

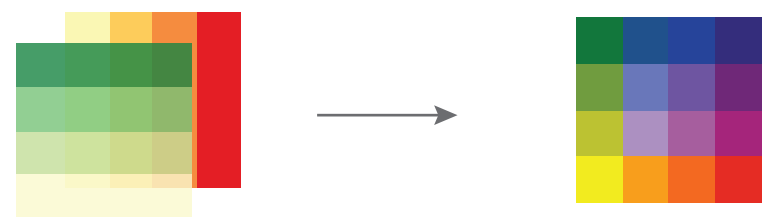
CHOOSING COLORS FOR BIVARIATE MAPS

By: Benjamin Thornton

Bivariate Mapping Intro

1976 Census - Overlay Method

Using the printing technology at the time, the census created the first color bivariate maps using their data. The result is a color scheme built from mixed colors and creates hard to distinguish sections. This technique is limited to answering one type of analytical question.



Trumbo (1981)

Statistical paper identifying that a bivariate map can answer 3 questions, not just 1. Using appropriate and intentioned colors, cartographers can focus attention on data and allows the map reader to answer the 3 questions more efficiently.

Trumbo's (1981) 4 Principles Summarized

Principle I. (Order) – Ordered quantitative data should be represented with color by using ordered color. (Progressions in hue, saturation, and brightness)

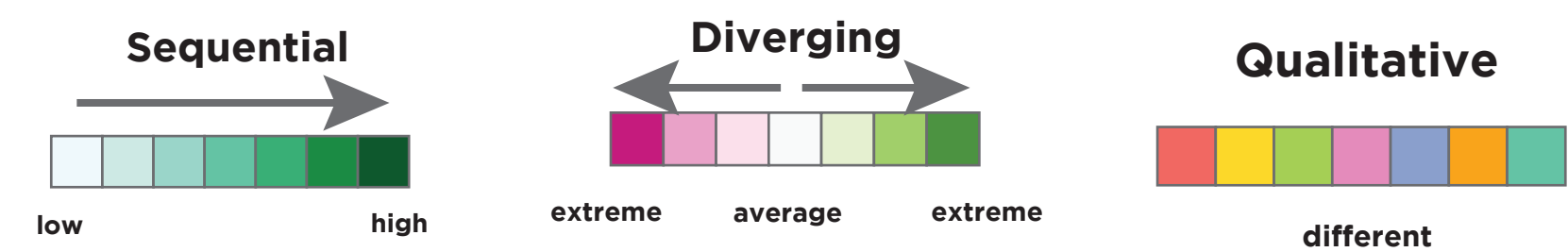
Principle II. (Separation) – Differences in values should be made easy to distinguish by using noticeably different colors.

Principle III. (Rows and Columns) – If the map's purpose is to preserve the univariate information, use distinct colors between variables. These colors should be in a sequence.

Principle IV. (Diagonal) – If how the variables interact is important, then the principal diagonal should be the focal point. The data should be divided into three classes: near or on the diagonal and those skewed to one side or the other. The principal diagonal should be visually separate from other scheme colors.

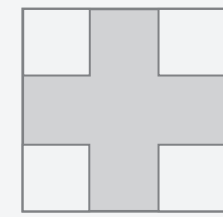
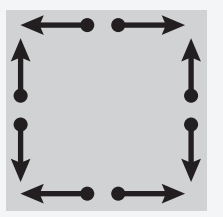
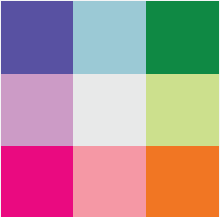
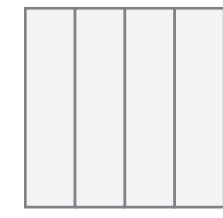
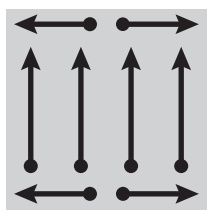
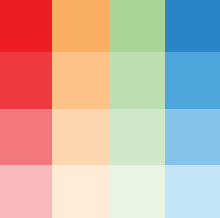
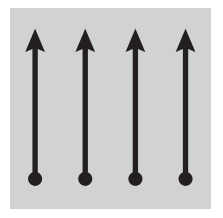
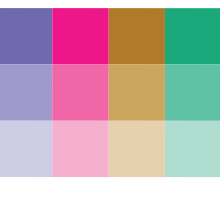
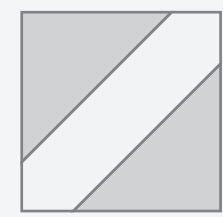
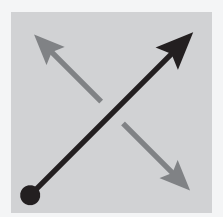
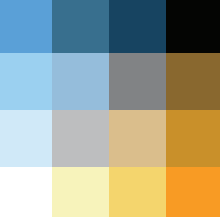
Designing with Intent

