

# Cartograms

Cartograms offer a way of accounting for differences in population distribution by modifying the geography.

**Geography can easily get in the way of making a good thematic map.** The advantage of a geographic map is that it gives us the greatest recognition of shapes we're familiar with but the disadvantage is that the geographic size of the areas has no correlation to the quantitative data shown. The intent of most thematic maps is to provide the reader with a map from which comparisons can be made and so geography is almost always inappropriate. This fact alone creates problems for perception and cognition. Accounting for these problems might be addressed in many ways such as manipulating the data itself. Alternatively, instead of changing the data and maintaining the geography, you can retain the data values but modify the geography to create a cartogram.

**There are four general types of cartogram.** They each distort geographical space and account for the disparities caused by unequal distribution of the population among areas of different sizes. Non-contiguous cartograms are the simplest type where the shapes of the enumeration units are resized according to a variable. Typically this results in an overlapping or non-overlapping version. In a non-contiguous cartogram, topology (adjacency and connectivity) is sacrificed to preserve shape and enable recognition of geographical areas. Contiguous cartograms maintain connectivity between adjacent geographical areas. This often results in dramatically distorted shapes as the data variable is used to warp geography. Graphical cartograms build on the principles of proportional symbol maps but disregard the underlying geography. The Dorling cartogram, perhaps the most well known, uses proportional circles, organised to provide the best adjacency possible. A variant of the Dorling cartogram is the DeMers cartogram, which uses squares instead of circles and thus reduces the gaps between shapes. A final type is the gridded cartogram, which is a compromise between geographic shape and a more uniform topology that enables people to find familiar places through more recognisable adjacencies. Squares and hexagons tend to be the preferred shape for these mosaic-style gridded cartograms.

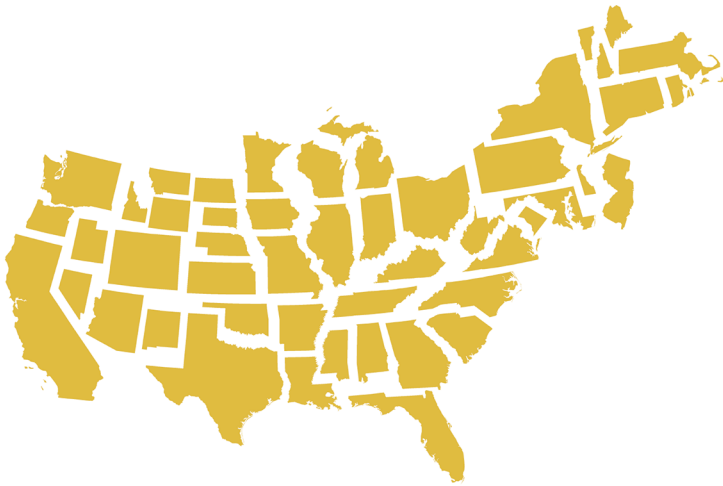
**See also:** [Chernoff faces](#) | [Schematic maps](#) | [Treemap](#) | [Voronoi maps](#) | [Waffle grid](#)

Consider the United States map in which states with larger populations will inevitably lead to larger numbers for most population-related variables.

However, the more populous states are not necessarily the largest states in area, and so a map that shows population data in the geographical sense inevitably skews our perception of the distribution of that data because the geography becomes dominant. We end up with a misleading map because densely populated states are relatively small and vice versa. Cartograms will always give the map reader the correct proportion of the mapped data variable precisely because it modifies the geography to account for the problem.

