GES 673 ESDA with Election Data

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This is an R Markdown document. Markdown is a simple formatting syntax for authoring web pages and allows both content as well as the output of any embedded R code chunks within a document.

Dataset Background

The datasets for this lab relate to voting results from the United States presidential election of 2004. The election was the 55th quadrennial presidential election. It was held on Tuesday, November 2, 2004. Republican Party candidate and incumbent President George W. Bush defeated Democratic Party candidate John Kerry, the then-junior Senator from Massachusetts.from the 2004 US presidential election - where Bush beat Kerry.

Nominee George W. Bush (Republican), VP Cheney John Kerry (Democratic), VP Edwards

```
*Electoral vote:     286[2]        251[2][3]
*States carried:     31            19 + DC
*Popular vote:    62,040,610       59,028,444
*Percentage:         50.7%            48.3%
```



```
library(maps)  ## Projections
library(maptools)  ## Data management
```

```
## Loading required package: sp
## Checking rgeos availability: TRUE
```

```
library(sp)  ## Data management
library(spdep)  ## Spatial autocorrelation
```

```
## Loading required package: Matrix
```

```
library(gstat)  ## Geostatistics
```

```
## Error: there is no package called 'gstat'
```

```
library(splancs)  ## Kernel Density
```

```
##
## Spatial Point Pattern Analysis Code in S-Plus
##
##   Version 2 - Spatial and Space-Time analysis
```

```
library(spatstat)  ## Geostatistics
```

```
##
## spatstat 1.36-0       (nickname: 'Intense Scrutiny')
## For an introduction to spatstat, type 'beginner'
```

```
library(pgirmess)  ## Spatial autocorrelation
library(RColorBrewer)  ## Visualization
library(classInt)  ## Class intervals
library(spgwr)  ## GWR
```

```
## NOTE: This package does not constitute approval of GWR
## as a method of spatial analysis; see example(gwr)
```

```
setwd("/Users/heimannrichard/Google Drive/Spatial Analysis
UMBC/RCode/spacestats/CodeData")
load("Datasets.RData")
ls()
```

```
## [1] "crime"    "dat88"    "election" "laos"     "mat88"
"volcano"
```

```
save(laos, crime, cities, election, dat88, mat88, file =
"Rspatial_lab.RData")
```

```
## Error: object 'cities' not found
```

```
summary(election)
```

```
## Object of class SpatialPolygonsDataFrame
## Coordinates:
##         min    max
## r1 -124.73 -66.97
## r2   24.96  49.37
## Is projected: TRUE
## proj4string :
## [+proj=lcc+lon_0=90w +lat_1=20n +lat_2=60n]
## Data attributes:
##            NAME          STATE_NAME      STATE_FIPS         CNTY_FIPS
##   Washington:  32   Texas   : 254   48     : 254   001    :  48
##   Jefferson :  26   Georgia : 159   13     : 159   003    :  48
##   Franklin  :  25   Virginia: 136   51     : 136   005    :  48
##   Jackson   :  24   Kentucky: 120   21     : 120   009    :  47
##   Lincoln   :  24   Missouri: 115   29     : 115   007    :  46
##   Madison   :  20   Kansas  : 105   20     : 105   011    :  46
##   (Other)   :2960   (Other) :2222   (Other):2222   (Other):2828
##       FIPS             AREA           FIPS_num          Bush
##   01001  :   1   Min.   :    2   Min.   : 1001   Min.   :     0
##   01003  :   1   1st Qu.:  435   1st Qu.:19048   1st Qu.:  2926
##   01005  :   1   Median :  622   Median :29217   Median :  6357
##   01007  :   1   Mean   :  965   Mean   :30699   Mean   : 19055
##   01009  :   1   3rd Qu.:  931   3rd Qu.:46012   3rd Qu.: 15894
##   01011  :   1   Max.   :20175   Max.   :56045   Max.   :954764
##   (Other):3105
##      Kerry           County_F           Nader            Total
##   Min.   :      0   Min.   :    0   Min.   :    0   Min.   :
## 0
##   1st Qu.:   1778   1st Qu.:19042   1st Qu.:    0   1st Qu.:
## 4808
##   Median :   4041   Median :29211   Median :   14   Median :
## 10407
##   Mean   :  17940   Mean   :30656   Mean   :  145   Mean   :
## 37140
##   3rd Qu.:  10418   3rd Qu.:46008   3rd Qu.:   67   3rd Qu.:
## 26552
##   Max.   :1670341   Max.   :56045   Max.   :13251   Max.
## :2625105
##
##      Bush_pct         Kerry_pct         Nader_pct          MDratio
```

```
##    Min.    : 0.0     Min.    : 0.0     Min.    :0.000    Min.    :   0.0
##    1st Qu.:52.7     1st Qu.:30.2     1st Qu.:0.000    1st Qu.:  37.3
##    Median :61.2     Median :38.5     Median :0.302    Median :  65.6
##    Mean    :60.6     Mean    :38.9     Mean    :0.401    Mean    :  93.0
##    3rd Qu.:69.4     3rd Qu.:46.8     3rd Qu.:0.633    3rd Qu.: 117.5
##    Max.    :92.8     Max.    :90.0     Max.    :4.467    Max.    :2189.5
##
##        hosp             pcthisp          pcturban          urbrural
##    Min.    : 0.00    Min.    :  0.0    Min.    :  0.0    Min.    :0.00
##    1st Qu.: 1.30    1st Qu.:  4.0    1st Qu.:  0.0    1st Qu.:3.00
##    Median : 3.29    Median :  8.0    Median : 33.4    Median :6.00
##    Mean    : 5.67    Mean    : 44.5    Mean    : 35.3    Mean    :5.54
##    3rd Qu.: 6.74    3rd Qu.: 24.0    3rd Qu.: 56.5    3rd Qu.:7.00
##    Max.    :84.07    Max.    :972.0    Max.    :100.0    Max.    :9.00
##
##       pctfemhh         pcincome          pctpoor          pctlt9ed
##    Min.    : 0.0    Min.    :    0    Min.    : 0.0    Min.    : 0.0
##    1st Qu.: 9.6    1st Qu.:15466    1st Qu.:11.0    1st Qu.: 8.9
##    Median :12.2    Median :17448    Median :15.1    Median :13.2
##    Mean    :13.0    Mean    :17788    Mean    :16.5    Mean    :14.3
##    3rd Qu.:15.4    3rd Qu.:19818    3rd Qu.:20.4    3rd Qu.:18.7
##    Max.    :41.1    Max.    :58096    Max.    :63.1    Max.    :56.3
##
##       pcthsed          pctcoled         unemploy          pctwhtcl
##    Min.    :  0.0    Min.    : 0.0    Min.    : 0.00    Min.    : 0.0
##    1st Qu.: 61.1    1st Qu.: 9.0    1st Qu.: 3.90    1st Qu.:38.5
##    Median : 71.2    Median :11.6    Median : 5.30    Median :43.5
##    Mean    : 68.3    Mean    :13.1    Mean    : 5.87    Mean    :44.5
##    3rd Qu.: 77.1    3rd Qu.:15.3    3rd Qu.: 7.20    3rd Qu.:50.7
##    Max.    :100.0    Max.    :53.4    Max.    :37.90    Max.    :81.4
##
##       homevalu          rent            popdens          crowded
##    Min.    :     0    Min.    :  0    Min.    :     0    Min.    : 0.00
##    1st Qu.: 35850    1st Qu.:255    1st Qu.:    15    1st Qu.: 1.80
##    Median : 44400    Median :297    Median :    39    Median : 2.60
##    Mean    : 52015    Mean    :313    Mean    :   194    Mean    : 3.61
##    3rd Qu.: 58600    3rd Qu.:352    3rd Qu.:    93    3rd Qu.: 4.50
##    Max.    :500001    Max.    :926    Max.    :53801    Max.    :44.40
##
##       ginirev          SmokecurM         SmokevrM          SmokecurF
##    Min.    :0.000    Min.    :0.000    Min.    :0.000    Min.    :0.000
##    1st Qu.:0.390    1st Qu.:0.220    1st Qu.:0.490    1st Qu.:0.190
##    Median :0.420    Median :0.240    Median :0.520    Median :0.210
```

