Comparing Visual Models

Inquire: Have it Your Way!

Overview

Math doesn’t allow a lot of interpretation, but visual imaging of data is all about interpretation. The numbers don’t lie, but they can be displayed in some ways that just look better than others. If you are doing research and collecting data, you need to know how to best present your findings. That means you need to be very familiar with different types of graphs and tables to display your data in the best light.

Big Question: Why is it important to choose the best type of graph or table to present data?

Watch: Finding that Killer Graph

The hour was getting late, and Employee A was a long way from having his presentation ready for the next day’s meeting. His plan was to ask his boss for a raise. He had kept careful records of the projects he had completed and the innovative ideas he had used to improve productivity in his department. All he needed now was a killer graph to seal the deal.

Finding that graph is a problem we will all face sooner or later. It may be to get that big promotion, or it may be to land an A in a tough course. Either way, knowledge of graphs and their particular uses can make the difference between success and failure. Employee A needs help, and he needs it now. What type of graph should he use?

He has two areas of data he wants to present; first, the projects he has completed. He could list the different projects and the time he devoted to them. That could be displayed in a pie graph showing the total hours spent on each project. It could also become a bar graph with the same information. He also has a table of the amount of time he spent each day on each project. That could become a line graph. Since the hour is late, and his computer is on the fritz, he decides to go with the bar graph.

His second area of data shows his innovative ideas and how they have increased productivity in his department. He has a table with his ideas in one column and the percentage of increase in the second column. He could just present the table, but he wants the visual image to wow his boss. Since the percentages are not parts of a whole, he knows a pie graph won’t work for this one. He decides to make a second bar graph, but this time he will stack the information in a stacked bar graph. The bottom part of each bar will show productivity before he implemented his new ideas, and the top of the bar will show the increase… in a different color! There are three specific ideas he wants to present, so he’ll have three stacked bars labeled with his ideas showing past and present productivity.
Because Employee A has basic skills and knowledge of graphing data, he will sleep well knowing his graphs are ready for the next day.

Read: Comparing Visual Models

Overview
Regardless of what the job is, to do any job well you need the proper tools. If you are cleaning a house, you need good quality cleaning tools. If you are mowing a lawn, you will use the best mower you have available to you. Imagine building a new highway interchange with only a wheelbarrow and a shovel. Whatever the project, appropriate tools are a necessity. After data has been collected, you need the proper and appropriate tools to best display your findings. All visual models are not created equal. Graphs and tables are not one size fits all.

Pie Graph
If you need to illustrate parts of a whole, the pie graph is probably the best choice. Pie graphs are sliced into sections, and each section represents a percentage of the whole pie. These graphs provide a quick picture of data and are usually straightforward and not difficult to analyze. However, you cannot compare multiple data sets with a pie graph or show trends or change over time. They can also become cluttered if more than six or seven segments are used. Pie graphs can only be used with discrete data, and require meticulous labeling.

Bar Graph
When you are working with categorical data, a bar graph may be just what you need. The bar graph consists of rectangular bars displayed on a chart with two axes. One axis shows a scale, and the other shows the categories. It is easy to analyze data and make comparisons between data sets when displayed on a bar graph. The bars should be in some planned order, but it does not have to be chronological order. If you have multiple data sets, you can make more complex graphs by using a grouped bar graph or stacked bar graph. A bar graph can show changes over time or trends, but can be misleading if the scale of values is not carefully constructed. Always check to see if the y-axis begins at zero and is divided into equal and appropriate values.

Histogram
While a histogram may look very much like a bar graph, appearance is where the comparison ends. A histogram is not a bar graph. Bar graphs are designed to compare different categories and use categorical data. Histograms show distribution of variables using quantitative data with ranges grouped in specific intervals or bins. For example: A histogram might have intervals of test scores on the x-axis and numbers of students who made a particular score on the y-axis. Both are quantitative data. One disadvantage of using a histogram is that it would be difficult to compare multiple categories because you would need multiple histograms. Problems can also arise using inappropriate or misleading scales.
Line Graph

The most simple graph to create and to read is a line graph. Points are plotted on a coordinate plane and then connected. The resulting line may be straight, curved, or the points may be connected in no pattern. A line graph is most commonly used to show change over time and is the best way to show trends and relationships in continuous data. A line graph can also show positive and negative values. Finding an appropriate scale is sometimes difficult if the range of data is large, and it is sometimes messy if too many lines are created on the same graph. The type of data that works on a line graph is limited, but it is obviously the best at continuous data.

