Multivariate Mapping

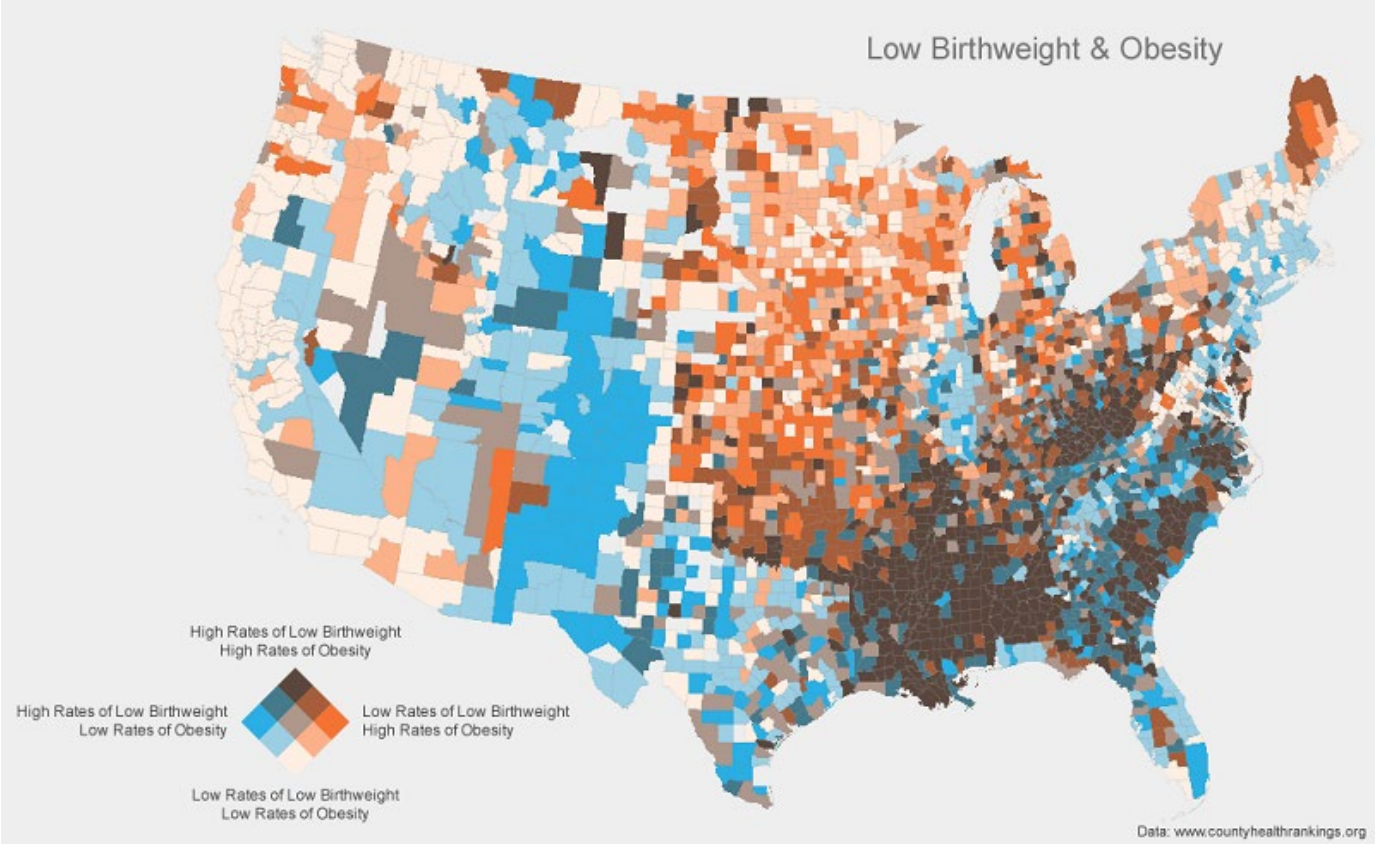
GEOG 5201 – Spring 2022

Outline

- Concepts of multivariate mapping
- Multivariate mapping techniques
  - Maps compared
    - Choropleth maps (small multiples)
  - Maps combined
    - Trivariate choropleth maps
    - Multivariate dot maps
    - Multivariate point symbol maps
    - Combining different types of symbols

Recall Bivariate Mapping

- The display of two attributes (or variables)

