

A13: Maps with tmap

Now that you've experimented with making graphs in R with **ggplot2**, you will move on to making maps with **tmap**. Your results should be delivered as an HTML webpage generated using R Markdown or Quarto that includes headers to label the maps, the code, and the resulting maps. You do not need to include any text descriptions.

Map 1: Indiana Voting Results Map (8 Points)

The provided **indiana.shp** layer consists of county boundaries for the state of Indiana with associated attributes. Use **tmap** to map the 2012 presidential race results. Counties where the democratic candidate won should be shown in blue while republican wins should be displayed in red. Here are some notes:

- The voting results are in the “winner12” column. Make sure to define the labels as “Democrat” and “Republican” and include a legend.
- Add a compass and scale bar.
- Add the following title: “Election Results”.
- Try to minimize overlap of map elements by adjusting positions and sizes.
- Cite the US Census.

Map 2: Indiana Median Income Map (8 Points)

The provided **indiana.shp** layer consists of county boundaries for the state of Indiana with associated attributes. Use **tmap** to map the median income by county. Here are some notes:

- The median income data are in the “med_income” column. Make sure to use a continuous color palette to visualize the data.
- Add a compass and scale bar.
- Add the following title: “Median Income”.
- Try to minimize overlap of map elements by adjusting positions and sizes.
- Cite the US Census.

Map 3: WV Population Data (12 Points)

The following data layers for West Virginia are provided. These data layers were obtained from the West Virginia GIS Technical Center (<http://wvgis.wvu.edu/>).

- **wv_counties.shp**: polygon county boundaries with associated attributes
- **wv_towns.shp**: point features of town with associated attributes
- **wv_interstates.shp**: line features of interstates in the state
- **wv_rivers.shp**: line features of major rivers in the state

Use **tmap** to map these West Virginia data layers with a focus on visualizing population data. The map should have the following attributes:

- All four layers (counties, interstates, rivers, towns) are included.
- Use fill color to visualize the population of each county. The population in the year 2000 is provided in the “POP2000” field.
- Map the interstates as red lines with a width of 2.
- Map the rivers as blue lines with a width of 1.5.
- Use size of the point features to represent the population of the town. Population data are provided in the “POPULATION” field.
- Add a compass.
- Add a scale bar.

- The legend for the county population should be titled “Population in 2000.” The title for the town legend should be titled “Population of Towns.” The layout should include the title “WV Population Data.”
- Try to minimize overlap of map elements by adjusting positions and sizes.

Map 4: Land Cover Map (12 Points)

Make a map of land cover for a subset of counties in New York state. The following layers have been provided.

- **ny_lc.tif**: raster grid of generalized land cover from the 2011 National Land Cover Database (NLCD) (1=Water, 2=Developed, 3=Forest, and 4=Other)
- **ny_counties.shp**: polygon county boundaries for subset of New York state

Use **tmap** to map these data layers with a focus on visualizing categorical land cover data. The map should have the following attributes:

- County boundaries are displayed above the land cover with an outline and no fill color. Use a line width of 2 and a color of your choosing.
- Symbolize the raster as categorical. Use the following labels for the categories: "Water", "Developed", "Forest", "Other". Define your own color palette to represent the four categories. Make sure the legend title is “Land Cover.”
- Add a compass.
- Add a scale bar.
- Add a title: “Land Cover”.
- Add credits to cite the NLCD.
- Try to minimize overlap of map elements by adjusting positions and sizes.