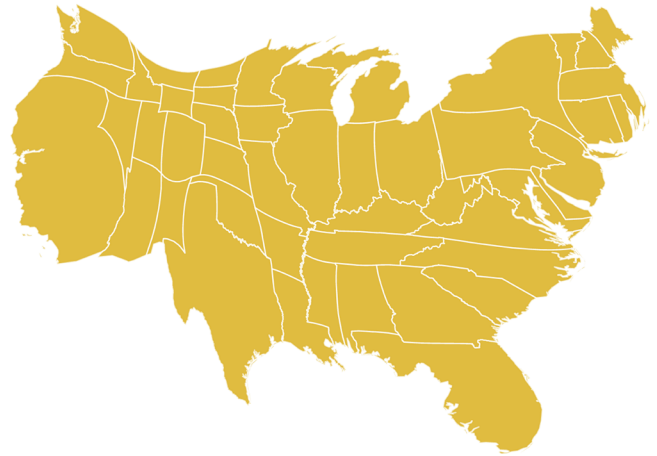
The term *cartogramme* can be traced to the work of Charles Minard in the mid-1800s and various maps since have taken the form of what we now refer to as *cartograms*. Because of the complexity of making a cartogram by hand it was not until the mid-1950s that computerised algorithms began to be developed. There have been many alternatives that to some extent fall into one of the four main categories. Perhaps the most infamous contiguous cartogram is the Gastner-Newman, otherwise known as a population-density equalising cartogram. It does an excellent job of retaining some character of the general shape of individual areas. However, the degree of distortion often renders the map difficult to interpret because of the abandonment of familiarity. Of course, they are attention grabbing and that is often their primary use.

Cartograms do not have to be area based. The distortion of line direction and size can be modified according to some character of its attributes to create a linear cartogram. For instance, subway maps are a type of linear cartogram.



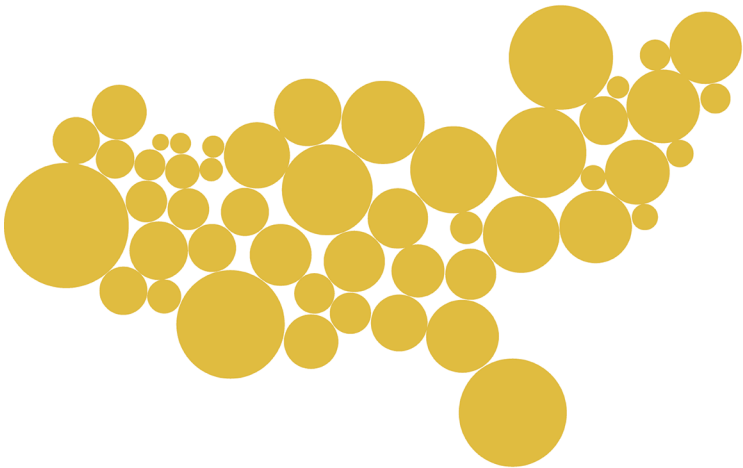
Non contiguous

Shape retained. Area modified. Adjacency not maintained.



Contiguous (Gastner-Newman)

Shape and area modified. Adjacency maintained.



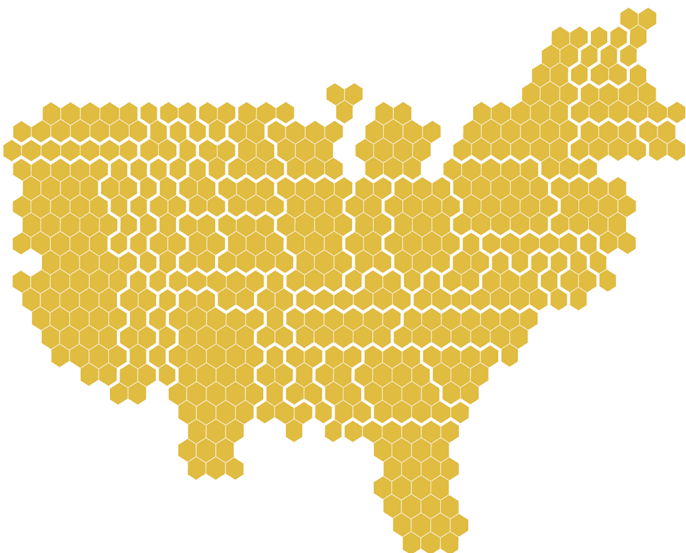
Graphical (Dorling)

Shape modified. Area modified. Adjacency not maintained.



