R. Notebook

Resources

Here are some links I found helpful:

- https://www.computerworld.com/article/3175623/mapping-in-r-just-got-a-whole-lot-easier.html
- $\bullet \ \ https://cran.r-project.org/web/packages/tmap/vignettes/tmap-getstarted.html$
- $\bullet \ \, \text{http://zevross.com/blog/2018/10/02/creating-beautiful-demographic-maps-in-r-with-the-tidy$ $census-and-tmap-packages/} \\$
- https://geocompr.robinlovelace.net/adv-map.html#introduction-5

Imports

These are the libraries I'm using (I silence masking warnings):

Show the current software versions I'm working with.

sessionInfo()

```
## R version 3.6.2 (2019-12-12)
## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS High Sierra 10.13.6
##
## Matrix products: default
           /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats
                 graphics grDevices utils
                                               datasets methods
                                                                    base
## other attached packages:
                           RColorBrewer_1.1-2 spDataLarge_0.3.1
##
   [1] reshape2_1.4.3
                                                                 spData_0.3.2
   [5] tmaptools_2.0-2
                                              raster_3.0-7
##
                           tmap_2.3-1
                                                                  sp_1.3-2
##
   [9] sf_0.8-0
                           ggplot2_3.2.1
                                              knitr_1.27
                                                                  dplyr_0.8.3
##
## loaded via a namespace (and not attached):
   [1] tidyselect_0.2.5
                           xfun_0.11
                                              purrr_0.3.3
                                                                  lattice_0.20-38
   [5] colorspace_1.4-1
                           viridisLite_0.3.0 htmltools_0.4.0
                                                                  yaml_2.2.0
                                              e1071_1.7-3
                                                                  pillar_1.4.2
   [9] XML_3.98-1.20
                           rlang_0.4.2
## [13] later_1.0.0
                           glue_1.3.1
                                              withr_2.1.2
                                                                  DBI_1.1.0
## [17] plyr 1.8.5
                           lifecycle 0.1.0
                                              stringr 1.4.0
                                                                  rgeos 0.5-2
                           gtable_0.3.0
                                              htmlwidgets_1.5.1 codetools_0.2-16
## [21] munsell_0.5.0
## [25] leafsync 0.1.0
                           evaluate 0.14
                                              fastmap_1.0.1
                                                                  httpuv 1.5.2
## [29] crosstalk_1.0.0
                           class_7.3-15
                                              Rcpp_1.0.3
                                                                  KernSmooth_2.23-16
```

```
## [33] xtable_1.8-4
                           scales_1.1.0
                                               promises_1.1.0
                                                                  classInt_0.4-2
                                               mime_0.8
                                                                  digest_0.6.23
## [37] lwgeom_0.1-7
                           leaflet_2.0.3
## [41] stringi_1.4.3
                           shiny_1.4.0
                                               grid_3.6.2
                                                                  rgdal_1.4-8
## [45] tools_3.6.2
                           magrittr_1.5
                                               lazyeval_0.2.2
                                                                  tibble_2.1.3
## [49] dichromat_2.0-0
                           crayon_1.3.4
                                               pkgconfig_2.0.3
                                                                  assertthat_0.2.1
## [53] rmarkdown 2.0
                                               units_0.6-5
                                                                  compiler_3.6.2
                           R6_2.4.1
```

Load Raw Data

This data was available from: https://www.kaggle.com/mikejohnsonjr/united-states-crime-rates-by-county/data with the following licesnse: CC0 1.0 Universal (CC0 1.0)

```
df <- read.csv("crime_data.csv")
head(df)</pre>
```

