

Data Science II

- Introduction to Data Visualization -

Visualizing Geospatial Data



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Visualizing Geospatial Data

Geospatial

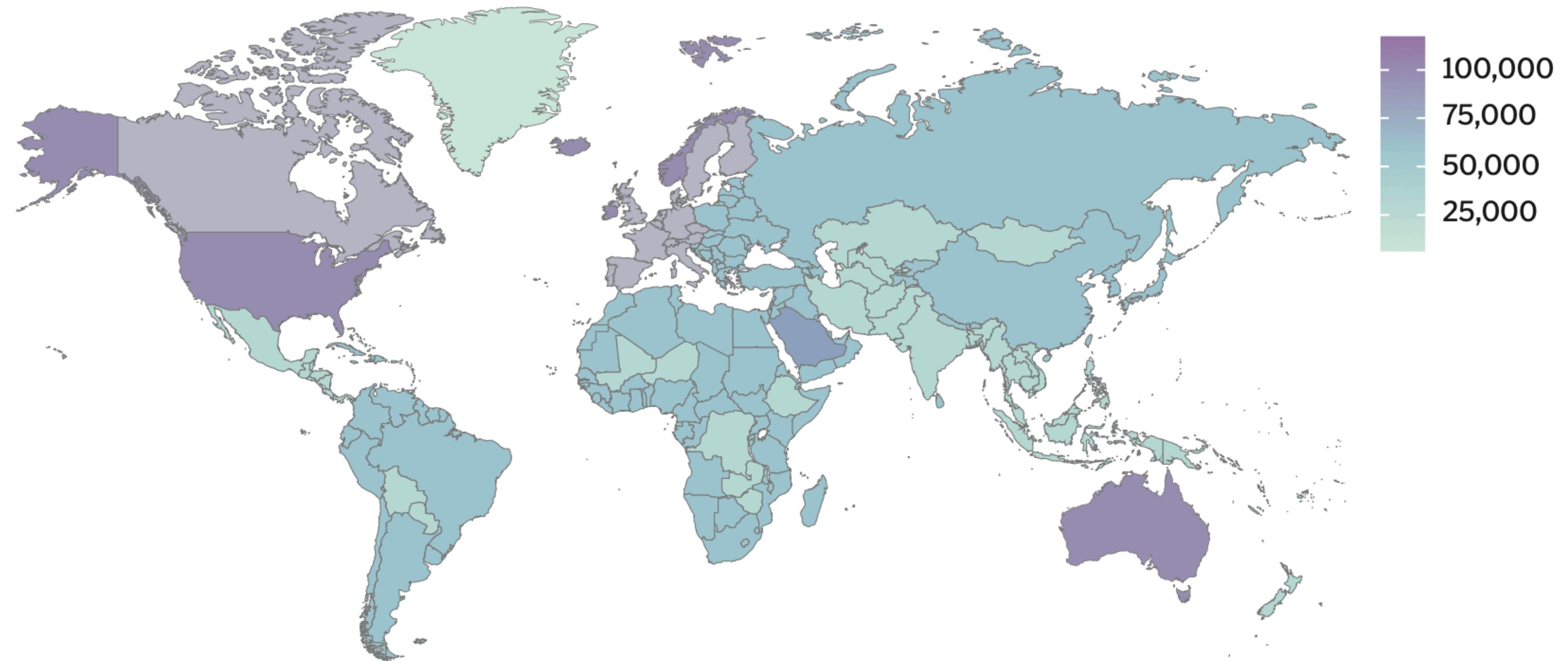
- datasets often contain **information linked to locations** in the physical world
 - ▶ e.g. where do people with specific attributes (income, age etc.) live
 - ▶ e.g. where have specific plants been found
- plotting geographic data involves adding color to geographic areas or adding symbols (circles, squares, lines) on top of a geographic map

Challenges of Maps

- the size of a geographic area sometimes does not correspond to the importance of the data value
 - the map can distort our perception of the important values being visualized
- you should always question if a map is truly the best way to present geographic data

Choropleth Map

PER CAPITA GDP AROUND THE WORLD IN 2017



Source: The World Bank

Choropleth Map

- choropleth maps use colors, shades, or patterns on geographic units to show proportionate quantities and magnitudes
- smaller numbers usually correspond to lighter colors and larger numbers to darker colors (a “color ramp”)

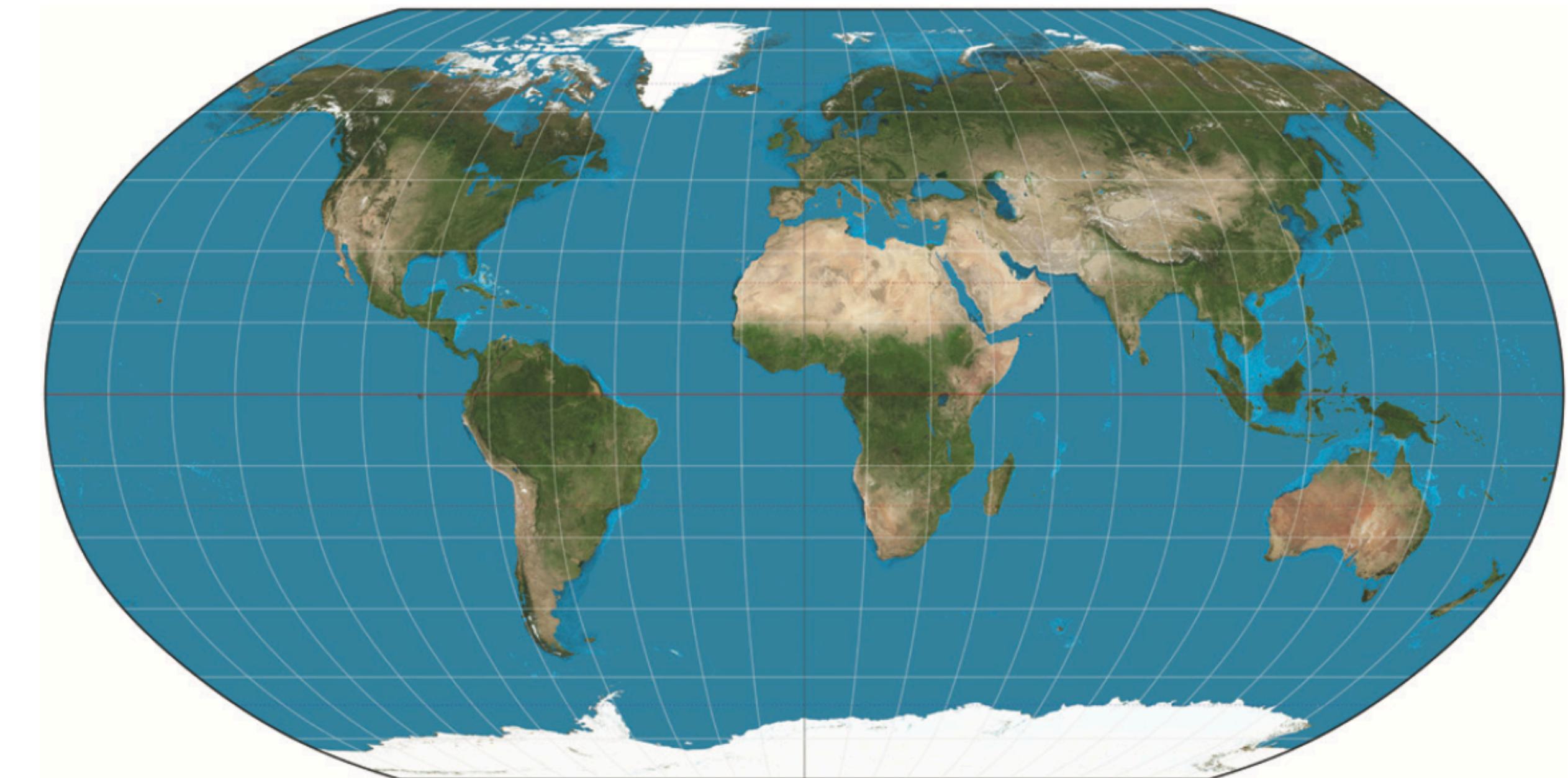
Projections

- the world is a **globe**, but maps are **flat**
 - ▶ a map maker must choose a map projection to transform the world's sphere into a two-dimensional plane
 - ▶ Which projection does the best job depicting the earth in two dimensions?