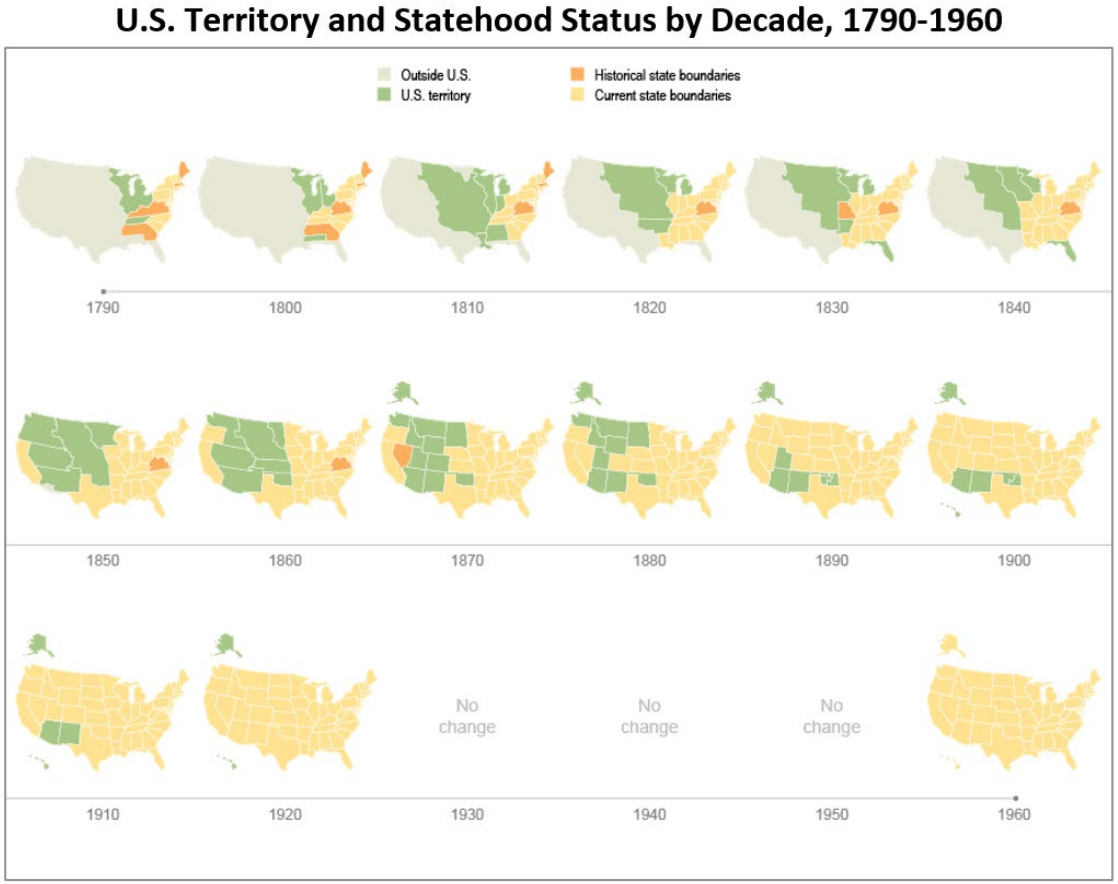


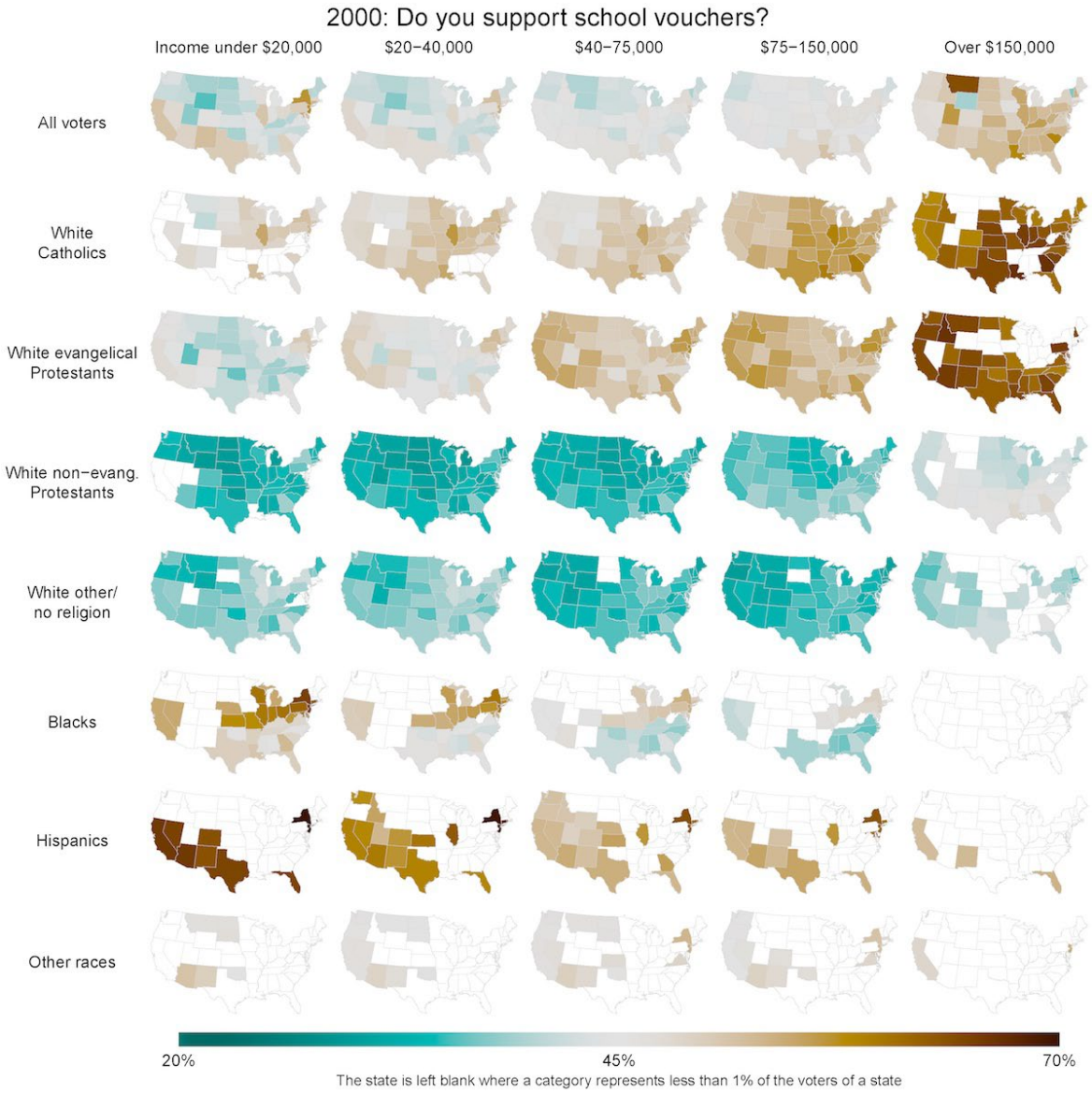
What is Multivariate Mapping?

- The cartographic display of more than two attributes (or variables) for data exploration using a single symbolization mechanism
- Bivariate maps are special multivariate maps
- Two major layouts
  - Comparing
  - Combining

Maps Compared

- A series of small maps to be shown for each variable; result in small multiples



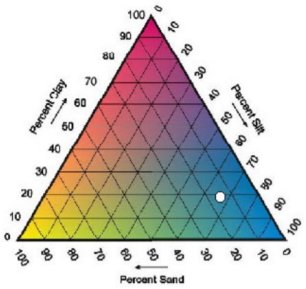

2000: Do you support school vouchers?
Income under $20,000
$20−40,000
$40−75,000
$75−150,000
Over $150,000
All voters
White Catholics
White evangelical Protestants
White non−evang. Protestants
White other/ no religion
Blacks
Hispanics
Other races
20%
45%
70%
The state is left blank where a category represents less than 1% of the voters of a state

