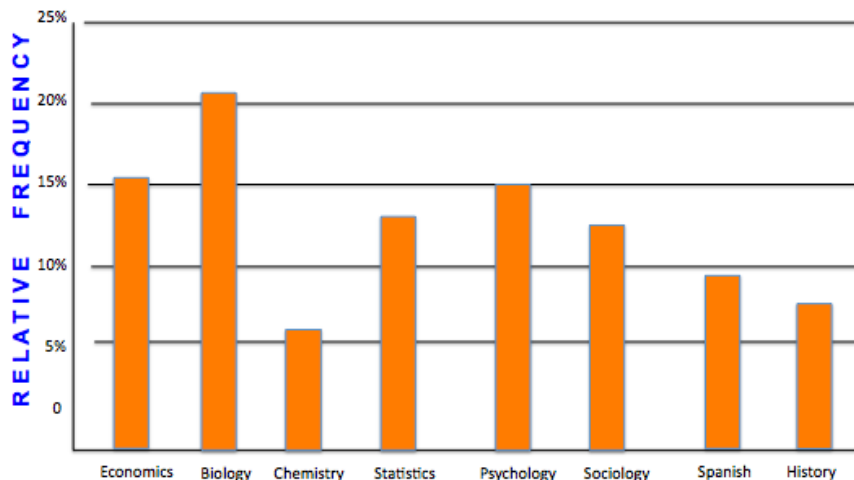
## 2. Bar Graphs: Relative Frequency

You can also use a bar graph to show relative frequency. Relative frequency shows how much of the whole each class represents. It is the percent of the values that are in each category.

How do you calculate relative frequency? Take each number, and divide it by the total number.

Course	Frequency	Relative Freq
Economics	331	$/2070 = 16\%$
Biology	435	$/2070 = 21\%$
Chemistry	124	$/2070 = 6\%$
Statistics	248	$/2070 = 12\%$
Psychology	311	$/2070 = 15\%$
Sociology	248	$/2070 = 12\%$
Spanish	207	$/2070 = 10\%$
History	166	$/2070 = 8\%$

There are 435 out of 2070 students in Biology, which means that Biology students make up  $435/2070 = 21\%$  of the total students. So you can see that the biology bar has just over 20% of the students.



Notice that in the previous example with counts, and this example with relative frequency, the shape and size of the bars didn't change. The only thing that changed was the vertical axis and what it was measuring.

### 3. Multiple Bar Graphs

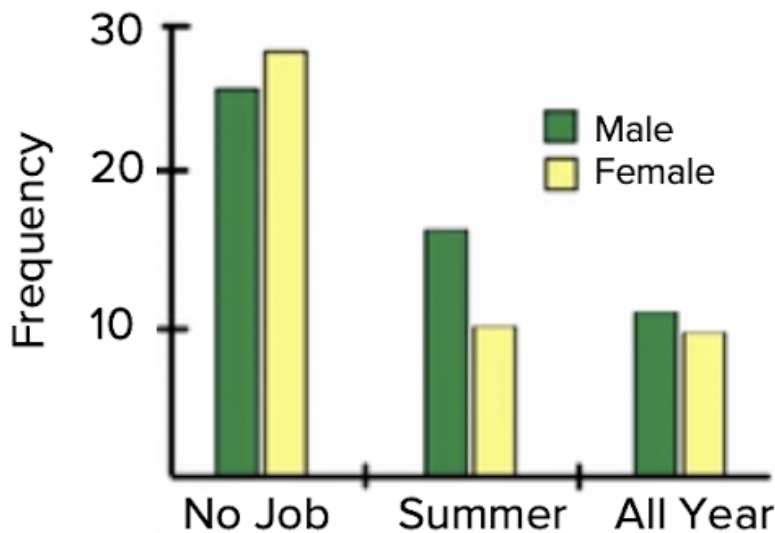
Suppose that you wanted to know about the work habits of college students so you sample of 100 students. Perhaps you want to know if they were male or female, and whether they did not work at all, worked during summer only, or had a job all year long.

