

Data Visualizations

Brief: Effective data visualization helps people analyze and reason about data and evidence, making complex data more accessible, understandable, and usable.

Learning Objective: Understand when and how to use data visualizations.

Key Terms:

- **Cartogram:** A map in which some thematic variable (e.g. population) is substituted for land area or distance.
- **Data visualization:** The science of the visual representation of data.
- **Misleading graph:** A graph that misrepresents data, constituting a misuse of statistics and with the result that an incorrect conclusion may be derived from it.

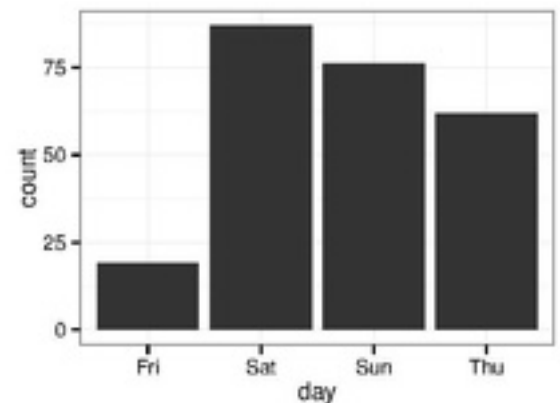
The Visual Representation of Data

Data visualization is considered both an art and a science. To communicate information clearly and efficiently, we use tables, line charts, bar charts, histograms, scatterplots, box plots, pie charts, area charts, cartograms, and a number of other graphical techniques to display quantitative information. Effective visualization helps people analyze and reason about data and evidence. It makes complex data more accessible, understandable, and usable.

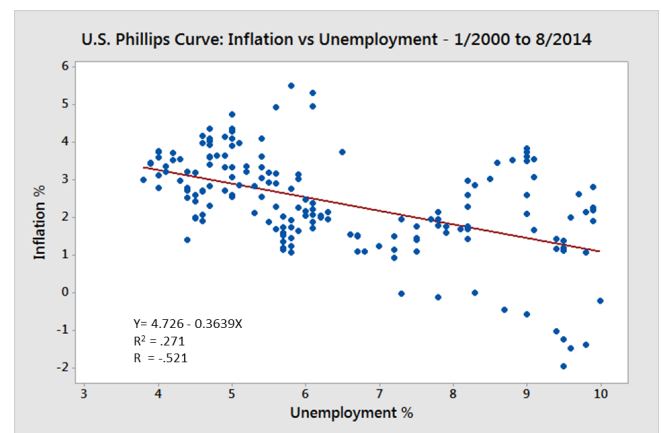
Data visualizations are often very detailed. If you use a complex data visualization, you will likely need to devote time during your presentation to explaining it to your audience, which of course will require you to thoroughly understand it. That said, data visualizations can make powerful visual aids, leading your audience to aha moments in which they understand the full significance of what you're saying.

Characteristics of Effective Graphical Displays

You shouldn't assume that any data visualization you uncover in your research that looks professional or authoritative is actually a high-quality graphical display. That said, you don't need to be a stats whiz to use graphs, for example, in your presentation. Edward Tufte, a statistician and one of the world's foremost experts on data visualizations, provides helpful



This is an example of a simple data visualization: a bar chart showing a count by day of the week.



This is an example of a more complex data visualization: a scatterplot showing a negative correlation between inflation and unemployment measured at points in time.

guidelines for evaluating the effectiveness of data visualizations. According to Tufte, graphical displays should:

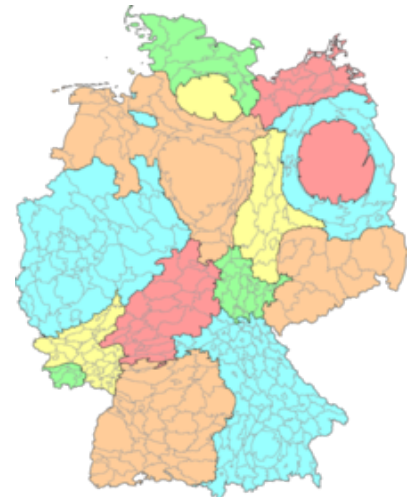
- serve a reasonably clear purpose: description, exploration, tabulation, or decoration
- make the viewer think about the substance, or the message, of the display
- show the data
- make large data sets coherent
- encourage the viewer to compare pieces of data
- reveal the data at several layers of detail, from a broad overview to the fine structure
- avoid distorting what the data has to say

Tufte explains that ignoring these principles can result in the creation of a misleading graph, a graph that misrepresents data, constituting a misuse of statistics, with the result that an incorrect conclusion may be derived from it.

Evaluating graphs takes some practice (and some knowledge), but keeping these guidelines in mind can help you ask the right questions about the data visualizations that you encounter in your research. If you're feeling unsure about including a particular graph in your presentation, for example, do not hesitate to reach out to an instructor or a friend for help interpreting and evaluating it.

Visual Context

While it's necessary to provide spoken context for a data visualization, sometimes added visual context is important, too. For example, the cartogram on the right shows Germany, but with the states and districts resized according to the population. While this could be an effective visual aid if you're giving a speech about population dynamics in Germany, a U.S.-based audience might need to see a "regular" map of Germany next to the cartogram for comparison. As always, when you're making decisions about what to include, keep your audience in mind!



A cartogram of Germany, with the states and districts resized according to population

From Concept to Action

Find a data visualization relating to your topic. (If your topic isn't data-related, find a data visualization relating to any topic that interests you.) Assess the data visualization according to Tufte's guidelines. Do you think it's effective? Why or why not? What questions do you have about the visualization? What context—both spoken and/or visual—would you need to provide to the audience if you incorporated it into a speech?

OER IMAGE SOURCES:

"Germany-population-cartogram.png." Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Germany-population-cartogram.png>. Accessed 7 June 2019. [GNU Free Documentation License]

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