```
##    Mean    :0.413    Mean    :0.241    Mean    :0.505    Mean    :0.208
##    3rd Qu.:0.440    3rd Qu.:0.270    3rd Qu.:0.540    3rd Qu.:0.240
##    Max.    :0.580    Max.    :0.580    Max.    :0.780    Max.    :0.420
##
##      SmokevrF           Obese             Noins           XYLENES__M
##    Min.    :0.000    Min.    :0.000    Min.    :0.000    Min.    :     0
##    1st Qu.:0.390    1st Qu.:0.320    1st Qu.:0.100    1st Qu.:    27
##    Median :0.420    Median :0.340    Median :0.120    Median :    58
##    Mean    :0.412    Mean    :0.335    Mean    :0.129    Mean    :   222
##    3rd Qu.:0.460    3rd Qu.:0.360    3rd Qu.:0.150    3rd Qu.:   170
##    Max.    :0.630    Max.    :0.630    Max.    :0.410    Max.    :16661
##
##      TOLUENE          TETRACHLOR          STYRENE          NICKEL_COM
##    Min.    :     0    Min.    :   0.0    Min.    :   0.0    Min.    : 0.00
##    1st Qu.:    44    1st Qu.:   0.7    1st Qu.:   0.8    1st Qu.: 0.00
##    Median :    91    Median :   1.9    Median :   1.8    Median : 0.01
##    Mean    :   336    Mean    :  13.7    Mean    :  15.4    Mean    : 0.37
##    3rd Qu.:   255    3rd Qu.:   6.6    3rd Qu.:   8.1    3rd Qu.: 0.11
##    Max.    :28305    Max.    :1966.6    Max.    :1413.0    Max.    :69.01
##
##     METHYLENE_         MERCURY_CO         LEAD_COMPO         BENZENE__I
##    Min.    :   0.0    Min.    :0.000    Min.    :   0.00    Min.    :     0
##    1st Qu.:   1.6    1st Qu.:0.002    1st Qu.:   0.01    1st Qu.:    22
##    Median :   3.9    Median :0.004    Median :   0.02    Median :    42
##    Mean    :  26.4    Mean    :0.057    Mean    :   0.82    Mean    :   105
##    3rd Qu.:  12.5    3rd Qu.:0.020    3rd Qu.:   0.23    3rd Qu.:    96
##    Max.    :2764.2    Max.    :3.220    Max.    :290.63    Max.    :4612
##
##     ARSENIC_CO          POP2000          POP00SQMIL         MALE2000
##    Min.    : 0.00    Min.    :       0    Min.    :       0    Min.    :
## 0
##    1st Qu.: 0.00    1st Qu.:  11343    1st Qu.:     17    1st Qu.:
## 5583
##    Median : 0.00    Median :  24747    Median :     43    Median :
## 12272
##    Mean    : 0.11    Mean    :  89145    Mean    :   244    Mean    :
## 43726
##    3rd Qu.: 0.02    3rd Qu.:  61896    3rd Qu.:   105    3rd Qu.:
## 30370
##    Max.    :32.47    Max.    :9519338    Max.    :66934    Max.
## :4704105
##
##     FEMALE2000           MAL2FEM           UNDER18             AIAN
```

```
##    Min.   :       0     Min.   :  0.0     Min.   : 0.0       Min.   : 0.00
##    1st Qu.:    5598     1st Qu.: 94.0     1st Qu.:23.7       1st Qu.: 0.20
##    Median :   12512     Median : 97.0     Median :25.3       Median : 0.30
##    Mean   :   45419     Mean   : 98.3     Mean   :25.5       Mean   : 1.61
##    3rd Qu.:   31548     3rd Qu.:100.0     3rd Qu.:27.1       3rd Qu.: 0.80
##    Max.   :4815233      Max.   :205.0     Max.   :45.3       Max.   :94.20
##
##       ASIA              BLACK              NHPI               WHITE
##    Min.   : 0.00     Min.   : 0.00     Min.   :0.000      Min.   : 0.0
##    1st Qu.: 0.20     1st Qu.: 0.30     1st Qu.:0.000      1st Qu.:77.1
##    Median : 0.30     Median : 1.70     Median :0.000      Median :91.3
##    Mean   : 0.77     Mean   : 8.83     Mean   :0.036      Mean   :84.7
##    3rd Qu.: 0.70     3rd Qu.:10.10     3rd Qu.:0.100      3rd Qu.:96.7
##    Max.   :30.80     Max.   :86.50     Max.   :1.500      Max.   :99.7
##
##     AIAN_MORE          ASIA_MORE          BLK_MORE           NHPI_MORE
##    Min.   : 0.00     Min.   : 0.00     Min.   : 0.00      Min.   :0.0000
##    1st Qu.: 0.50     1st Qu.: 0.30     1st Qu.: 0.40      1st Qu.:0.0000
##    Median : 0.80     Median : 0.50     Median : 2.10      Median :0.1000
##    Mean   : 2.22     Mean   : 0.97     Mean   : 9.13      Mean   :0.0995
##    3rd Qu.: 1.40     3rd Qu.: 0.90     3rd Qu.:10.70      3rd Qu.:0.1000
##    Max.   :95.10     Max.   :32.60     Max.   :86.70      Max.   :2.6000
##
##     WHT_MORE           HISP_LAT          CH19902000         MEDAGE2000
##    Min.   : 0.0      Min.   : 0.00     Min.   :-37.4      Min.   : 0.0
##    1st Qu.:79.0      1st Qu.: 0.90     1st Qu.:  1.0      1st Qu.:35.2
##    Median :92.6      Median : 1.80     Median :  8.4      Median :37.4
##    Mean   :85.9      Mean   : 6.18     Mean   : 11.1      Mean   :37.3
##    3rd Qu.:97.6      3rd Qu.: 5.10     3rd Qu.: 17.4      3rd Qu.:39.8
##    Max.   :99.9      Max.   :97.50     Max.   :191.0      Max.   :54.3
##
##     PEROVER65
##    Min.   : 0.0
##    1st Qu.:12.1
##    Median :14.4
##    Mean   :14.8
##    3rd Qu.:17.1
##    Max.   :34.7
##
```

```
names(election)
```

```
##   [1] "NAME"       "STATE_NAME" "STATE_FIPS" "CNTY_FIPS"  "FIPS"
##   [6] "AREA"       "FIPS_num"   "Bush"       "Kerry"
"County_F"
##  [11] "Nader"      "Total"      "Bush_pct"   "Kerry_pct"
"Nader_pct"
##  [16] "MDratio"    "hosp"       "pcthisp"    "pcturban"
"urbrural"
##  [21] "pctfemhh"   "pcincome"   "pctpoor"    "pctlt9ed"
"pcthsed"
##  [26] "pctcoled"   "unemploy"   "pctwhtcl"   "homevalu"   "rent"
##  [31] "popdens"    "crowded"    "ginirev"    "SmokecurM"
"SmokevrM"
##  [36] "SmokecurF"  "SmokevrF"   "Obese"      "Noins"
"XYLENES__M"
##  [41] "TOLUENE"    "TETRACHLOR" "STYRENE"    "NICKEL_COM"
"METHYLENE_"
##  [46] "MERCURY_CO" "LEAD_COMPO" "BENZENE__I" "ARSENIC_CO"
"POP2000"
##  [51] "POP00SQMIL" "MALE2000"   "FEMALE2000" "MAL2FEM"
"UNDER18"
##  [56] "AIAN"       "ASIA"       "BLACK"      "NHPI"       "WHITE"
##  [61] "AIAN_MORE"  "ASIA_MORE"  "BLK_MORE"   "NHPI_MORE"
"WHT_MORE"
##  [66] "HISP_LAT"   "CH19902000" "MEDAGE2000" "PEROVER65"
```

```
data <- election
```

```
# proj4string(data) <- CRS('+proj=lcc+lon_0=90w +lat_1=20n
+lat_2=60n')
summary(data)[1:4]
```

```
## $class
## [1] "SpatialPolygonsDataFrame"
## attr(,"package")
## [1] "sp"
##
## $bbox
##        min    max
## r1 -124.73 -66.97
## r2   24.96  49.37
##
## $is.projected
## [1] TRUE
##
## $proj4string
## [1] "+proj=lcc+lon_0=90w +lat_1=20n +lat_2=60n"
```

```
par(mar = c(0, 0, 0, 0))
plot(data)
```
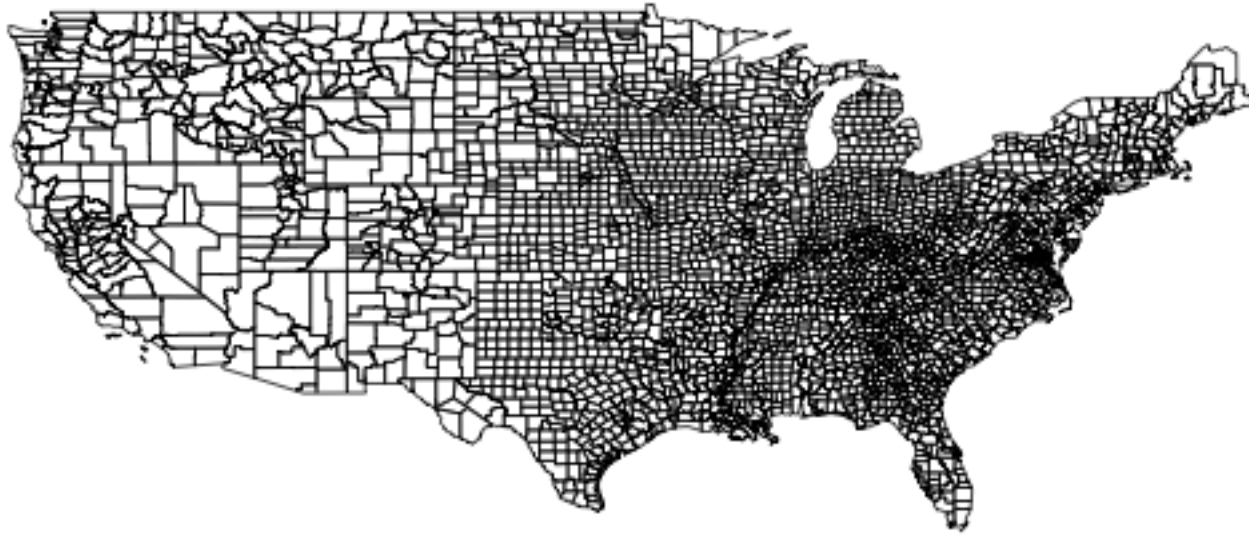
```
# Look at some of the options
par(mar = c(0, 3, 0, 0), cex = 0.6)
display.brewer.all(n = 5)
```
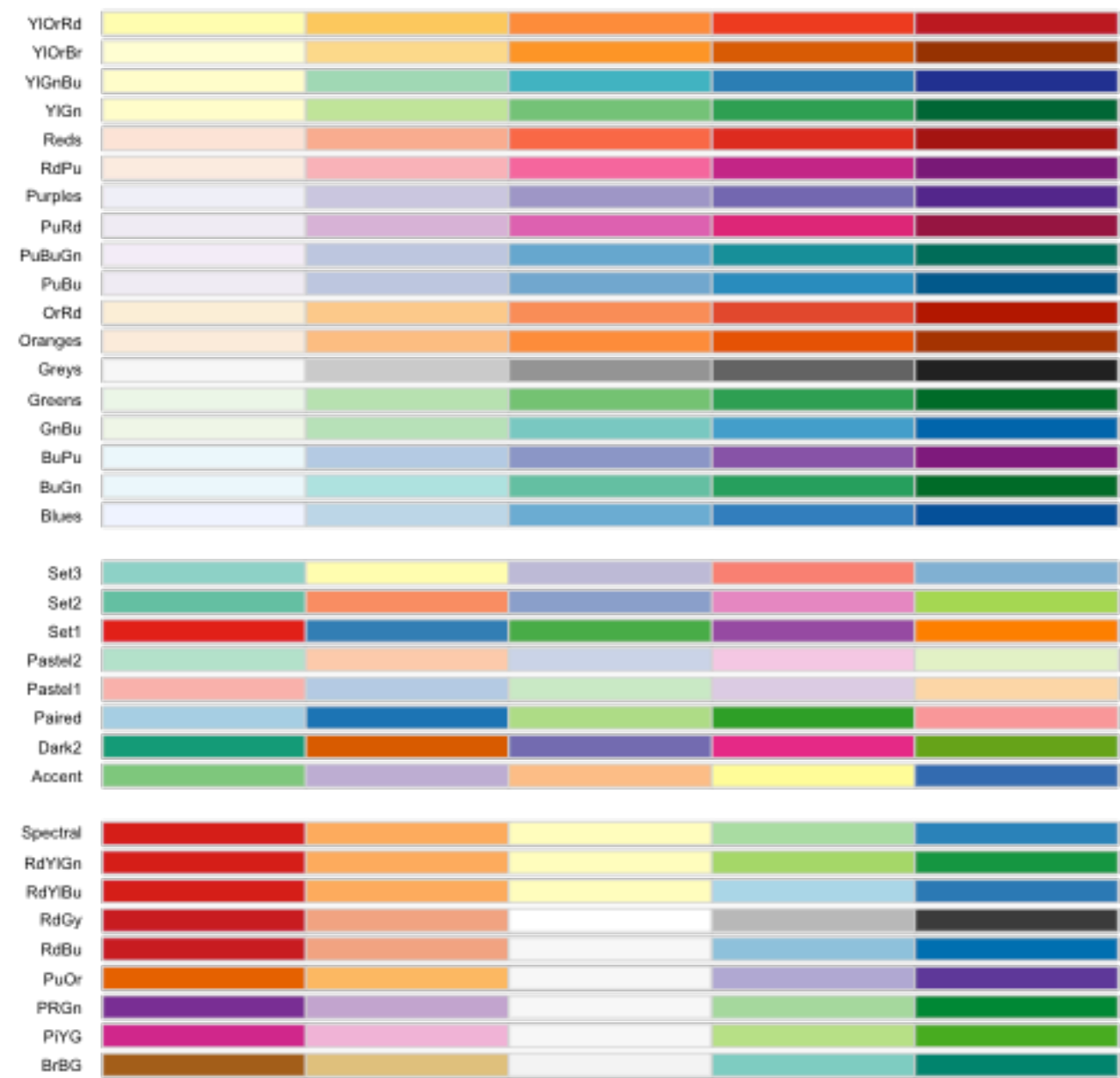
```
# Create blue-state red-state palette
br.palette <- colorRampPalette(c("blue", "red"), space = "rgb")
br.palette(5)
```

```
## [1] "#0000FF" "#3F00BF" "#7F007F" "#BF003F" "#FF0000"
```

```
# Let's plot the % of vote for Bush
data <- election
var <- data$Bush_pct
summary(var)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0    52.7    61.2    60.6    69.4    92.8
```

