Pie Graph

Inquire: Creating and Interpreting Pie Graphs

Overview

In the world of visual modeling, the pie graph stands alone. No axis, no scale, no coordinate plane. Each pie is a circular graph with sections that show different proportions of data. They are relatively simple to understand as each shows 100% of the data that has been collected. Pie graphs will not show trends or changes over time, but can quickly give a picture of parts of a whole. Creating a pie graph requires either a computer program or a basic knowledge of proportions and angle construction.

Big Question: When is a pie graph the best choice to display data?

Watch: Pizza is Educational!

Hands down, pizza is the easiest way to teach the proportions and percentages of a pie graph.

Imagine a pizza cut into six equal slices. It would be simple to divide this pizza into two, three, or six equal sections because it is separated into sixths. Each sixth of a circle is an angle of 60°, and is 16.6% of the whole pizza. However, it would be difficult to envision a fourth of this pizza because of the way it is cut. We would need to start with a new pie and create new angles. Pizza is usually cut into equal pieces. That is not the case with a pie graph. It would be some pretty amazing data for all of the sections to be the same.

Look at this pie graph showing how Tree Valley High School will budget the money raised from its fall fundraiser.
You can quickly see the smallest section is student scholarships at 3%, and the largest is campus renovations at 24%. But, how much money was actually spent on student scholarships? To answer this, we would have to know either the total budget or the budget for one section. Let’s assume the budget for campus renovations was $60,000. By knowing this amount, we can figure all the others.

Let $x$ = the total budget. We are given the fact that 24% of $x$ = $60,000. We can solve for $x$ by dividing both sides of the equation by .24. The total budget is $250,000. Now that we know the total budget, we can find 3% by multiplying $250,000 times .03. The budget for student scholarships is $7,500.

Whether you are analyzing data that someone else has collected, or deciding how to best display your own data, knowledge of pie graphs is imperative. Remember their pros and cons. Pie graphs are excellent when you need to show all the parts of a whole and their proportional relationships. They are not as effective when you want to show relationships between values, patterns, trends, or change over the passage of time. Look at your data. Decide what you want to display, and choose the best possible visual model for your data and purpose.

What have you discovered that will make it easier for you to work with pie graphs?

**Read: Pie Graphs**

**Overview**

Pie graphs are a type of visual modeling commonly used to compare parts of a whole. A pie graph is a circle divided into sections, usually labeled as percentages. Information can be easily read from a pie graph, but trends cannot be identified. This means that although it is possible to use a pie graph to show the monthly budget of a particular person, it would be difficult to identify trends in his spending pattern. Pie graphs also do not show changes over time. They can be constructed with the help of a computer and knowledge of drawing programs, or they can also be created with pencil, paper, and a protractor.

**Creating a Pie Graph**

Let’s look at a sample pie graph.
The title of the graph is clearly presented: Favorite Colors of Mr. Joe’s Kindergarten Class. The data is divided into sections and labeled as percentages. The total is 100%. The information is easily read. So, let’s see what steps are involved in actually creating a pie graph. We will pretend we have collected the following data by surveying 20 friends.

<table>
<thead>
<tr>
<th>Favorite Types of Candy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

Next we will divide each number by the total number to get a percentage.

6/20 = 30%
5/20 = 25%
1/20 = 5%
5/20 = 25%
3/20 = 15%
Total = 100%

The next step is to figure out how to show these percentages of the circle. Since every circle has 360°, we can multiply each percentage times 360. Six people chose chocolate. That was 30% of the total number of people, so that section of the pie should be 30% of 360. Thirty percent of 360 is 108. The section for chocolate should measure 108°.

6/20 = 30%, 30% of 360 = 108
5/20 = 25%, 25% of 360 = 90
1/20 = 5%, 5% of 360 = 18
5/20 = 25%, 25% of 360 = 90
3/20 = 15%, 15% of 360 = 54
Total Number of Degrees = 360

Now you will need a circle and a protractor. Copy or trace a circle of whatever size you like. Mark the center and a radius from the center to any point on the circle. Use this side as the base of the first angle you choose to draw. You can do the sections in any order.

After all the sections have been drawn, you will need to label them and, if you like, color code them and add a key.
Interpreting Data

Consider the following graph.

The graph is entitled “Party Planning Budget.” It is divided into proportional parts and labeled with percentages. Using the information given to us regarding the data, see if you can answer the following questions.

