Application: Misleading Tables, Graphs, and Charts

Inquire: Identifying Misleading Data

Overview

You can’t believe everything you hear, read, or see on the Internet. In our technology-driven society, it is increasingly necessary to question almost everything. We must check sources, analyze data, and look for additional or missing information that could create bias. Data can easily be misrepresented either intentionally or by accident. Some of the most common ways that graphs and charts can be misleading are inappropriate scales (too large, too small, or not starting at zero), improper labels, incomplete data, and disproportionate bars.

Big Question: What specific skills can help you ensure the data you see is accurate?

Watch: Danger! Misleading Data Ahead!

Statistics clearly show that every summer, there is increased incidence of drowning. This is the same time ice cream sales increase. So, if you want to be safe in the summer, stay away from ice cream!

We know these events have no relationship, but we could create a variety of charts or graphs to “prove” our data. It might make a pretty graph, but it would only show that there are statistically more drownings and ice cream sales in the summertime. All they have in common is their higher frequency during the same time of the year.

Are there other kinds of misleading data out there that are not so obvious? Oh, yes! Some of it is accidental, while some of it is intentional. One of the most common types of misleading data is caused by inappropriate scales on line graphs and bar graphs.

If the scale is too small or large, the data will be clustered at the top or bottom of the graph and will be difficult to compare with any accuracy. If the vertical scale doesn’t start at zero, the visual difference between the bars will be disproportionate to the actual difference.

Improper or missing labels and incomplete data can also cause data to be misleading. The most excellent data collection and presentation will be useless if there are no words to explain them. One of the first things you should know about creating and reading visual models is that the labels are critical. Every graph should be self-explanatory. You should be able to understand the graph without someone guiding you. Often, the deception is slight and difficult to identify. Like most things in life, if something seems too good to be true, it probably is!
There are many potential pitfalls in creating and interpreting visual models of data. A nice cold scoop of ice cream in the summertime isn’t one of them!

Read: Misleading Tables, Graphs, and Charts

If you don’t know the difference between a square and a rectangle, you might mistake one for the other. If you forget that a square must have equal sides, you might assume four right angles would be sufficient to construct a square. Those details may seem small, but they are critical. In constructing shapes, details matter. Similarly, in visual modeling, the details also matter. To trust presentation data, you should know how tables, graphs, and charts may be misleading. Some of the most common ways of presenting misleading graphs and charts are inappropriate scales, improper labels, incomplete data, and disproportionate bars. While some misleading graphs are accidental, they are often intentional with the goal of leading you to a particular conclusion.

Inappropriate Scale

One example of misleading information in graphs is the use of an inappropriate scale. The scale for the y-axis may be too large or too small. It may skip numbers, have uneven intervals, or not start at zero. A vertical scale that is too large may show all of the data near the bottom of the graph with very little difference between variables. If the same scale were too small, the data would still be clustered together with very little differentiation, but at the top of the graph. A scale that skips numbers or has uneven intervals is an inaccurate presentation, but the scale that does not start at zero is the most common type of misleading graph. (Most sources say a line graph does not have to start at zero. Bar graphs should.) The scale on a bar graph should always be proportional to the data that is being graphed. You don’t want excess white space above the data, nor do you want all of the data to be pushing the upper limits of the scale.

Improper Labels

The most excellent data is useless when displayed in a graph that is not labeled or is incorrectly labeled. Here is an example of a great looking graph, but we have no idea what it is measuring.

Sometimes when looking at a graph, you may suspect that the labels are wrong, but you can’t know for sure. If it looks suspicious, don’t trust its accuracy. This is another reason to study the proper construction and labeling of graphs.
Incomplete Data

Whether withheld accidentally or on purpose, incomplete data is inaccurate data. For example, all pie graphs are divided into sections. The size of each section is proportional to the percent of the data corresponding to that section. The total percentages must always add up to 100%, but what if they don’t and something is missing? The visual image of the pie graph is inaccurate; it is not representing the parts of the whole and thus may show an attempt to mislead you.

