

Homework 1: Map making practice

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Comparing Low Income and Potential Exposure to PM 2.5 in Washington

Objective: Using census data to understand an EJScreen defined socioeconomic and environmental indicator and their relationship to each other, in Washington State at the county level.

To understand the extent of environmental justices issues in the state of Washington, the proportion of low income and the potential exposure of PM 2.5 levels were selected for this analysis.

Loading in libraries, data, and data cleaning

```
# loading the required packages
library(tidyverse)
library(sf)
library(here)
library(tmap)

# read in geodatabase of EJScreen data at the Census Block Group level
ejscreen <- sf::st_read(here::here(
  "data", "ejscreen", "EJSCREEN_2023_BG_StatePct_with_AS_CNMI_GU_VI.gdb"))
```

```
Reading layer `EJSCREEN_StatePctiles_with_AS_CNMI_GU_VI' from data source
  `/Users/gigimiura/Documents/MEDS/EDS-223/eds223-hw1/data/ejscreen/EJSCREEN_2023_BG_StatePc
  using driver `OpenFileGDB'
Simple feature collection with 243021 features and 223 fields
Geometry type: MULTIPOLYGON
Dimension:      XY
```

Bounding box: xmin: -19951910 ymin: -1617130 xmax: 16259830 ymax: 11554350
Projected CRS: WGS 84 / Pseudo-Mercator

```
# filter the ejsscreen data set to Washington state
washington <- ejsscreen %>%
  dplyr::filter(ST_ABBREV == "WA")

# filter washington to King County which represents Seattle
seattle <- washington %>%
  dplyr::filter(CNTY_NAME %in% c("King County"))

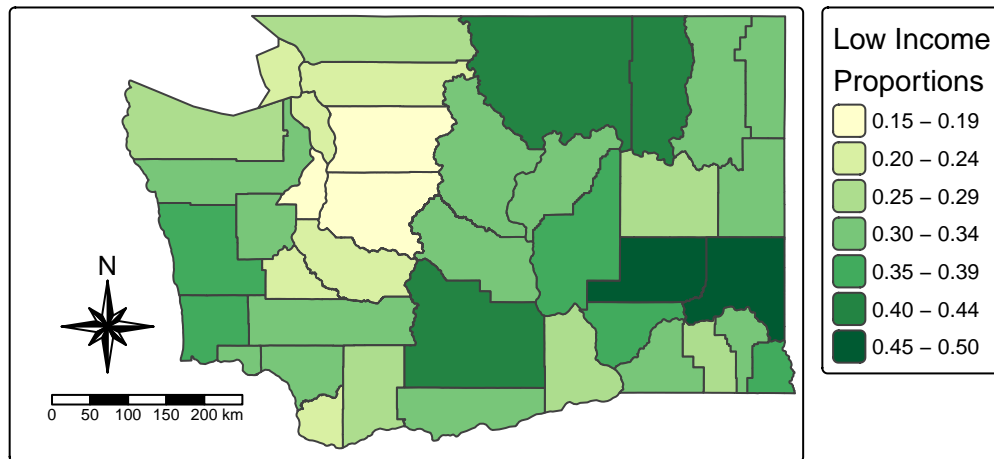
# find the average values for all variables within counties
wa_counties <- aggregate(washington, by = list(washington$CNTY_NAME),
  FUN = mean,
  na.rm = TRUE)
```

Creating Map 1

```
# using wa_counties to map low income proportions

tm_shape(wa_counties, bbox = c(-126, 45.5, -117, 49)) +
  tm_polygons(
    fill = "LOWINCPCT",
    fill.scale = tm_scale(values = "brewer.yl_gn"),
    fill.legend = tm_legend(title = "Low Income\nProportions")) +
  tm_title(text = "Washington State Low Income Proportions, by County",
    fontface = "bold") +
  tm_compass(position = c("left", "bottom"),
    type = "8star",
    size = 3) +
  tm_scalebar(position = c("left", "bottom")) +
  tm_components(c("tm_compass", "tm_scalebar"),
    position = c("left", "bottom"))
```

Washington State Low Income Proportions, by County



Interpretation: The above map displays the average proportion of low income of each county in Washington state. According to the *EJScreen Technical Documentation for Version 2.2*, low income is defined when a household’s income is less than or equal to twice the federal “poverty-level” (EPA, 2023). From the map we can see that there is a spread of low income proportions across the state. The three counties colored the lightest shade of green, indicates a low income proportion of 0.15-0.19. Which is likely due to these counties containing the state’s largest populated cities, such as Seattle and Tacoma.