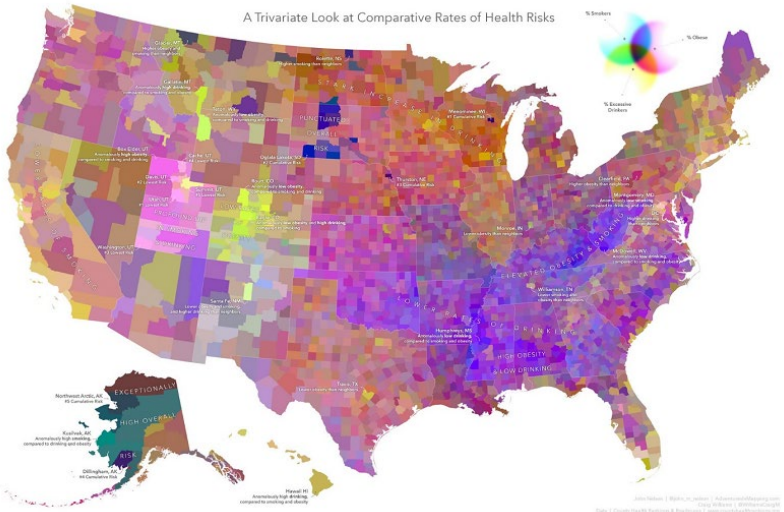
Maps Combined

- Multiple variables to be shown on the same map
  - Integral symbols
    - Trivariate choropleth maps
    - Multivariate point symbol maps
  - Separable symbols
    - Combining different types of symbols

Maps Combined I: Trivariate choropleth maps

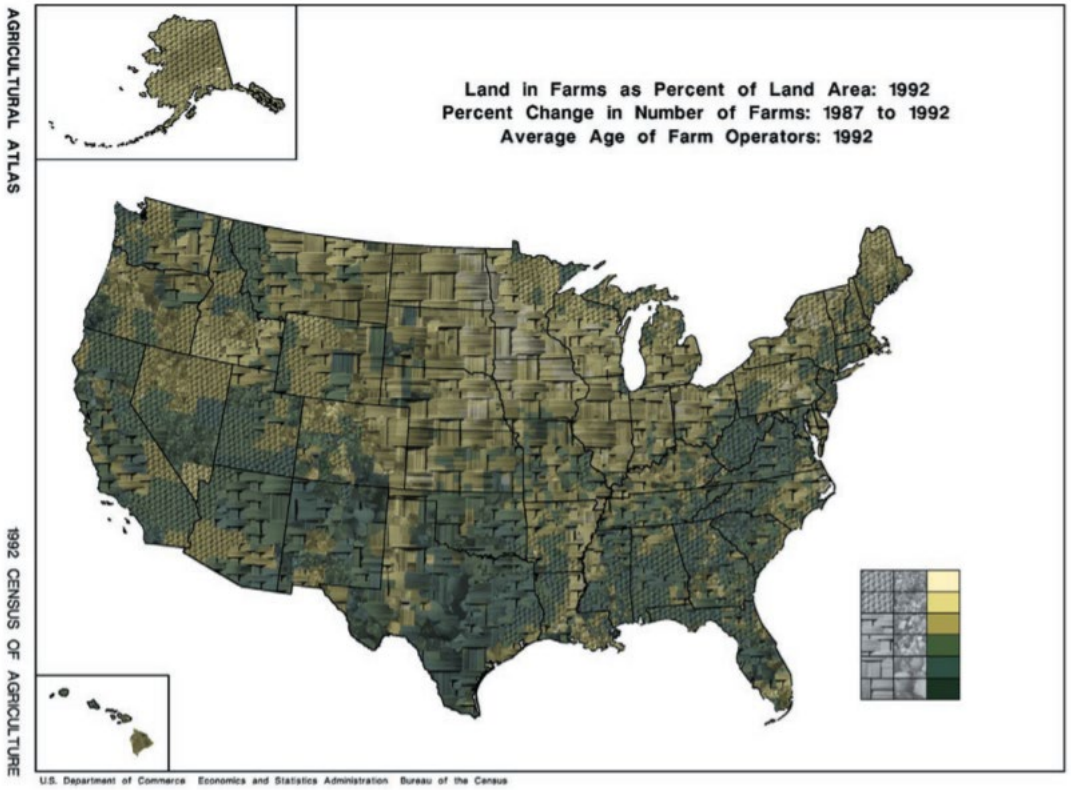
- Blending three colored choropleth maps into a single choropleth map
- Ideally, this approach should be used only for three attributes that add to 100%
  - Colors will be restricted to a triangular two-dimensional space
  - Examples:
    - Soil texture -- percent sand, silt, and clay
    - Voting data -- percent voting Republican, Democrat, and independent





Maps Combined I: Trivariate choropleth maps

- An alternative is to use textures/patterns as a substitute for smooth, colored tones