What is the mean vote for Bush? What was reported above? Is there a difference? If so, WHY?

```
# Easy but unflexible option
spplot(data, zcol = "Bush_pct", col.regions = br.palette(100), main
= "Percent of County Vote for Bush (2004)")
```


Percent of County Vote for Bush (2004)
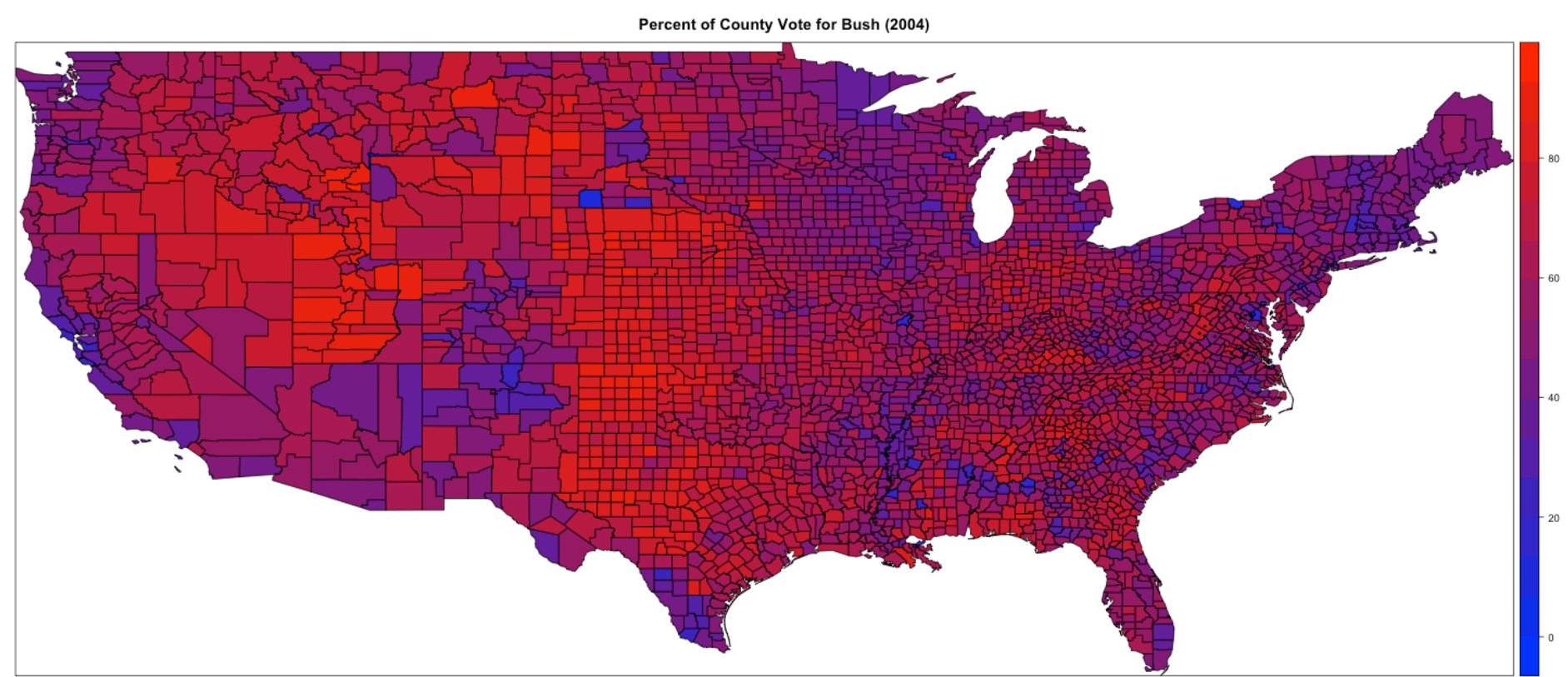
What general patterns do you detect? Are you able to determine some smooth and rough patterns?

```
# This section hopefully gives more intuition about plotting and
# specifically classification for symbol classes.

# Define number of colors in a palette
pal <- br.palette(n = 5)

# Class intervals for symbol classes
classes_fx <- classIntervals(var, n = 5, style = "fixed",
fixedBreaks = c(0,
    10, 25, 50, 75, 100), rtimes = 1)
classes_sd <- classIntervals(var, n = 5, style = "sd", rtimes = 1)
classes_fi <- classIntervals(var, n = 5, style = "fisher", rtimes =
3)
classes_eq <- classIntervals(var, n = 5, style = "equal", rtimes =
1)
classes_km <- classIntervals(var, n = 5, style = "kmeans", rtimes =
1)
classes_qt <- classIntervals(var, n = 5, style = "quantile", rtimes
= 1)

# Class intervals for symbol classes (print values)
classes_fx
```

```
## style: fixed
##    [0,10)   [10,25)   [25,50)   [50,75) [75,100]
##         4        22       563      2119      403
```

```
classes_sd
```

```
## style: sd
## [-15.96,9.563)   [9.563,35.08)    [35.08,60.6)    [60.6,86.12)
[86.12,111.6]
##                4              93            1398            1583
33
```

```
classes_fi
```

```
## style: fisher
##      [0,40.28) [40.28,53.32) [53.32,63.26) [63.26,73.55)
[73.55,92.83]
##              187          646          938          858
482
```

classes_eq

```
## style: equal
##      [0,18.57) [18.57,37.13)  [37.13,55.7)  [55.7,74.26)
[74.26,92.83]
##               15          116          899         1641
440
```

classes_km

```
## style: kmeans
##      [0,39.63) [39.63,52.85) [52.85,62.93) [62.93,73.38)
[73.38,92.83]
##              172          615          951          881
492
```

classes_qt

```
## style: quantile
##      [0,50.52) [50.52,58.07) [58.07,64.37) [64.37,71.31)
[71.31,92.83]
##              622          622          622          622
623
```

```
# Class intervals for symbol classes (plot values) || Take some
time to
# compare the impact of the various class intervals.
par(mar = c(2, 2, 2, 1) + 0.1, mfrow = c(2, 3))
plot(classes_fx, pal = pal, main = "Fixed Intervals", xlab = "",
ylab = "")
plot(classes_sd, pal = pal, main = "Standard Deviation", xlab = "",
ylab = "")
plot(classes_fi, pal = pal, main = "Fisher-Jenks", xlab = "", ylab
= "")
plot(classes_km, pal = pal, main = "K Means", xlab = "", ylab = "")
plot(classes_eq, pal = pal, main = "Equal Interval", xlab = "",
ylab = "")
plot(classes_qt, pal = pal, main = "Quantile", xlab = "", ylab =
"")
```
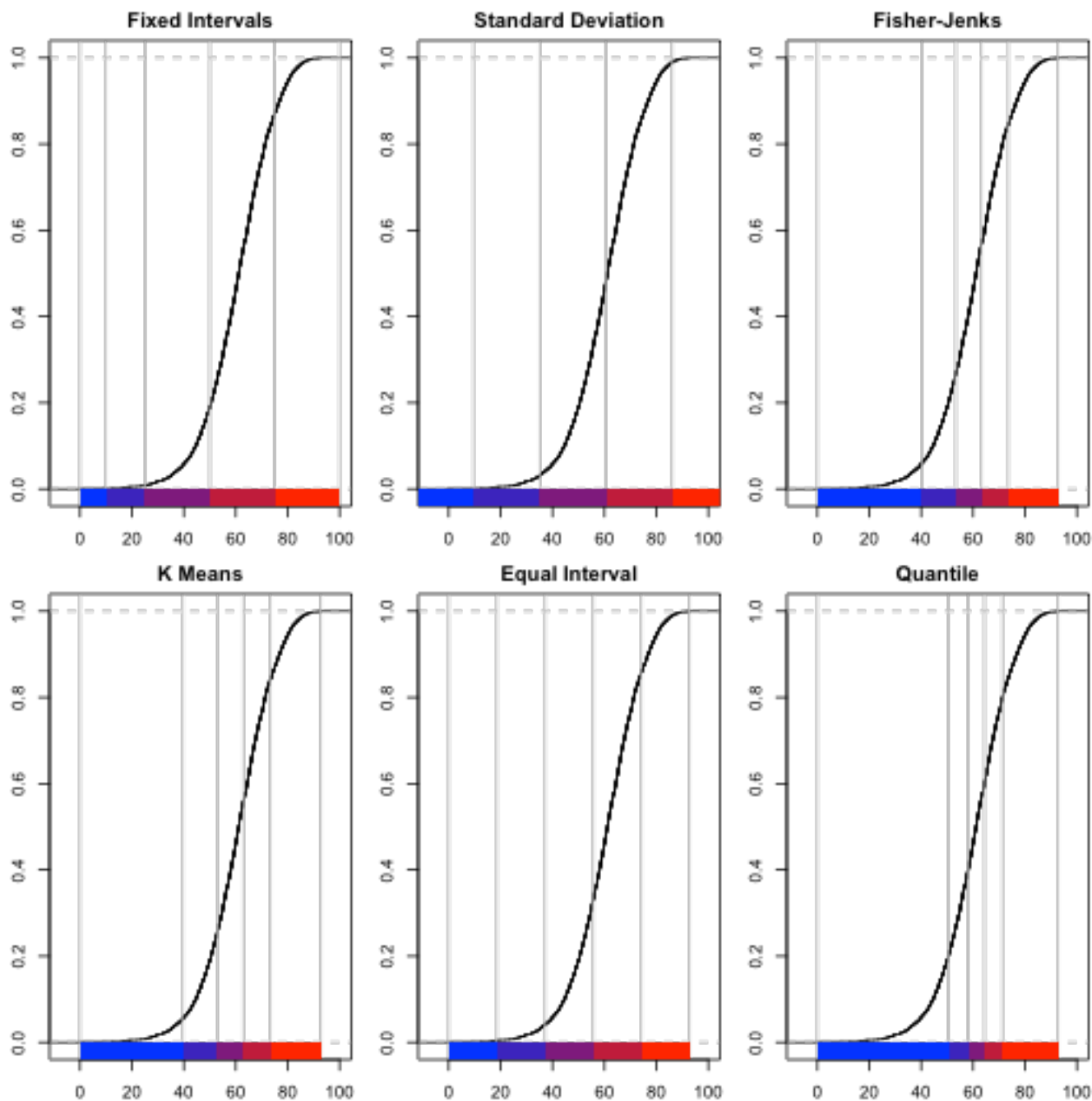
```
# plot using fixed intervals
cols <- findColours(classes_fx, pal)

par(mar = rep(0, 4))
plot(election, col = cols, border = NA)
legend(x = "bottom", cex = 0.7, fill = attr(cols, "palette"), bty =
"n", legend = names(attr(cols,
    "table")), title = "Percent of County Vote for Bush (2004)",
ncol = 5)
```
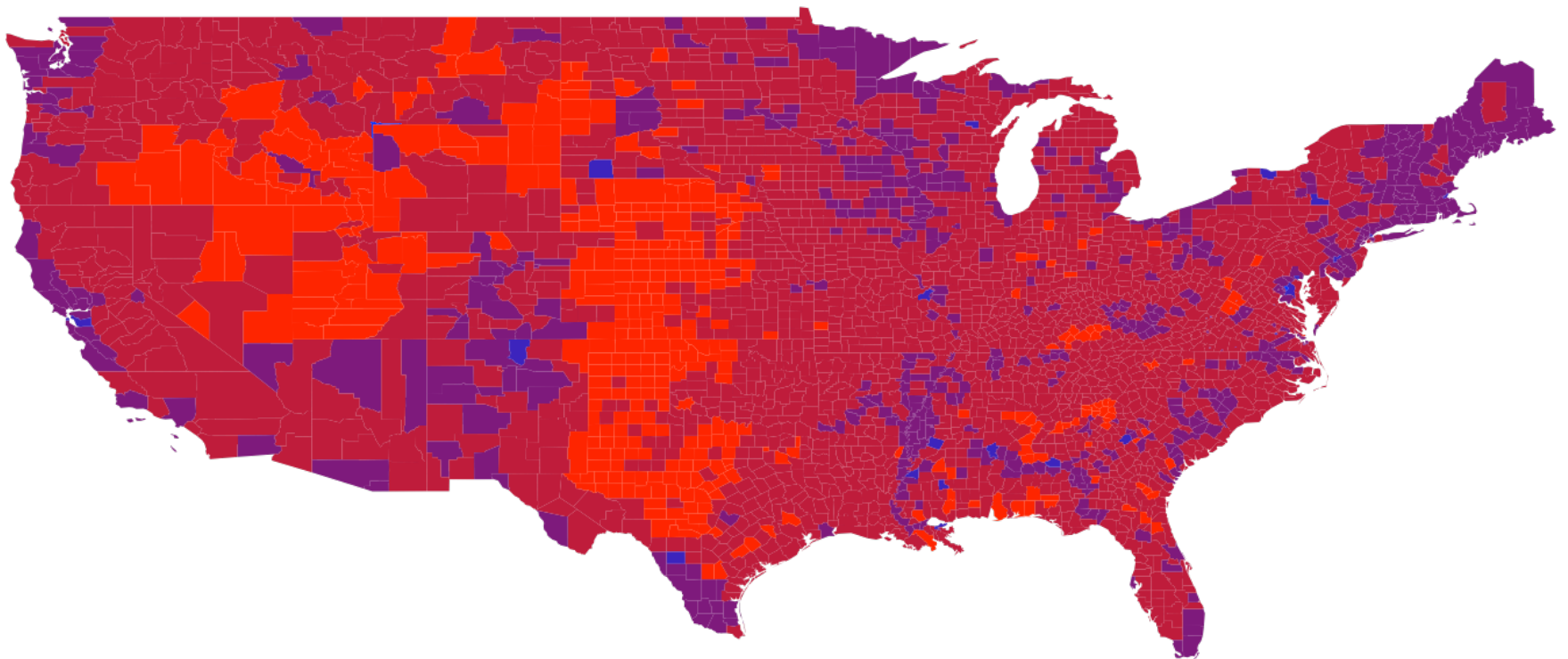