Projections



Mercator projection

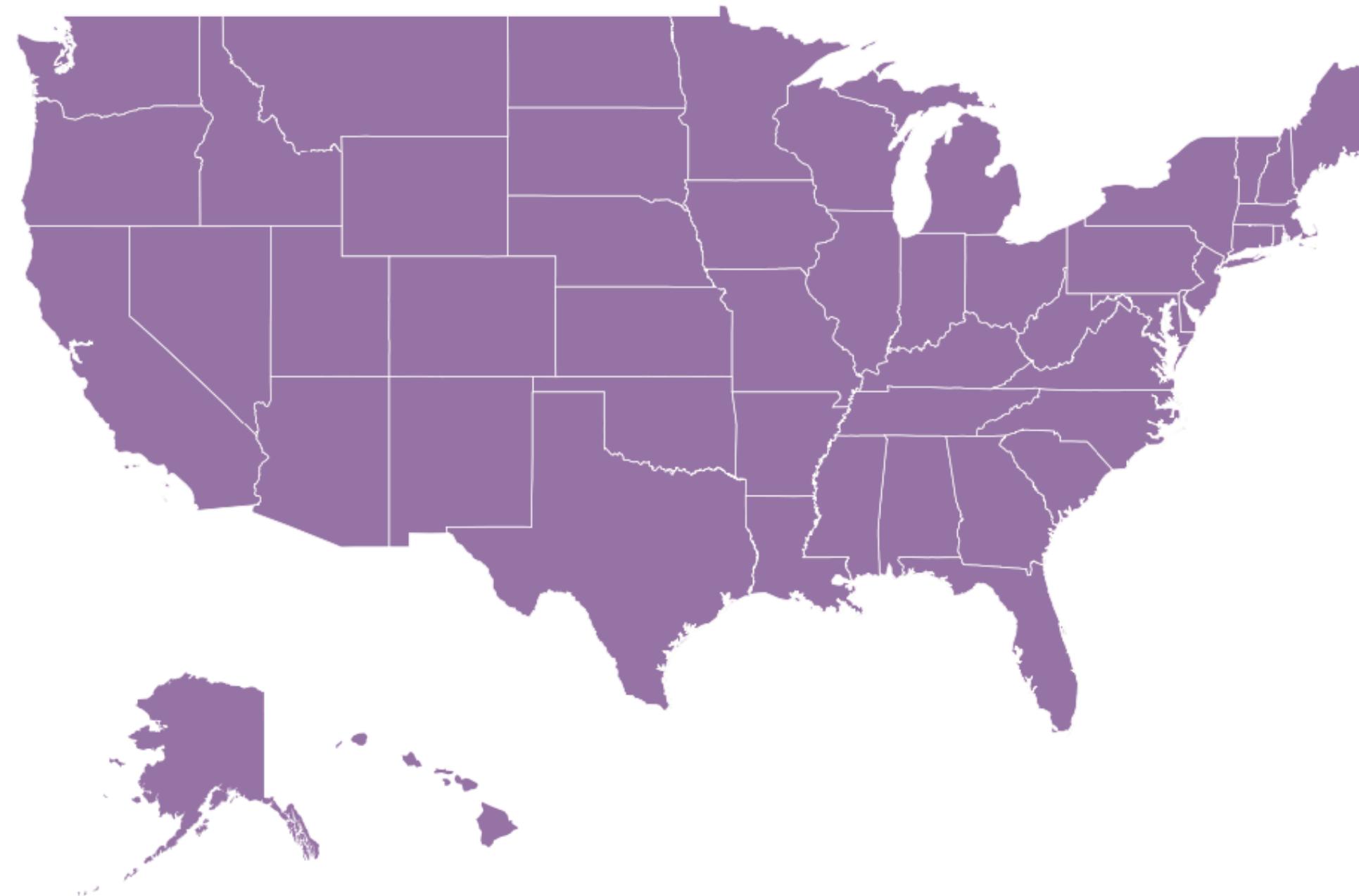


Robinson projection

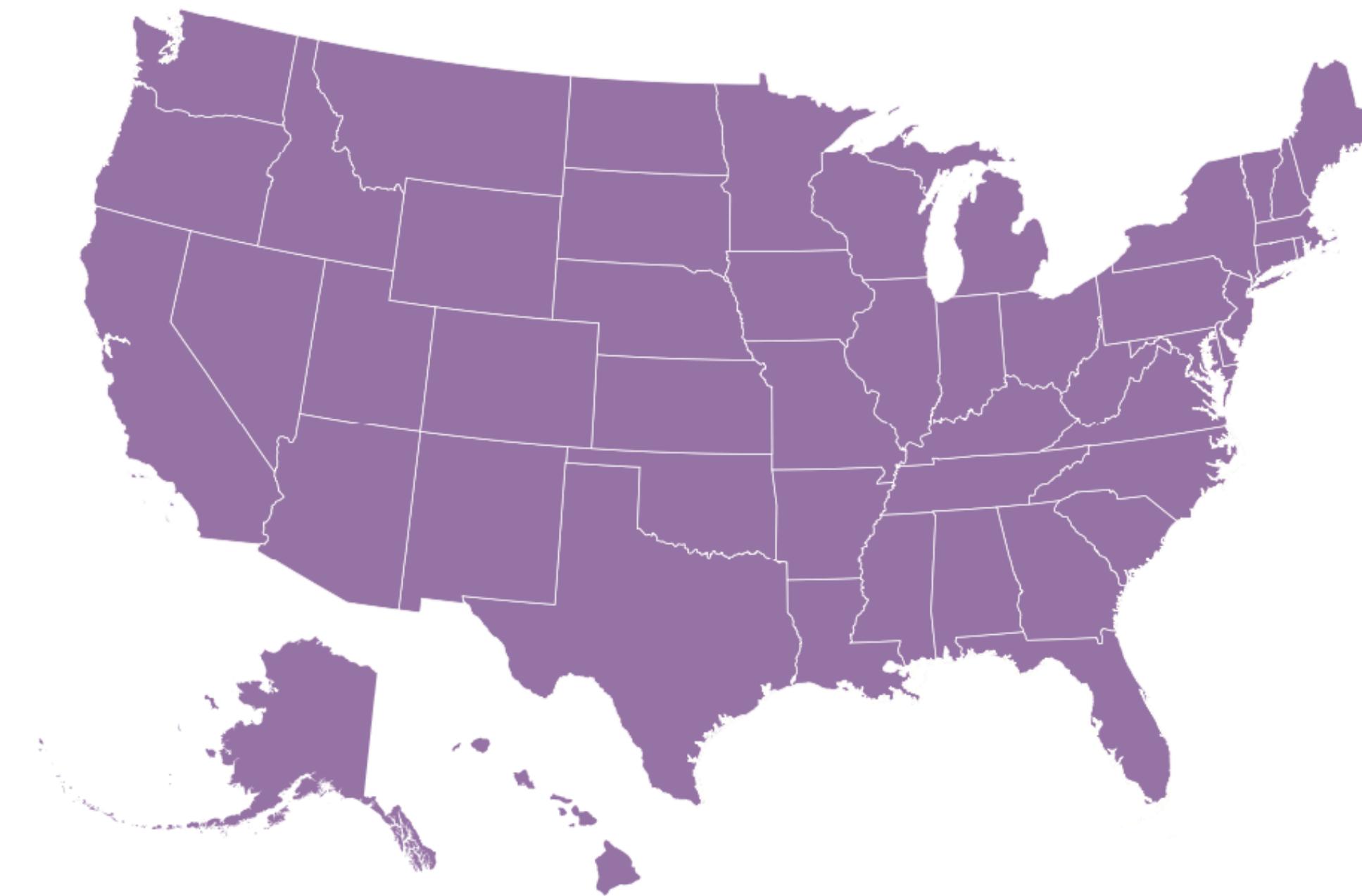
Projections

- Mercator projection:
 - ▶ distorts the size of objects as the latitude increases from the equator to the north and south poles
 - ▶ countries closer to poles (e.g. Greenland) appear much larger than they actually are
 - Greenland appears to be about the same size as South America, when it is about one-eighth the actual size
 - ▶ can work well for small areas