		county	_name c	rime_rate	e_per_:	100000 f	index	EDITION	PART	IDNO	CPOPARST
								1	. 4	1612	318667
2	Crittende	en Count	y, AR		175	54.915	2	1	. 4	130	50717
	Alexande	er Count	y, IL		166	34.700	3	1	. 4	604	8040
4	Kened	dy Count	y, TX		145	56.311	4	1	. 4	2681	444
5	De Sot	to Paris	sh, LA		144	47.402	5	1	. 4	1137	26971
6	Baltin	nore cit	y, MD		14:	19.538	6	1	. 4	1227	625474
	CPOPCRIM	AG_ARRS	T AG_OF	F COVIND	INDEX	MODINDX	K MURI	DER RAPI	ROBBI	ERY A	GASSLT
1	318667	1	.5 1	5 100	5706	22329) :	119 200	1	778	3609
2	50717		4	4 100	873	3424	1	8 38	3	165	662
3	8040		2	2 100	127	278	3	1 2	?	5	119
4	444		1	1 100	6	13	3	0 3	3	1	2
5	26971		3	3 100	392	703	3	3 4		17	368
6	625474		9	9 100	8831	29868	3 2	216 317	30	338	4660
	BURGLRY I	LARCENY	MVTHEFT	ARSON p	opulat:	ion FIPS	S_ST E	FIPS_CTY	•		
1	4995	13791	3543	464	3184	116	29	510)		
2	1482	1753	189	28	497	746	5	35	•		
3	82	184	12	2	76	329	17	3	3		
4	5	4	4	0	4	112	48	261			
5	149	494	60	0	270	083	22	31			
6	7804	18055	4009	251	622	104	24	510)		
	2 3 4 5 6 1 2 3 4 5 6 1	1 St. Lo 2 Crittende 3 Alexande 4 Kenec 5 De So 6 Baltin	1 St. Louis cit 2 Crittenden Count 3 Alexander Count 4 Kenedy Count 5 De Soto Paris 6 Baltimore cit CPOPCRIM AG_ARRS 1 318667 1 2 50717 3 8040 4 444 5 26971 6 625474 BURGLRY LARCENY 1 4995 13791 2 1482 1753 3 82 184 4 5 4 5 149 494	1 St. Louis city, MO 2 Crittenden County, AR 3 Alexander County, IL 4 Kenedy County, TX 5 De Soto Parish, LA 6 Baltimore city, MD CPOPCRIM AG_ARRST AG_OF 1 318667 15 1 2 50717 4 3 8040 2 4 4444 1 5 26971 3 6 625474 9 BURGLRY LARCENY MVTHEFT 1 4995 13791 3543 2 1482 1753 189 3 82 184 12 4 5 4 4 5 149 494 60	1 St. Louis city, MO 2 Crittenden County, AR 3 Alexander County, IL 4 Kenedy County, TX 5 De Soto Parish, LA 6 Baltimore city, MD	1 St. Louis city, MO 175 2 Crittenden County, AR 175 3 Alexander County, IL 166 4 Kenedy County, TX 145 5 De Soto Parish, LA 146 6 Baltimore city, MD 147 CPOPCRIM AG_ARRST AG_OFF COVIND INDEX 1 318667 15 15 100 5706 2 50717 4 4 100 873 3 8040 2 2 100 127 4 444 1 1 1 100 6 5 26971 3 3 100 392 6 625474 9 9 100 8831 BURGLRY LARCENY MVTHEFT ARSON populat: 1 4995 13791 3543 464 3184 2 1482 1753 189 28 495 3 82 184 12 2 76 4 5 4 4 0 4 5 149 494 60 0 276	1 St. Louis city, MO 1791.995 2 Crittenden County, AR 1754.915 3 Alexander County, IL 1664.700 4 Kenedy County, TX 1456.311 5 De Soto Parish, LA 1447.402 6 Baltimore city, MD 1419.538	1 St. Louis city, MO 1791.995 1 2 Crittenden County, AR 1754.915 2 3 Alexander County, IL 1664.700 3 4 Kenedy County, TX 1456.311 4 5 De Soto Parish, LA 1447.402 5 6 Baltimore city, MD 1419.538 6 CPOPCRIM AG_ARRST AG_OFF COVIND INDEX MODINDX MURI 1 318667 15 15 100 5706 22329 2 50717 4 4 100 873 3424 3 8040 2 2 100 127 278 4 444 1 1 1 100 6 13 5 26971 3 3 100 392 703 6 625474 9 9 100 8831 29868 3 BURGLRY LARCENY MVTHEFT ARSON population FIPS_ST 1 1 4995 13791 3543 464 318416 29 2 1482 1753 189 28 49746 5 3 82 184 12 2 7629 17 4 5 4 4 0 412 48 5 149 494 60 0 27083 22	1 St. Louis city, MO 1791.995 1 1 2 2 Crittenden County, AR 1754.915 2 1 3 Alexander County, IL 1664.700 3 1 4 Kenedy County, TX 1456.311 4 1 5 De Soto Parish, LA 1447.402 5 1 6 Baltimore city, MD 1419.538 6 1 CPOPCRIM AG_ARRST AG_OFF COVIND INDEX MODINDX MURDER RAPE 1 318667 15 15 100 5706 22329 119 200 2 50717 4 4 100 873 3424 8 38 3 8040 2 2 100 127 278 1 2 4 444 1 1 1 100 6 13 0 3 5 26971 3 3 100 392 703 3 4 6 6 625474 9 9 100 8831 29868 216 317 BURGLRY LARCENY MVTHEFT ARSON population FIPS_ST FIPS_CTY 1 4995 13791 3543 464 318416 29 510 2 1482 1753 189 28 49746 5 35 35 3 82 184 12 2 7629 17 3 3 3 82 184 12 2 7629 17 3 3 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 5 149 494 60 0 27083 22 31 5 149 494 60 149 494 60 149 494 60 27083 22 31 5 149 494 60 27083 22 31 5 149 494 60 27083 22 31 5 149 494 60 27083 27	1 St. Louis city, MO	1 St. Louis city, MO 1791.995 1 1 4 1612 2 Crittenden County, AR 1754.915 2 1 4 130 3 Alexander County, IL 1664.700 3 1 4 604 4 Kenedy County, TX 1456.311 4 1 4 2681 5 De Soto Parish, LA 1447.402 5 1 4 1137 6 Baltimore city, MD 1419.538 6 1 4 1227 CPOPCRIM AG_ARRST AG_OFF COVIND INDEX MODINDX MURDER RAPE ROBBERY AG 1 318667 15 15 100 5706 22329 119 200 1778 2 50717 4 4 100 873 3424 8 38 165 3 8040 2 2 100 127 278 1 2 5 4 444 1 1 1 100 6 13 0 3 1 5 26971 3 3 100 392 703 3 4 17 6 625474 9 9 9 100 8831 29868 216 317 3638 BURGLRY LARCENY MUTHEFT ARSON population FIPS_ST FIPS_CTY 1 4995 13791 3543 464 318416 29 510 2 1482 1753 189 28 49746 5 35 3 82 184 12 2 7629 17 3 4 5 4 4 0 412 48 261 5 149 494 60 0 27083 22 31