The following table shows the data collected in this sample.

	Male	Female
No Job	25	28
Summer Only	17	10
Job All Year	11	9

You can create multiple bar graphs on the same set of axes and compare them by category. One way to display these items in a bar graph would be to break it up by male and female. You choose green to be males and yellow to be females.

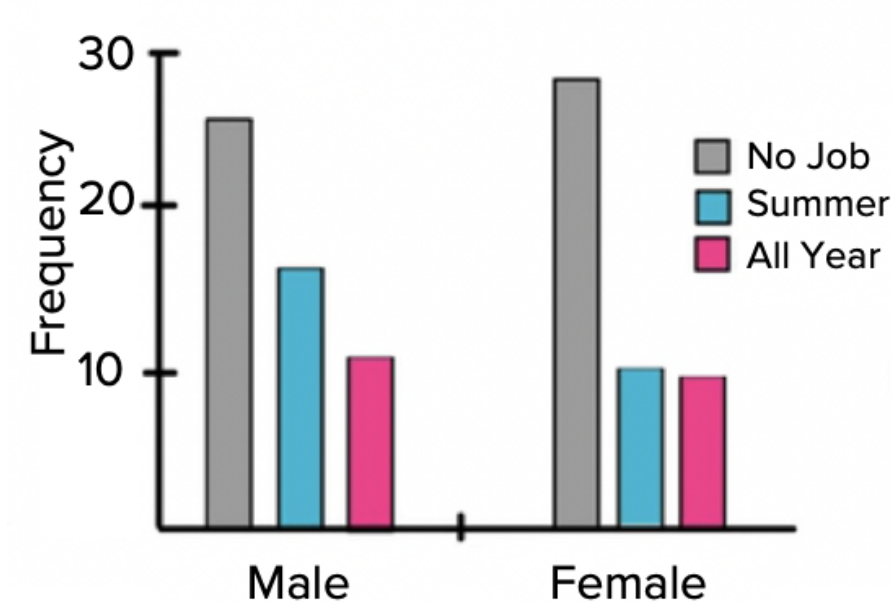
Next, you would break the horizontal axis into no job, summer only, and job all year.



Both bar graphs would be presented side-by-side within each category. There are 25 males who had no job and 29 females who had no job, etc.

What this one tells us is that males are more likely than females to have a job all year and in summer, and a little bit less likely than females to never have had a job.

The other way would be to flip-flop which category is represented by the colors and which category goes on the axis. Male and female could go on the axis, and the job status could be the colors. In that case, it would look like the following graph:



This graph will tell you that both males and females have a tendency towards not having a job, then have a summer job or have a job all year.

### 3. Pie Charts

As mentioned, qualitative data can be displayed in a couple of different ways. As discussed above, one way is to display it in a bar graph. Another way to display it is with a **pie chart**. A pie chart displays relative frequencies for each category, which considers how these categories relate to the whole.

Let's use the same set of information from the first example with the 2070 students enrolled in college courses.

To make a pie chart, the first thing to do is to calculate relative frequencies. Remember, relative frequency is the percent of the values that are in each category and can be calculated by dividing each data value by the total number.

Course	Frequency	Relative Freq
Economics	331	/2070 = 16%
Biology	435	/2070 = 21%
Chemistry	124	/2070 = 6%
Statistics	248	/2070 = 12%
Psychology	311	/2070 = 15%
Sociology	248	/2070 = 12%
Spanish	207	/2070 = 10%

History	166	/2070 = 8%
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Now its time to create the pie chart by following the steps below:

**Step 1:** First, find the relative frequency.

**Step 2:** Next, calculate the central angle for each category using the relative frequency. You may recall there are 360 degrees in a circle. The central angle for economics has to be 16 percent of the circle. So how do you set this up? You need 16% of 360 degrees. Multiply each percent by 360.

