

# Data Visualization

## 4. Visualizing/Presenting Data

# Visualizing and Presenting Data

## About this class

You will learn

- What does it mean to “design for an audience”
- How to decide what your chart(s) will look like and the importance of having clear what their function will be
- What is “visual hierarchy” and why is it important
- How to deal with imperfect data
- Few tips to design accessible and respectful data visualizations
- What are misleading graphs and how to avoid them
- From planning to crafting: tools for visualizing data

# Visualizing and Presenting Data

## About this class

## Slide Contents

<b>Planning a dataviz, the basics.....</b>	<b>6</b>
Designing for an audience.....	6
Chart function, chart form.....	8
<b>Planning a dataviz, visual strategies.....</b>	<b>12</b>
Giving guidance.....	13
Dealing with inaccuracies, uncertainty, missing data, multiple possible outcomes.....	14
Designing for accessibility and respect.....	18
Humanizing numbers.....	19
<b>Planning a dataviz, look out for.....</b>	<b>21</b>
Misleading graphs.....	21
Misleading graphs, truncated axis.....	22
Misleading graphs, irregular interval of ticks on axis.....	23
Awkward graphs, colors.....	24
Awkward graphs, pies.....	26
A word on map projections.....	28
<b>From planning to crafting.....</b>	<b>32</b>
Paper and pencil.....	32
"Swiss-Army Knife" tools for beginners.....	33
Other tools for quick data visualizations.....	43

In the previous lesson, we saw some techniques on how to analyze datasets to find insights. We also saw how to make quick **exploratory** visualizations in Google Sheets, as a visual aid to better understand the data and discover what could be interesting about it.

Those types of **exploratory** visualization might look like the final ones you make to present your data stories, but with a fundamental difference: those were quick prototypes, with the scope of assisting data **discovery**, intended as "extracting actionable patterns from data" [[Technopedia](#)]. Most of the data visualizations you will make to present your data, on the other hand, will be designed specifically with the goal of aiding **communication**.

It is a subtle difference, but an essential one to keep in mind throughout this lesson. Generally speaking, your main goal when presenting data is to **communicate complex messages clearly**, resorting to visuals if/when they offer a more effective mode of communication than words.

Of course, this primary purpose can be paired with other ones, like striving to create something aesthetically pleasing. However don't forget that your goal is the communication of insights, to inform your audience. Other characteristics of your work that make it beautiful, innovative, amusing, or engaging are of course very welcome, in the terms that they are means to an end - the end being the effective communication of insights and stories.

When devising ways to communicate clearly, one of the main fallbacks is producing something that dumbs-down the complexity of an issue. Providing clarity means bringing light to the shadows and complexities of the topic, so that an issue can be better understood in all its shades. Simplifying, on the other hand, means reducing or removing those complexities, thus obscuring knowledge rather than enhancing it. For this reason, remember that presenting data is not only about the visualization: it is also about the text and narrative, with which the chart stands in a symbiotic relationship.

As [Alberto Cairo](#) writes in his book "[The Functional Art](#)", you should always seek depth, never sacrifice nuances in the name of clarity and remember that clarifying a message is quite different than simplifying it.

While these might sound like abstract ideas, you can begin to put them in practice by reflecting on the general goals of your work, on the specific communication targets of each data visualization and on its function. What do you want readers to focus on? What should they learn within the few first seconds? What are they expecting to learn and how can you guide them in this? What do they likely already know and what will they struggle more to understand? What visual conventions is your audience already familiar with?

Think about all of this **before** you start designing your data visualization: only then will you have the tools to develop good visual strategies.

# Visualizing and Presenting Data

## Planning a Dataviz: The Basics

### Designing for an audience

You have probably heard about this before: when visualizing data, just like whenever you are writing and communicating, you should always have in mind who your audience is and act accordingly.

How do you learn how to do this? It takes practice, of course, but again asking yourself some questions about your audience will help you bring focus to this aspect and ground it in your practice.

- How much they know already?
- How much do they need this information?
- Why do they need this information?
- What will they do with this information?
- Where will they likely read/experience my work, in what context?

(Read more on this in "[Visualizing Data](#)" by [Andy Kirk](#))

# Visualizing and Presenting Data

## Planning a Dataviz: The Basics

### Designing for an audience

The existing knowledge of the audience helps you determine the level of depth of your work - although you should also work in layers and with hierarchy to provide different possible levels of depth. For example, with bold titles and colors for the main information, annotations for those who wish to dig-in further, footnotes and pop-up windows for even deeper levels of information, etc

If the audience really needs your information (or is forced to pay attention, like in a business meeting), then you probably will use less eye-grabbing and attention-retaining strategies than if your work is "out in the wild", where you compete more fiercely for attention.

The time and context also play a role in determining the best type of presentation for your data: if you expect your audience to enjoy your work for a few minutes, on the mobile phone during a rush-hour metro ride...well, in that case better to avoid complex data-rich interactive charts.

# Visualizing and Presenting Data

## Planning a Dataviz: The Basics

Chart function, chart form

A fundamental concept found throughout data visualization guides and advices is that the form a data visualizations takes is somewhat **constrained by the function** the data visualization should serve for.

In practice, there are different views<sup>1</sup> as to how this plays out: should function shape form in a deterministic way? Can I give more space to aesthetics and decorative elements that attract the reader to my work? How many of such decorative elements can I add before they distract from the main message of the visualization?