Percent of County Vote for Bush (2004)

[0,10)   [10,25)   [25,50)   [50,75)   [75,100]

```
# We have been using percent vote which is a continuous variable.
Now lets
# plot a categorical variable, specifically a # binary variable for
winning
# vote for Bush/Kerry respectively (Red/Blue).

# We are creating a new data object of class 'character' that has
the RGB
# values for red and blue or if bush > kerry (red) # and if kerry >
bush
# (blue).
binary.cols <- ifelse(data$Bush > data$Kerry, "red", "blue")
class(binary.cols)
```

```
## [1] "character"
```

```
par(mar = rep(0, 4))
# We now map cols and add a legend
plot(election, col = binary.cols, border = NA)
legend(x = "bottom", cex = 0.7, fill = c("red", "blue"), bty = "n",
legend = c("Bush",
    "Kerry"), title = "Winner of County Vote (2004)", ncol = 2)
```
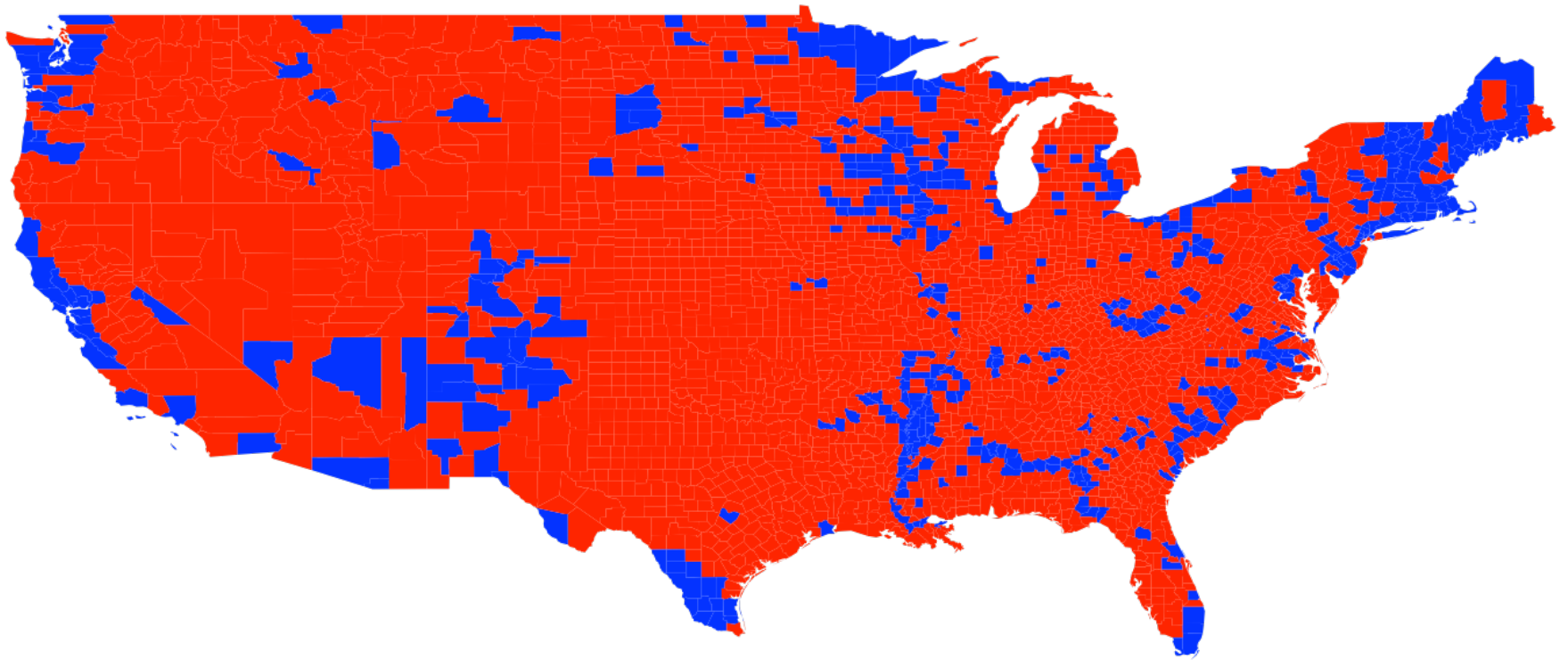
Winner of County Vote (2004)
■ Bush ■ Kerry

