

Homework Assignment 1 EDS 223

10-06-2025

Reading in Packages and Dataset

```
# Importing Required Packages  
library(tidyverse)
```

```
-- Attaching core tidyverse packages ----- tidyverse 2.0.0 --  
v dplyr      1.1.4      v readr      2.1.5  
v forcats    1.0.0      v stringr    1.5.1  
v ggplot2    3.5.2      v tibble     3.3.0  
v lubridate  1.9.4      v tidyr      1.3.1  
v purrr      1.1.0
```

```
-- Conflicts ----- tidyverse_conflicts() --
```

```
x dplyr::filter() masks stats::filter()
```

```
x dplyr::lag()     masks stats::lag()
```

```
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become
```

```
library(sf)
```

Linking to GEOS 3.13.0, GDAL 3.8.5, PROJ 9.5.1; sf_use_s2() is TRUE

```
library(tmap)  
library(here)
```

here() starts at /Users/williammullins/Documents/MEDS/EDS-223/EDS223-HW1

```
# 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"))
```

```
Reading layer `EJSCREEN_StatePctiles_with_AS_CNMI_GU_VI' from data source
  `~/Users/williammullins/Documents/MEDS/EDS-223/EDS223-HW1/data/ejscreen/EJSCREEN_2023_BG_StatePctiles_with_AS_CNMI_GU_VI.gdb'
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
```

Data Preparation

```
# Read in Kansas and Missouri data sets
# Due to overlapping county names this must be done separately
kansas <- ejscreen %>%
  dplyr::filter(ST_ABBREV == c('KS'))
missouri <- ejscreen %>%
  dplyr::filter(ST_ABBREV == c('MO'))

# Read in counties located in the Kansas City Metropolitan Area
county_map_kansas <- kansas %>%
  filter(CNTY_NAME %in% c("Johnson County",
                        "Wyandotte County",
                        "Leavenworth County"))
county_map_missouri <- missouri %>%
  filter(CNTY_NAME %in% c("Jackson County",
                        "Platte County",
                        "Clay County",
                        "Cass County"))

# Merge the two data sets together by binding rows
kcmo_counties <- bind_rows(county_map_kansas, county_map_missouri)

# Specify the area the map will display
custom_bbox <- c(xmin = -94.83, ymin = 38.875, xmax = -94.35, ymax = 39.25)
```

Figure 1. The Prevalence of Low Income Households and the Release of Airborne Toxins

```
# Bivariate plot of airborne toxin release and percent of households in low income
tm_shape(kcmo_counties, bbox = custom_bbox) +
  tm_graticules(x = c(-94.80, -94.70, -94.60, -94.50, -94.40, -94.30),
               crs = 4326,
               labels.show = TRUE) + # Show coordinates on x and y of map
tm_polygons(fill = tm_vars(c("RSEI_AIR", "LOWINCPCT"), multivariate = TRUE),
            fill.scale = tm_scale_bivariate(
              values = "brewer.seqseq2",
              scale1 = tm_scale_intervals(
                breaks = c(5, 25, 100, 500, 2000, 10000, 50000, 250000, 1250000),
                labels = c("(5", "25", "100", "500", "2,000",
                          "10,000", "50,000", "250,000", "1,250,000")),
                scale2 = tm_scale_intervals(
                  breaks = c(0, 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.7, 0.8, 0.9, 1),
                  labels = c("0", "10", "20", "30", "40", "50", "60", "70", "80", "90", "100"))
              )
            # Format the legend and give titles
            fill.legend = tm_legend_bivariate(
              orientation = "landscape",
              xlab = "Percent Low Income (10%)",
              ylab = "Toxic Releases to Air µg/m (m\u00B3)",
              xlab.size=2.3,
              ylab.size=2.3,
              item.height = 1.5,
              item.width = 1.5,
              reverse = FALSE
            )
            ) +
tm_layout(main.title = "Airborn Toxin Release and % Low Income \n in the Kansas City Metro",
          main.title.fontface = "bold",
          main.title.position = "center",
          legend.title.fontfamily = "monospace",
          legend.text.size = 2)
```

[v3->v4] `tm_layout()`: use `tm_title()` instead of `tm_layout(main.title =)`
[plot mode] fit legend/component: Some legend items or map compoments do not fit well, and are therefore rescaled.
i Set the tmap option `component.autoscale = FALSE` to disable rescaling.
Labels abbreviated by the first letters, e.g.: "0" => "0"

Airborn Toxin Release and % Low Income in the Kansas City Metropolitan Area

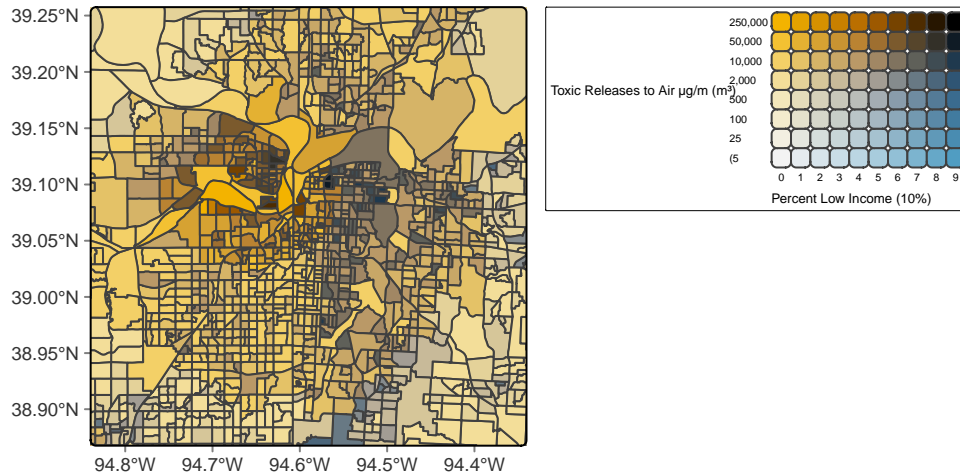


Figure 2. The Prevalence of People of Color and the Release of Airborne Toxins

```
# Bivariate plot of the percent of people of color and the release of airborne3 toxins
tm_shape(kcmo_counties, bbox = custom_bbox) +
  tm_graticules(x = c(-94.80, -94.70, -94.60, -94.50, -94.40, -94.30),
               crs = 4326,
               labels.show = TRUE) +
  tm_polygons(fill = tm_vars(c("RSEI_AIR", "PEOPCOLORPCT"), multivariate = TRUE),
             fill.scale = tm_scale_bivariate(
               values = "brewer.seqseq2",
               scale1 = tm_scale_intervals(
                 breaks = c(5, 25, 100, 500, 2000, 10000, 50000, 250000, 1250000),
                 labels = c("(5", "25", "100", "500", "2,000",
                           "10,000", "50,000", "250,000", "1,250,000")),
               scale2 = tm_scale_intervals(
                 breaks = c(0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.7, 0.8, 0.9, 1),
                 labels = c("10", "20", "30", "40", "50", "60", "70", "80", "90", "100")
               )
             ),
             # Format the legend and give titles
```

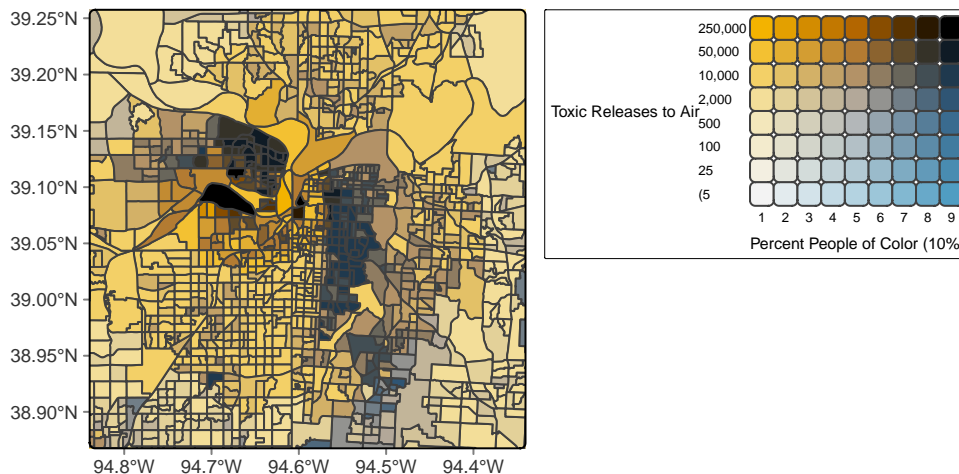
```

fill.legend = tm_legend_bivariate(
  orientation = "landscape",
  xlab = "Percent People of Color (10%)",
  ylab = "Toxic Releases to Air",
  xlab.size=2.3,
  ylab.size=2.3,
  item.height = 1.5,
  item.width = 1.5,
  reverse = FALSE)) +
tm_layout(main.title = "Release of Airborn Toxins and % People of Color \n in the Kansas (
  main.title.fontface = "bold",
  main.title.position = "center",
  legend.title.fontfamily = "monospace",
  legend.text.size = 2)

```

[v3->v4] `tm_layout()`: use `tm_title()` instead of `tm_layout(main.title =)`
 [plot mode] fit legend/component: Some legend items or map components do not fit well, and are therefore rescaled.
 i Set the tmap option `component.autoscale = FALSE` to disable rescaling.
 Labels abbreviated by the first letters, e.g.: "10" => "1"

**Release of Airborn Toxins and % People of Color
in the Kansas City Metropolitan Area**



Discussion

These maps reveal that communities in the Kansas City area with higher percentages of people of color and/or low-income residents are constantly located in the same areas with the highest levels of airborne toxic releases. The overlap is prominent, with nearly every block with a high proportion of either group being the darkest-shaded zones on the map, with a notable lack of blue colored areas. Interestingly, both maps also show the state line between Kansas and Missouri despite not being explicitly drawn in. This indicates that communities on the Missouri side may be more exposed to harmful airborne chemicals than those in Kansas.