Choosing colors purposefully will allow the reader to better understand the map and spend less time looking between the map and the legend. By mixing colors using the overlay, you inherently result in brown or purple hues which can hinder map reading.



These color schemes allow easier recognition and understanding of patterns in your data allowing you to accentuate parts of your data. These form the basis of a bivariate legend.

Method

Focal Model	Iquiry Syntax & Simple Questions	Focal Areas	Focal Axes	Sample Color Palette
Corners	Low/High of x Low/High of y Where are areas of high income and low education?			
Range	Diverging range of y within low/high of x What is the range of education among high earners?			
	Qualitative range of y within category What is the range of education within -- categories?			
Diagonal	relationship of x and y What is the relationship of income and education?			

Based on Trumbo's Four Principles (1981)

Overview of Process

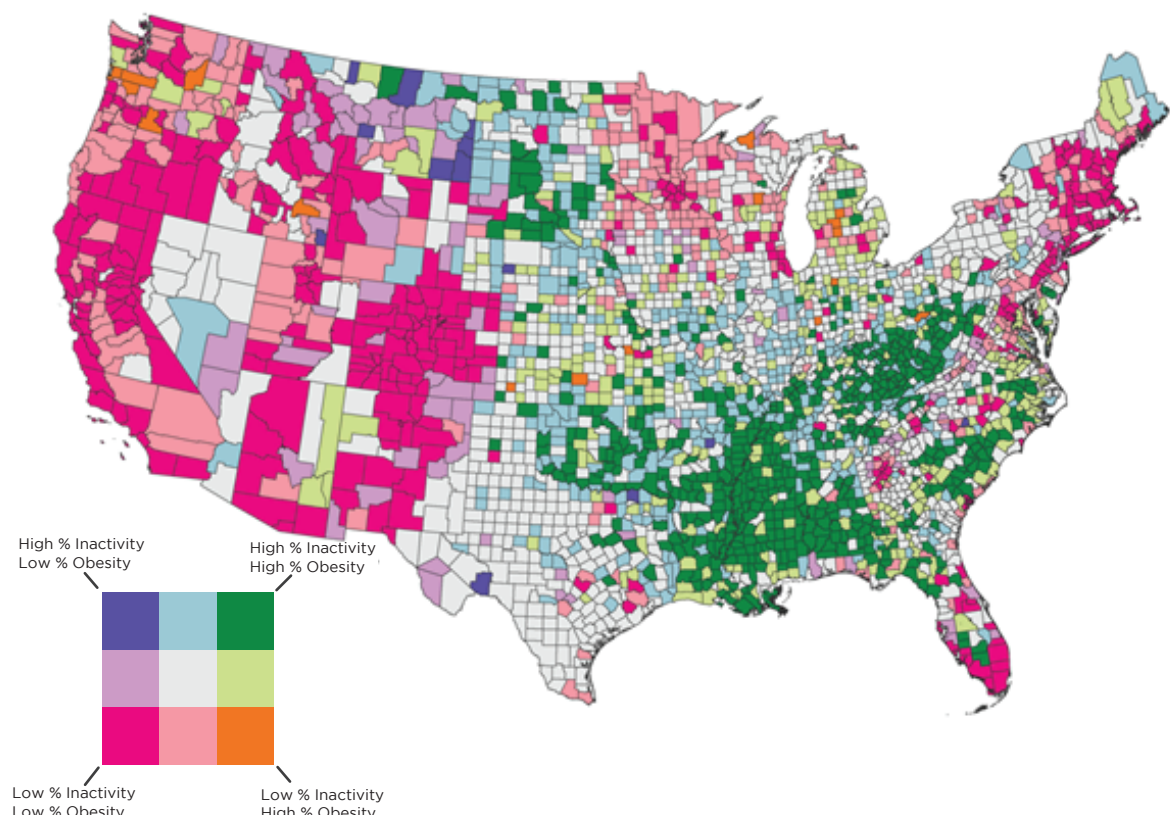
1. Explore your data to determine your map's purpose.
2. Using your chosen purpose, pick a focal model which best suits.
3. Use the sample color palette or a similar derivative to color choropleth map units.