Data Preparation

Notice how the state name is part of the "county name" variable? I'll create a new column for the state name.

```
# note that we trim whitespace and explicitly convert
# to a factor
df$state_abbr <- as.factor(trimws(sub('.*,\\s*', '', df$county_name)))
head(df)</pre>
```

```
##
               county_name crime_rate_per_100000 index EDITION PART IDNO CPOPARST
        St. Louis city, MO
                                        1791.995
                                                      1
                                                                   4 1612
                                                                            318667
                                                              1
                                                                   4 130
## 2 Crittenden County, AR
                                        1754.915
                                                      2
                                                              1
                                                                             50717
## 3 Alexander County, IL
                                        1664.700
                                                      3
                                                                   4 604
                                                                              8040
                                                      4
## 4
        Kenedy County, TX
                                        1456.311
                                                              1
                                                                   4 2681
                                                                               444
## 5
       De Soto Parish, LA
                                        1447.402
                                                      5
                                                                   4 1137
                                                                             26971
                                        1419.538
                                                      6
                                                                   4 1227
                                                                            625474
## 6
       Baltimore city, MD
                                                              1
```

```
CPOPCRIM AG_ARRST AG_OFF COVIND INDEX MODINDX MURDER RAPE ROBBERY AGASSLT
## 1
       318667
                      15
                              15
                                     100
                                          5706
                                                   22329
                                                             119
                                                                  200
                                                                          1778
                                                                                    3609
## 2
                                                                    38
         50717
                       4
                               4
                                     100
                                            873
                                                    3424
                                                               8
                                                                            165
                                                                                     662
                                                                                     119
## 3
          8040
                       2
                               2
                                     100
                                            127
                                                     278
                                                                     2
                                                                              5
                                                               1
## 4
           444
                       1
                               1
                                     100
                                              6
                                                      13
                                                               0
                                                                     3
                                                                              1
                                                                                       2
## 5
                       3
                               3
                                     100
                                            392
                                                     703
                                                               3
                                                                     4
                                                                             17
                                                                                     368
         26971
## 6
                       9
                               9
                                     100
                                           8831
                                                   29868
                                                             216
                                                                  317
                                                                           3638
       625474
                                                                                    4660
     BURGLRY LARCENY MVTHEFT ARSON population FIPS_ST FIPS_CTY state_abbr
##
## 1
         4995
                 13791
                           3543
                                   464
                                            318416
                                                         29
                                                                  510
## 2
         1482
                                    28
                                                          5
                                                                    35
                  1753
                            189
                                             49746
                                                                                AR
## 3
           82
                   184
                             12
                                     2
                                              7629
                                                         17
                                                                     3
                                                                                IL
## 4
            5
                                     0
                                               412
                                                         48
                                                                  261
                                                                                TX
                     4
                              4
## 5
          149
                   494
                             60
                                     0
                                             27083
                                                         22
                                                                    31
                                                                                LA
## 6
         7804
                 18055
                           4009
                                   251
                                            622104
                                                         24
                                                                  510
                                                                                MD
```