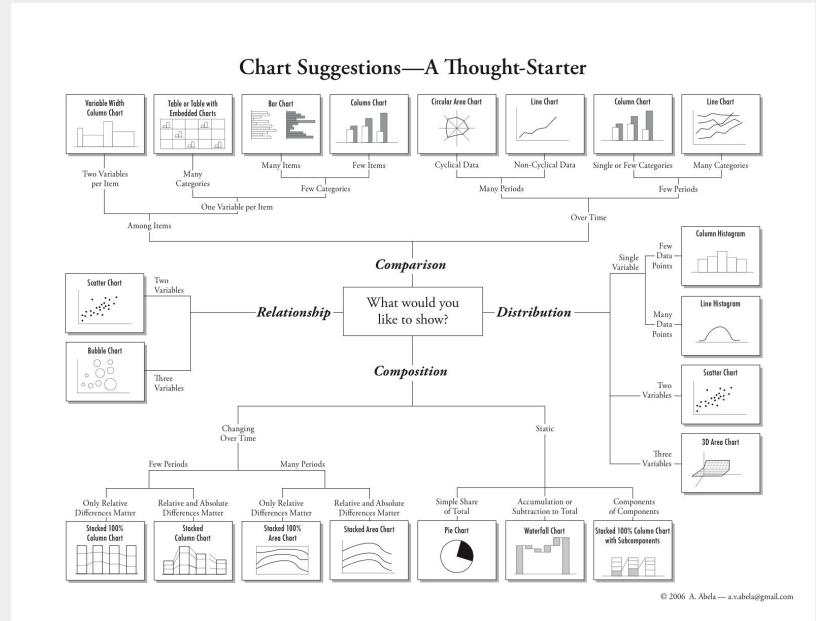
Without getting into the nuances of this debate, it is somewhat undeniable that knowing what function the visualization will serve is a fundamental prerequisite to actually designing what the chart will look like.

<sup>1</sup> If you are interested in this fascinating debate, sometimes referred to as "The Chartjunk Debate", you can read more about it [here](#), [here](#) and [here](#). The names of [Edward Tufte](#) and [Nigel Holmes](#) will likely pop-up.

# Visualizing and Presenting Data

## Planning a Dataviz: The Basics

Chart function, chart form



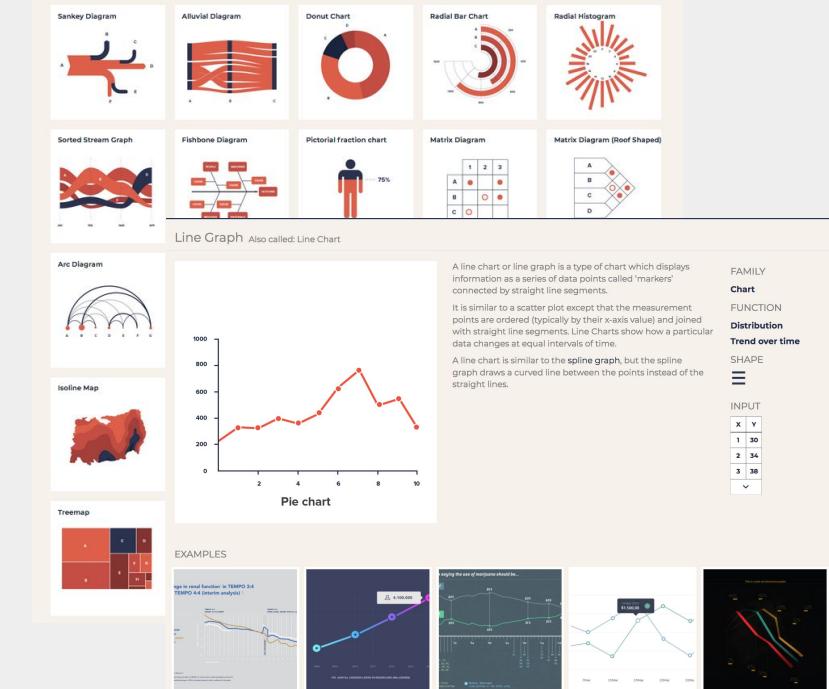
[Chart Suggestions - A Thought Starter](#) by A. Abela

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# Visualizing and Presenting Data

## Planning a Dataviz: The Basics

Chart function, chart form



[Data Viz Project](#) by Ferdio

# Visualizing and Presenting Data

## Planning a Dataviz: The Basics

Chart function, chart form



[The Data Visualization Catalogue](#)

# **Visualizing and Presenting Data**

## **Planning a Dataviz: Visual Strategies**

From the previous steps, you should now have in mind the narrative and the angle of your story, and its main insights or patterns.

You have also defined the basics of the data visualization: who is it for, what is the content and function of the chart(s) you will use and what is its/their form (a line chart? a bar chart? a custom chart?).

The next step is to fine-tune the visual strategies you will use to better communicate your message.

The following slides are a non-exhaustive list illustrating a few common things you will have to deal with, when designing your visualization.

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Giving guidance

### Visual Hierarchies

When you arrange the elements of your project within a page, or the elements of your visualization within the canvas area, you are making important choices. You are positioning some things at the top, others at the bottom. Some are in color, others are black/white. Some text is in bold, some is in a smaller font size.

You should never make these choices randomly, but **organize the content so that its positioning, order, contrast, size and visual appearance reflect its relevance and importance for the narrative**. In other words, you should strategically define visual hierarchies between the elements of your work.

For example, important things at the top or in bold or in larger sizes or in striking colors. Contextual and non-fundamental information in smaller font sizes. And so on. Remember that these type of choices might also be culturally-dependent (for example, the meaning of colors and the reading direction/orientation) and medium-dependent (paper, desktop, mobile, big poster, etc.)

Visual hierarchies are probably the most powerful strategy you have to guide your audience through your visualization, by facilitating how they retrieve information from the page/work.