Spatial Autocorrelation

```
map_crd <- coordinates(data)

## Contiguity Neighbors

W_cont_el <- poly2nb(data, queen = T)
W_cont_el_mat <- nb2listw(W_cont_el, style = "W", zero.policy =
TRUE)
```

```
## Plot the connections

par(mar = rep(0, 4))
plot(W_cont_el_mat, coords = map_crd, pch = 19, cex = 0.1, col =
"gray")
```
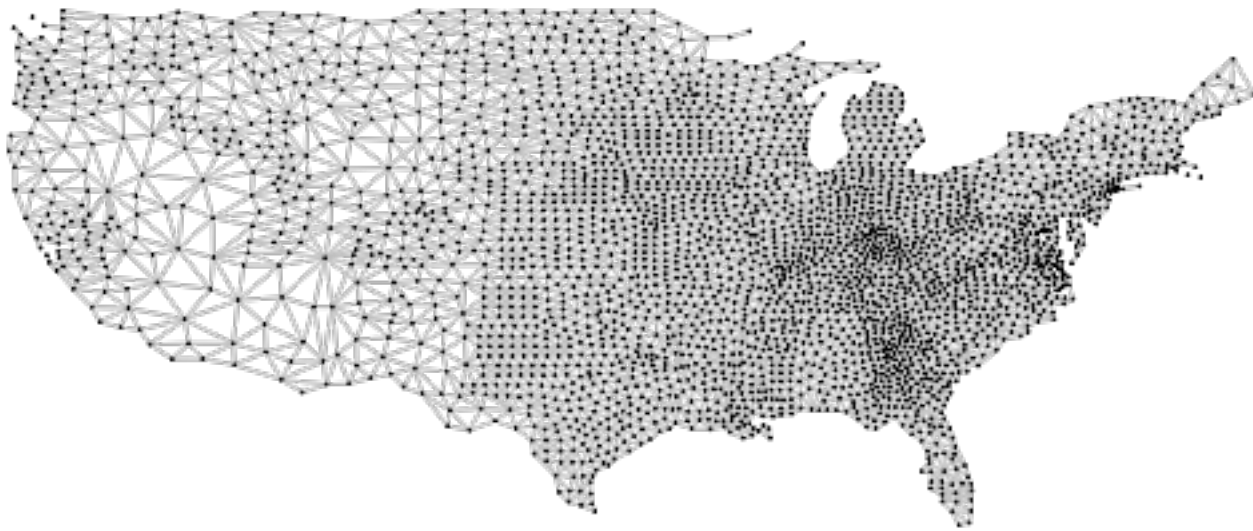


```
# Global Autocorrelation Tests: Moran's I

moran.test(data$Bush_pct, listw = W_cont_el_mat, zero.policy = T)
```

```
##
##  Moran's I test under randomisation
##
## data:  data$Bush_pct
## weights: W_cont_el_mat
##
## Moran I statistic standard deviate = 51.73, p-value < 2.2e-16
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic       Expectation          Variance
##        0.5565174        -0.0003220         0.0001159
```

```
moran.test(data$Kerry, listw = W_cont_el_mat, zero.policy = T)
```

```
##
##  Moran's I test under randomisation
##
## data:  data$Kerry
## weights: W_cont_el_mat
##
## Moran I statistic standard deviate = 25.32, p-value < 2.2e-16
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic       Expectation          Variance
##        0.2597409        -0.0003220         0.0001055
```

```
moran.test(data$POP2000, listw = W_cont_el_mat, zero.policy = T)
```

```
##
##  Moran's I test under randomisation
##
## data:  data$POP2000
## weights: W_cont_el_mat
##
## Moran I statistic standard deviate = 35.56, p-value < 2.2e-16
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic       Expectation          Variance
##        0.3563453        -0.0003220         0.0001006
```

What can you tell about the raw Moran's I statistic?

What can you tell about the raw Moran's I statistic standard deviation?

What can you tell about the raw Moran's I statistic p-value?

Using the Moran's I output (I, SD & p-value) what can you say about the so-called "two map comparison" between

- Bush & Kerry
- Bush/Kerry & Population

Joint Count (JC) Statistics are quite rudementary yet useful when data has been collected at a nominal or ordinal level of measurement. JC evaluates the presence or the absence of a specific thematic property. We have been considering characteristics of continious spatial distributions and spatial dependency of continious variables but recall that as a good analyst we need to be able to understand how our items have been measured as well as to what level of measurement they have been measured.

The nominal level can be particular category or a set of categories, for example the presence of a socio-economic category or a type of plant association or whether citizens of the US voted for one canidate or another. Essentially, the thematic property to be described is reduced to a variable of binomial level (a binary variable) containing only two values referring to the properties of presence/absence (e.g. yes/no, white/black, 0/1, bush/kerry).

```
# Global Autocorrelation Tests: Join Count
data$BushWin <- as.factor(ifelse(data$Bush > data$Kerry, 1, 0))
joincount.multi(data$BushWin, listw = W_cont_el_mat, zero.policy =
T)
```

```
##         Joincount Expected Variance z-value
## 0:0       130.75     54.06      6.77    29.5
## 1:1      1111.08   1030.82     12.61    22.6
## 1:0       311.67    472.63     29.48   -29.6
## Jtot      311.67    472.63     29.95   -29.4
```

```
## Moran Scatterplot
par(mar = c(4, 4, 1.5, 0.5))
moran.plot(data$Bush_pct, listw = W_cont_el_mat, zero.policy = T,
xlim = c(0,
    100), ylim = c(0, 100), pch = 16, col = "black", cex = 0.5,
quiet = F, labels = as.character(data$NAME),
    xlab = "Percent for Bush", ylab = "Percent for Bush (Spatial
Lag)", main = "Moran Scatterplot")
```