Projections



Mercator projection

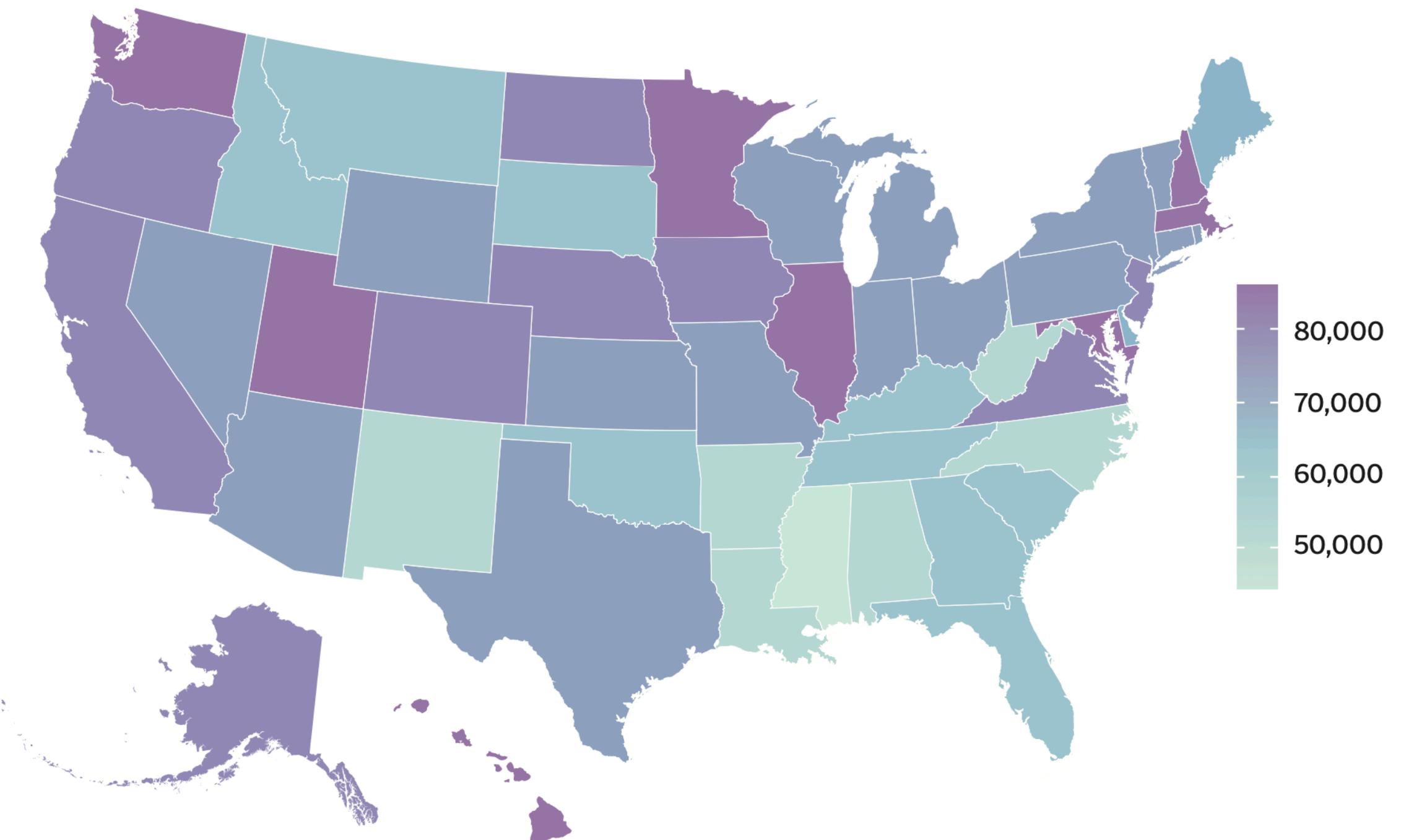


Albers projection

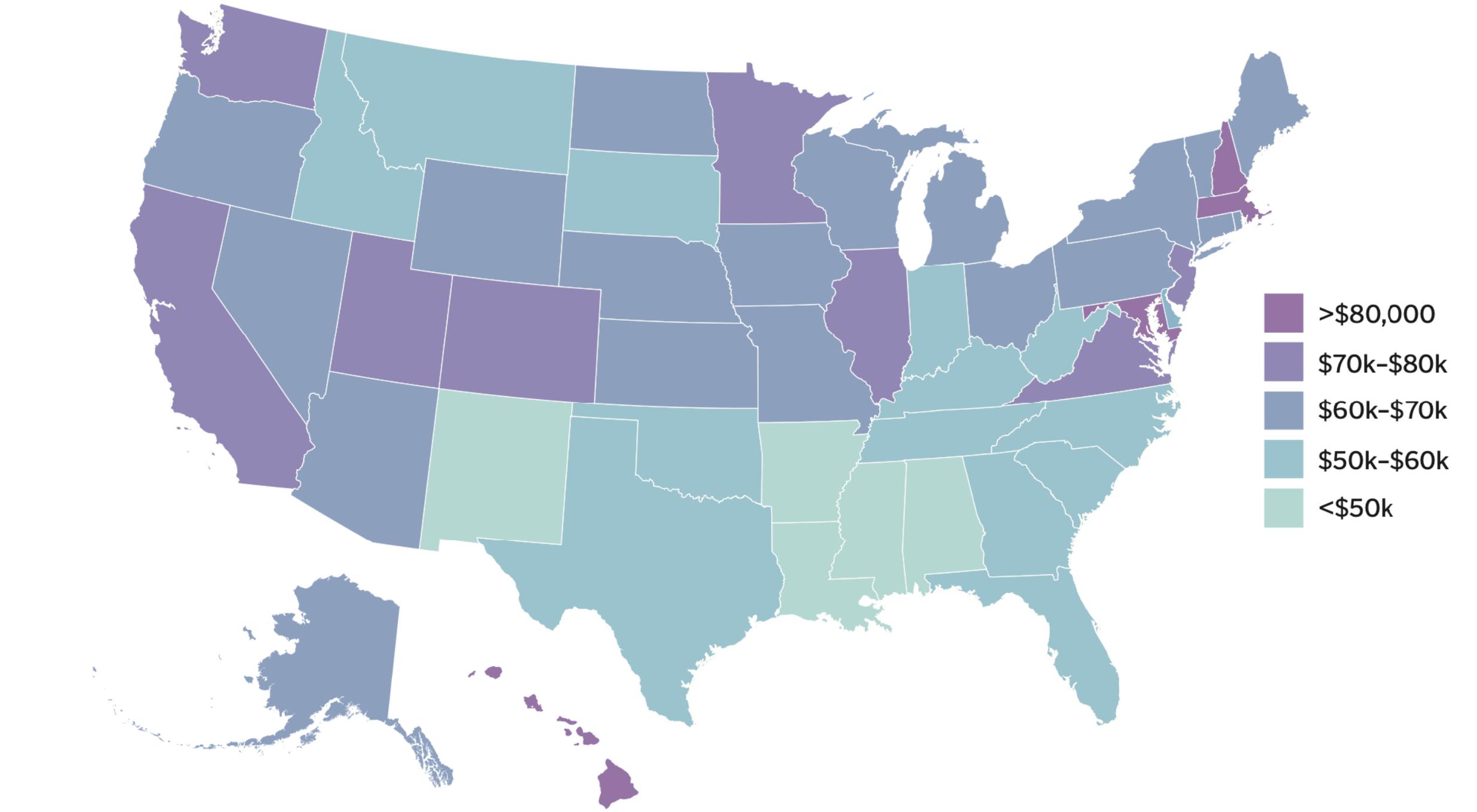
Choosing the Bins

- the choice of intervals that will shade the geographic units plays an important role for our visualization
- binning methods:
 1. **no bins**: choose a continuous color palette
 - ▶ each data value receives its own unique color tone
 2. **equal interval bins**: divide the data range into an equal number of groups
 3. **data distribution bins**: arrange bins to hold the same number of observations (or use variance or standard deviation)
 4. **arbitrary bins**: use an arbitrary criterion (e.g. round numbers) for binning