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Dealing with inaccuracies,  
uncertainty, missing data,  
multiple possible  
outcomes

A problem you have already faced in data cleaning is the fact that a dataset will often have **missing values** in some cells. In data analysis, you sometimes end up calculating estimates and predictions according to several scenarios, with different margins of error. Even the simple measurement of the central tendency through the median, mode and mean might return three very different values, leaving you to weight the pros and cons of each before deciding which to use.

When plotting the data, you have a chance to give back a voice to all these nuances.

Plotting the inaccurate and missing values of a dataset, the confidence intervals and margins of error, the projections according to different models...these are all ways to communicate to your audience the fact that you are not dealing with some absolute Truth but with data - measurements of the world that inevitably come with a certain level of blur.

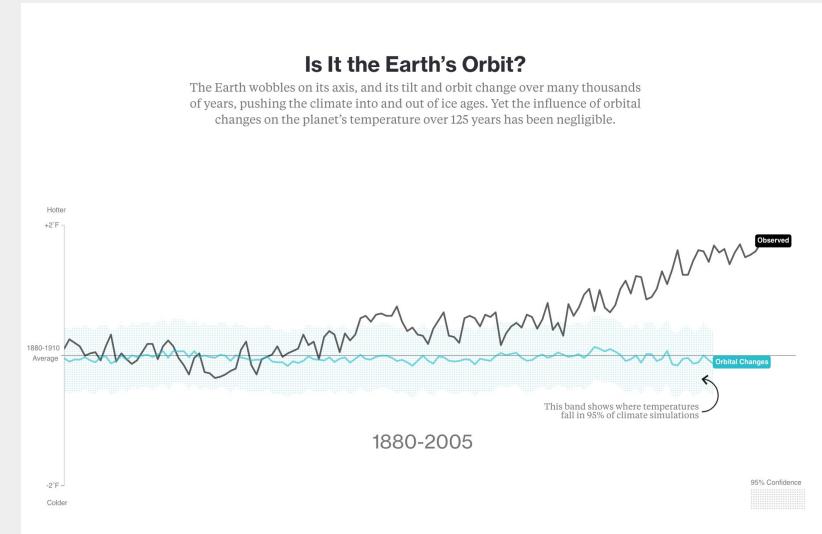
Strategies to plot this "blur" help to contextualize your findings with nuances and subtleties that cannot otherwise be communicated efficiently. **Ultimately, it is a way to be honest and transparent about your work.**

But how do you do this in practice? It depends on your data, but here are a few strategies, for inspiration.

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Dealing with inaccuracies,  
uncertainty, missing data,  
multiple possible  
outcomes

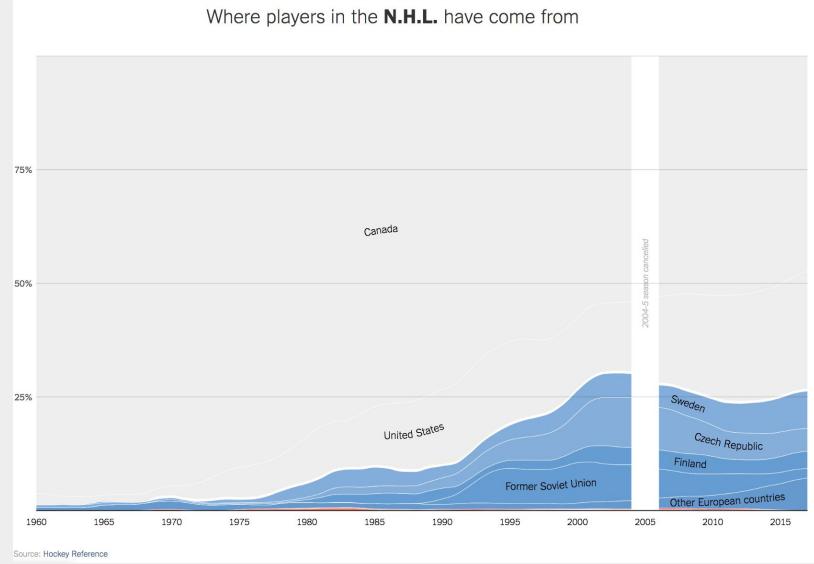


[What's really warming up the world](#) by Eric Roston and Blacki Migliozi · Bloomberg

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Dealing with inaccuracies,  
uncertainty, missing data,  
multiple possible  
outcomes

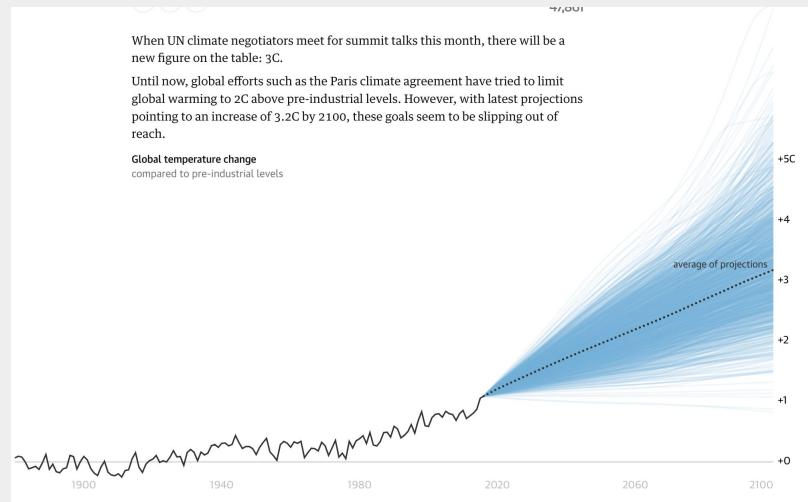


[Where Athletes in the Premier League, the N.B.A. and Other Sports Leagues Come From, in 15 Charts](#) by GREGOR AISCH, KEVIN QUEALY and RORY SMITH. The Upshot, The New York Times

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Dealing with inaccuracies,  
uncertainty, missing data,  
multiple possible  
outcomes



[The three-degree world: the cities that will be drowned by global warming](#) by Josh Holder, Niko Kommenda and Jonathan Watts · The Guardian

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

### Designing for accessibility and respect

Part of designing for an audience means you should always account for other people's way of perceiving and making sense of the world.

Be mindful to design visualizations that:

- Are [color-blind friendly](#)
- Add alternative text and descriptions for screen readers
- Add legends, annotations and references
- Consider socio-cultural factors, like:
  - left-to-right or right-to-left reading direction imply different ways to interpret the space in the page. For example, what comes first and what comes last; what is perceived to enter a scene and what to exit a scene, etc.
  - specific meanings associated with specific colors in different cultures. Is the meaning of "green = ok" and "red = warning" universal?
  - respectful icons, especially in pictograms. Is a wheelchair an appropriate icon to represent people with disabilities, even when these disabilities will rarely involve the use of a wheelchair?

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Humanizing numbers

Your data visualization might be about numbers, but the story it tells will probably have a human component to it. Find ways to balance numbers and statistics with human stories that create emphatic connections to your piece.

- Contextualise numbers and make them relatable
- Interview, make phone calls, quote
- Document more in depth specific stories found in the dataset with words, emotions, photos, videos, etc.
- Whatever else works for story!

# Visualizing and Presenting Data

## Planning a Dataviz: Visual Strategies

Humanizing numbers

But it is now where he lives.

SINCE YOU STARTED READING, ROUGHLY **56 SYRIANS** HAVE LEFT THE COUNTRY.

SINCE YOU STARTED READING, ROUGHLY **58 SYRIANS** HAVE LEFT THE COUNTRY.

SINCE YOU STARTED READING, ROUGHLY **60 SYRIANS** HAVE LEFT THE COUNTRY.

[Changing region, changing lives](#) · The Washington Post  
(look at the end of the article after you have spent some time on the page)

# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

Misleading graphs

Data visualizations should portray data with high fidelity, meaning that graphical representation of data should be consistent with the numbers they stand for (Edward Tufte).

For example, if I have a bar chart, the bar representing a value of two should be half the length of a bar representing a value of 4.

Sometimes, charts do not adhere to such integrity principles and, on purpose or not, they mislead the audience.

While we are at it: you can browse through [WTF Visualizations](#) and [JunkCharts](#) for “excellent” examples of misleading or simply ugly data visualizations, along with commentary on what’s wrong with them.

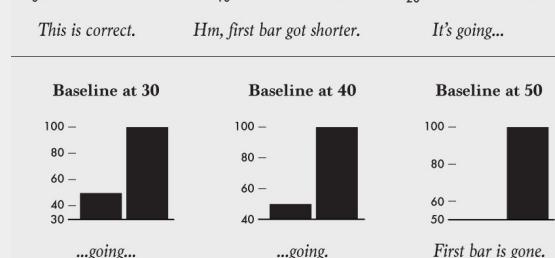
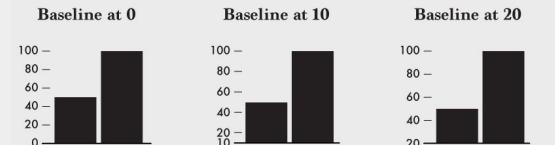
# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

Misleading graphs:  
Truncated axis

Bar charts should have their Y-axis starting at 0. Otherwise the lengths and proportions between the different bars are not interpreted correctly.

(For line-charts the issue is [debatable](#), but is generally acceptable to truncate the Y-axis, depending on the circumstances. The rule to not truncate the axis is always valid for charts where the user is asked to visually assess lengths/heights, like the height of bars)



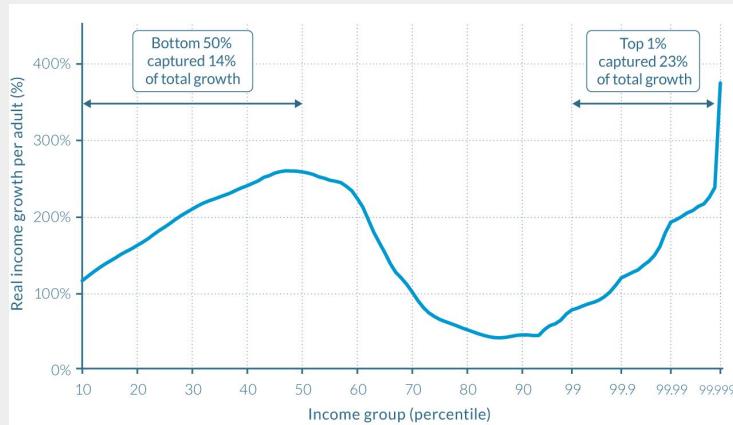
[Real Chart Rules to Follow](#) by Nathan Yau

# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

Misleading graphs:  
Irregular interval of ticks  
on axis

The ticks on the X and Y axis should have consistent scale throughout the whole axis and should be distributed so that the same space interval on the axis corresponds to the same interval in the values. Here's what happens when this rule isn't applied:



[Misleading axes on graphs](#) by Carl Bergstrom and Jevin West · Calling Bullshit

# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

Awkward graphs:  
Colors

Color should be used with care, because color is a very powerful perceptual encoding, rich in metaphors.

When in doubt, start designing your chart in black/white/grays, and only then add color, where needed and meaningfully.

This means using it to highlight important datapoints, to make connection between similar or related elements, to encode additional data through color hue or saturations, etc.