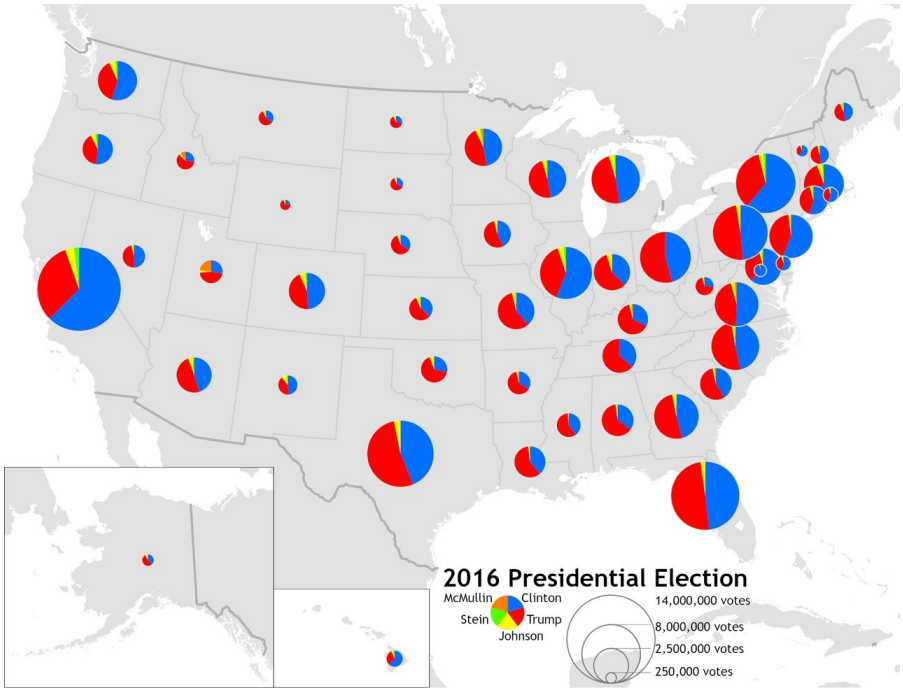


Question 2-2-1

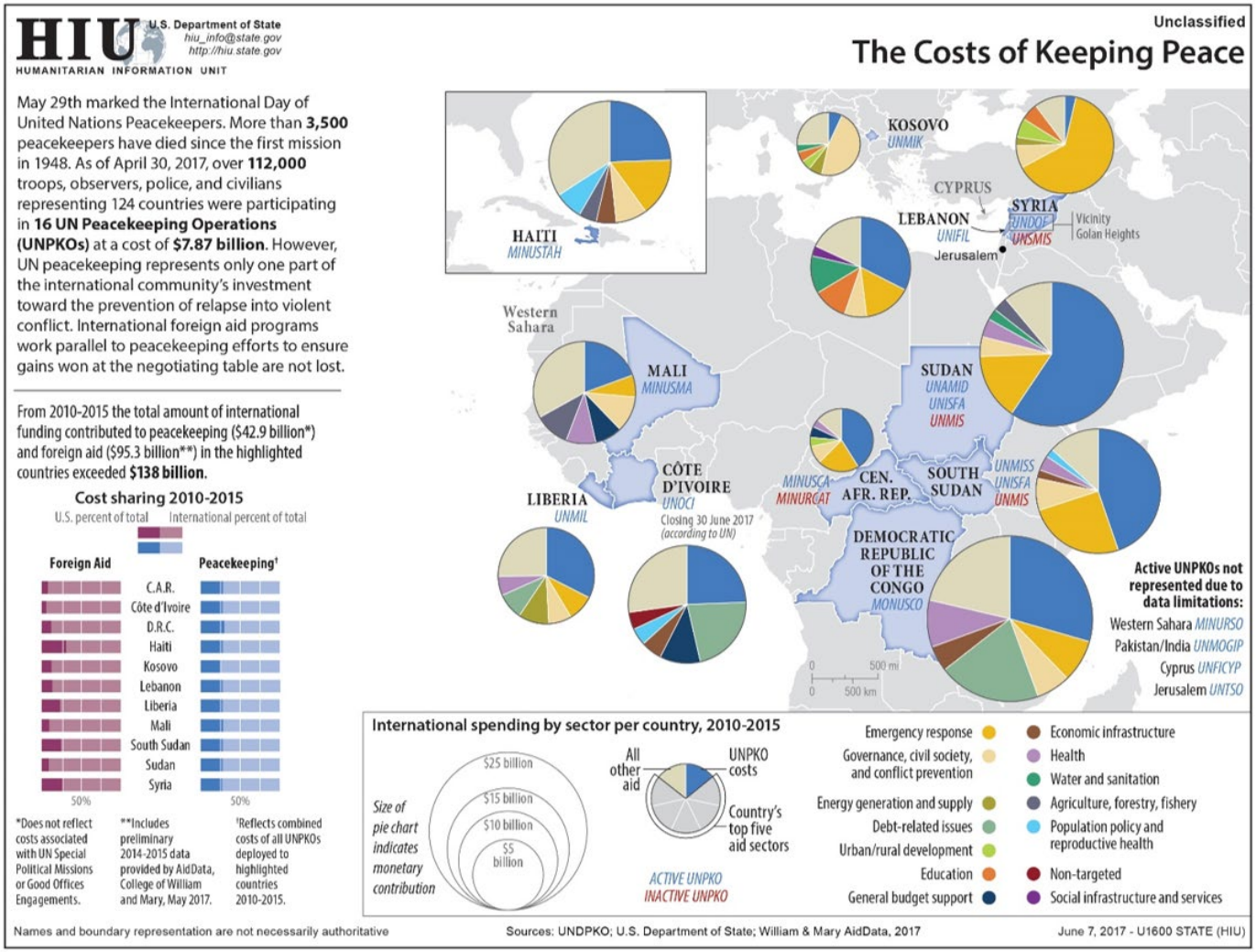
Name three variables that you think are suitable to be represented using a trivariate choropleth map (with color only). Explain.

Maps Combined II: Multivariate Point Symbol Maps

- **Related attributes: measured in the same units and part of a larger whole**
  - Example: percentages of White, Black/African American, Asian/Pacific Islander, Native American
  - Depicted using pie chart



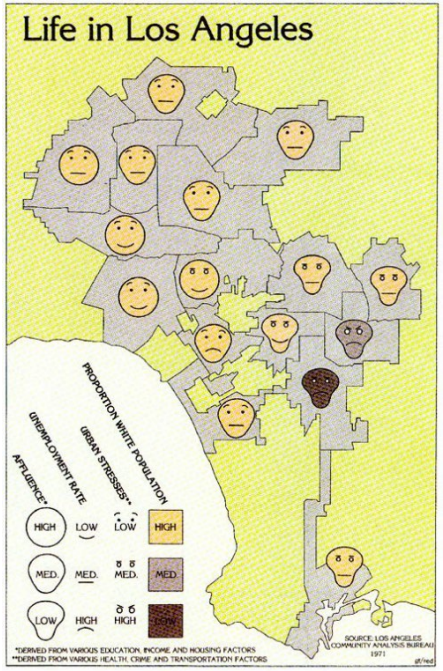
The size of pie charts is also proportional to the number of voters!

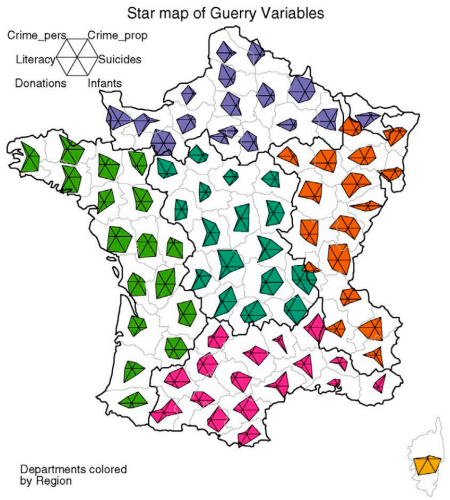


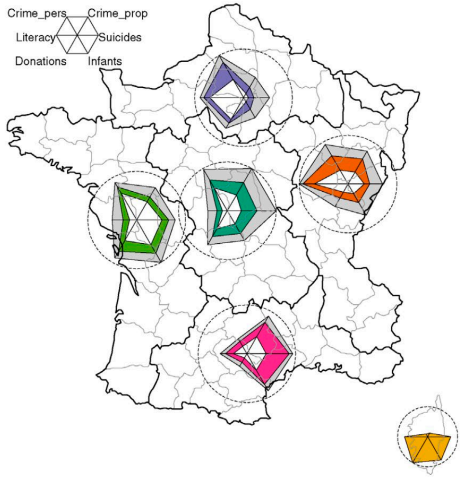
A multivariate map using pie charts showing the total amount of international funding for peacekeeping

