

# CHOOSING COLORS FOR BIVARIATE MAPS

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## 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 that creates difficult-to-distinguish sections. This technique is limited to answering one type of analytical question.



### Trumbo (1981)

Trumbo's statistical paper posits that a bivariate map can answer three types of questions, not just one. By using appropriate and intentioned colors, cartographers can focus attention on data and allow the map reader to answer the three questions more efficiently.

#### Trumbo's (1981) Four Principles Summarized

**Principle I. (Order)** - Ordered quantitative data should be represented by using ordered color through progressions in hue, saturation, and brightness.

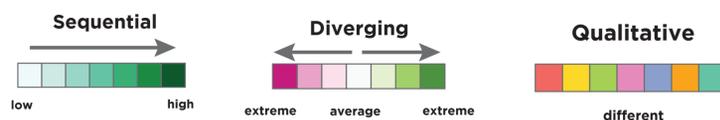
**Principle II. (Separation)** - Differences in values should be made easy to distinguish by using noticeably different colors.

**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 variable interaction 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.

### Brewer (1994)

Brewer offers color schemes for univariate maps that relate color to the behavior of data.



### Designing with Intent

This research combines Trumbo's three bivariate questions with Brewer's proven univariate color methods. The resulting models can serve as a basis for bivariate map-making.

## Method

Focal Models	Inquiry Syntax & Sample Questions	Focal Areas	Focal Axes	Sample Color Palettes
<b>Corners</b>	<b>low/high of x</b> <b>low/high of y</b>  Where are areas of high income and low education?			
<b>Range</b>	<b>Diverging</b> <b>range of y within low/high of x</b>  What is the range of education among high earners?			
	<b>Qualitative</b> <b>range of y within category</b>  What is the range of education within -- categories?			
<b>Diagonal</b>	<b>relationship of x and y</b>  What is the relationship of income and education?			

Based on Trumbo's Four Principles (1981)

## Process Overview

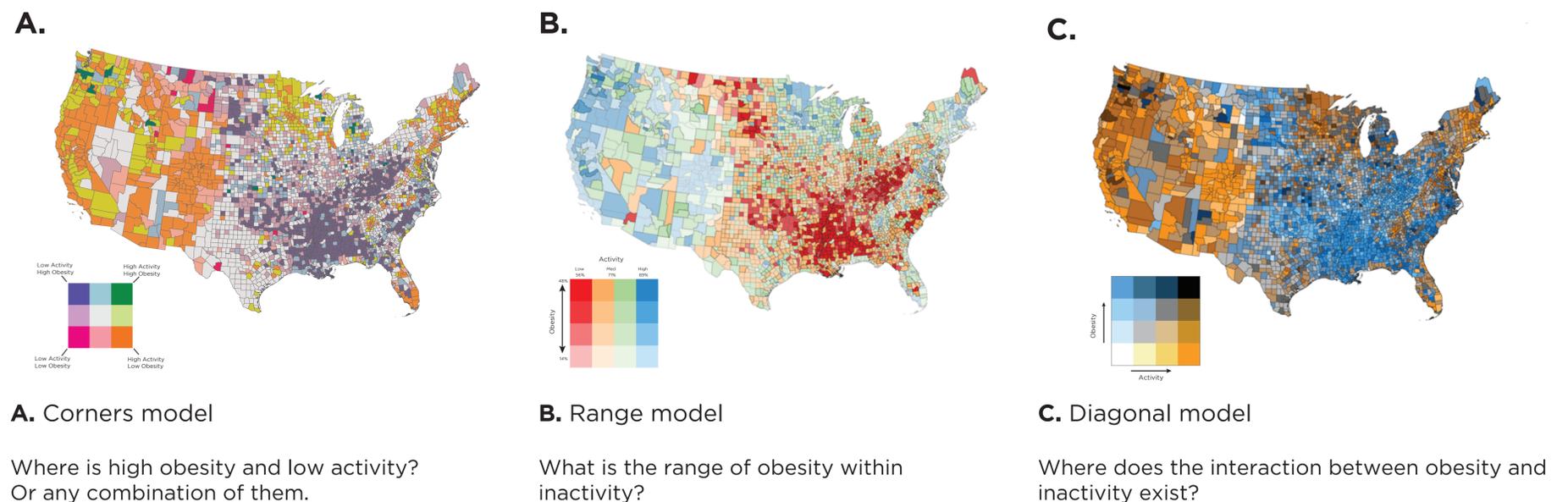
1. Explore the data to determine the map's purpose.
2. Choose a focal model to support the map's purpose.
3. Use the sample color palette or a customized derivative to style map features.

The color palettes direct focus to the important information while reducing distraction from less important data.

The three examples below illustrate the ability to ask and identify unique answers of the same data set. These types of questions, first posed by Trumbo, allow for a deeper understanding of data trends.

## Examples

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



## Acknowledgements & Citations (abbreviated)

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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>.