Moran Scatterplot

```
## Potentially influential observations of
##    lm(formula = wx ~ x) :
```
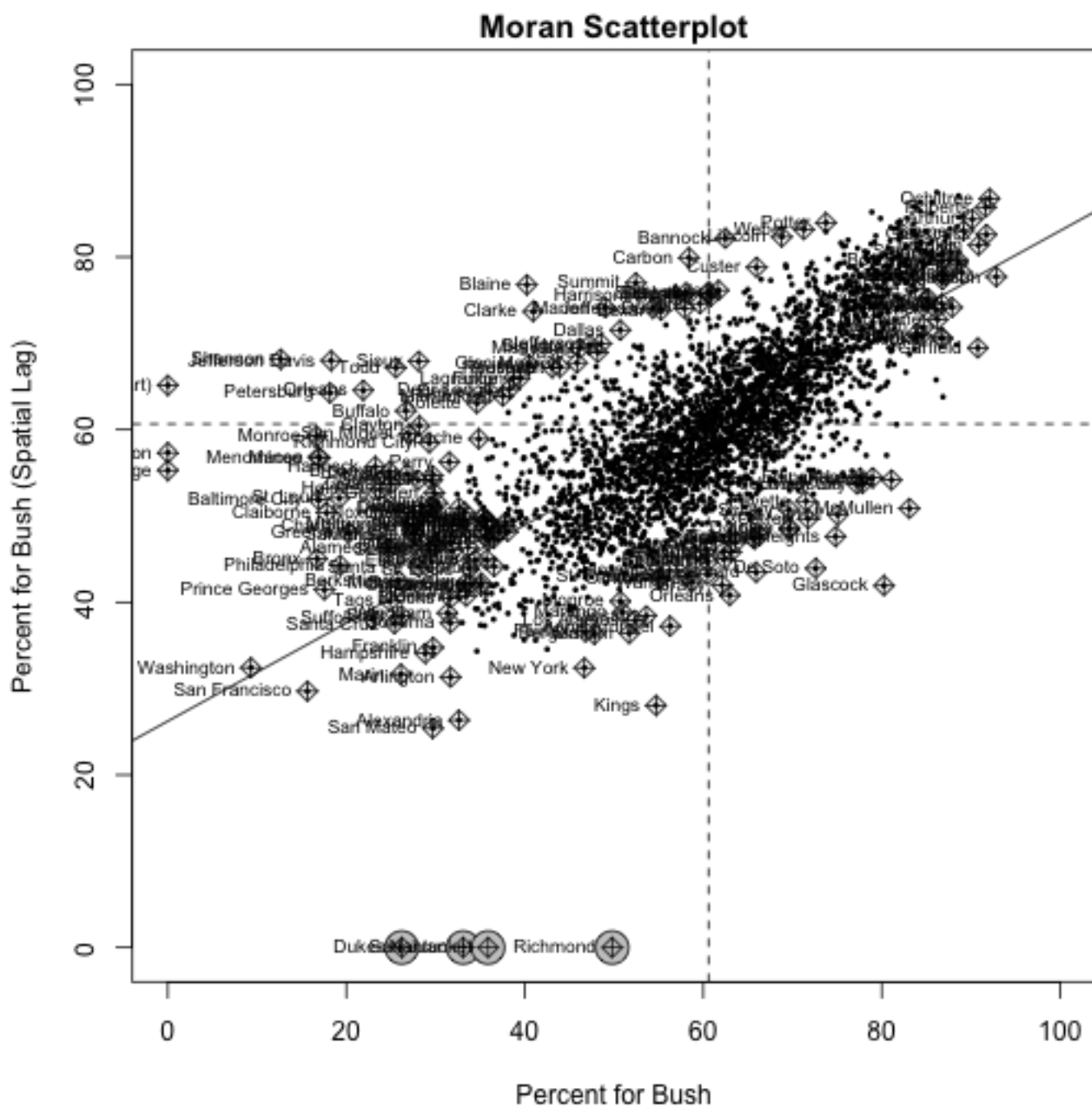
```
##
##                         dfb.1_  dfb.x  dffit    cov.r
cook.d
## Glacier                  0.09  -0.08   0.09_*  1.00_*
0.00
## Rolette                  0.10  -0.09   0.10_*  1.00
0.01
## St. Louis               -0.01   0.01  -0.01    1.00_*
0.00
## San Juan               -0.28   0.26  -0.29_*  0.97_*
0.04
## Roosevelt                0.06  -0.06   0.07    1.00_*
0.00
## Clallam                -0.05   0.04  -0.06    1.00_*
0.00
## Jefferson                0.01  -0.01   0.01    1.00_*
0.00
## Garfield                 0.05  -0.05  -0.06    1.00
0.00
## Missoula                 0.06  -0.05   0.07    1.00_*
0.00
## Custer                  -0.01   0.02   0.04    1.00_*
0.00
## Douglas                  0.01  -0.01   0.01    1.00_*
0.00
## Ashland                  0.00   0.00   0.00    1.00_*
0.00
## Sioux                    0.18  -0.17   0.19_*  0.99_*
0.02
## Deer Lodge               0.09  -0.08   0.09_*  1.00_*
0.00
## Carter                  -0.01   0.02   0.02    1.00_*
0.00
## Big Horn                 0.05  -0.05   0.06    1.00_*
0.00
## Harding                 -0.01   0.01   0.01    1.00_*
0.00
## Multnomah                0.05  -0.05   0.05    1.00_*
0.00
## Dewey                    0.10  -0.09   0.10_*  1.00_*
0.01
## Valley                   0.01   0.00   0.04    1.00_*
0.00
```

```
## Ramsey                              0.01  -0.01  0.01    1.00_*
0.00
## Yellowstone National Park (Part)  0.51  -0.50  0.51_*  0.99_*
0.13
## Clinton                            -0.03   0.02 -0.04    1.00_*
0.00
## Lamoille                           -0.02   0.02 -0.03    1.00_*
0.00
## Chittenden                         -0.02   0.02 -0.02    1.00_*
0.00
## Clark                              -0.02   0.03  0.03    1.00_*
0.00
## Buffalo                             0.16  -0.15  0.16_*  1.00_*
0.01
## Blaine                              0.13  -0.12  0.14_*  0.99_*
0.01
## Teton                               0.02  -0.01  0.05    1.00_*
0.00
## Madison                             0.01  -0.01 -0.01    1.00_*
0.00
## Mower                               0.01  -0.01  0.01    1.00_*
0.00
## Ada                                 0.00   0.00  0.04    1.00_*
0.00
## Shannon                             0.36  -0.35  0.36_*  0.99_*
0.06
## Todd                                0.20  -0.19  0.21_*  0.99_*
0.02
## Windham                            -0.03   0.03 -0.04    1.00_*
0.00
## Bannock                             0.00   0.01  0.05    1.00_*
0.00
## Sioux                               0.01  -0.01 -0.02    1.00_*
0.00
## Berkshire                           0.01  -0.01  0.01    1.00_*
0.00
## Franklin                           -0.06   0.05 -0.06    1.00
0.00
## Cassia                              0.00   0.00  0.00    1.00_*
0.00
## Hampshire                          -0.06   0.06 -0.06    1.00_*
0.00
## Suffolk                            -0.01   0.01 -0.01    1.00_*
```

```
0.00
## Franklin                        -0.02   0.02  0.02    1.00_*
0.00
## Blaine                          -0.03   0.04  0.04    1.00_*
0.00
## Box Elder                       -0.02   0.02  0.02    1.00_*
0.00
## Rich                            -0.01   0.01  0.01    1.00_*
0.00
## Arthur                          -0.04   0.04  0.05    1.00_*
0.00
## Geauga                          -0.01   0.00 -0.05    1.00_*
0.00
## Banner                           0.00  -0.01 -0.01    1.00_*
0.00
## Cuyahoga                         0.03  -0.03  0.03    1.00_*
0.00
## Dukes                           -0.31   0.30 -0.32_*  0.98_*
0.05
## Weber                           -0.03   0.04  0.06    1.00_*
0.00
## Lincoln                         -0.02   0.03  0.05    1.00_*
0.00
## Nantucket                       -0.26   0.24 -0.27_*  0.97_*
0.04
## Morgan                           0.02  -0.03 -0.03    1.00_*
0.00
## Summit                           0.05  -0.04  0.07    0.99_*
0.00
## Mahoning                         0.00   0.00  0.00    1.00_*
0.00
## Bergen                          -0.05   0.05 -0.06    1.00_*
0.00
## Bronx                            0.09  -0.09  0.09_*  1.00_*
0.00
## Salt Lake                        0.01   0.00  0.04    1.00_*
0.00
## Nassau                          -0.04   0.03 -0.06    1.00_*
0.00
## Essex                            0.01  -0.01  0.01    1.00_*
0.00
## New York                        -0.07   0.06 -0.08_*  1.00_*
0.00
```

```
## Uintah                         0.02  -0.03 -0.03     1.00_*
0.00
## Duchesne                       0.01  -0.01 -0.01     1.00_*
0.00
## Hudson                        -0.02   0.02 -0.02     1.00_*
0.00
## Queens                         0.09  -0.08  0.09_*   1.00
0.00
## Kings                         -0.05   0.04 -0.09_*   0.99_*
0.00
## Hayes                         -0.02   0.02  0.02     1.00_*
0.00
## Richmond                      -0.15   0.12 -0.19_*   0.96_*
0.02
## Utah                           0.01  -0.01 -0.01     1.00_*
0.00
## Philadelphia                   0.06  -0.06  0.06     1.00_*
0.00
## Marion                         0.06  -0.05  0.07     1.00_*
0.00
## Carbon                         0.02  -0.01  0.06     1.00_*
0.00
## Denver                         0.05  -0.05  0.06     1.00_*
0.00
## Pitkin                         0.05  -0.05  0.06     1.00
0.00
## Montgomery                    -0.02   0.02 -0.02     1.00_*
0.00
## Monroe                         0.05  -0.05  0.06     1.00_*
0.00
## Anne Arundel                  -0.03   0.02 -0.06     0.99_*
0.00
## Prince Georges                 0.05  -0.05  0.05     1.00_*
0.00
## Washington                     0.01  -0.01  0.01     1.01_*
0.00
## St. Louis                      0.13  -0.13  0.13_*   1.00
0.01
## Sonoma                        -0.04   0.04 -0.04     1.00_*
0.00
## Monroe                        -0.02   0.01 -0.04     1.00_*
0.00
## Marin                         -0.07   0.07 -0.07     1.00_*
```

```
                                   0.00
## Elliott                         0.06  -0.05  0.06    1.00_*
                                   0.00
## San Miguel                      0.13  -0.13  0.13_*  1.00
                                   0.01
## Garfield                       -0.01   0.01  0.01    1.00_*
                                   0.00