Course	Frequency	Relative Freq	Angle
Economics	331	$\div 2070 = 16\%$	$\times 360 = 57.6^\circ$
Biology	435	$\div 2070 = 21\%$	$\times 360 = 75.6^\circ$
Chemistry	124	$\div 2070 = 6\%$	$\times 360 = 21.6^\circ$
Statistics	248	$\div 2070 = 12\%$	$\times 360 = 43.2^\circ$
Psychology	311	$\div 2070 = 15\%$	$\times 360 = 54^\circ$
Sociology	248	$\div 2070 = 12\%$	$\times 360 = 43.2^\circ$
Spanish	207	$\div 2070 = 10\%$	$\times 360 = 36^\circ$
History	166	$\div 2070 = 8\%$	$\times 360 = 28.8^\circ$



Remember, when multiplying by a percent, you need to change it into a decimal. For example, you would enter 0.16 for 16%.

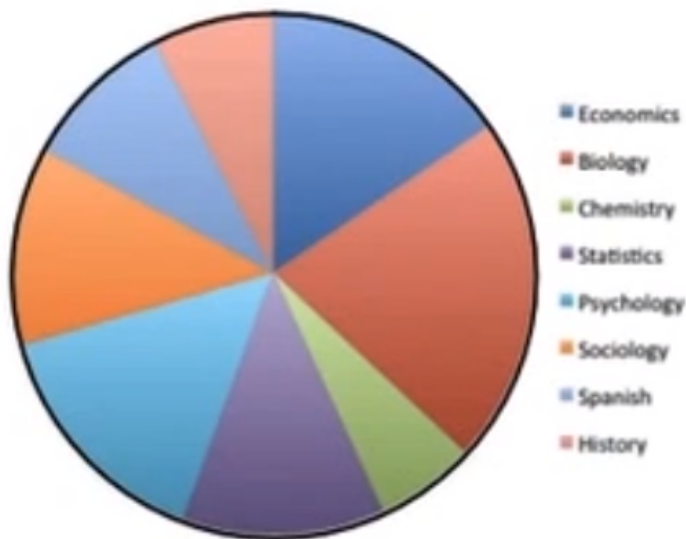
0.16 times 360 gives you about 58 degrees. Therefore, your central angle, representing economics, with be approximately 58 degrees. Do the same thing with the remainder of the categories to obtain angle measurements for each of these central angles.

**Step 3:** Once you have determined the relative frequency of each category, you can create the sectors of your pie chart, shown below:



But which sector corresponds to which category? You could write the words inside each sector, labeling each with the names of the majors. It's fairly clear that the biggest slice is biology. But which ones are the rest? You need to create a key.

**Step 4:** Finally, add a key off to the side. You can either have written the word economics within the blue sector, or you can create a blue square and write "Economics" next to it. That shows that anything that's blue means economics. You can do the same for each of the sectors.



#### STEP BY STEP

1. Find relative frequency
2. Calculate the central angle using the relative frequency.
3. Create the sectors
4. Add a key



## TERM TO KNOW

### Pie Chart/Circle Graph

A distribution of qualitative data that shows the relative frequency of each category as a sector of a circle.



## SUMMARY

Bar graphs are a nice way to view categorical data or the counts in a category for a qualitative data set. We can use frequencies or relative frequencies, if there's no overlap between the categories, to show how each category relates to the others. We can also put multiple bar graphs on the same set of axes. Pie charts are another form of visual display used for qualitative data. They display the relative frequency or percent of each category by dividing a circle into sectors that relate those relative sizes. The biggest advantage of a pie chart over a bar graph is that it is possible to see how each category relates to the whole. It's important to note that sometimes, because of rounding, the relative frequencies don't add up to 100%. They might add up to only 99% or 101%, as they did in our example. However, as long as the relative sizes of each are in the right proportions, it is not a major cause for concern. You can also fix this issue by rounding your values more precisely.

Good luck!

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## TERMS TO KNOW

### Bar Graph

A distribution of qualitative data that displays bars that are proportional in length to the frequency or relative frequency of a particular data value

### Pie Chart/Circle Graph

A distribution of qualitative data that shows the relative frequency of each category as a sector of a circle.