Binning Methods

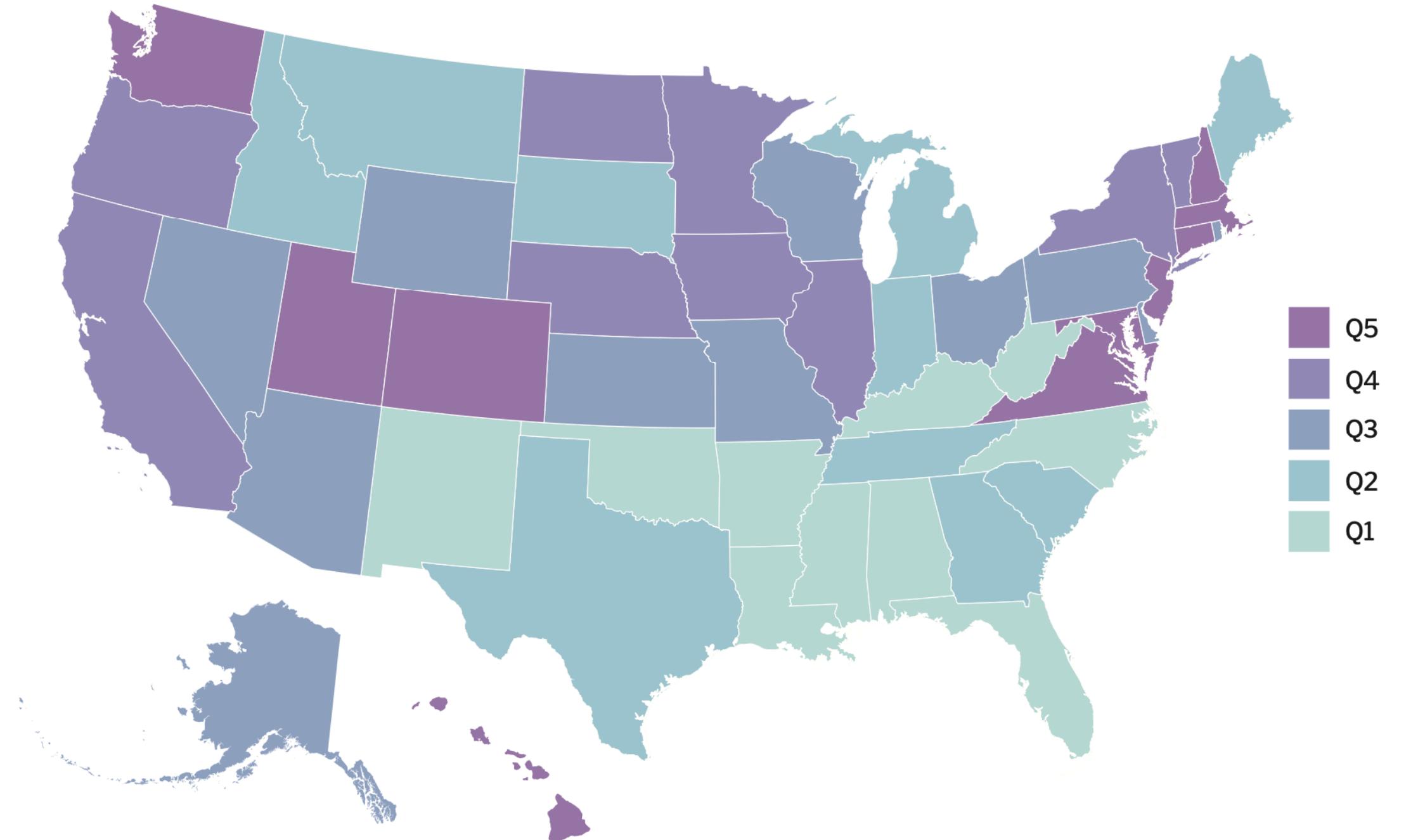


No bins

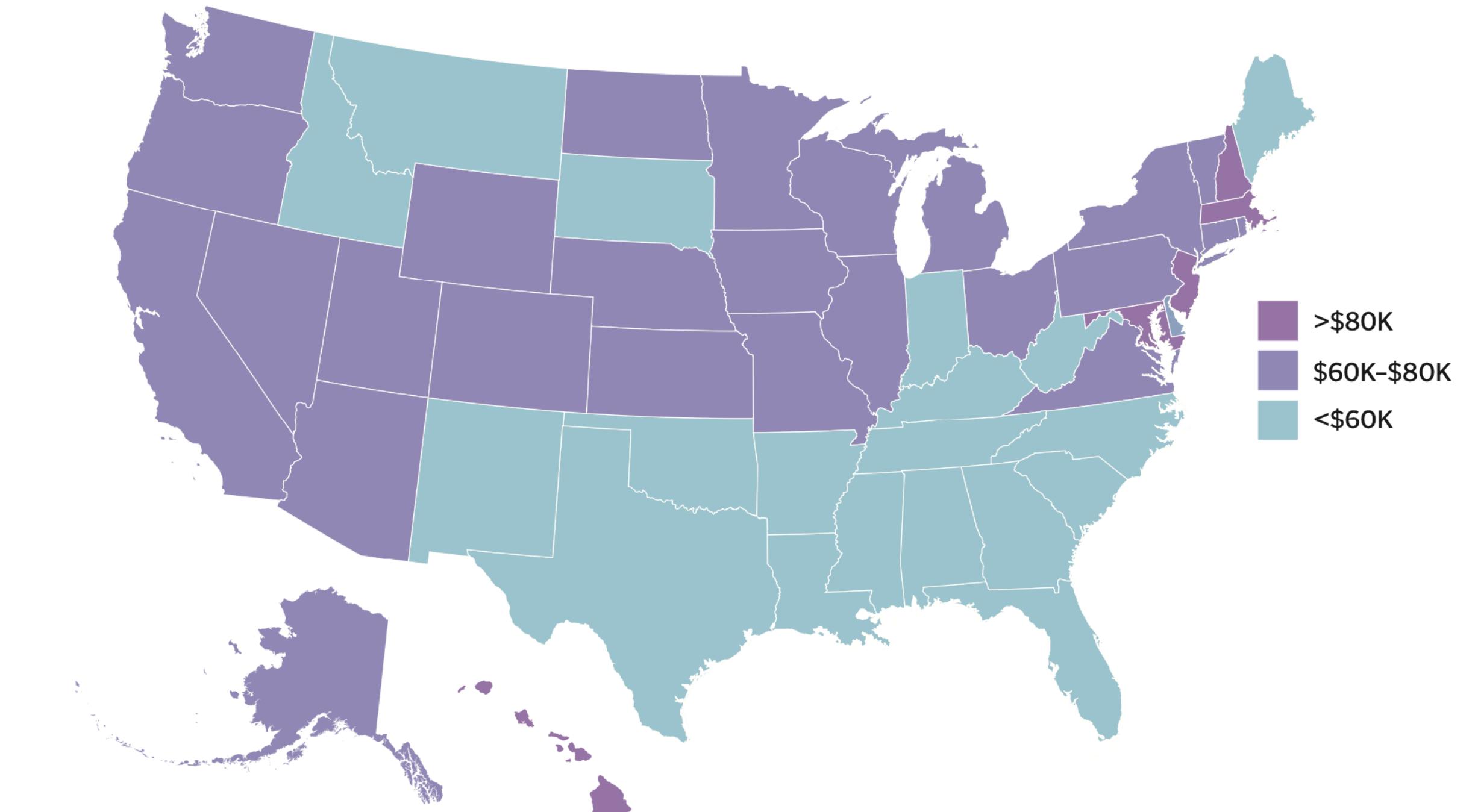


Equal interval bins

Binning Methods

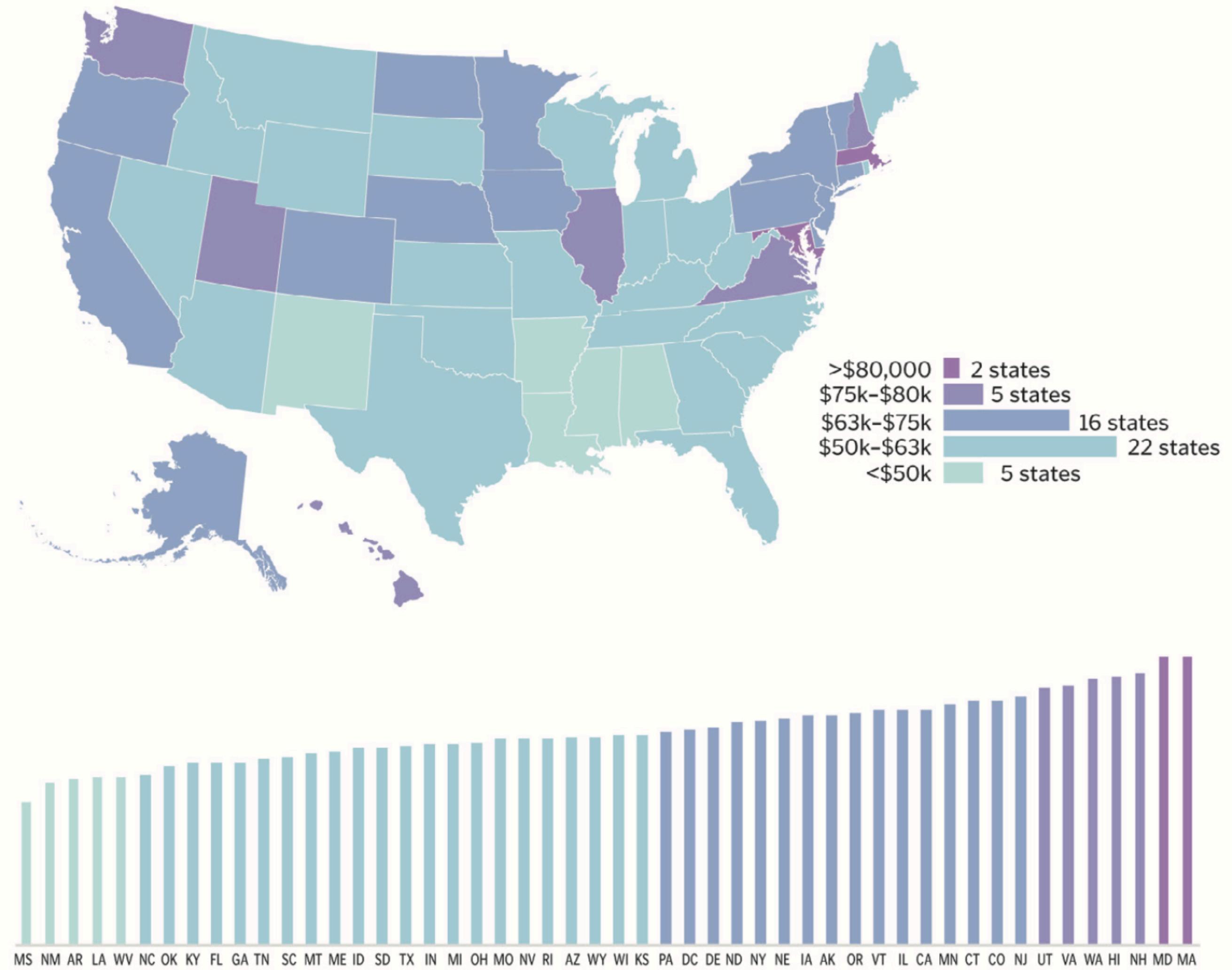


Data distribution bins



Arbitrary bins

Binning Methods

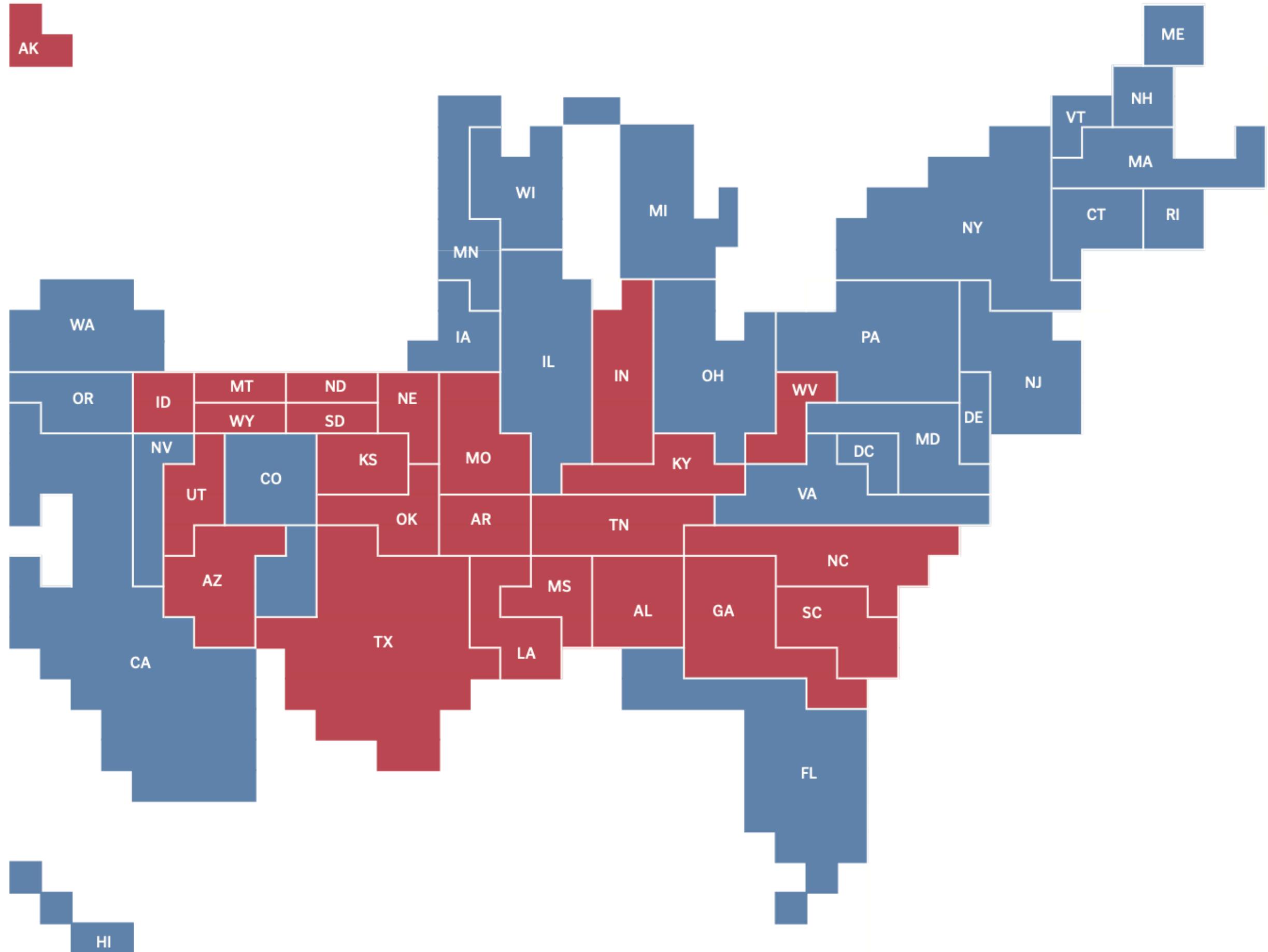


Source: U.S. Census Bureau

Cartograms

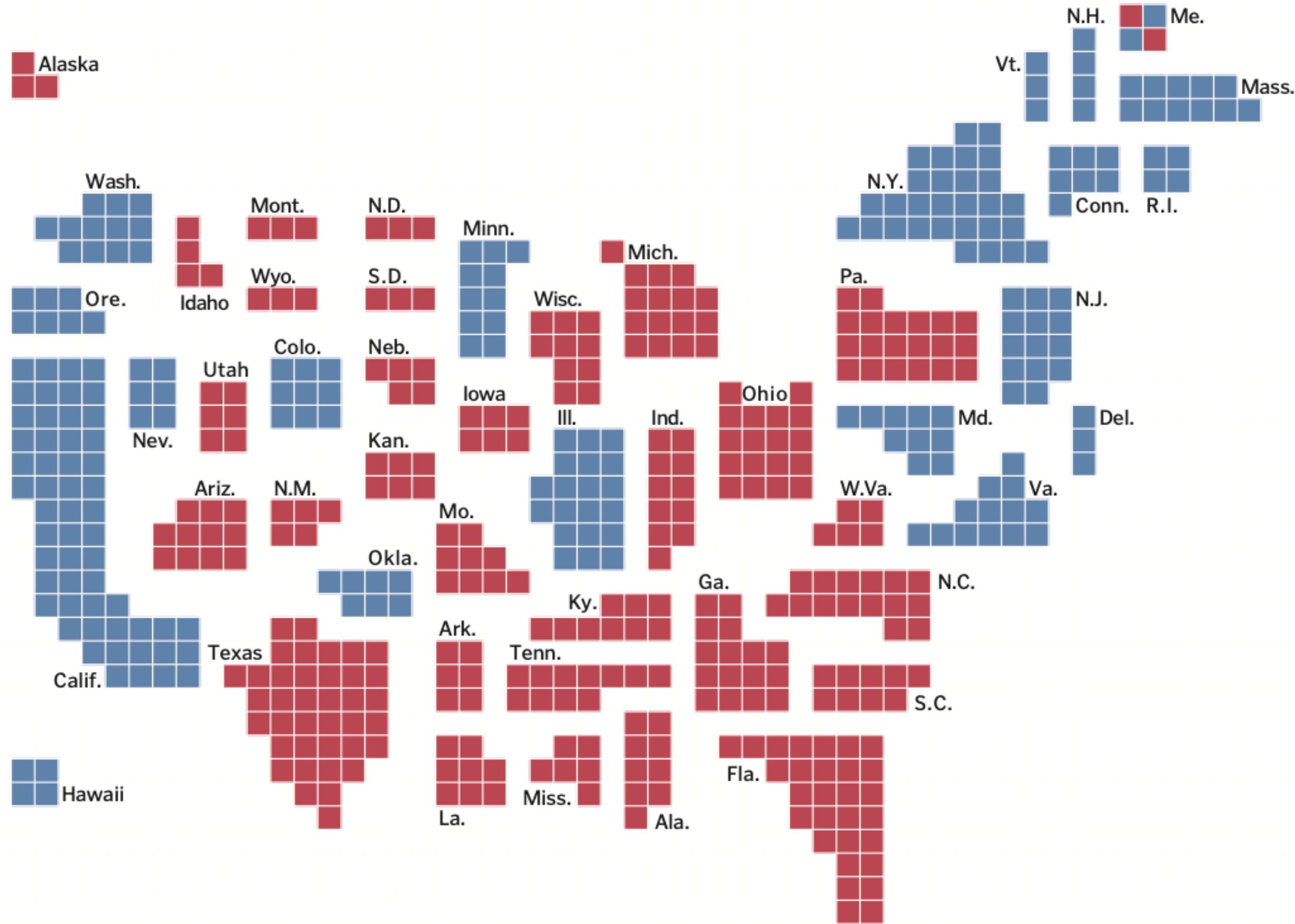
- a cartogram reshapes geographic areas based on their values
- these adjustments more accurately visualize the data because cartograms correlate the data and the geographic size
- but they are less intuitive for us
- there are four primary types of cartograms: **contiguous**, **noncontiguous**, **graphical** and **gridded**

Contiguous Cartogram



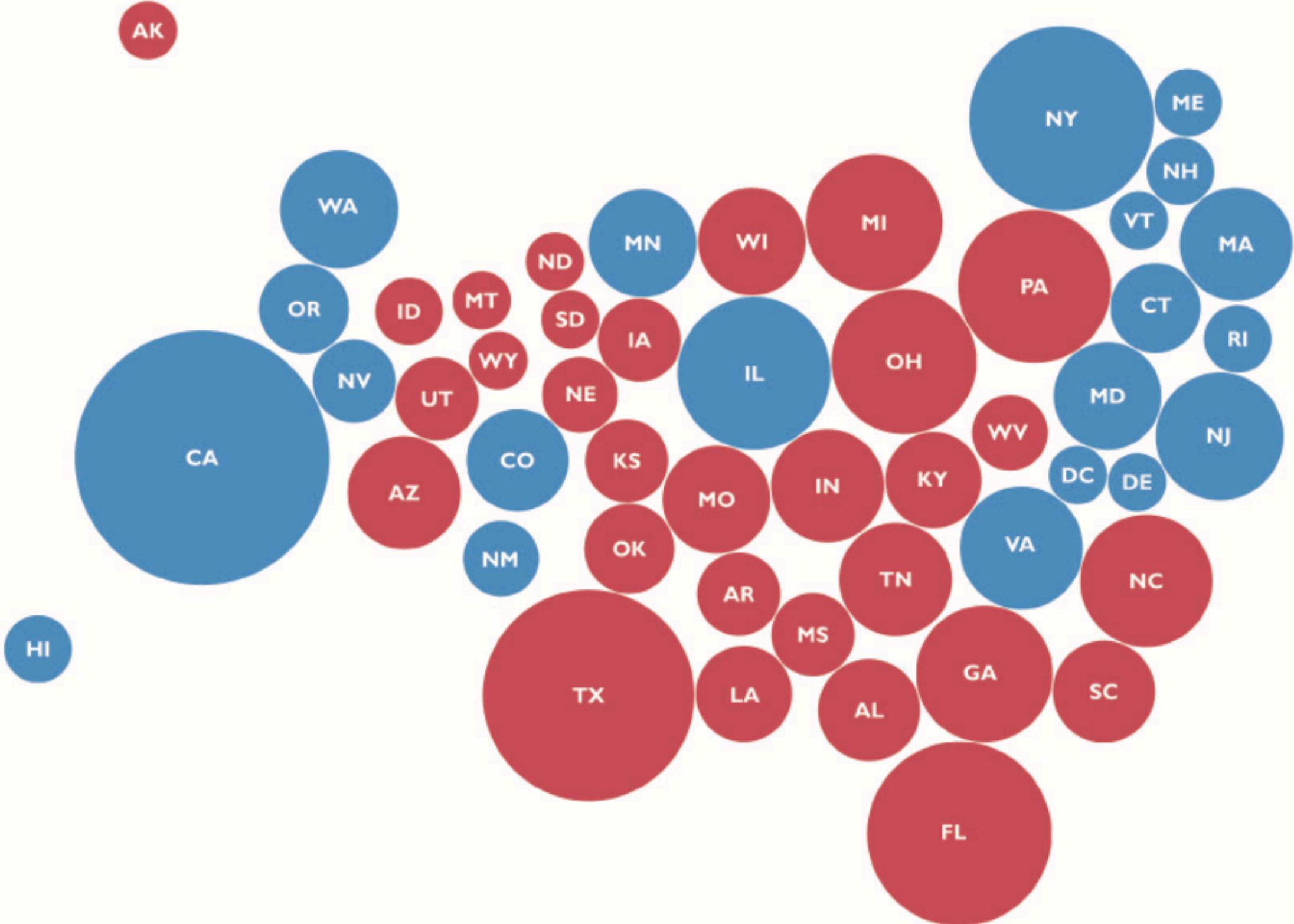
- the contiguous cartogram adjusts the size of each geographic unit according to the data
- here: each state is sized to its number of electoral votes

Noncontiguous Cartogram



- the noncontiguous cartogram adjusts the size of each geographic unit according to the data, but the units are broken apart and not kept adjacent
- this way we maintain the shape of the individual units but distort the overall view

Graphical Cartogram

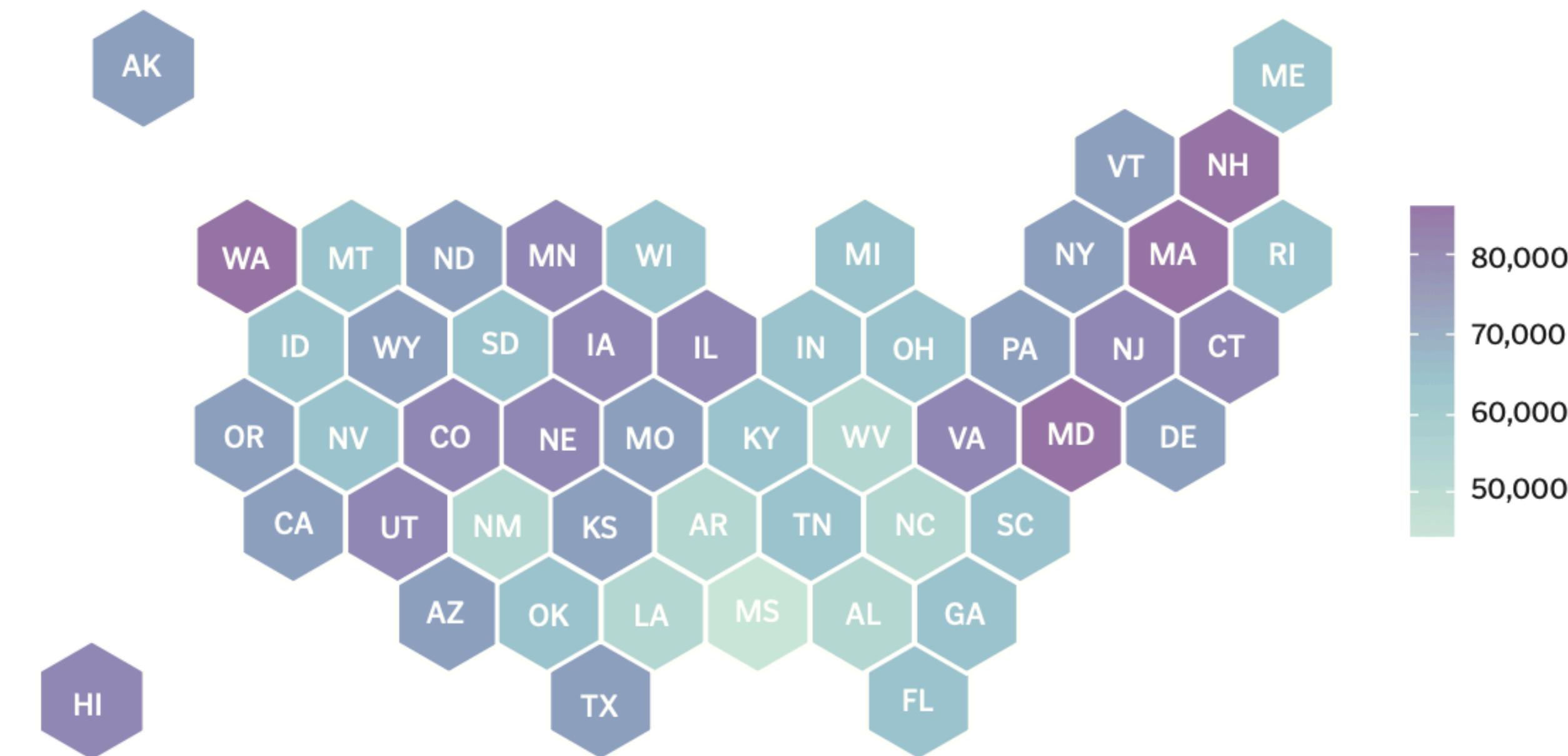


- graphical cartograms do not maintain the original shape of the geographic units and instead use other shapes sized to the data values

Source: Courtesy Kenneth Field, Esri Inc.

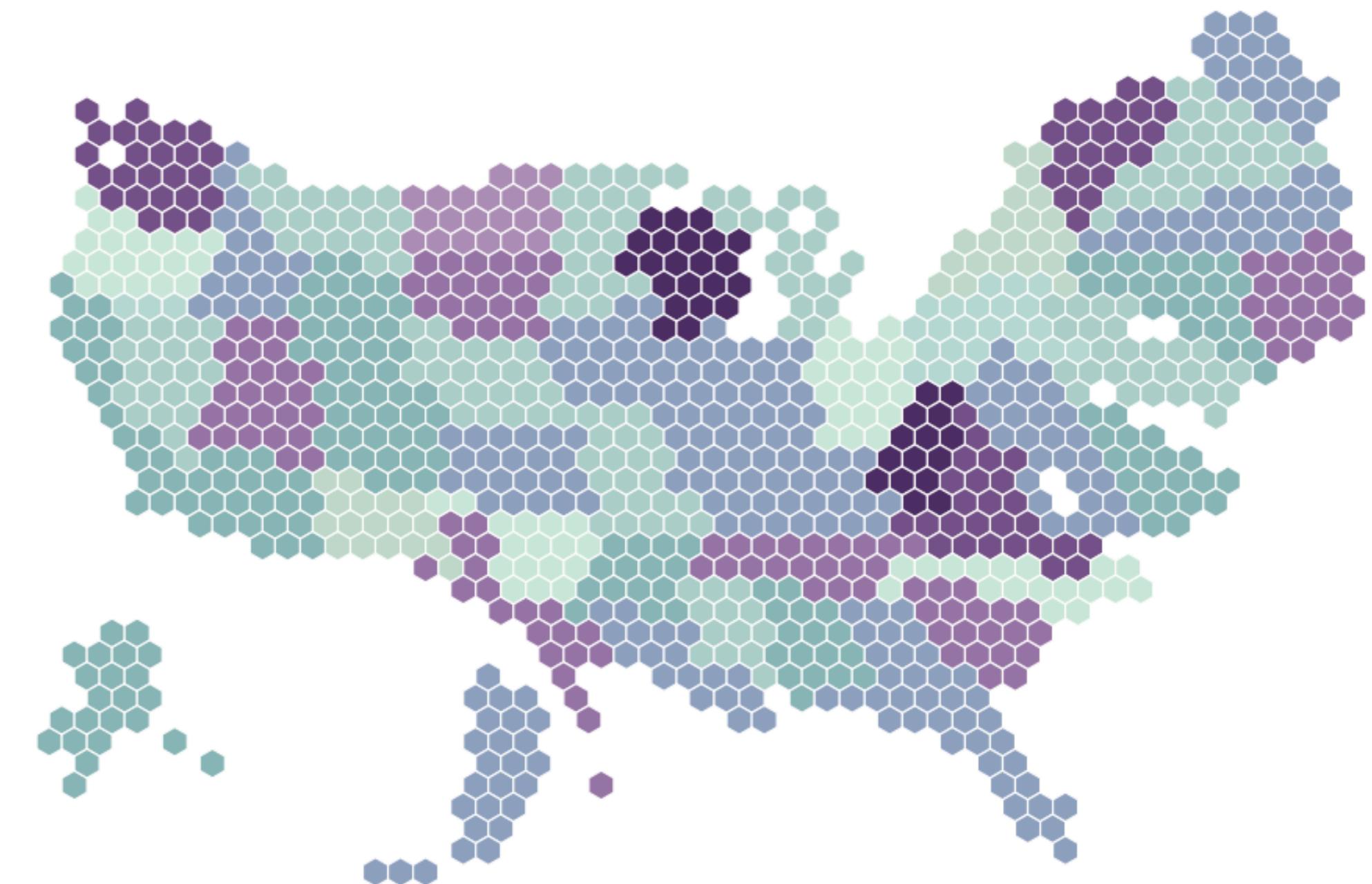
Gridded Cartogram

MEDIAN HOUSEHOLD INCOME IN THE UNITED STATES, 2018



Source: U.S. Census Bureau

MEDIAN HOUSEHOLD INCOME IN THE UNITED STATES, 2018



Source: U.S. Census Bureau

Different shapes are scaled to the data and arranged so they maintain the general shape of the major geography (hexagons are most often used).

Proportional Symbol Maps

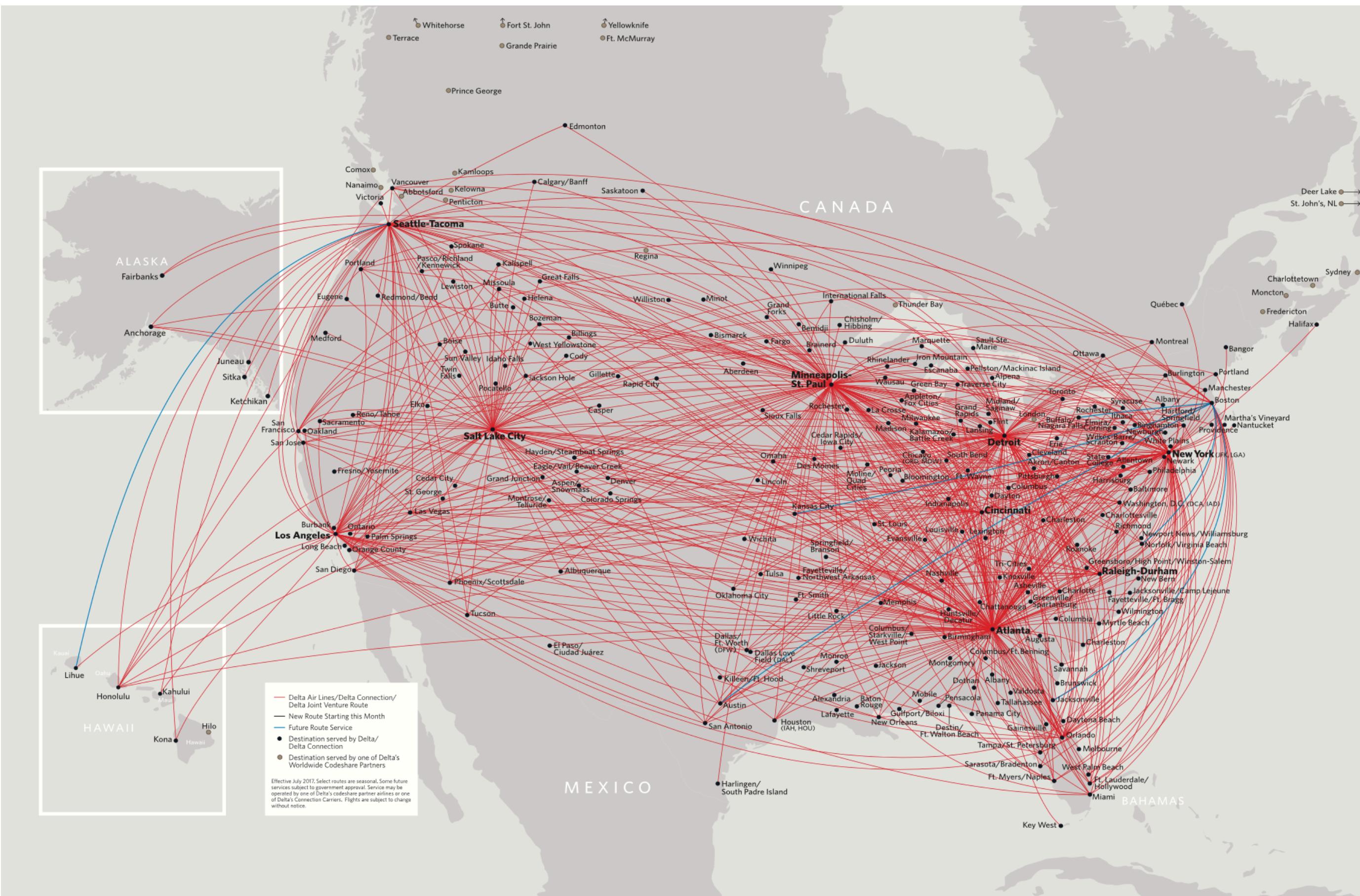
PER CAPITA GDP IN EUROPE, 2017



- proportional symbol maps: symbols are sized proportionate to the data
- the two maps show per capita GDP for European countries encoded with circles and squares

Source: The World Bank

Flow Map

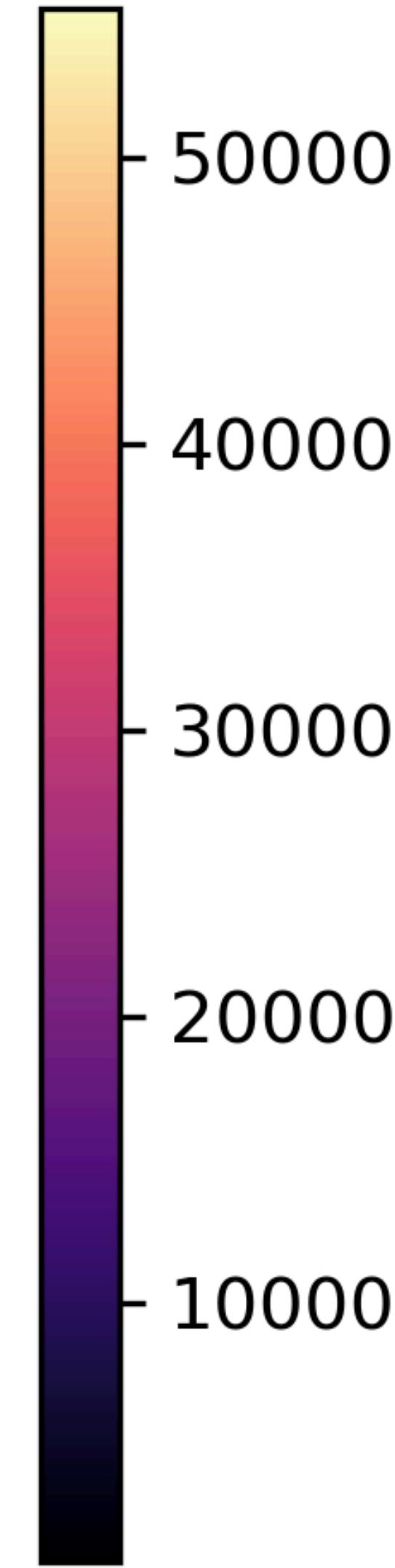
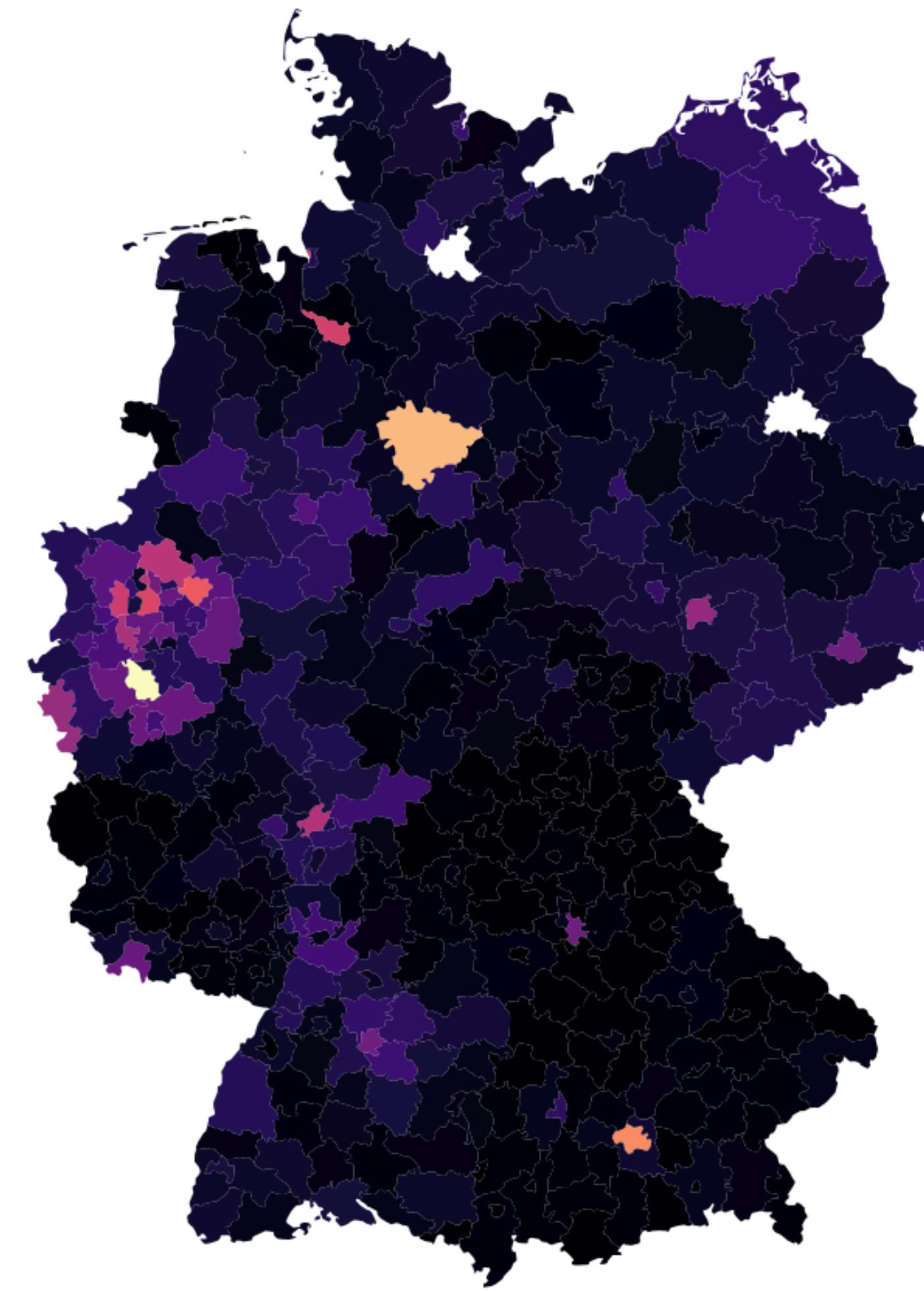
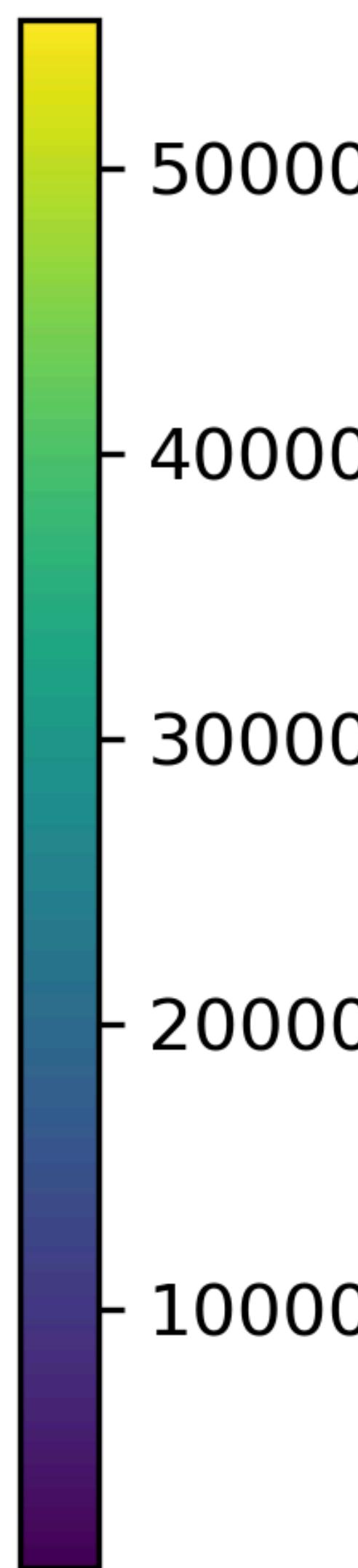
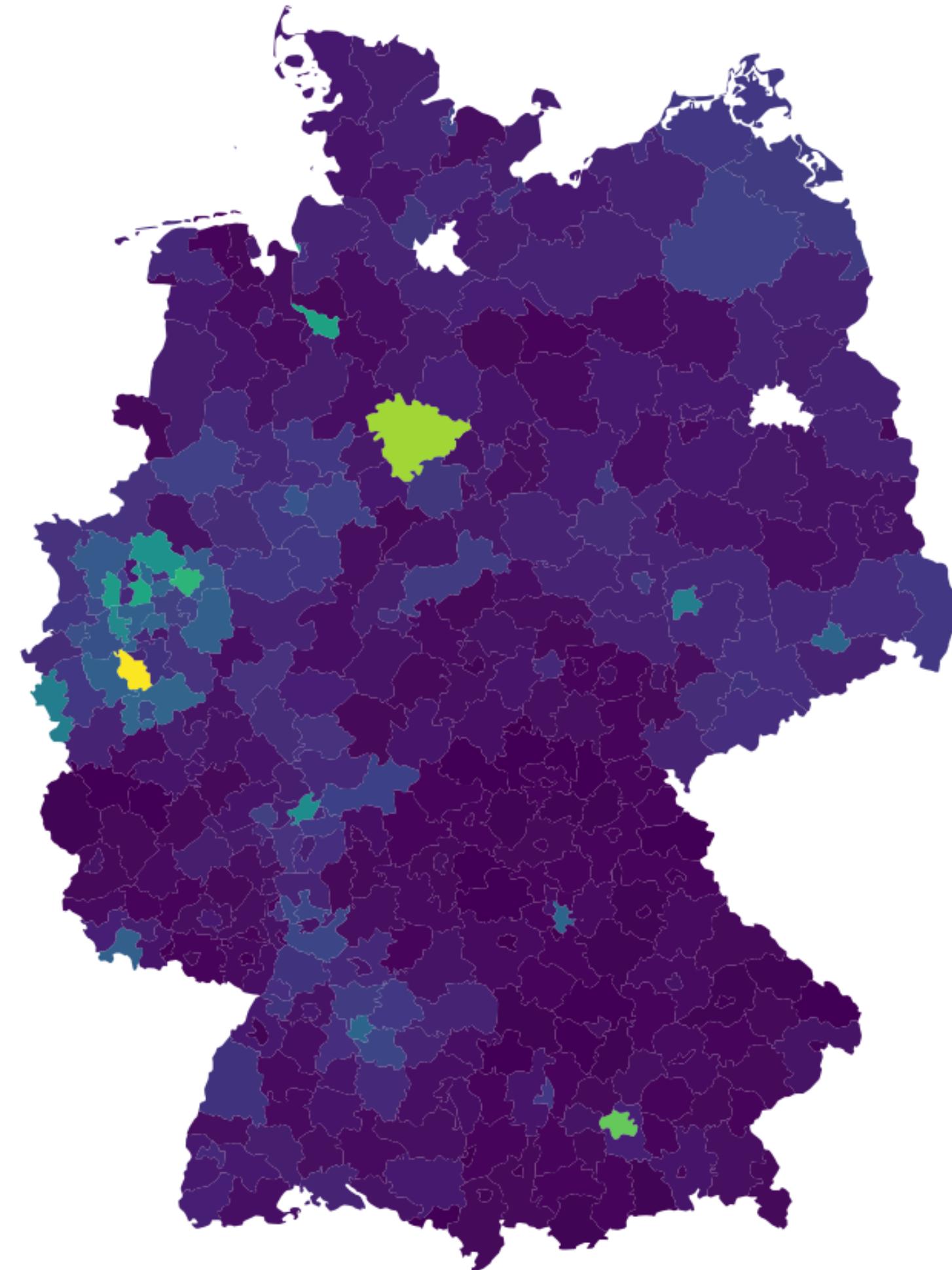


- flow maps show movement between places
- arrows and lines denote the direction of the flow
- the width of the line can correspond to the data value

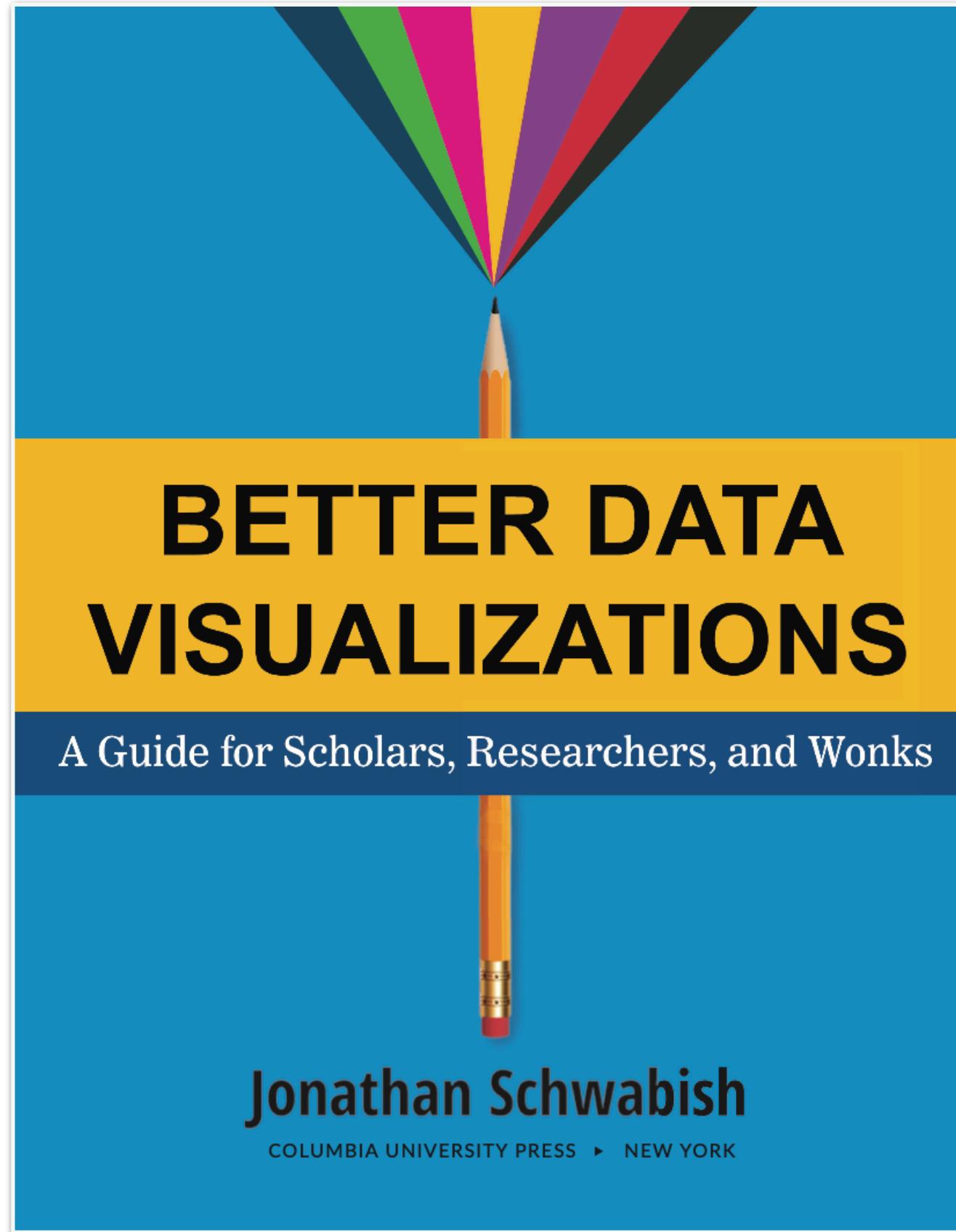
Choropleth Maps with Python

- there exist several Python libraries for choropleth map visualizations, e.g.
 - ▶ [geoplot](#) (see also [geopandas](#))
 - ▶ [folium](#)
 - ▶ [plotly.choropleth](#) (see [tutorial](#))
- download German geo data from [“Bundesamt für Kartografie und Geodäsie”](#)
- use [geopandas](#) to read in [vg2500_krs.shp](#)
- download German unemployment data from [Statistisches Bundesamt](#):
“Arbeitslose nach ausgewählten Personengruppen - Jahresdurchschnitt - regionale Tiefe: Kreise und krfr. Städte - Jahr 2020”
- from both datasets create the corresponding choropleth map

Choropleth Maps with Python



Literature



References

- Slide 5,8,10,12-14,16-21; Image Source: J. Schwabisch - Better Data Visualizations, Columbia University Press