

Bivariate Choropleth Maps: Overview and “How To” for ArcGIS

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ATSDR/GRASP

GeoSWG Forum

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What is a bivariate choropleth map?

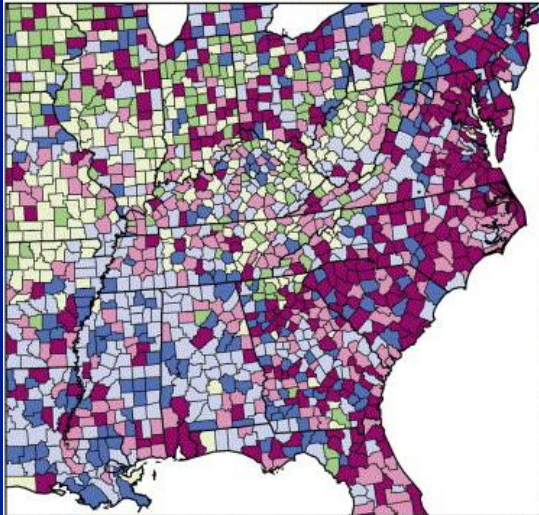
- ❑ Bivariate - two variables included in one map representation
- ❑ Choropleth – Areal enumeration units (states, census tracts, etc.) filled with colors symbolizing ranges in the data¹
- ❑ A bivariate choropleth map is “a variation of the simple choropleth map that enables us to portray two separate phenomena simultaneously”²

¹Brewer, CA. Basic Mapping Principles for Visualizing Cancer Data Using Geographic Information Systems (GIS). American Journal of Preventive Medicine, Volume 30, Issue 2, Supplement 1, February 2006, Pages S25-S36

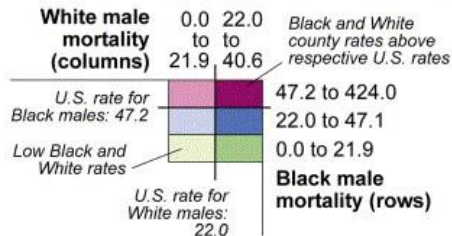
²Leonowicz, A. Research on Two-Variable Choropleth Maps as a Method for Portraying Geographical Relationships. Proceedings of the 21st International Cartographic Conference (ICC) Durban, South Africa, 10 -16 August. 2003.

Examples

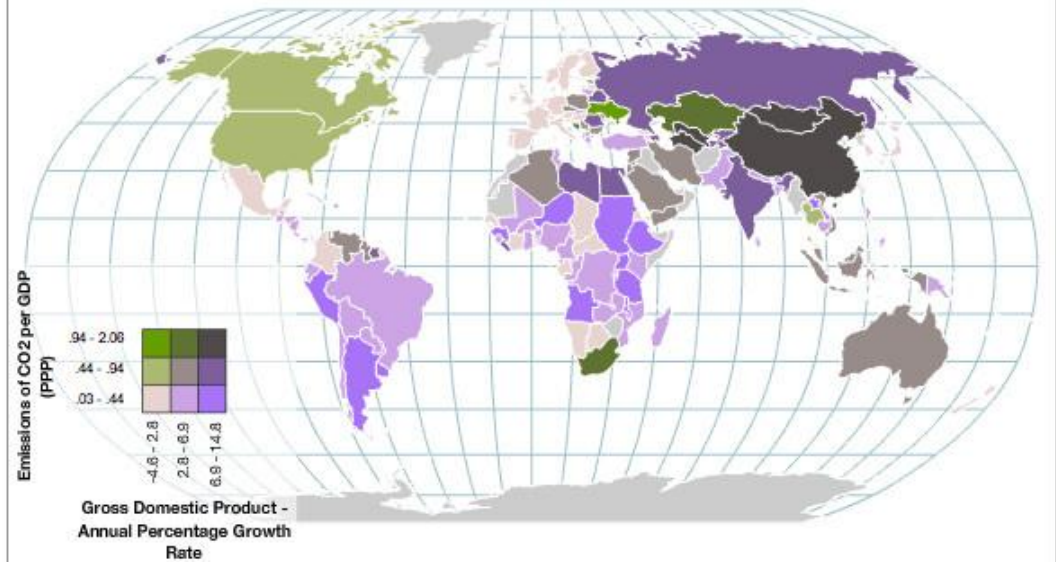
**Prostate Cancer Race Comparison
1970 to 1994**