If you are using a gradient of the same color, make sure it is used in a meaningful way - for example darker shades for lower values and lighter ones for higher values. If using many colors, make sure the human eye is still able to distinguish them effectively. If you are at loss of ideas, see [ColorBrewer](#) for reliable color schemes.

# Visualizing and Presenting Data

Planning a Dataviz:  
Look out for

Awkward graphs:  
Colors

So many random colors make it hard to understand what the colors stand for, without constantly looking at the legend, thus making it hard to quickly grasp the patterns.

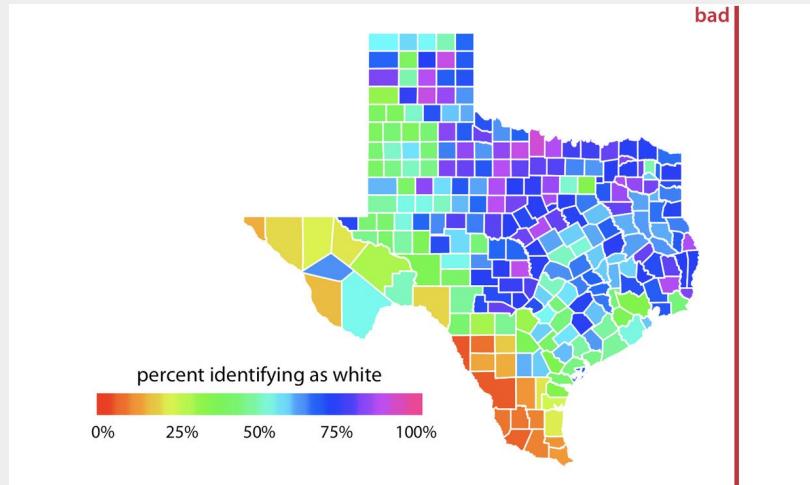


Figure 15.5: Percentage of people identifying as white in Texas counties. The rainbow color scale is not an appropriate scale to visualize continuous data values, because it tends to place emphasis on arbitrary features of the data. Here, it emphasizes counties in which approximately 75% of the population identify as white.

From "[Fundamentals of Data Visualization](#)" by Claus O. Wilke

# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

Awkward graphs:  
Pies

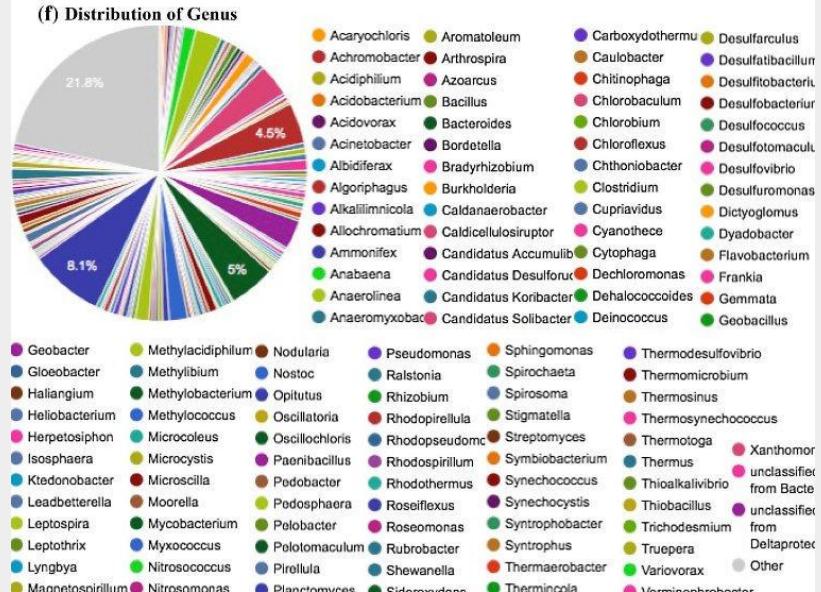
Pie charts are a common target of criticism in the data viz community. **There's nothing inherently wrong about using pie charts correctly, and when used well they can be very effective.** The problem is that they are often used inappropriately and to awful consequences. Here are common pie-chart mistakes to avoid at all costs:

- The sum of the pies doesn't add up to 100% - the whole purpose of pies is to show how a *meaningful whole* (100%) breaks down into its components.
- The function of the chart is to allow for accurate comparison of the slices. It just won't work, humans are not good at such task. Try a bar chart instead
- It has more than 3 slices
- It's a 3D pie-chart (why not?)
- You plan on having a series of pie charts and expect your readers to make comparison between them. Again, opt for bar chart(s) instead.

# Visualizing and Presenting Data

# Planning a Dataviz: Look out for

# Awkward graphs: Pies



Via [John Johnson](#) on Twitter

# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

### A word on map projections

Every map is a projection - there's no other way to present a 3D object on a 2D surface. This means your map won't be an accurate depiction of reality, but the consequences of a choice you (or the software you uses) makes when presenting the geographical data. For this reason, keep in mind that every map you create:

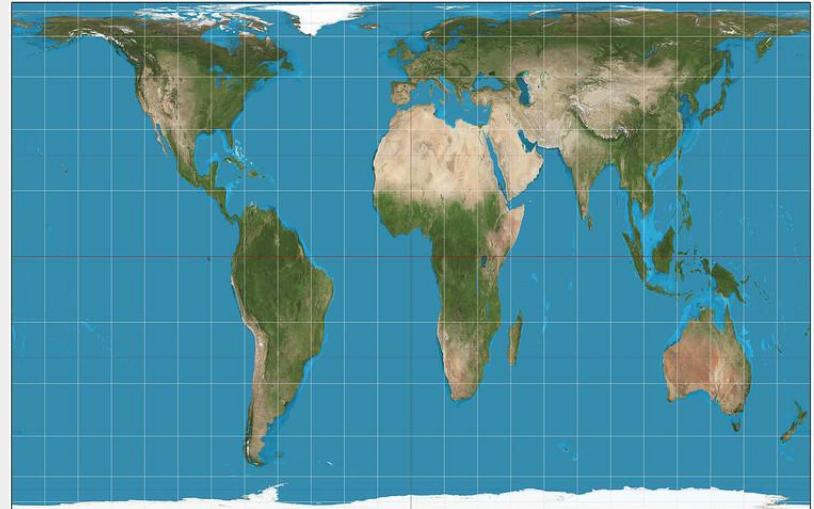
- Will include some distortions as to how big/small certain countries are in comparison to their real size or appearance
- Will, often for cultural reasons, put some countries in the center of the map (and of the viewer's sight) and others in the periphery.