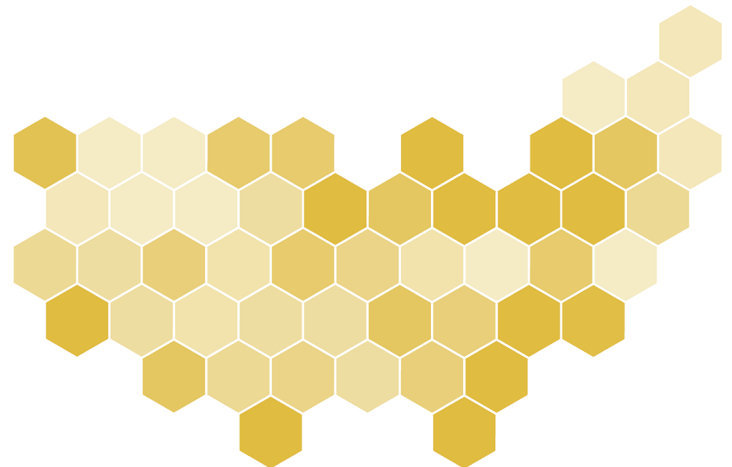
Graphical (DeMers)

Shape modified. Area modified. Adjacency not maintained.



Gridded (multiple units)

Shape modified. Area modified. Adjacency not always maintained.



Gridded (single units)

Shape modified. Area uniform. Adjacency not always maintained.

# Cartographic process

The journey from blank page/screen to map.

**Rarely will a great map simply fall out of your head and onto the page or screen.** Clarity of thought and an appetite for the end result are fundamental to creating an effective outcome. The importance of workflow, or process, is critical. This guides you and acts as a trigger at various stages. Even the simplest of map should establish a workflow because it forces thinking. Given the huge truncation of time that technology has brought to the cartographic process, incorporating time to think has never been more important. It's a good habit to get into because you'll end up making fewer mistakes and develop more nuanced products.

**There are many decisions to make when thinking of making a map.** Medium, format and size, and the story to tell are all large decisions. Whether you're going to use 10% or 20% grey for a line colour is a smaller decision but they are all important. In order to tackle these issues, process is vital. Being flexibly pragmatic rather than dogmatic will help your creativity. Breaking down the larger task into smaller components helps reduce the burden of pressure. Build in time to experiment with alternative approaches to the mapping task rather than ploughing straight into your first idea. Be capable of adapting and iterating. This helps overcome problems and recover rapidly. Being able to focus on different tasks helps compartmentalize the overall task. Sometimes you'll be thinking and formulating your ideas. At other times you'll be sketching and gathering raw data. You make the product by translating ideas into action.

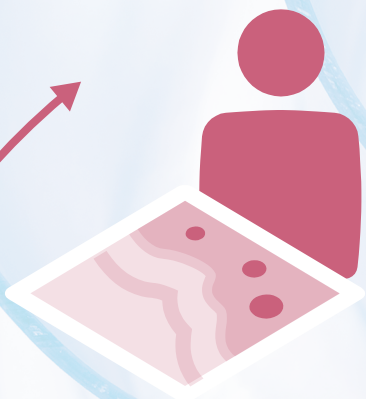
**In truth there is no single cartographic process.** What works for you will be different from what works for someone else. Work out what works for you but try and make it a framework you can stick to. There will be aspects of every job you don't particularly care for but be regimented. They still need doing. Ask for help. Collaborating can be rewarding, and a problem shared is halved. Learn from each project to know what works and what doesn't in terms of both the process and your skills. Finally...if the map isn't working, kill it. Many cartographers have a mass of unpublished work. It's how you learn.

**See also:** [Abstraction and signage](#) | [Defining map design](#) | [Defining maps and cartography](#) | [Graphicacy](#) | [How maps are made](#) | [Types of maps](#)

Remembering that you will never create the perfect map is important. There will always be aspects that could have been different. Someone will likely point something out that irritates them or you'd overlooked. Cartography does not exist in a vacuum and perfection does not exist. Instead of trying to achieve perfection, strive instead for excellence.

1. Planning. Managing your time and resources will keep you on track and prevent scope creep. Time scales are critical. Avoid distractions. Don't overstretch. Build in time for delays.
2. Thinking. Work out when and how you think best. Maybe alone, listening to a favourite piece of music or with a pen.
3. Sketching. Draw out your ideas, literally. Make lists of ideas too, notes that record thoughts, sources, questions, tasks, and ideas. Your memory will not hold all your ideas so they need recording.
4. Listening. Throw ideas around with others. Present and seek feedback. Gain the perspective of experts in the subject you're mapping. Be prepared to be challenged.
5. Researching. Learn about the subject. Ensure sources and content are valid. Ask questions, fill in the blanks, and be interested.
6. Focusing. Be committed. Every aspect of your map deserves meticulous attention. Deal with the minutiae, and the big picture will fall into place more easily.
7. Doing. Find a place that works for you to make the map. Ensure you have the tools at hand and know how to deploy them.
8. Testing. Have others look over your work. Seek a critique and find errors. They do exist, and here's the chance to catch them.
9. Iterating. Change what needs changing. Fix what needs fixing. Don't be so proud that you ignore advice and feedback.
10. Ending. Once you're done, you're done. Don't keep going back to the work as this can become the biggest time sink of all.

Map use



The process doesn't end with map use.

Map authors and publishers will monitor the use and gain feedback to improve subsequent editions of the map or to inform new maps

Share, refine, and iterate



Make a draft or a prototype



Identify the map problem and need



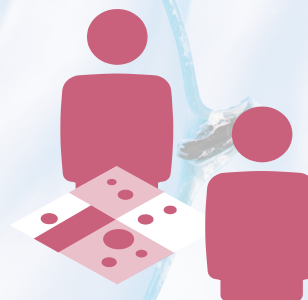
Sketch out initial ideas



Map production



Test, seek feedback, and decide the final design



# Chernoff faces

Multivariate data displays can be distinctly geometric. Chernoff faces encode data into an altogether more human representation.

**Displaying more than one data variable on a map can present complications.** It's difficult to encode more than a few pieces of information into a symbol without risking symbol overload, misinformation, and difficulties for interpretation. Chernoff faces provide a way of encoding multiple data values into a symbol that takes on the form of a human face. Developed by Herman Chernoff in 1973 (Chernoff, 1973), individual facial features such as eyes, ears, nose, and mouth are modified in size, placement, shape, and orientation to represent data. In all, Chernoff suggested up to 18 separate variables could be encoded on a face at one time.

**The broad idea proposed by Chernoff was that human beings easily recognise faces and their expressions.**

Psychologically, humans are very good at understanding different emotions from facial expressions so the theory follows that if you design a face in such a way that it emotes the data along the sort of lines of recognition we might interpret, then data might also be better interpreted. Even small changes in the shape of a mouth or an eye can be easily seen, perhaps in a way that a similarly small changes in the size of a segment on a pie chart cannot.

**Chernoff faces handle the different facial features in different ways because they are, in their basic sense, different shapes with different dimensions.** They can also be plotted such that they are centred on the most critical x,y component, and the size of the face can be made proportional to a different variable.