Deaths per 100,000 person years by county



Emissions per GDP by Growth Rate



<http://indiemapper.com/blog/2010/07/indiemapper-data-library/>

Brewer, CA. Basic Mapping Principles for Visualizing Cancer Data Using Geographic Information Systems (GIS). Am J Prev Med. 2006 Feb;30(2S)

Things to Consider

□ Data Classification Scheme

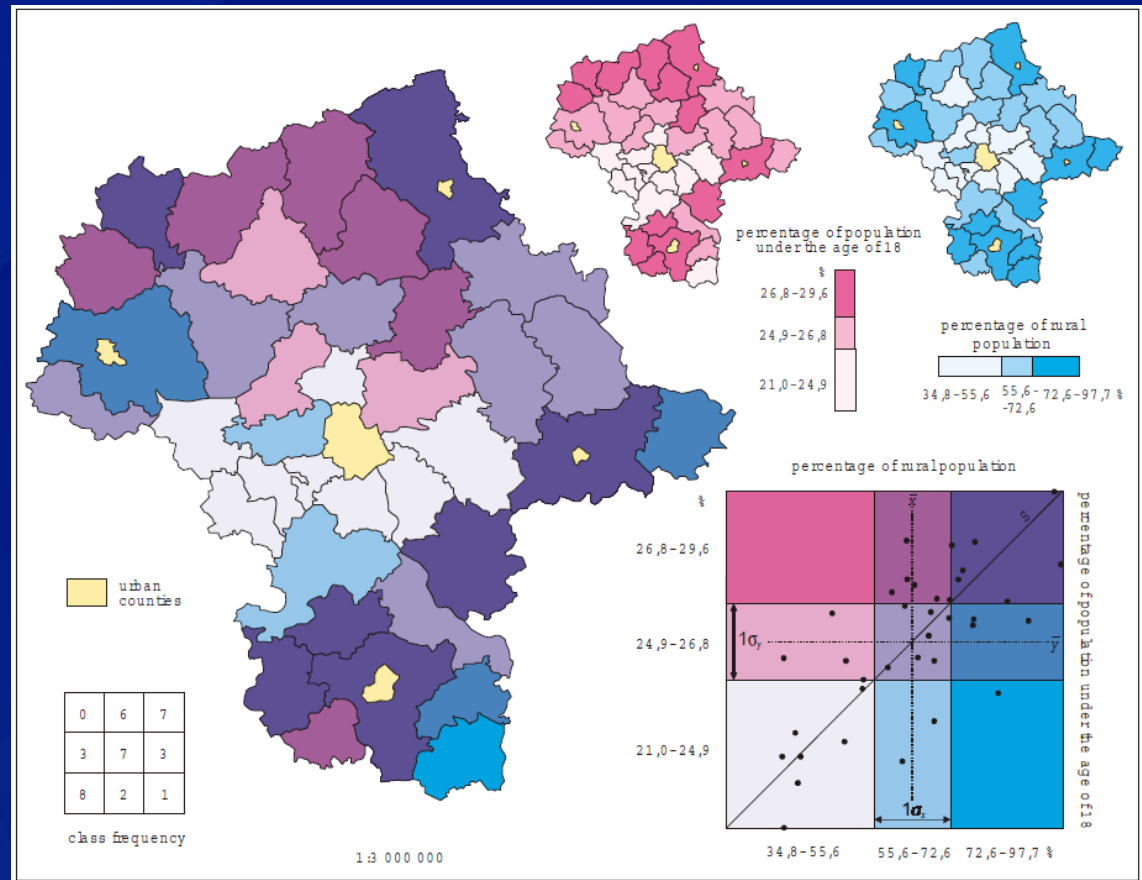
- Use classification methods that are appropriate for map comparison*
 - Standard Deviations
 - Nested Means
 - Quantiles
 - Equal Areas

* Slocum, Terry A. 1999. Thematic Cartography and Visualization. New Jersey: Prentice-Hall, Inc.