But this gives us abbreviations, we really want the names. There's a file in this directory with the mapping.

```
states <- read.csv("state.csv")
# note that we trim whitespace and explicitly convert
# to a factor
states$state_abbr <- as.factor(trimws(states$state_abbr))
head(states)</pre>
```

```
state_name state_abbr
## 1 District of Columbia
## 2
                   Alabama
                                    AL
## 3
                                    AK
                    Alaska
## 4
                   Arizona
                                    AZ
## 5
                                    AR
                  Arkansas
## 6
                California
                                    CA
```

We'll add the state names using a right join:

```
df <- merge(x = df, y = states, by = "state_abbr", all.x = TRUE)
head(df)</pre>
```

```
county_name crime_rate_per_100000 index EDITION
##
     state_abbr
## 1
              AK
                    Anchorage Municipality, AK
                                                                824.7217
                                                                              50
                                                                                        1
## 2
                   Juneau City and Borough, AK
                                                                             667
              AK
                                                                352.1127
                                                                                        1
## 3
              AK
                     Kodiak Island Borough, AK
                                                                856.0311
                                                                              44
                                                                                        1
## 4
                    Sitka City and Borough, AK
                                                                133.0377
                                                                           2018
                                                                                        1
## 5
              AK Northwest Arctic Borough, AK
                                                               1014.9642
                                                                              21
                                                                                        1
## 6
              AK
                          Nome Census Area, AK
                                                                232.5111
                                                                                        1
##
     PART IDNO CPOPARST CPOPCRIM AG_ARRST AG_OFF COVIND INDEX MODINDX MURDER RAPE
## 1
        4
             71
                   299143
                             299143
                                            3
                                                    3
                                                          100
                                                               2482
                                                                       10728
                                                                                  15
                                                                                       303
                                                                        1099
## 2
        4
             77
                    32553
                              32553
                                                          100
                                                                115
                                                                                   0
                                                                                         9
                                            1
                                                    1
## 3
        4
             80
                     6332
                               6332
                                                          100
                                                                121
                                                                         254
                                                                                   0
                                                                                         8
                                            1
                                                    1
## 4
        4
             87
                     9060
                               9060
                                            1
                                                    1
                                                          100
                                                                 12
                                                                         143
                                                                                   0
                                                                                         1
## 5
             85
                     3334
                               3334
                                                          100
                                                                 78
                                                                                        23
                                            1
                                                    1
                                                                         210
                                                                                   0
                                                                                   0
## 6
        4
             83
                     3776
                               3776
                                            1
                                                    1
                                                          100
                                                                 23
                                                                          44
                                                                                         3
##
     ROBBERY AGASSLT BURGLRY LARCENY MVTHEFT ARSON population FIPS_ST FIPS_CTY
          488
                                             845
                                                     98
                                                                           2
## 1
                 1676
                          1159
                                   8724
                                                             300950
                                                                                    20
                                                      9
                                                                           2
## 2
           16
                    90
                             94
                                     975
                                              30
                                                              32660
                                                                                   110
                                                                           2
## 3
           10
                   103
                             23
                                     200
                                              31
                                                      3
                                                              14135
                                                                                   150
## 4
            1
                    10
                             17
                                    120
                                               6
                                                      0
                                                               9020
                                                                            2
                                                                                   220
## 5
           12
                    43
                             46
                                     126
                                              38
                                                      2
                                                               7685
                                                                            2
                                                                                   188
## 6
                                     23
                                               9
                                                      2
                                                               9892
                                                                           2
                                                                                   180
            2
                    18
                             12
```

```
## state_name
## 1 Alaska
## 2 Alaska
## 3 Alaska
## 4 Alaska
## 5 Alaska
## 6 Alaska
```

Next we need some aggregates by state. I'll just take the sum here, but we could choose different functions if we wanted to.

Maps!

First we append our data into the map object. Note the warning that we only have data for the lower 48.

```
## Warning: This function is deprecated and has been migrated to github.com/
## mtennekes/oldtmaptools
```

Over coverage: 2 out of 51 data records were not appended. Run over_coverage() to get the correspond Now we can plot this bad boi!