Creating Map 2

```
# using wa_counties to map potential PM 2.5 exposure levels

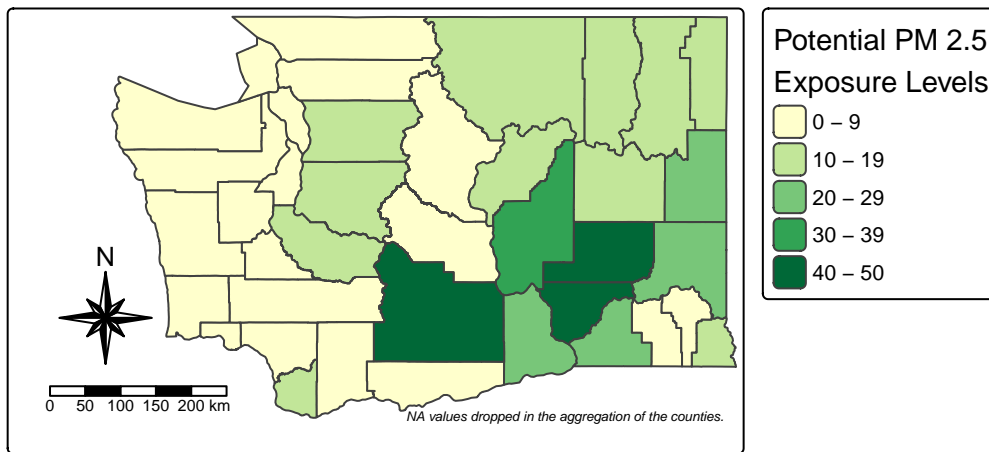
tm_shape(wa_counties, bbox = c(-126, 45.3, -117, 49)) +
  tm_polygons(
    fill = "D2_PM25",
    fill.scale = tm_scale(values = "brewer.yl_gn"),
    fill.legend = tm_legend(title = "Potential PM 2.5\nExposure Levels")) +
  tm_title(text = "Levels of Potential Exposure of PM 2.5 Washington, by County",
    fontface = "bold") +
  tm_credits(text = "NA values dropped in the aggregation of the counties.",
    position = c("right", "bottom"),
    size = 0.4,
```

```

fontface = "italic") +
tm_compass(type = "8star",
           size = 3) +
tm_scalebar() +
tm_components(c("tm_compass", "tm_scalebar"),
             position = c("left", "bottom"))

```

Levels of Potential Exposure of PM 2.5 Washington, by County



Interpretation: From the EJScreen data set, PM 2.5 was measured by taking an annual average (EPA, 2023). For our map, each county is assigned a potential PM 2.5 Exposure Level, which was done by using the aggregation function to find the average value of the PM 2.5 EJ Index. To use this function, NA values were dropped. In comparison to our previous map, we see that some counties with the highest proportions of low income also experience the highest Potential PM 2.5 Exposure Levels. The counties with low proportions of low income, which we noted contains Washington’s largely populated cities (Seattle and Tacoma) experience moderate Potential PM 2.5 Exposure Levels. Many counties that were determined to have moderately to moderately high proportions of low income, experience the lowest levels of Potential PM 2.5 Exposure Levels, denoted by the lightest shade of green.

Citation:

U.S. Environmental Protection Agency (EPA), 2023. EJScreen Technical Documentation.

United States Environmental Protection Agency. 2015. EJSCREEN. Retrieved: October, 6, 2025, https://19january2017snapshot.epa.gov/ejscreen/download-ejscreen-data_.html