Be mindful about the implications of your choice. Make sure you are confident, conscious and informed about with the projection you use, and eventually tell your audience about it.

# Visualizing and Presenting Data

Planning a Dataviz:  
Look out for

A word on map projections

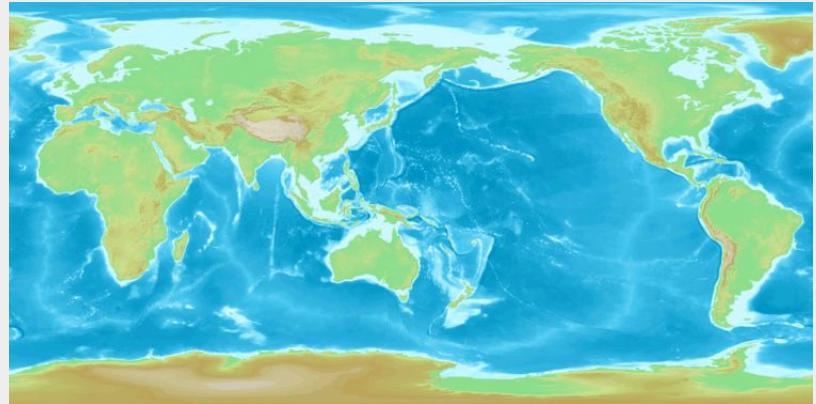


Peters projection by [Daniel R. Strebe](#), via [5 Maps that will change how you see the world](#)

# Visualizing and Presenting Data

Planning a Dataviz:  
Look out for

A word on map projections



Pacific-centred map by [DEMIS Mapserver/Wikimedia](#), via  
[5 Maps that will change how you see the world](#)

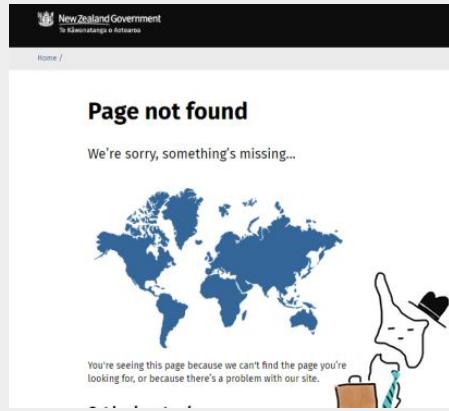
# Visualizing and Presenting Data

## Planning a Dataviz: Look out for

A word on map projections

A funny not so funny anecdote: many world maps you find around the web forget to include New Zealand. This forgetfulness is apparently so common that there's an entire website dedicated to the issue, "[World Maps Without New Zealand](#)", from which the following examples are taken. Make sure you don't end up in this gallery!

(The "["Page Not Found" error page of the New Zealand Government website](#)" is the best thing ever)



# Visualizing and Presenting Data

## From Planning to Crafting

### Paper and Pencil

With all the previous considerations in mind, you should start designing your data visualization.

The first-absolute-best tool to use is the good old paper and pencil. You have many things to take into account: from your audience, to a chart's function & form; from colors to establishing visual hierarchies; from thinking about accessibility to dealing with the imperfections of your data.

**Pencil and paper are the most flexible tools to sketch and erase quickly, as you try to optimize for all the previously-mentioned factors.**

It's advisable that you move to creating your visualization through software only after you have some sketched prototype of what you want the visualization to look like.

## Visualizing and Presenting Data

### From Planning to Crafting

“Swiss-Army Knife” tools  
for beginners

#### Data Wrapper

[Data Wrapper](#) guides you through all the steps required to create an interactive chart and generate the code to embed it.

It will ask you to upload/paste a dataset and will let you define chart type, colors, annotations, and many more extra features.

It also conveniently lets you check for color-blindness and directly add nicely-formatted links to your data sources.

# Visualizing and Presenting Data

# From Planning to Crafting

# “Swiss-Army Knife” tools for beginners

# Data Wrapper

**1 Upload Data**

**2 Check & Describe**

**3 Visualize**

**4 Publish & Embed**

### How do you want to upload your data?

Copy & paste data table    XLS/XLSX upload    Import Google Spreadsheet    Link external dataset

**Copy & paste your data**

Select your data (including header row/column) in Excel or LibreOffice and paste it in the text field on the right. You can also upload a CSV or Excel file from your computer.