1. What category takes up the largest percentage of the pie graph?
2. Which two categories are the closest in percentages?
3. What is the percentage attributed to food?
4. Which two categories combine to make over 60% of the graph?


Caution About Pie Charts

The goal is to enlighten with visuals that tell the story of the data. Pie charts have a number of common problems. Too many pieces of the pie overwhelm the reader. Five or six categories ought to give an idea of the relative importance of each piece. If there are more components than this, perhaps another type of graph would be better, or perhaps some could be consolidated into an "other" category.

Pie charts cannot show changes over time, although we see this attempted all too often. In government finance documents, pie charts are often presented to show the components of revenue: income tax, sales tax, motor vehicle taxes, etc. This is interesting information and can be nicely done with a pie chart. The error occurs when two years are set side-by-side. Because the total revenues change year to year, but the size of the pie is fixed, no real information is provided and the relative size of each piece of the pie cannot be meaningfully compared.

As with all visual representations of data, it is wise to know the pitfalls when data is not handled appropriately.
Reflect Poll: Going Around in Circles

Sometimes, people avoid pie graphs because they can be difficult to construct. If you believed your data would be best presented in a pie graph, but did not know how to make one, where would you begin?

- Google “make pie graph”
- Read the Read section of this lesson and follow the instructions
- Try Excel
- Try PowerPoint
- Beg your geek friend to do it for you

Expand: Solving Problems with a Pie Graph

Overview

It is good to know how to create pie graphs for your own data, but you also need to know how to solve problems with other pie graphs. It’s all ratio, proportion, percent, and a matter of taking the information you are given to solve for the information you need.

Problems and Solutions

Let’s solve problems for this more complicated graph.

We are given a lot of information in this graph, but the one thing we aren’t told is the size of the sample. Let’s first suppose the sample size was 1000 people. (That will make the math easy!)

Question:
How many people were in the largest class structure of Employees?
Solution:
Since the Employees proportion of the pie is 39.1%, the answer will be 39.1% x 1000 = 391 people.

Question:
Now suppose we didn’t know the sample size, but we knew there were 2,730 people in the Middle Management group. How many people are in Lower Management?

Solution:
We will start with what we know. There are 18.2% of the total number in Middle Management. That number is 2730. Let x equal the total number of people. In an equation, we would change the percent to a decimal and write the equation as:

\[ .182x = 2730 \]

Solve for x by dividing both sides of the equation by 182. The value for the total number is 15,000. Since the total number is 15,000, and Lower Management is 31.4% of the total, 31.4% times 15,000 is 4,710 people. There are 4,710 people in Lower Management.

Question:
Now assume we didn’t have the percentage given for the Upper Management section of the graph, but we had all the other percentages.

Solution:
We know that the sections of a pie graph must always total 100%. To solve this problem, total all of the given sections and subtract that value from 100%. The percent for Upper Management equals 0.7%.

One of the best things about solving problems with pie graphs is that the totals of the sections must always be 100%. You will always be working with parts of the whole, and pie graphs are the only type of visual modeling that will give you that assurance. It’s good to have absolutes!

Lesson Toolbox

Additional Resources and Readings
A teacher-created video focusing on solving problems using pie charts
- Link to resource: https://youtu.be/flfRVAIOhSo

A video helping a CIA operative create a circle graph to show his expenses
- Link to resource: https://youtu.be/S3yRRP6F-mo

A video showing how to find the percent of a number using data from a pie chart
- Link to resource: https://youtu.be/G5vqSr0YRZ8

Lesson Glossary

die graph: a circular graph divided into slices to illustrate numerical proportion; used to illustrate parts of a whole
protractor: an instrument for measuring angles, typically in the form of a flat semicircle marked with degrees along the curved edge
radius: a straight line from the center of a circle to any point on the edge of the circle

Check Your Knowledge

1. A pie graph cannot show...
   a. change over time.
   b. the proportions of sections to a whole.
   c. the relationship of parts to a whole.
   d. a category for “other.”

2. If you know the percentages of each section on a pie graph and the numerical value of at least one of the sections, you can algebraically solve for the total numerical value of the graph.
   a. True
   b. False

3. If the total numerical value for a pie graph is 1000 and the largest section is 53%, what is the numerical value of that section?
   a. 5.3
   b. 530
   c. 53
   d. .53

Answer Key:

Citations

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