Maps Combined II: Multivariate Point Symbol Maps

- **Non-related attributes: measured in dissimilar units and not part of a larger whole**
  - Example: percentages of service employees, electorate voting, adult employment, and mean housing price
  - Depicted using glyphs

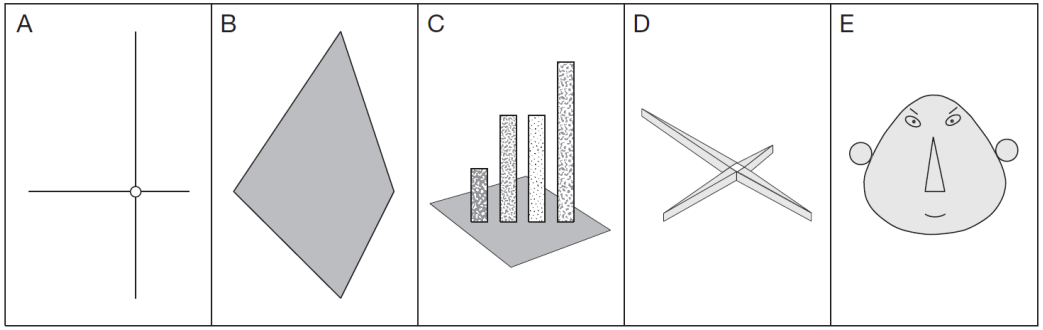


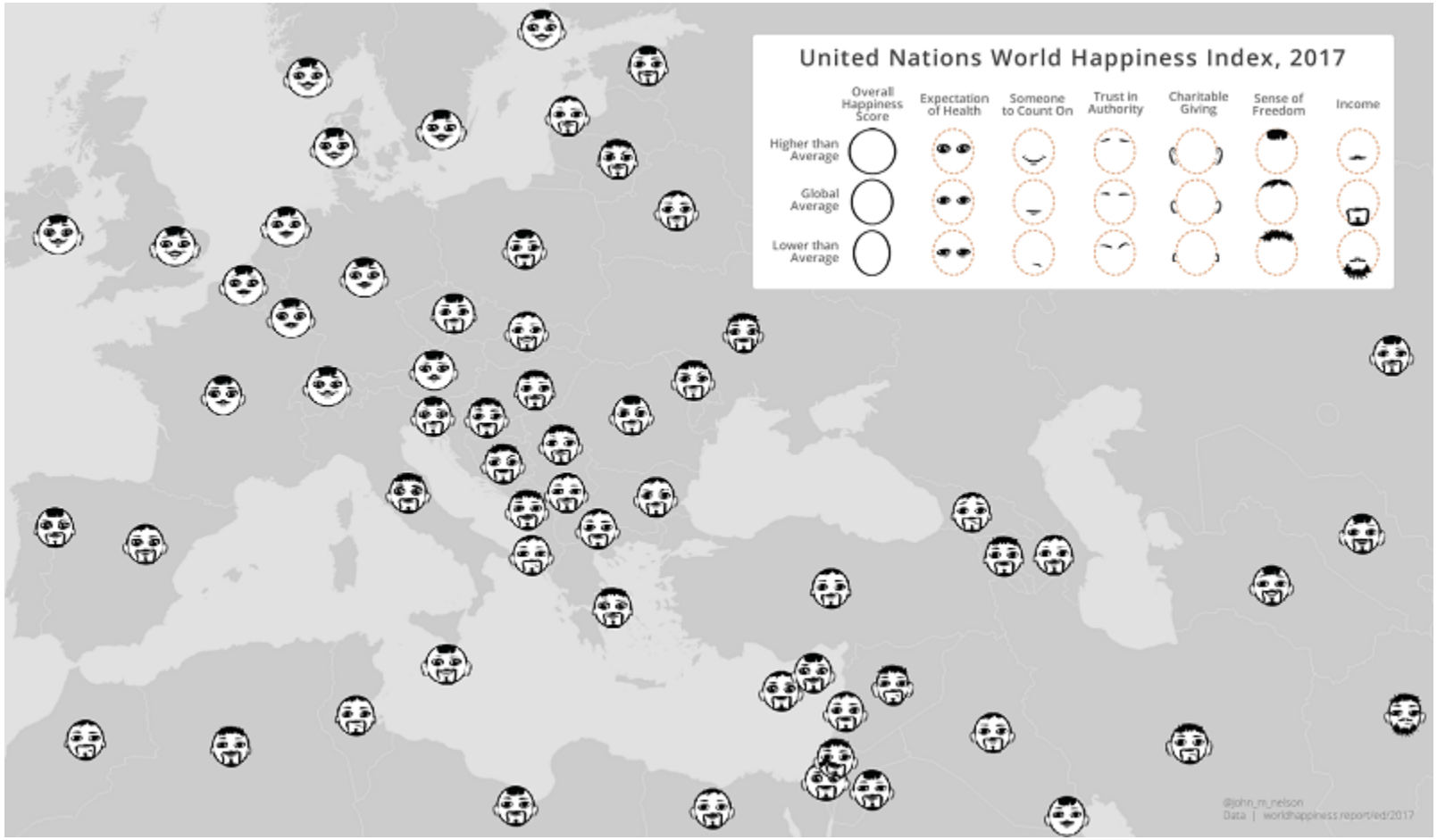




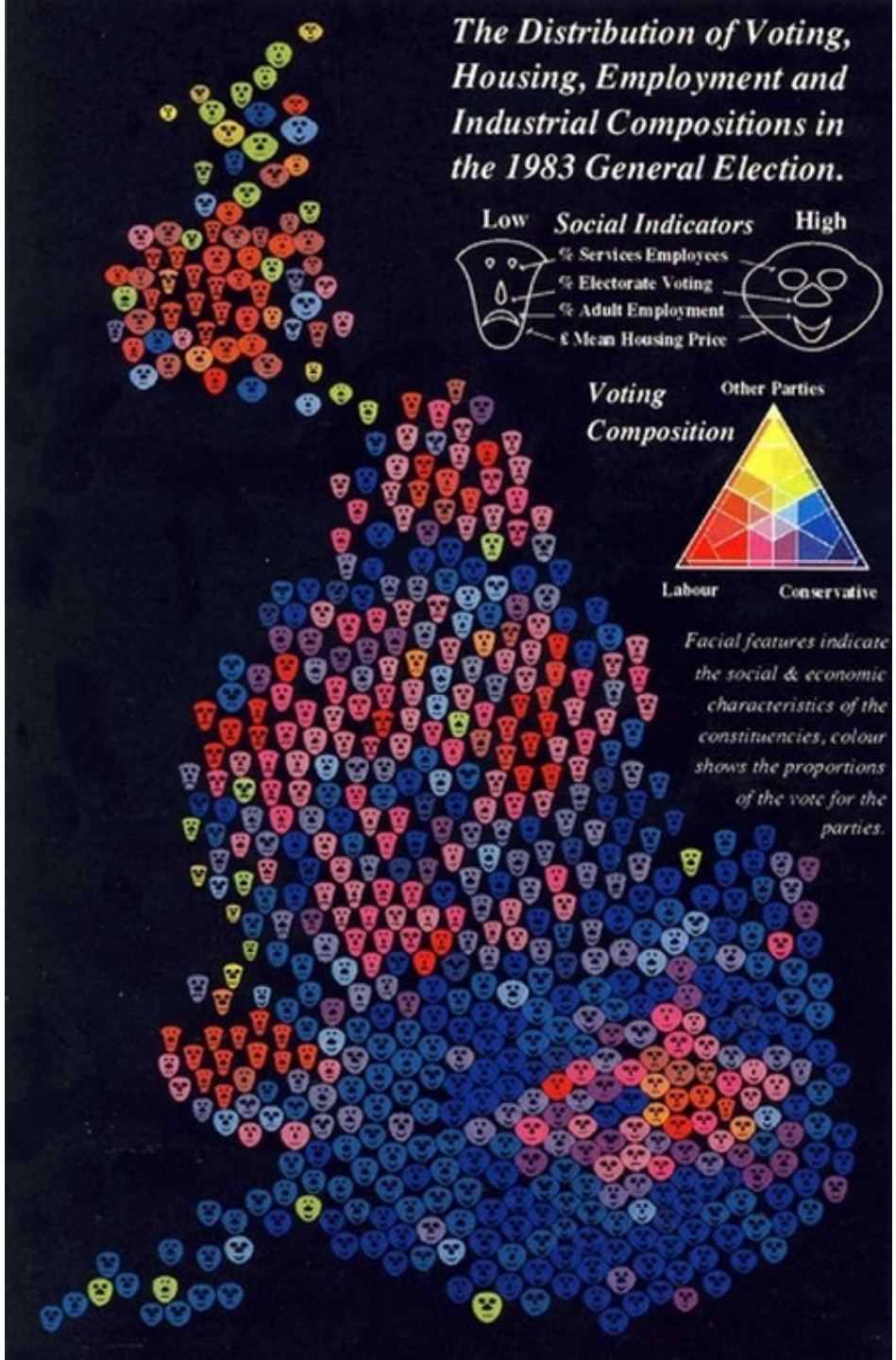
Maps Combined II: Multivariate Point Symbol Maps

- Commonly used glyphs
  A. Multivariate ray-glyphs or stars: the length of rays are proportional to the values of attributes
  B. Polygonal glyphs or snowflakes: a polygon connects the endpoints of the rays shown in A
  C. Three dimensional bars: the height of bars is proportional to the magnitude of attributes
  D. Data jacks: the spikes of the jack are proportional to the magnitude of each attribute
  E. Chernoff faces: individual facial features (e.g., the size of the eyes) are associated with individual attributes