If you just want to try Datawrapper, here's a list of some example datasets you can use:

Year;Liquid fuel;Solid fuel;Gas fuel;Cement production;Gas flaring  
 1850;0;54;0;0;0  
 1851;0;54;0;0;0  
 1852;0;57;0;0;0  
 1853;0;59;0;0;0  
 1854;0;69;0;0;0  
 1855;0;71;0;0;0  
 1856;0;76;0;0;0  
 1857;0;76;0;0;0  
 1858;0;75;0;0;0  
 1859;0;83;0;0;0  
 1860;0;91;0;0;0

**Proceed →**

**1 Upload Data**    **2 Check & Describe**    **3 Visualize**    **4 Publish & Embed**

**Chart type**    Refine    Annotate    Design

Bar Chart    Split Bars    Stacked Bars    Bullet Bars  
 Dot Plot    Range Plot    Arrow Plot    Column Chart  
 Grouped Column Chart    Stacked Column Chart    **Area Chart**    Lines  
 Scatter Plot    Pie chart    Donut chart    Election Donut  
 Short Table    Long Table

[Insert title here]

Global CO<sub>2</sub> Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring, 1751-2014.

Liquid fuel    Solid fuel    Gas fuel    Cement production    Gas flaring

Apple stopped to report iPod sales at the end of 2014.  
 Source: Carbon Dioxide Information Analysis Center - Get the data • Created with Datawrapper

CHART SIZE    COLORSCALE IND. CHICKEN

600 x 400

## Visualizing and Presenting Data

### From Planning to Crafting

“Swiss-Army Knife” tools for beginners

#### Infogram

[Infogram](#) is a good choice if you need to combine several charts together and need to do it quick, for example to generate infographics, reports and dashboards.

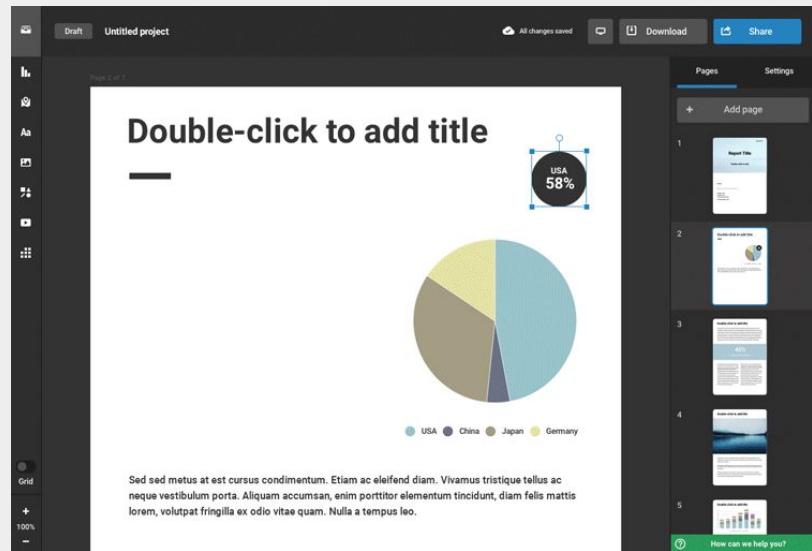
While most tools will allow you to create one chart at the time, Infogram is very powerful because it lets you combine text and graphics, without needing to export and embed the charts into the text. This makes it easier to play around with visual hierarchies and ways to integrate smoothly the narrative with the charts.

# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools  
for beginners

## Infogram



GIF taken from [Infogram's landing page](#)

# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools for beginners

### RAW

[RAW](#) is the tool to go to if you need a fancy, not very common, static (.SVG) chart in less than a minute.

Its best feature is the fact that it supports less common charts (like the Sankey Diagram or the Clustered Force Layout).

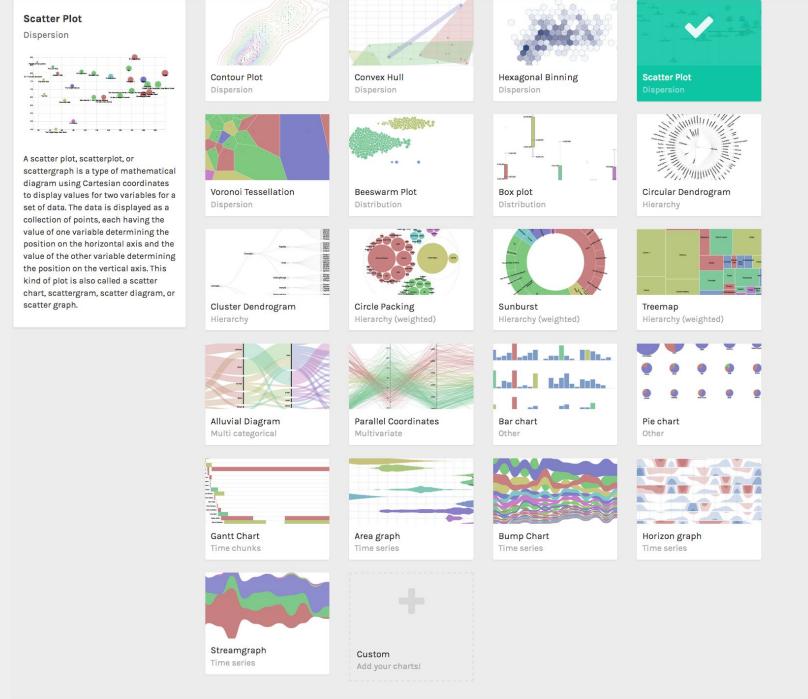
The fact that the charts are exported in a .SVG format means that they can be immediately imported into Illustrator (or the open source Inkscape) to be edited in detail.

# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools  
for beginners

RAW



# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools  
for beginners

### Flourish

[Flourish](#) is a great tool to quickly go from a spreadsheet to an interactive and animated data visualization. Especially useful if you need a less common chart like a network graph or a Sankey.