## Dolores                         0.02  -0.03 -0.06    1.00_*
                                   0.00
## Alameda                         0.05  -0.04  0.05    1.00_*
                                   0.00
## San Francisco                  -0.05   0.05 -0.05    1.00_*
                                   0.00
## San Mateo                      -0.12   0.11 -0.12_*  1.00
                                   0.01
## Costilla                        0.01  -0.01  0.01    1.00_*
                                   0.00
## Jackson                         0.01  -0.01 -0.01    1.00_*
                                   0.00
## Knott                           0.00   0.00  0.00    1.00_*
                                   0.00
## Santa Clara                    -0.02   0.02 -0.02    1.00_*
                                   0.00
## Santa Cruz                     -0.02   0.02 -0.02    1.00_*
                                   0.00
## San Juan                        0.01  -0.02 -0.05    1.00_*
                                   0.00
## Rio Arriba                     -0.01   0.00 -0.01    1.00_*
                                   0.00
## Apache                          0.07  -0.07  0.08_*  1.00
                                   0.00
## Taos                            0.00   0.00  0.00    1.00_*
                                   0.00
## Hertford                       -0.02   0.01 -0.02    1.00_*
                                   0.00
## Warren                          0.01  -0.01  0.01    1.00_*
                                   0.00
## Person                         -0.01   0.00 -0.04    1.00_*
                                   0.00
## Ochiltree                      -0.05   0.05  0.06    1.00_*
                                   0.00
## Orange                          0.04  -0.04  0.04    1.00_*
                                   0.00
```

```
## Durham                           0.03  -0.03  0.03    1.00_*
0.00
## Kingfisher                       0.00   0.00  0.00    1.00_*
0.00
## Roberts                         -0.04   0.05  0.05    1.00_*
0.00
## Santa Fe                         0.01  -0.01  0.01    1.00_*
0.00
## McKinley                         0.02  -0.02  0.02    1.00_*
0.00
## Los Alamos                      -0.04   0.03 -0.06    1.00_*
0.00
## San Miguel                       0.04  -0.04  0.05    1.00_*
0.00
## Tipton                           0.01  -0.02 -0.05    1.00_*
0.00
## Potter                          -0.03   0.04  0.06    1.00_*
0.00
## Oldham                          -0.01   0.01  0.01    1.00_*
0.00
## St. Francis                     -0.02   0.02 -0.04    1.00_*
0.00
## Torrance                         0.00  -0.01 -0.04    1.00_*
0.00
## De Soto                          0.04  -0.06 -0.09_*  0.99_*
0.00
## Tunica                           0.02  -0.02  0.03    1.00_*
0.00
## Parmer                           0.01  -0.01 -0.01    1.00_*
0.00
## Catron                           0.03  -0.04 -0.06    1.00_*
0.00
## Grant                            0.00  -0.01 -0.04    1.00_*
0.00
## Florence                        -0.02   0.01 -0.04    1.00_*
0.00
## Foard                            0.01   0.00  0.04    1.00_*
0.00
## Fulton                           0.08  -0.08  0.09_*  1.00_*
0.00
## Clarke                           0.11  -0.10  0.12_*  0.99_*
0.01
## Jefferson                        0.03  -0.02  0.05    1.00_*
```

```
0.00
## Taliaferro                          0.02  -0.02  0.02    1.00_*
0.00
## Carroll                             0.01  -0.02 -0.05    1.00_*
0.00
## Clayton                             0.13  -0.12  0.13_*  1.00
0.01
## Chicot                              0.01  -0.01  0.01    1.00_*
0.00
## Fayette                             0.03  -0.03 -0.05    1.00_*
0.00
## Hancock                             0.13  -0.13  0.13_*  1.00
0.01
## Bamberg                            -0.01   0.01 -0.01    1.00_*
0.00
## Holmes                              0.11  -0.10  0.11_*  1.00
0.01
## Dorchester                          0.00  -0.01 -0.04    1.00_*
0.00
## Glascock                            0.10  -0.12 -0.15_*  0.99_*
0.01
## Noxubee                             0.06  -0.05  0.06    1.00_*
0.00
## Greene                              0.09  -0.09  0.09_*  1.00_*
0.00
## Allendale                           0.04  -0.04  0.04    1.00_*
0.00
## West Carroll                        0.05  -0.06 -0.08    1.00_*
0.00
## Dallas                              0.04  -0.03  0.06    1.00_*
0.00
## Sumter                              0.02  -0.02  0.02    1.00_*
0.00
## Shackelford                         0.00   0.00  0.00    1.00_*
0.00
## Perry                               0.08  -0.07  0.08_*  1.00
0.00
## Warren                             -0.02   0.01 -0.05    1.00_*
0.00
## Macon                               0.20  -0.19  0.20_*  1.00
0.02
## Effingham                           0.05  -0.06 -0.07    1.00_*
0.00
```

```
## Marengo                         -0.04   0.03 -0.05     1.00_*
0.00
## Schley                           0.02  -0.03 -0.05     1.00_*
0.00
## Lowndes                          0.08  -0.07  0.08_*   1.00
0.00
## Bullock                          0.02  -0.02  0.02     1.00_*
0.00
## Wilcox                           0.02  -0.02  0.02     1.00_*
0.00
## Beaufort                        -0.01   0.00 -0.04     1.00_*
0.00
## Jasper                           0.05  -0.04  0.06     1.00_*
0.00
## Claiborne                        0.13  -0.13  0.13_*   1.00
0.01
## Sterling                        -0.02   0.03  0.03     1.00_*
0.00
## Glasscock                       -0.02   0.03  0.03     1.00_*
0.00
## Loving                           0.01  -0.02 -0.02     1.00_*
0.00
## Lee                              0.05  -0.06 -0.08_*   1.00_*
0.00
## Jefferson Davis                  0.29  -0.28  0.29_*   0.99_*
0.04
## Crane                           -0.01   0.01  0.01     1.00_*
0.00
## Miller                           0.02  -0.03 -0.06     1.00_*
0.00
## Decatur                          0.10  -0.09  0.10_*   1.00
0.01
## Grady                            0.00  -0.01 -0.05     1.00_*
0.00
## Gadsden                          0.06  -0.06  0.07     1.00
0.00
## Livingston                       0.05  -0.06 -0.07     1.00_*
0.00
## Duval                            0.02  -0.01  0.04     1.00_*
0.00
## Jefferson                        0.05  -0.04  0.06     1.00_*
0.00
## Orleans                          0.22  -0.21  0.22_*   0.99_*
```