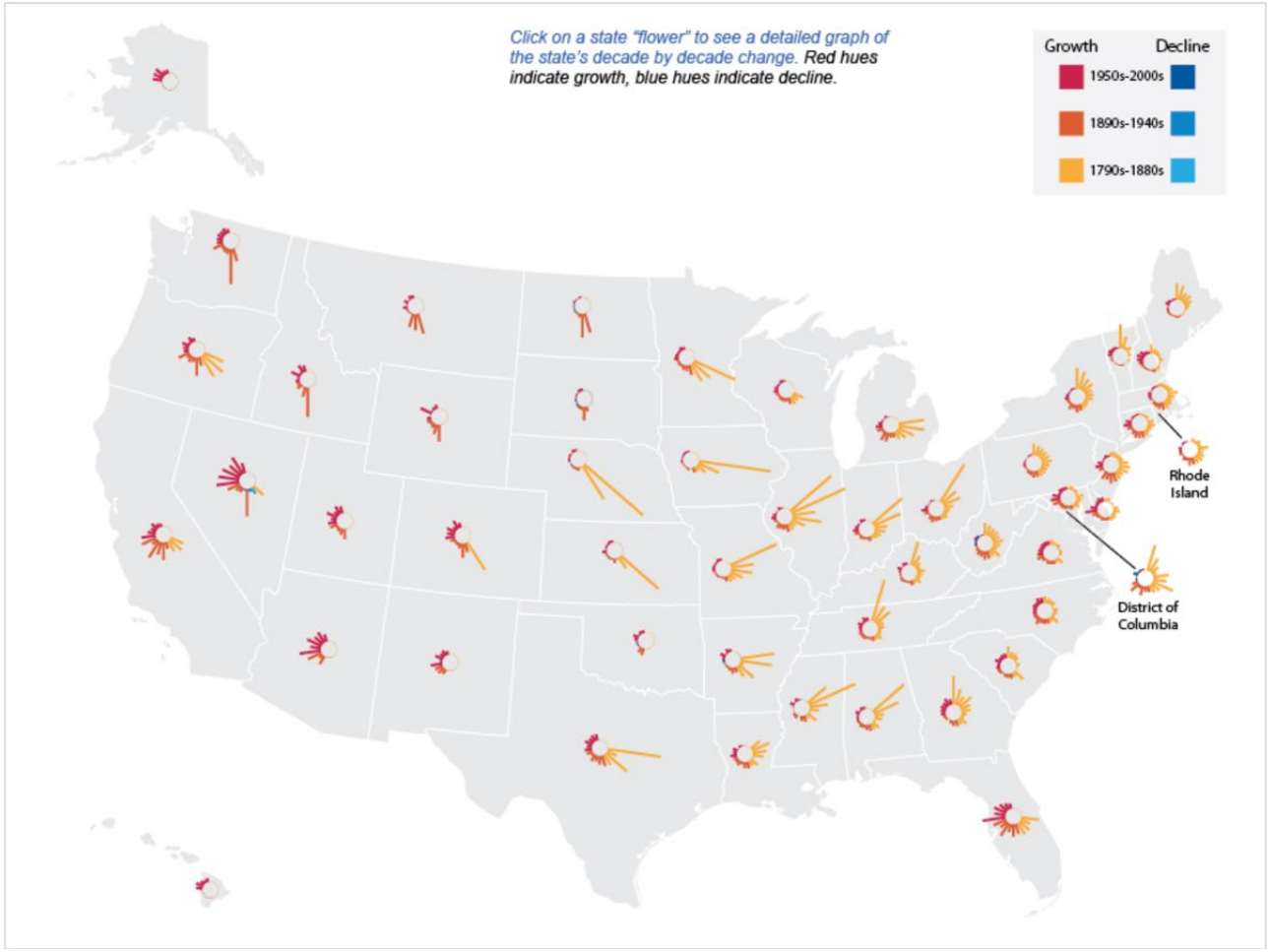


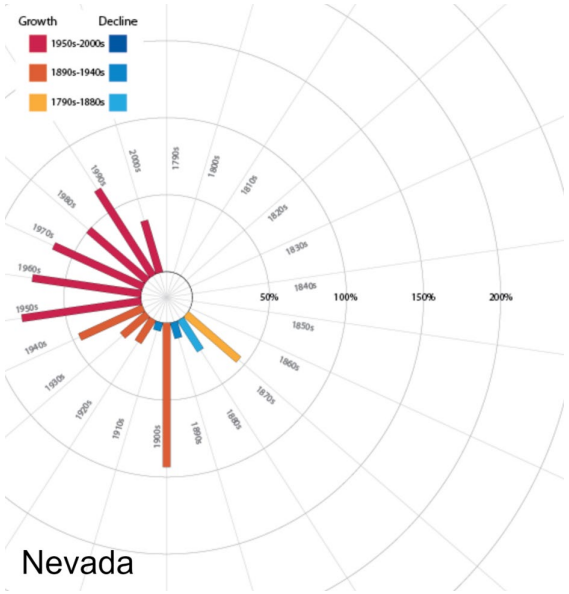
A Chernoff map showing the overall happiness and the relative strength of six happiness influences



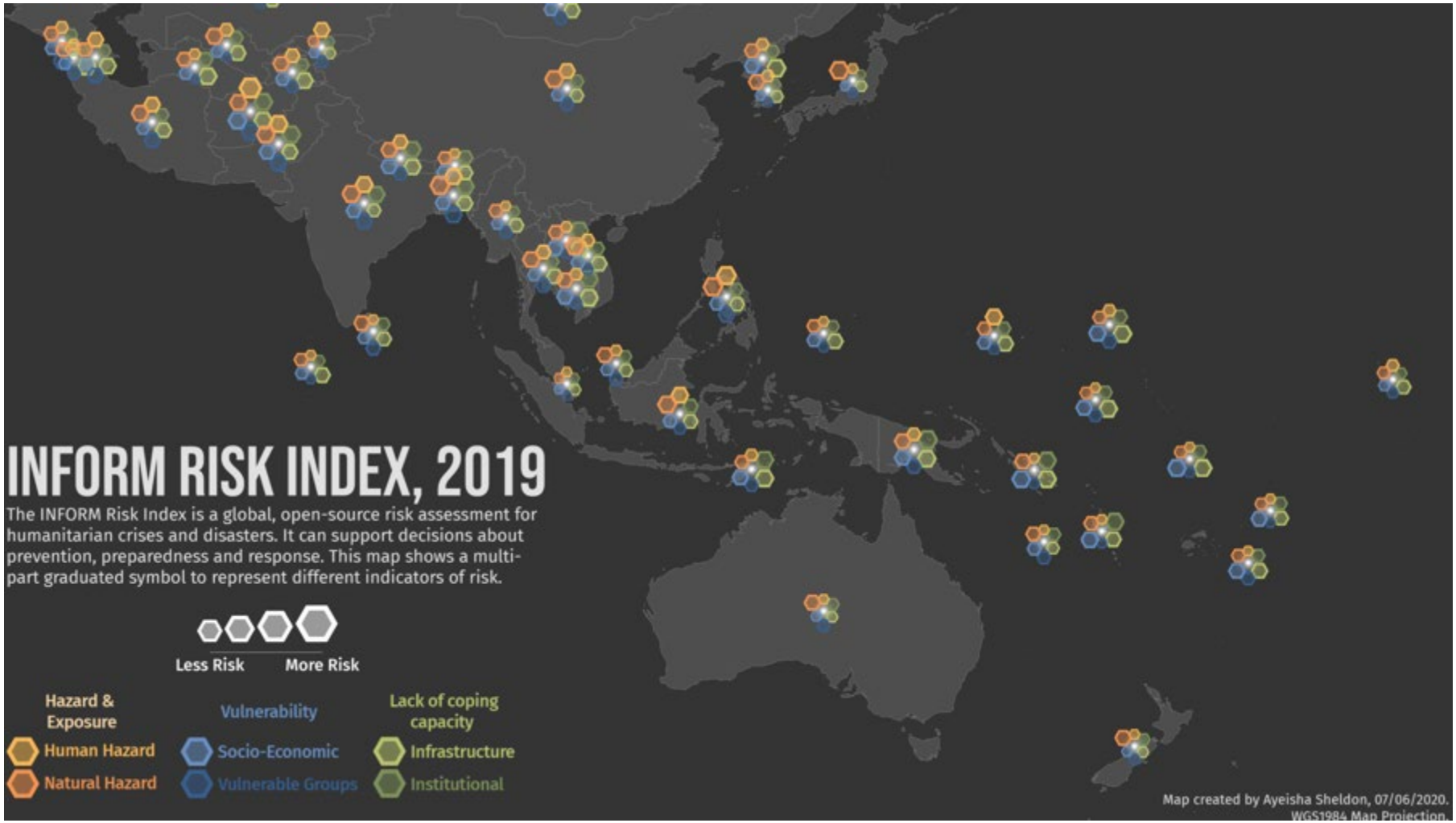
A Chernoff map showing the distribution of voting, housing, employment, and industrial compositions in the 1983 general election