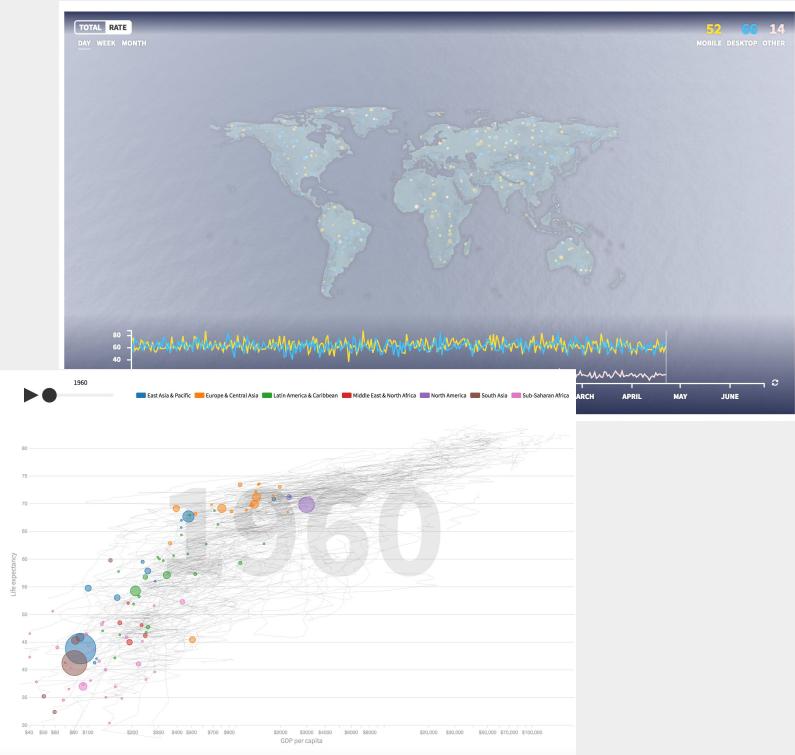
As a bonus, it lets you arrange and present your charts in a slideshow, with text and navigation.

# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools  
for beginners

## Flourish



# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools for beginners

### Tableau

[Tableau Public](#) is one of the most used to create both single interactive charts and beautiful dashboards seamlessly integrating charts and text. [This gallery](#) will give you an idea of all the possibilities offered by the tool.

Given the amount of options, you might need some practice before you make the best out of this tool. Luckily, there are [several online courses](#) and [official tutorials](#) to help you advance through its functionalities.

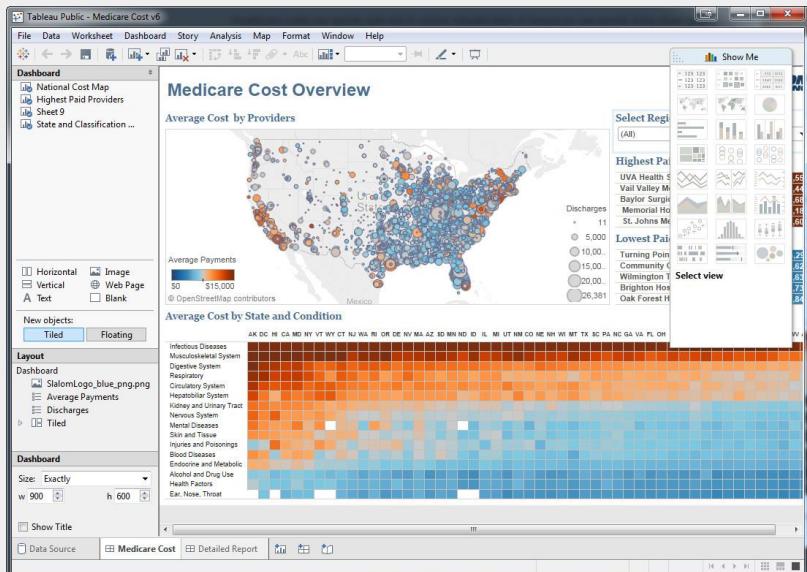
Note: [Tableau Public](#) is the free version, but there is also a [premium.paid](#) version which you can try for free.

# Visualizing and Presenting Data

## From Planning to Crafting

“Swiss-Army Knife” tools  
for beginners

## Tableau



Screenshot of the creation of a Tableau Public dashboard. **Image credits:** [Tableau Public for Data Visualizations](#) by Community Health Maps.

# Visualizing and Presenting Data

## From Planning to Crafting

### Other tools

- Google's [Data GIF Maker](#): compare and create GIF animations out of Google Trends data
- " [Insert → Chart...](#)" from inside a Google Sheet
- [Data Illustrator](#): a very promising tool to create data-driven vector illustrations
- [Gephi](#), open source tool specifically targeted at creating network visualizations
- [TimelineJS](#), to create interactive timelines
- [StorymapJS](#) for map-based stories
- [Charted](#) only needs a link to .CSV file or a Google Sheet to return an interactive viz. It does not store data.  
Created by [Medium](#)
- [Power BI](#), to create interactive reports and data dashboards
- [QGIS](#), probably the best free and open source tools if you need to work with maps (requires some time to learn)
- [Palladio](#) by Standford's Humanities + Design Lab. Great for hisotric data
- [Exhibit](#), open source tool by MIT to create data-driven web pages
- [Keshif](#), to create live dashboards

# Visualizing and Presenting Data

## Visualizing and Presenting Data

### Tips & Tricks

- Do you need a data visualization? Not every data storytelling piece needs visuals. Ask yourself whether it will add value or clutter.
- Graphics and interactivity doesn't exempt you from storytelling. You shouldn't just dump all the data in a visualisation and add filters for the user to explore the dataset: even with data dashboards, try to make the main story/insights easy to parse and discover. Have a headline, introduction and everything needed for context.
- Visual ways to encode data, like color or size, are not the only way to go. See [data sonification](#) and [data physicalisation](#).

## LICENCE

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# Data Visualization

**4. Visualizing/Presenting Data**