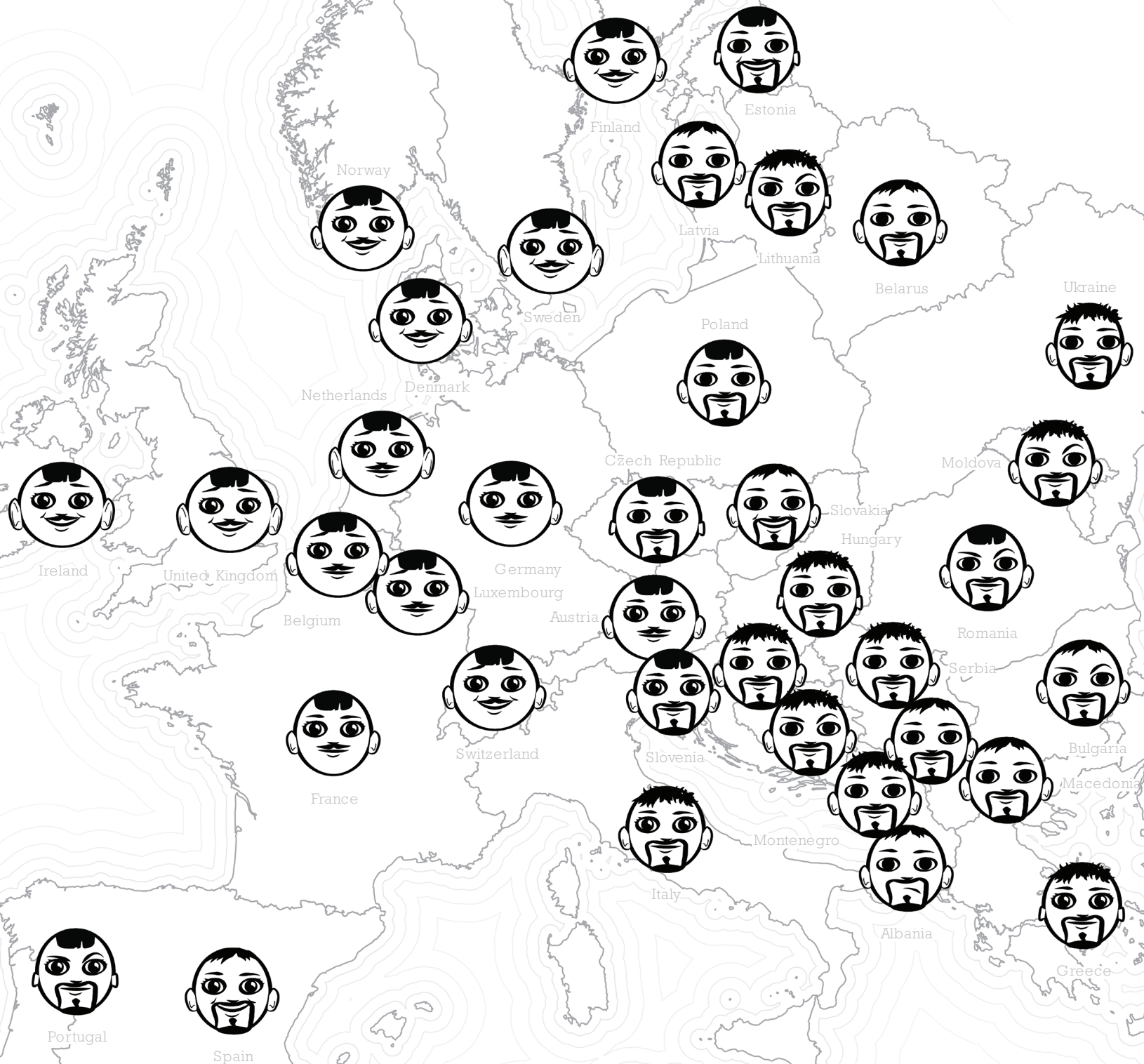
**For some, Chernoff faces are contentious, and the use of a human face can bring unintentional consequences.**

Inevitably, insensitive use of colour or modifying facial features that may appear stereotypical can encode unwanted messages. It is perhaps for this reason that they are not often used. Interestingly, the use of facial icons (emoji) are commonly used in SMS (Short Message Service) and instant messaging to relay a simple emotion, and so the basic idea has a wider acceptance in society beyond the cartographic realm.

A variation on Chernoff's original idea would be to create an asymmetrical version such that one half of the face encodes a different set of data from the left. This could be used to show two time periods and, so, a way of showing how a theme changes between two important time periods. It might also deal with the issue that creating symmetrical Chernoff faces inevitably results in wasted space as one side of the face is encoded in the same way as the other. Other variations might be to use actual human faces with variations in expression or, possibly, some development of emoji.