The resulting color scheme will allow you to create a bivariate map that is easy to read and interpret. By switching color schemes on the same data set, different trends will be accentuated and show how changes in color can completely change how a map is understood.

Examples

Obesity and Inactivity in US Counties, 2007 (Centers for Disease Control and Prevention)

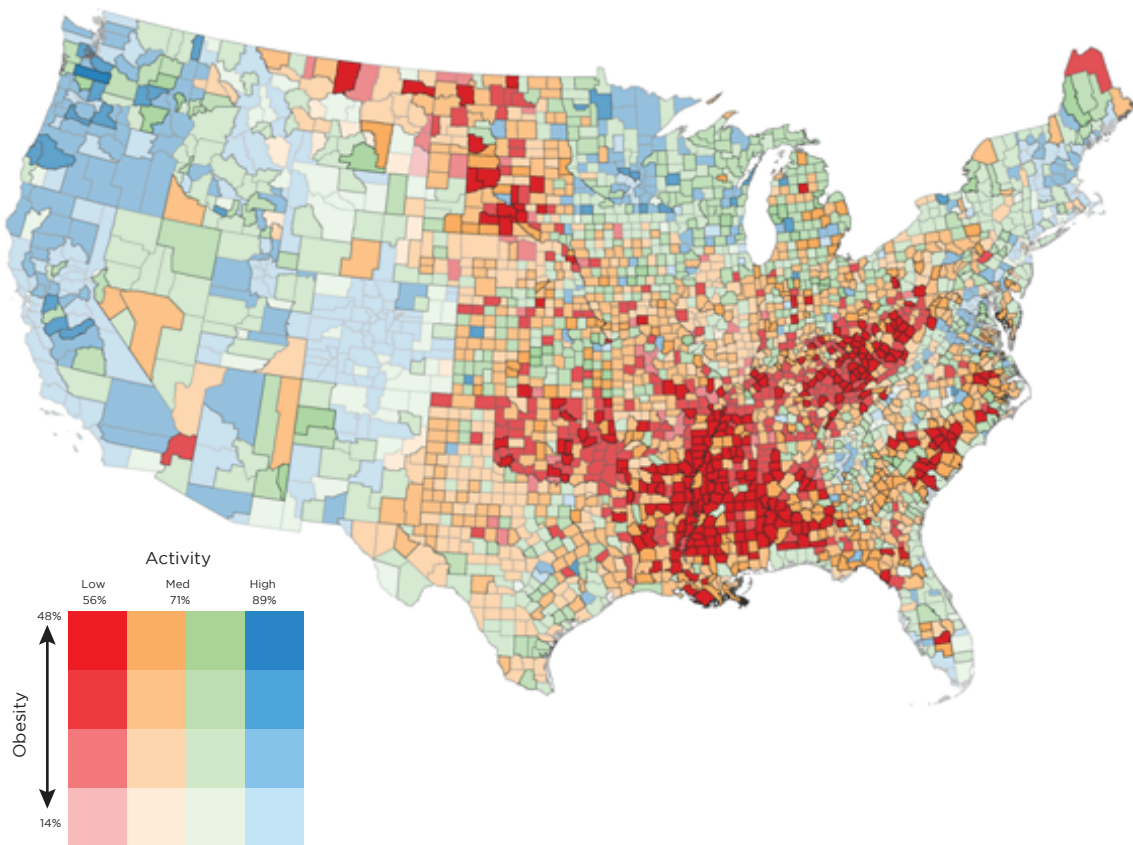
A.