Things to Consider

Legend Design

- Colors must be logical and distinguishable
- 16 classes (4 x 4) or fewer

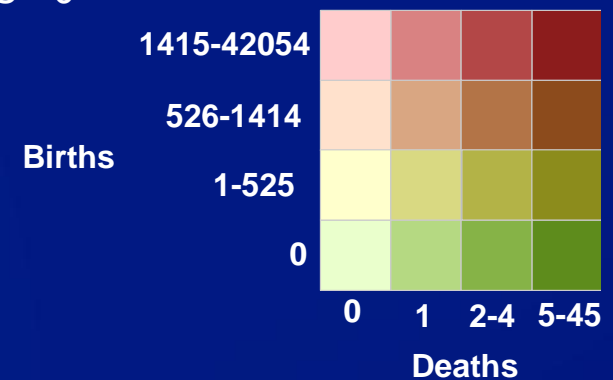


Leonowicz, A. Research on Two-Variable Choropleth Maps as a Method for Portraying Geographical Relationships. Proceedings of the 21st International Cartographic Conference (ICC) Durban, South Africa, 10 -16 August. 2003.

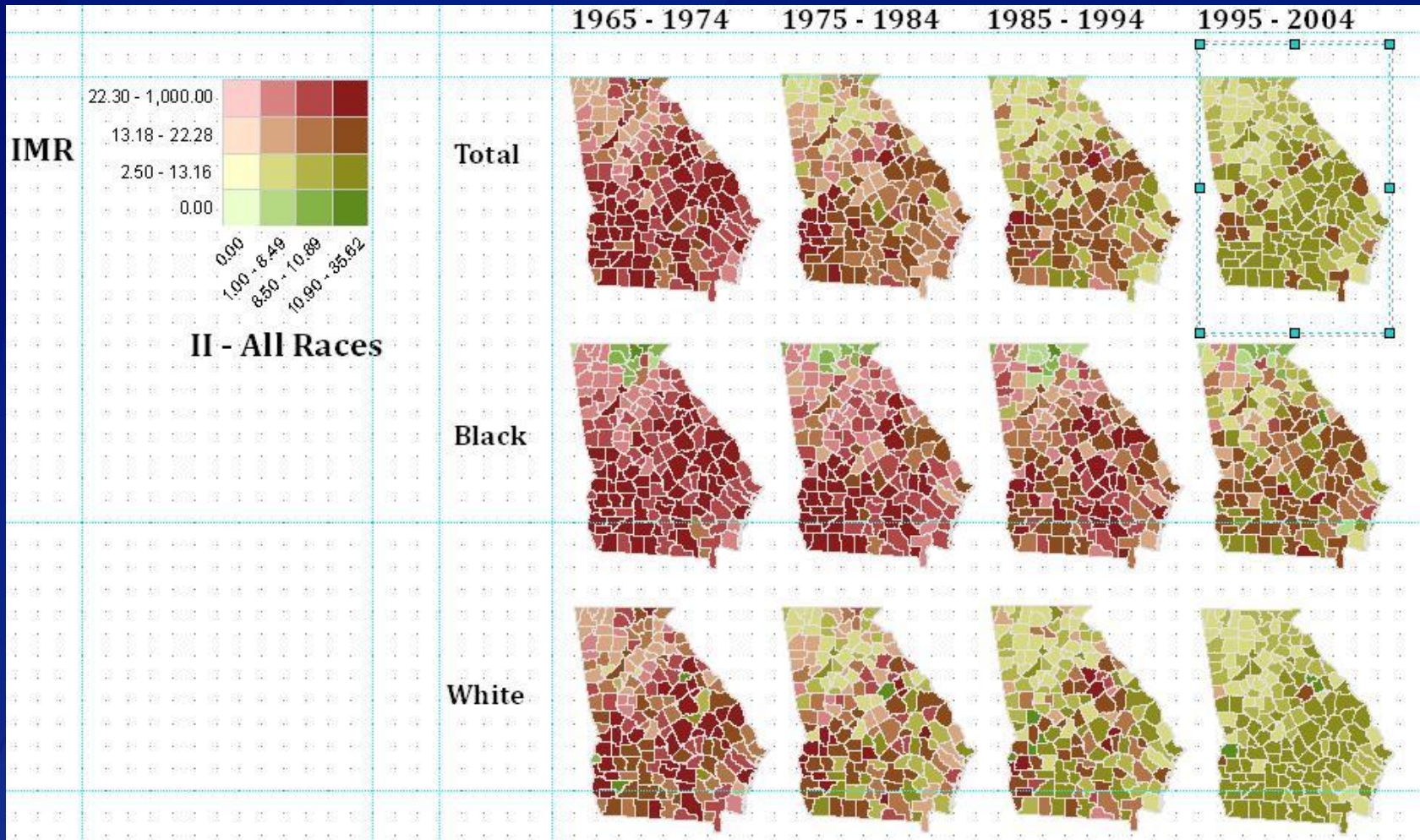
“How to”