The use of Chernoff faces has provided some contentious examples. In 1977 Eugene Turner made a map called *Life in Los Angeles* where the faces carried emotion. As he said, 'It is probably one of the most interesting maps I've created because the expressions evoke an emotional association with the data. Some people don't like that.' (Turner 2004). His map explored wealth, employment, stress, and the relationship with proportions of white population. Needless to say the map was controversial since affluent white faces gave way to poor black faces. The statement was powerful and proves how the cartographer needs to tread a fine line between statement and overstatement or downright offence.

See also: [Graphs](#) | [Multivariate maps](#) | [Pie and coxcomb charts](#)



HAPPINESS	Overall Happiness Score	Expectation of Health	Someone to Count On	Trust in Authority	Charitable Giving	Sense of Freedom	Income
Higher than Average							
Global Average							
Lower than Average							

# Choosing type

What typeface should I use? It's a simple question. There's no simple answer.

**Many national mapping agencies have a specific typeface that contributes to their house style and the consistent appearance and recognition of their products.** These typefaces grew out of a mechanical process with a significant cost associated with lettering a map. Type blocks were re-used across different maps so there was very little choice for the mapmaker. They support a consistent style and brand recognition. Occasionally, typefaces are changed as styles, fashions, technologies, or use demand a different approach.

**Modern choices of font are limited only by what's installed on your computer—and if it's not installed, it doesn't take long to find or buy a particular font.** So the cartographer is faced with a different question: What font should I use? For many, they will simply default to Times New Roman or Arial as the obvious fonts because of the default status they hold in word processing software. Others that are commonly used might be Calibri or Myriad. Are they useful in cartography? Possibly—but the possibilities are far richer.

**The answer to the question is as vague as 'the right font for the job'.** But that doesn't necessarily make the choice any easier. The right font must be legible in the context in which it is used. It should connote meaning and not clash with the style of the rest of the map. It must be appropriate, which may result in choosing a sober font or, for a persuasive map, a more eccentric font.

**Fonts can evoke emotions in people.** They might be described as 'too clever' or 'not very interesting', and although we might ponder how a typeface can lead to such emotion, nevertheless it's a fact we have to work with or around. We all have our preferences too. For instance, I spent a considerable amount of time thinking about the typefaces that we would use in this book and, perhaps of more interest, the ones we would not consider under any circumstances. I chose Rockwell, a slab serif font described as sturdy, blunt, and with a no-nonsense character but which harks to a handmade charm. It seemed to speak to the character of the book as a whole.

**See also:** [Elements of type](#) | [Fonts and type families](#) | [Form and function](#) | [Guidelines for lettering](#)

Explore how others use typefaces in maps, posters, and graphic design. Fonts are often associated with particular artistic or design movements. Their character almost becomes engrained in a particular reaction so use that expectation to your advantage.

Perhaps the best advice is just don't be boring! Be different and go to the effort of exploring different typefaces and how they might work. If in doubt, revert to classic maps and graphic work to see how others use fonts to develop a particular look and feel. For instance, the designer Massimo Vignelli (whose magnificent 1972 New York Subway map is still held as an icon of information design) limited himself to what he considered the six 'best' typefaces: Garamond, Bodoni, Century Expanded, Futura, Times Roman, and Helvetica.

It's also worth considering how different fonts relate to one another, and rather than selecting a single font, explore how fonts can be paired and which work well together and which don't. Some fonts harmonise well while others create visual clashes. The idea is to find concord and contrast but limit conflict between fonts. They can be very different but still remain complementary which might mean choosing a serif alongside a sans serif font. They will likely conflict if they are too similar.

Old style serifs (e.g. Garamond) generally work well with Humanist sans serifs (e.g. Gills Sans). Transitional or Geometric serifs with their contrast between thick and thin strokes (e.g. Bookman or Bodoni) work well with Geometric sans serifs (e.g. Avenir).





APPARIEMENT<sup>des</sup>  
POLICES de CARACTÈRES



hors d'oeuvre

**Rockwell**  
Futura

potage

Garamond  
Helvetica Neue

poisson

Caslon  
Myriad

entrée

Noto Sans  
Noto Serif

sorbet

**Rockwell Bold**  
Bembo

salades

Arial  
Georgia

fromage

**Franklin Gothic Demi**  
Baskerville Old Face

desserts\*

Comic Sans  
Papyrus

\*Sometimes you have to really question if a dessert is worth it



# Choropleth maps

A statistical thematic map that displays quantitative differences in area data using shading or pattern.

## A choropleth map represents quantitative data for areas.

Areas that display relatively less of the mapped phenomena are shown as lighter and areas that display more are shown as darker. The areas might be countries, states, counties, or other enumeration units. You should be able to recognise differences in symbols across the map that reveal areas of high and low with differences and patterns of common characteristics being legible.

## A single data value is represented by each area on the map.

Data should be in the form of ratios, percentages, or rates. Mapping totals is inappropriate because most maps have unequally sized areas which play a misleading part when trying to visually compare symbols across the map.

**Data is most often organised into classes.** A good guide is to use between four and seven classes. Fewer classes tends to over-simplify the map. Too many classes can create difficulties differentiating between symbols on the map. For a single choropleth map, using a natural breaks scheme is a good default as it groups similar data values into the same class. Alternatives such as equal interval and quantile can be useful: for instance, if you are comparing two maps side by side, a quantile scheme creates a uniform scheme for both maps which allows them to share a legend and be comparable.

**Symbols help distinguish different classes from one another.** This is achieved by varying the symbol colour or pattern. There should be sufficient variation between symbols that each can be recognized on the map. If the data contains a critical value (or class), for which the map needs to illustrate differences above and below, then a diverging colour scheme might be used.

**Unclassed choropleth maps display data across an entire shading scheme.** Individual data values are given their own unique shade in sequence. Although this approach is useful for identifying outliers, it is not so useful for identifying areas that share similar characteristics.

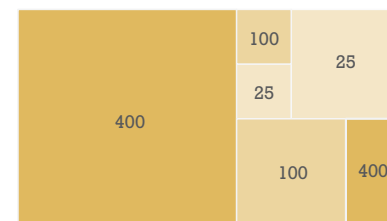
See also: [Data classification](#) | [Pointillism](#) | [Unclassed maps](#) | [Value-by-alpha maps](#)

American geographer John Kirtland Wright coined the term 'choropleth map' in 1938, although the mapping technique itself was first used by Charles Dupin in 1826. Wright cautioned against the use of choropleth maps because of their potential to treat geography as a homogeneous surface (particularly when used to map totals), instead espousing the virtues of the dasymetric map which makes allowances for spatial heterogeneity.

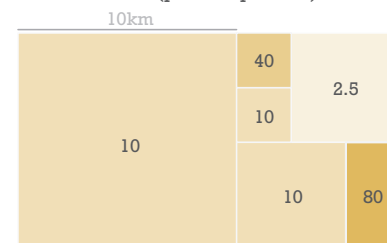
Spectral colour schemes should be avoided because they don't visually convey numerical differences between values of data. Consequently, you cannot decipher the relative differences between classes. Avoid using white or black, or full lightness to full darkness of your chosen colour, at either end of a shading scheme because it suggests absence at the lower end and totality at the upper end. Using white may also clash with your map background.

Mapping totals misleads since areas are different sizes. Emphasis is wrongly given to raw totals in the shading scheme. Mapping derived values, proportional to the area, corrects the map to show data consistently represented across the map and from which proper visual comparisons can be made.

Total (persons)

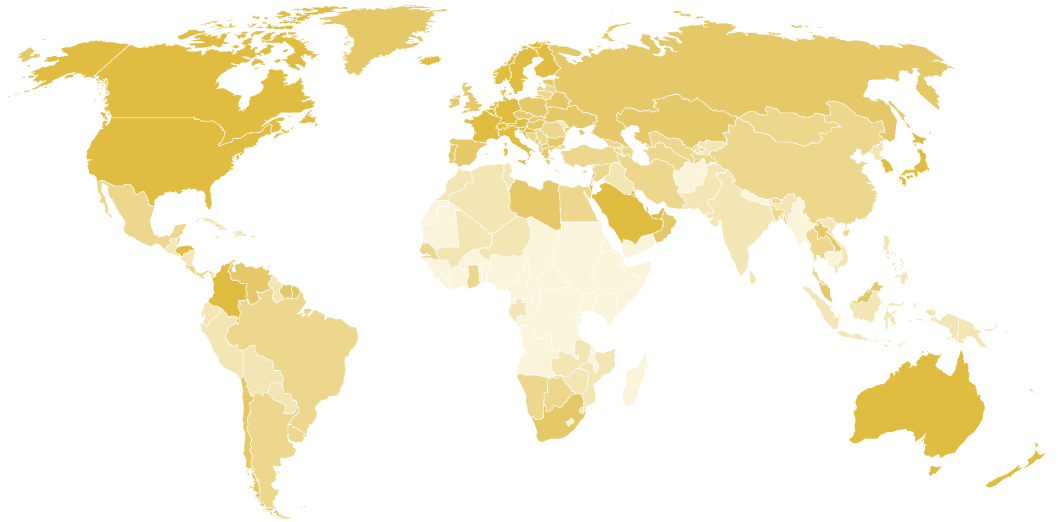
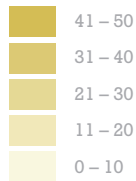


Derived values (persons per km<sup>2</sup>)



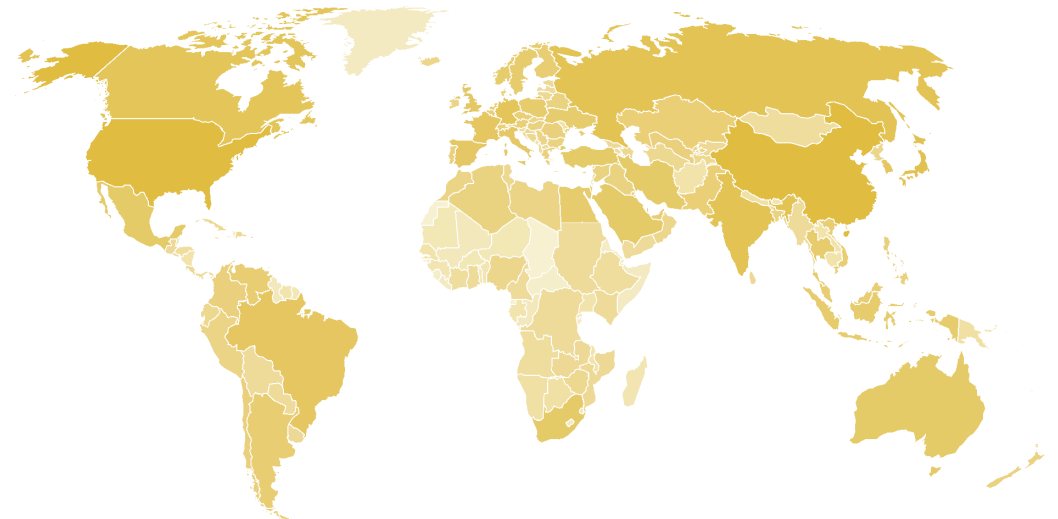
A 5 class choropleth map symbolised using a single hue sequential colour scheme where value changes to connote high to low.

This supports the reader in making comparisons between high and low areas that share similar characteristics.



An unclassed choropleth map symbolised with a gradient sequential hue scheme. Each area on the map is shaded uniquely.

This supports the reader in viewing the position of each area in sequence as well as identifying outliers.



A 6 class choropleth map symbolised using a diverging colour scheme centred around a critical value in the data (in this case zero). This is effectively two sequential colour schemes where value changes to connote high to low.

This supports the reader in making comparisons between areas that share similar characteristics above and below the central value.