Sometimes a person creating a visual model may sift through data and choose only what supports his beliefs, and disregard the rest. This occurs when someone is not actually doing research, but only looking for data to support an opinion. It is fairly common in advertising and politics to see data ignored when it does not support a particular cause. This leads to incomplete data and skewed results. You see what they want you to see, but what is being hidden?

Disproportionate Bars

The purpose of visual modeling is to help the observer "picture" the numbers in a way that accurately represents the data. The size of bars created in bar graphs can provide an accurate or misleading picture of the data. It is important to keep proportions aligned with the scale. If the values you are graphing have a minimum of 30 and a maximum of 50, your scale should start at zero and have increments of 15-20. If your scale has intervals of 40 and goes up to 120, your bars will not be proportional to the scale you have chosen. Disproportionate bars will produce misleading data.

Misleading Statistics

Can statistics be manipulated? Of course they can! From faulty polling to purposeful bias, data can be presented as something it is not. The two most obvious culprits are advertisers and politicians, because they both want something from us: advertisers and the companies they represent want our money, while politicians want our votes… and our money!

Reflect Poll: Deceptive Advertising

A popular weight loss plan advertises on TV, “You are guaranteed to lose up to 13 pounds in the first month or your money back!” The key deception included here is “up to.” If you lose one pound in the first month, you have met their guarantee. How do you feel about this type of deceptive advertising?

- I didn’t notice and thought I was guaranteed to lose 13 pounds.
- I thought it was funny!
- It made my blood boil!
- I’m so used to deception that I just don’t care anymore.

Expand: Misleading… On Purpose!

Overview

Yes, there are unscrupulous characters out there who would lie, cheat, and steal to sway our opinions and our spending habits — and they consistently use data as a favorite tool. If one is trying to sway opinion and decisions, data has weight! The challenge is recognizing visual model inaccuracies and understanding deceptive intents.
Misleading Advertising

Nine out of ten doctors recommend Product X for their patients! We have all seen and heard these ads. The question to ask is, “What are we not being told?” Often the answer is that nine doctors have been paid by Company X to endorse their product. This is an example of a paid endorsement. Paid endorsements are one way for a brand to attach their products to a celebrity, public figure, or respected professional. You may have never considered buying Product X, but after you hear their new ad, you are more likely to purchase it.

Frequently, graphs and statistics play a part in misleading advertisements, and the culprits are the same as we’ve seen before: inappropriate scales, improper labels, incomplete data, and disproportionate bars. It is not always easy to identify the errors, but it can be done. An amazing amount of such misleading data is actually illegal. One particular cereal used a graph which claimed the cereal contained 25% of the daily value of antioxidants and nutrients (which it didn’t). After the Federal Trade Commission stepped in, they settled out of court and paid affected consumers $2.5 million and donated another $2.5 million to charity.

Misleading Political Data

Very similar to consumer ads, political ads want to sway your opinion in favor of specific candidates. There are often endorsements from famous people from all walks of life. If there is someone with the charisma to influence voters, you can bet he or she will be tapped to join the campaign. And again we will find data misrepresented or under-explained.

Lesson Toolbox

Additional Resources and Readings

An excellent video showing the difference between accurate and misleading graphs by showing the same data with different results

- Link to resource: https://youtu.be/ETbc8GlhfHo

A video providing examples of distortion in graphs, complete with cartoon images and current events

- Link to resource: https://youtu.be/E91bGT9BjYk

This video explains how “lurking variables” can make data appear very different by how it is grouped and divided

- Link to resource: https://youtu.be/sxYrzzy3cq8

Lesson Glossary

paid endorsement: when someone is paid to give support to someone or something, particularly celebrities in advertisements

Check Your Knowledge

1. What is the term for the celebrity who gets paid to use a product?
   a. paid endorsement
   b. product placement
c. fortunate son
d. branding

2. On what type of graph must the total percentages of each part equal 100%?
   a. pie graph
   b. bar graph
   c. line graph
   d. histogram

3. What are disproportionate bars? (Choose all that apply)
   a. bars on a graph that are not proportional to their scale
   b. a way that data can be misleading
   c. an attempt by politicians to buy votes in pubs
   d. bars of unequal lengths

Answer Key:

Citations

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