A. Four corners model

Where is high obesity and low activity? Or any combination of them.

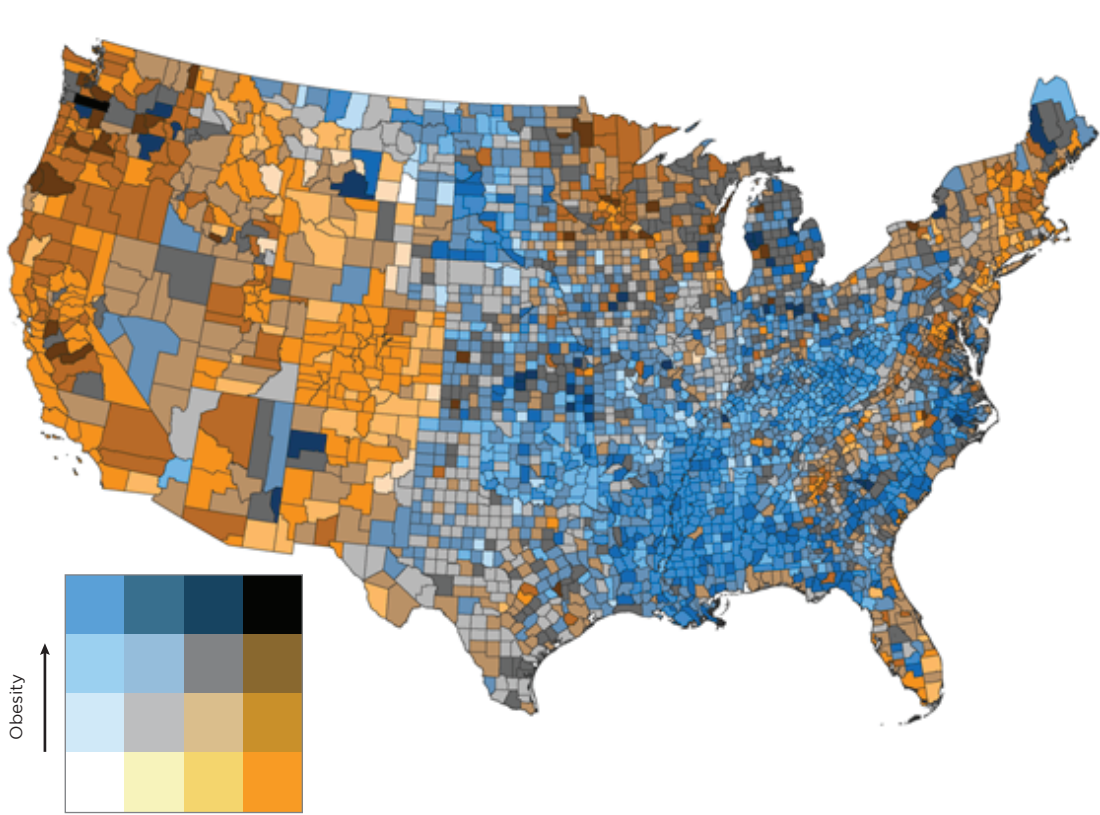
B.



B. Range model

What's the range of obesity within inactivity?

C.



C. Diagonal model

Where does the interaction between obesity and inactivity exist?

Acknowledgements & Citations (abbreviated)

Thank you to Bruce Trumbo for revisiting his original ideas and providing clarification and guidance on our interpretations of his work. Special thanks to the co-authors of the working paper this poster is derived from: Georgianna Strode, Victor Mesev, Derek Morgan, Evan Rau, Sean Shortes, Nathan Johnson, Xiaojun Yang

Brewer, Cynthia A. 1994. "Color Use Guidelines for Mapping and Visualization." Modern Cartography. Vol. 2: Visualization in Modern Cartography, edited by Alan M MacEachren and Taylor, D.R. Fraser, 123-147. New York: Elsevier Science Inc

Trumbo, B. E. 1981. "A Theory for Coloring Bivariate Statistical Maps." The American Statistician. 35.4: 220-226. JSTOR. Accessed June 24, 2015. <http://www.jstor.org/stable/2683294>.