Blooming States, US Census Bureau





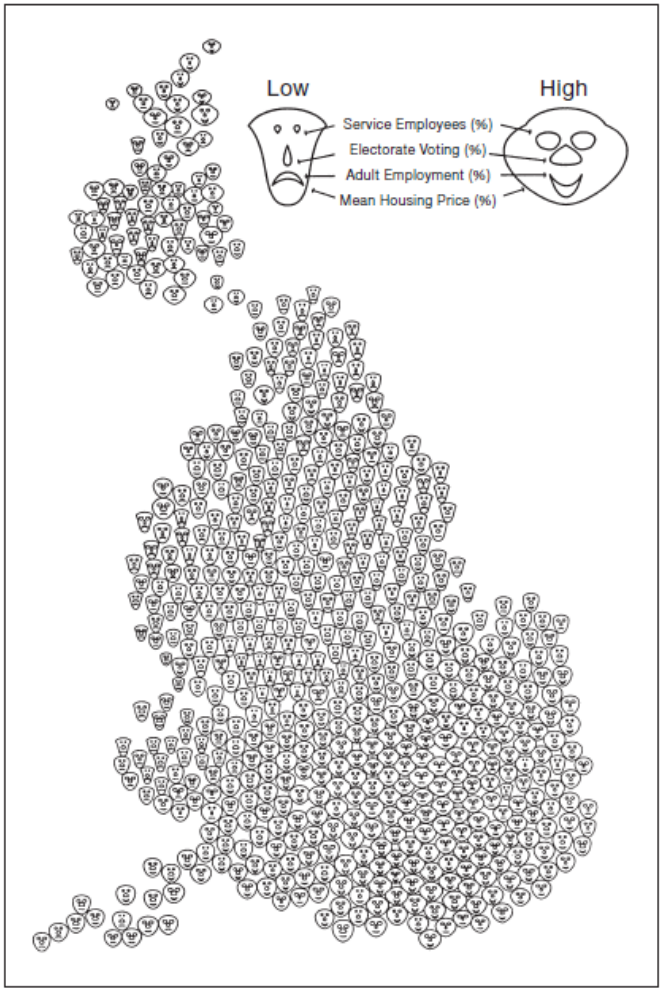
A map created with multivariate ray-glyphs showing the state population change from 1790 to 2000



A glyph map showing the risks of humanitarian crises and disasters

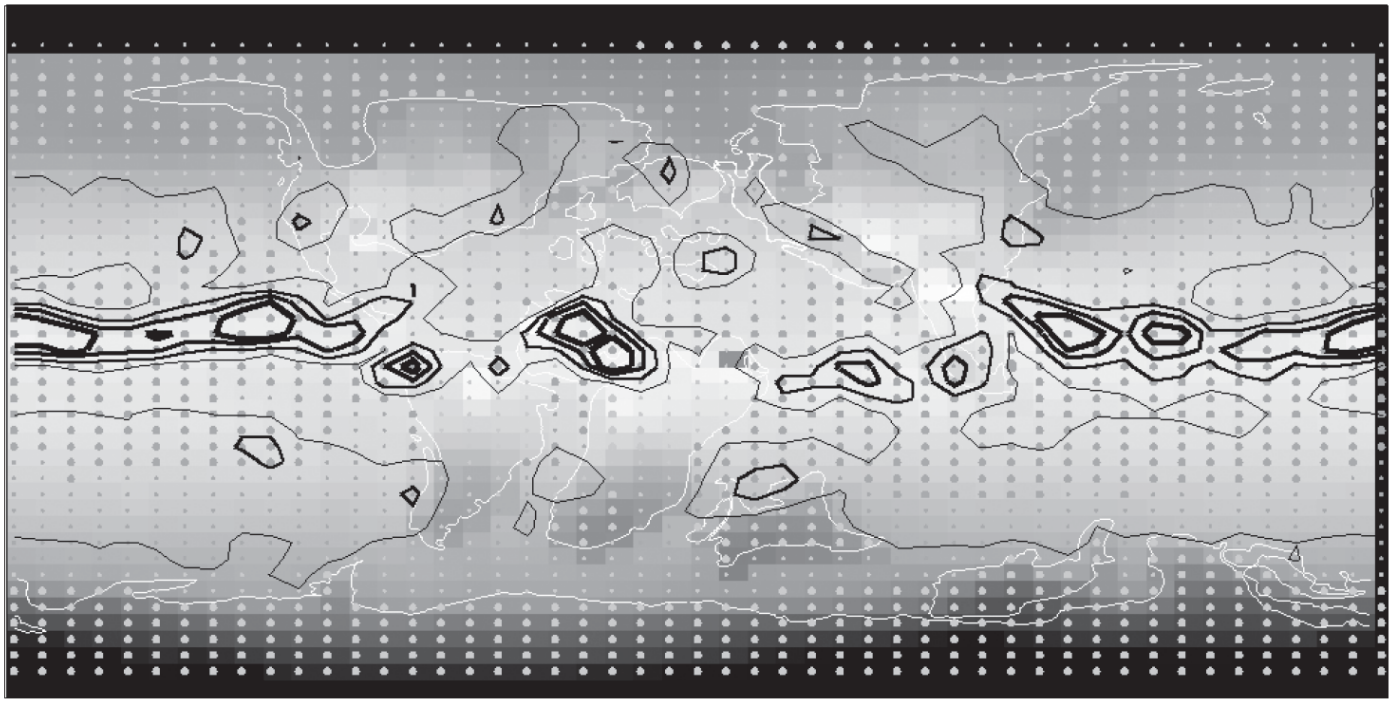
Question 2-2-2

Explain why Chernoff faces are appropriate symbolizations for the four attributes: percentages of service employees, electorate voting, adult employment, and mean housing price.



Maps Combined III: Combining Different Types of Symbols

- Use different types of symbols on the same map
  - Overlay lines, points, and area symbolizations
  - Example: use proportional symbols for mean annual evaporation, weighted isolines for precipitation, and choropleth shading for temperature



Question 2-2-3

Find a multivariate map from online resources. Discuss the map's layout and symbolization strategies. Please also provide a link to the map.

- Useful resources
  - Census Interactive Gallery
  - Esri Map Gallery
  - Chronic Disease GIS Exchange Map Gallery
  - Map Gallery - WHO