□ Manual Method

- Start with a single feature class containing the two variables to be mapped
- Determine class data ranges for each of the two variables
- Create a new field and perform queries to populate the new field with all the class combinations
 - e.g. for the 16 classes in the example on this page
BIRTHS = 0 AND DEATHS= 0
BIRTHS> 0 AND BIRTHS <= 525 AND DEATHS= 0
and so on
- Color the mapped enumeration units



Example of Automated Method Output



Example "How to"

Manual Algorithm Automated

- Geoprocessing tool created using Python scripting

Bivariate Choropleth Script

Input Feature Layer: \\Cdc\project\ATS_GIS_Store4\Projects\prj03595_Spirit_Lu

Output Feature Class: \\Cdc\project\ATS_GIS_Store4\Projects\prj03595_Spirit_Lu

First Variable

First Variable Field: IMRA95_04

First Input Field MAX value: 18.036072

Maximum Class Values for First Variable:

0	+
13.16	x
18.036072	↑
	↓

Second Variable

Second Variable Field: IIAI2000

Second Input Field MAX Value: 27.295503

Maximum Class Values for Second Variable:

0	+
8.49	x
10.89	↑
27.295503	↓

First Variable Field

Field 1 of 2 used in the Bivariate script method. Valid fields may be of type:

- SHORT
- LONG
- FLOAT
- DOUBLE

The color scheme for each of the classes specified for the first variable will be as shown on the vertical, or y-axis

First Variable Classes

Second Variable Classes

Highest Class	4-1	4-2	4-3	4-4
	3-1	3-2	3-3	3-4
	2-1	2-2	2-3	2-4
Lowest Class	1-1	1-2	1-3	1-4
	Lowest Class			Highest Class

OK Cancel Environments... << Hide Help Tool Help

Example

Manual Algorithm Automated

- Two new fields are added to the output shapefile

4-1	4-2	4-3	4-4
3-1	3-2	3-3	3-4
2-1	2-2	2-3	2-4
1-1	1-2	1-3	1-4

Attributes of BVC_OUTPUT_Polygon_102610_11:18:45AM

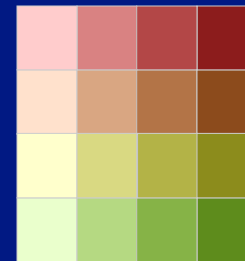
PB2000	BVC_CLASS	BVC_EXPR
0.043981	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.019956	2-2	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 0 AND IIAI2000 <=8.49
0.009177	2-2	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 0 AND IIAI2000 <=8.49
0.037809	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.01402	2-2	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 0 AND IIAI2000 <=8.49
0.038131	2-2	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 0 AND IIAI2000 <=8.49
0.004817	2-2	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 0 AND IIAI2000 <=8.49
0.010166	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.000858	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.001791	2-2	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 0 AND IIAI2000 <=8.49
0.000505	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.006709	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.011943	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.566837	2-4	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 10.89 AND IIAI2000 <=27.295503
0.516927	2-4	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 10.89 AND IIAI2000 <=27.295503
0.531451	2-4	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 10.89 AND IIAI2000 <=27.295503
0.486077	2-4	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 10.89 AND IIAI2000 <=27.295503
0.495827	2-4	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 10.89 AND IIAI2000 <=27.295503
0.480904	2-4	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 10.89 AND IIAI2000 <=27.295503
0.399804	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89
0.266587	2-3	IMRA95_04 > 0 AND IMRA95_04 <= 13.16 AND IIAI2000 > 8.49 AND IIAI2000 <=10.89

Record: 1 Show: All Selected Records (0 out of 159 Selected) Options

Example

❑ Manual Algorithm Automated

- For the script as currently written, legend colors are limited to the palette shown below.
- The script uses a layer file, so you can create a new palette layer and modify the script to call for your layer. Or, you can symbolize the map and legend grid using your own layer file once the script has run.
- The legend grid is available as a shapefile to make it easy to modify the palette.
- We plan to develop additional palettes and make them available as part of the bivariate choropleth geoprocessing tool.



Thank you

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.



U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry