

Waller SISIMID 2023 Reading and Mapping Shapefiles: Alcohol, Drugs, and Crime in Houston

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- **What we have** An ArcGIS shapefile for census tracts in Houston.
 - A “shapefile” is actually several separate files with the same file name and different extensions.
 - The .dbf file is a dbase database file containing the attribute table
 - The .shp file contains information on the outlines of the tracks.
 - The .shx, .sbn, and .sbx files have the connective tissue to link it all together (sometimes you can have a .prj paper for the map projection). The following attributes are of interest to us: Population (census), violent crimes (police), number of illegal drug arrests (police), total alcohol sales (state alcoholic beverage license data)

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- **What we want**
 - *Choropleth* maps of the violent crime rate and standardized log drug arrests and standardized log alcohol sales.
 - Will need to calculate these variables, choose intervals and colors, and map.

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- **How we get it**
 - We will use the ‘rgdal’ package and the function ‘readOGR’ function.
 - We will use the ‘RColorBrewer’ and ‘classInt’ libraries to choose colors and intervals.
 - For this example, we will use the basic ‘plot’ function to make maps.

First, load the libraries and set my working directory (you’ll need to change the working directory to your working directory).

```
##Load libraries
```

```
#library(maptools)      # loads sp library too
library(RColorBrewer)   # creates nice color schemes
library(classInt)       # finds class intervals for continuous variables
library(spgwr)          # Adds the geographically weighted regression functions
```

```
## Loading required package: sp
```

```
## The legacy packages maptools, rgdal, and rgeos, underpinning the sp package,
## which was just loaded, will retire in October 2023.
## Please refer to R-spatial evolution reports for details, especially
## https://r-spatial.org/r/2023/05/15/evolution4.html.
## It may be desirable to make the sf package available;
## package maintainers should consider adding sf to Suggests:.
## The sp package is now running under evolution status 2
```

```

##      (status 2 uses the sf package in place of rgdal)
## Loading required package: spData
## To access larger datasets in this package, install the spDataLarge
## package with: `install.packages('spDataLarge',
## repos='https://nowosad.github.io/drat/', type='source')`
## NOTE: This package does not constitute approval of GWR
## as a method of spatial analysis; see example(gwr)
library(rgdal)      # Provides tool for reading in shapefiles

## Please note that rgdal will be retired during October 2023,
## plan transition to sf/stars/terra functions using GDAL and PROJ
## at your earliest convenience.
## See https://r-spatial.org/r/2023/05/15/evolution4.html and https://github.com/r-spatial/evolution
## rgdal: version: 1.6-7, (SVN revision 1203)
## Geospatial Data Abstraction Library extensions to R successfully loaded
## Loaded GDAL runtime: GDAL 3.5.3, released 2022/10/21
## Path to GDAL shared files: /Library/Frameworks/R.framework/Versions/4.3-x86_64/Resources/library/rgdal
## GDAL does not use iconv for recoding strings.
## GDAL binary built with GEOS: TRUE
## Loaded PROJ runtime: Rel. 9.1.0, September 1st, 2022, [PJ_VERSION: 910]
## Path to PROJ shared files: /Library/Frameworks/R.framework/Versions/4.3-x86_64/Resources/library/rgdal
## PROJ CDN enabled: FALSE
## Linking to sp version:1.6-1
## To mute warnings of possible GDAL/OSR exportToProj4() degradation,
## use options("rgdal_show_exportToProj4_warnings"="none") before loading sp or rgdal.
library(here)

## here() starts at /Users/lwaller/Downloads/2022-SISMID-main
# Set my working directory (Lance's here for example)
# setwd("~/OneDrive - Emory University/meetings/SISMID.2021/SISMID.2021.Waller.Rcode")

```

Now to read in the shapefile. You will need these files in your working directory:

- HoustonENAR2012final.shp
- HoustonENAR2012final.dbf
- HoustonENAR2012final.shx
- HoustonENAR2012final.sbx
- HoustonENAR2012final.sbn

```

##Read in shapefile - Houston Census Tracts
houston = readOGR(dsn = here("data"), layer = "HoustonENAR2012final")

```

```

## Warning: OGR support is provided by the sf and terra packages among others
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```

```
## OGR data source with driver: ESRI Shapefile
## Source: "/Users/lwaller/Downloads/2022-SISMID-main/data", layer: "HoustonENAR2012final"
## with 439 features
## It has 133 fields
```

Plotting the map

- To get the outlines simply plot our 'houston' data object.
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```
plot(houston)
```



Next, we want to make choropleth maps (shading in each tract based on its attribute value).

To do this, we need to decide how many intervals (colors) we want. I like odd numbers so there is a 'middle' color, and I usually start with quintiles.

'classInt' will assign each tract to the appropriate quintile for a particular attribute.

'RColorBrewer' will assign a color scheme for the quantiles... lots of fascinating work on color choices by Cynthia Brewer, well worth reading and checking the ColorBrewer webpage (<https://colorbrewer2.org/>)

```
## Making choropleth maps
# Plot the outlines (we'll add color below)
plot(houston)

# Define the variable (attribute) to shade tracts by
pop2000 <- houston@data$POP2000

# Define the number of classes
nclr <- 5 # quintiles

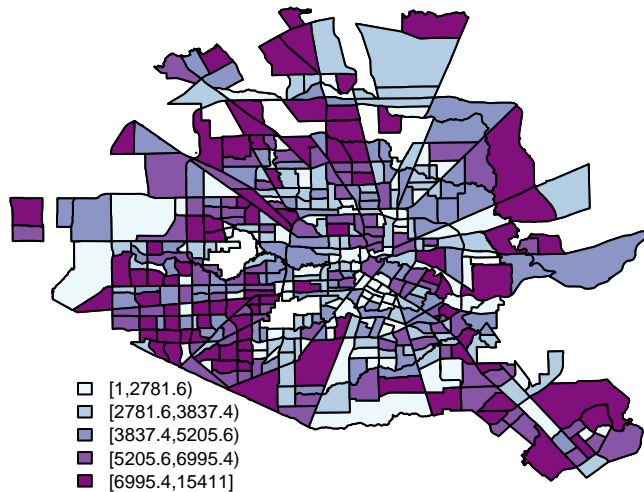
# Use RColorBrewer to choose the colors
plotclr <- brewer.pal(nclr, "BuPu")
class <- classIntervals(pop2000, nclr, style="quantile")
colcode <- findColours(class, plotclr)

# Fill in the tracts with the colors
plot(houston, col=colcode, add=T)
```

```
#Add a title
title(main="Population 2000",
      sub="Quantile (Equal-Frequency) Class Intervals")

#Add a legend (Coordinates are in longitude, latitude).
legend(-95.7, 29.65, legend=names(attr(colcode, "table")),
      fill=attr(colcode, "palette"), cex=0.6, bty="n")
```

Population 2000



Quantile (Equal-Frequency) Class Intervals

OK, great, we can map the data. Let's map the main variables for our analysis.

The data table has a lot of census data and various transformations of the violent crime, alcohol sales, and drug arrest data. The next section pulls the values we want. ***

```
# Outcome: Number of violent crimes by tract
violence = houston@data$violence_2

# Divide by the 2000 population to get the rate
violence.rate = violence/houston@data$tot_pop

# Covariate 1 (log standardized total alcohol sales)
Z.log.total = houston@data$Zl_total

# Covariate 2 (log standardized illegal drug arrests)
Z.log.drug = houston@data$Zl_drug
```

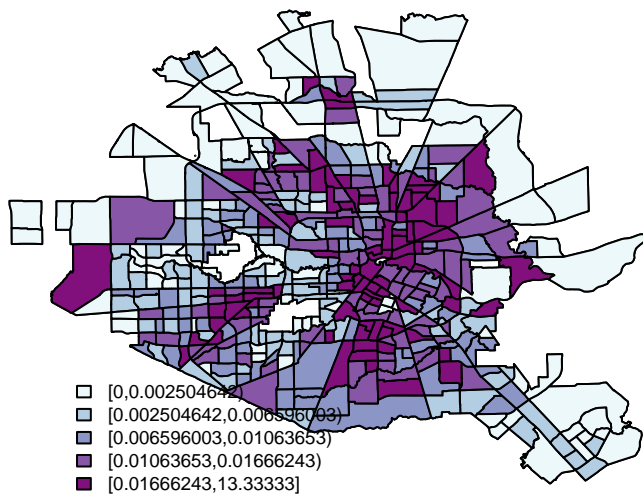
Now to map the outcome. ***

```

# Plot Outcome first
plot(houston)
# Define the number of classes
nclr <- 5 # quintiles
# Use RColorBrewer to choose the colors
plotclr <- brewer.pal(nclr, "BuPu")
class <- classIntervals(violence.rate, nclr, style="quantile")
colcode <- findColours(class, plotclr)
# Fill in the tracts with the colors
plot(houston, col=colcode, add=T)
# Add a title
title(main="Violence Rate",
      sub="Quantile (Equal-Frequency) Class Intervals")
# Add a legend (Coordinates are in longitude, latitude).
legend(-95.7, 29.65, legend=names(attr(colcode, "table")),
      fill=attr(colcode, "palette"), cex=0.6, bty="n")

```

Violence Rate



Quantile (Equal-Frequency) Class Intervals

Next, map standardized log total alcohol sales.

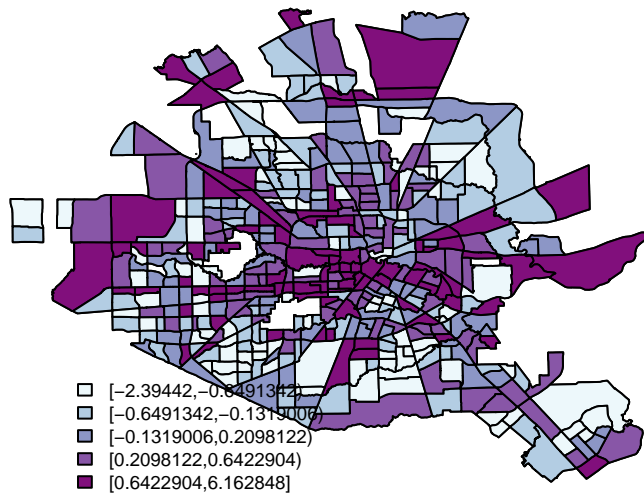
```

# Next plot stdized log total alcohol sales
plot(houston)
# Define the number of classes
nclr <- 5 # quintiles
# Use RColorBrewer to choose the colors
plotclr <- brewer.pal(nclr, "BuPu")
class <- classIntervals(Z.log.total, nclr, style="quantile")
colcode <- findColours(class, plotclr)
# Fill in the tracts with the colors
plot(houston, col=colcode, add=T)

```

```
#Add a title
title(main="Std log total sales",
      sub="Quantile (Equal-Frequency) Class Intervals")
#Add a legend (Coordinates are in longitude, latitude).
legend(-95.7, 29.65, legend=names(attr(colcode, "table")),
      fill=attr(colcode, "palette"), cex=0.6, bty="n")
```

Std log total sales

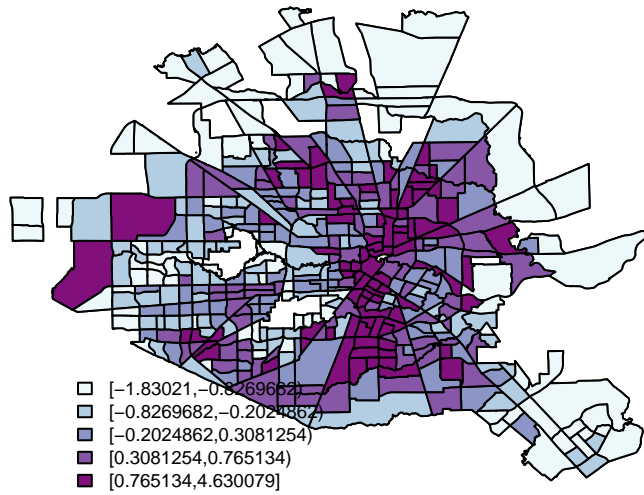


Quantile (Equal-Frequency) Class Intervals

Finally, plot standardized log illegal arrests.

```
# Next plot stdized log illegal arrests
plot(houston)
# Define the number of classes
nclr <- 5 # quintiles
# Use RColorBrewer to choose the colors
plotclr <- brewer.pal(nclr,"BuPu")
class <- classIntervals(Z.log.drug, nclr, style="quantile")
colcode <- findColours(class, plotclr)
#Fill in the tracts with the colors
plot(houston, col=colcode, add=T)
#Add a title
title(main="Std log drug arrests",
      sub="Quantile (Equal-Frequency) Class Intervals")
#Add a legend (Coordinates are in longitude, latitude).
legend(-95.7, 29.65, legend=names(attr(colcode, "table")),
      fill=attr(colcode, "palette"), cex=0.6, bty="n")
```

Std log drug arrests



Quantile (Equal-Frequency) Class Intervals ***

These three figures will match the maps in Figure 1 of:

Waller LA, Zhu L, Gotway CA, Gorman DM, and Gruenewald PJ (2007) "Quantifying geographic variations in associations between alcohol distribution and violence: A comparison of geographically weighted regression and spatially varying coefficient models". *Stochastic Environmental Research and Risk Assessment*. **21**, 573-588.

We'll return to these data on Friday for our discussion of "Slippery Slopes".