Table

After data has been collected, it usually finds its way into a table. A table is an arrangement of data in rows and columns. A table can be as simple as a frequency table in which a category is listed in the first column, and the frequency with which that category appears is listed in the second column. A common table in elementary school is a multiplication table. Tables are an excellent way to gather data and prepare it to become part of another type of graph or chart. A data table should always be clearly labeled and self-explanatory.

Deciding which type of table or graph to use for the data you have collected depends largely on what you are trying to visually represent. Do you want to show relationships between variables? Do you want to analyze trends, show the composition of something, or understand distribution? After you make a decision on what story you want to tell with your numbers, you will probably need to try on more than one type of visual model. For instance, will your data look better in a bar graph or a line graph? Try both before you make a decision, and try different scales. You may be surprised at what you find!

Reflect Poll: The Best Choice

You have data that needs to be represented as a visual model. After you study the data, how will you decide which type of graph to use?

- The one that fits the type of data (categorical or quantitative) that I have.
- The one that looks like I know what I’m doing.
- The one that seems the easiest to create.
- The one that someone will create for me.

Expand: Graph vs. Graph

Overview

After you have gathered data and arranged it into a table, you will probably have some idea of how you want it to look visually. Knowing what each type of graph does best will help you narrow your choices. It’s a good idea to try your data in at least two different graphs. You can also adjust scales to emphasize the comparisons between categories. If there is very little difference in your numbers, you may need a smaller scale to make the differences stand out. Play with a few graphs until you find what works best for your data.
Line vs. Bar

In a survey, 40 mothers were asked how many times per week a teenager must be reminded to do his or her chores. The results are shown in the following table.

<table>
<thead>
<tr>
<th>Number of times teenager is reminded</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

In the line graph shown, the x-axis (horizontal axis) consists of data values and the y-axis (vertical axis) consists of frequency points. The frequency points are connected using line segments.

How would this data look different if it were plotted on a bar graph?
Because these are simple examples, there are more similarities than differences. Each data display clearly shows a near normal distribution of the data. However, this is a simplified example of what may be a complex situation based on your data set.

**Bar vs. Pie**

Any pie graph can be translated into a bar graph, but not every bar graph can be constructed into a pie graph. Every pie graph must have data that shows percentages of a whole at a specific time. You could create a pie graph to show the percentages of different blood types donated at a Red Cross chapter during a particular month. You could just as easily create a bar graph of the same information as long as you have calculated the percentages and they add to 100%.

Both graphs will have exactly the same information; however, it will look different. Study them and decide which way you like best. Are the comparisons more clear with the bar graph? You can do this process with a variety of different graphs and tables. There are no wrong answers!

**Lesson Toolbox**

**Additional Resources and Readings**

A simple comparison of histograms and bar charts
- Link to resource: https://youtu.be/JsEwJD1mYpU

A video covering types of graphs and how to choose the right one for a specific data table
- Link to resource: https://youtu.be/Ka5pGmHJENI

An illustrated review of graphs and the benefits of each
- Link to resource: https://youtu.be/exNWSLlkbLQ

**Lesson Glossary**

- **bar graph**: a chart that uses bars to show comparisons between categories of data
- **categorical data**: data defined as groups or categories of things, like "breeds of dog" or "voting preference"
- **discrete data**: can be counted in specific numbers. For example: the number of days in a week or the number of fish in a tank
- **histogram**: a graphical display in which data is grouped into intervals (such as "100 to 149," "150 to 199," etc), and then plotted as bars; the data is quantitative
- **line graph**: a graph with points connected by lines to show how something changes
- **pie graph**: a circle graph in which the relative proportions of parts of a whole are shown as different sized sections
- **table**: a visual representation of data structured in columns and rows

**Check Your Knowledge**

1. What type of graph must always contain all the parts of a whole?
   - a. histogram
   - b. pie graph
   - c. line graph
2. Which type of graph uses values divided into intervals or bins?
   a. histogram
   b. pie graph
   c. line graph
   d. bar graph
3. A histogram is a bar graph.
   a. True
   b. False

Answer Key:

Citations

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