				0.02
## St. Bernard	0.01	-0.02	-0.06	1.00_*
				0.00
## Alachua	0.07	-0.06	0.07	1.00_*
				0.00
## LaFourche	0.07	-0.08	-0.09_*	1.00_*
				0.00
## Bexar	0.03	-0.02	0.05	1.00_*
				0.00
## Zavala	0.10	-0.10	0.10_*	1.00
				0.01
## McMullen	0.09	-0.11	-0.12_*	0.99_*
				0.01
## Dimmit	-0.03	0.03	-0.03	1.00_*
				0.00
## Duval	0.06	-0.06	0.06	1.00
				0.00
## Brooks	-0.02	0.02	-0.02	1.00_*
				0.00
## Starr	-0.02	0.02	-0.02	1.00_*
				0.00
## Willacy	0.00	0.00	0.00	1.00_*
				0.00
## Menominee	0.20	-0.19	0.20_*	1.00
				0.02
## Orleans	0.00	-0.01	-0.06	0.99_*
				0.00
## Monroe	0.22	-0.22	0.23_*	1.00_*
				0.03
## Wayne	-0.01	0.00	-0.04	1.00_*
				0.00
## Dane	0.03	-0.03	0.03	1.00_*
				0.00
## Milwaukee	0.09	-0.08	0.09_*	1.00
				0.00
## Livingston	0.00	-0.01	-0.04	1.00_*
				0.00
## Wayne	0.02	-0.02	0.02	1.00_*
				0.00
## Washtenaw	0.02	-0.01	0.02	1.00_*
				0.00
## Broome	0.12	-0.11	0.12_*	1.00
				0.01

```
## Cook                      0.08  -0.07   0.08_*  1.00
0.00
## Monroe                   -0.04   0.03  -0.05    1.00_*
0.00
## Lagrange                  0.09  -0.08   0.09_*  1.00_*
0.00
## Baltimore City            0.15  -0.15   0.15_*  1.00
0.01
## Fairfax                  -0.05   0.05  -0.06    1.00_*
0.00
## Arlington                -0.08   0.08  -0.08_*  1.00
0.00
## Alexandria               -0.12   0.11  -0.12_*  1.00_*
0.01
## Harrisonburg              0.02  -0.01   0.05    1.00_*
0.00
## Staunton                  0.01   0.00   0.04    1.00_*
0.00
## Charlottesville           0.05  -0.05   0.05    1.00_*
0.00
## Clifton Forge             0.38  -0.37   0.38_*  1.00_*
0.07
## Richmond City             0.11  -0.10   0.11_*  1.00
0.01
## Colonial Heights          0.05  -0.06  -0.08_*  1.00_*
0.00
## Petersburg                0.26  -0.25   0.26_*  0.99_*
0.03
## Poquoson City             0.05  -0.06  -0.07    1.00_*
0.00
## South Boston              0.40  -0.40   0.40_*  0.99_*
0.08
##                        hat
## Glacier                 0.00
## Rolette                 0.00
## St. Louis               0.00
## San Juan                0.00
## Roosevelt               0.00
## Clallam                 0.00
## Jefferson               0.00
## Garfield                0.00_*
## Missoula                0.00
## Custer                  0.00
```

```
## Douglas                               0.00
## Ashland                               0.00
## Sioux                                 0.00_*
## Deer Lodge                            0.00
## Carter                                0.00
## Big Horn                              0.00
## Harding                               0.00
## Multnomah                             0.00_*
## Dewey                                 0.00
## Valley                                0.00
## Ramsey                                0.00
## Yellowstone National Park (Part)      0.01_*
## Clinton                               0.00
## Lamoille                              0.00
## Chittenden                            0.00
## Clark                                 0.00
## Buffalo                               0.00_*
## Blaine                                0.00
## Teton                                 0.00
## Madison                               0.00_*
## Mower                                 0.00
## Ada                                   0.00
## Shannon                               0.00_*
## Todd                                  0.00_*
## Windham                               0.00_*
## Bannock                               0.00
## Sioux                                 0.00
## Berkshire                             0.00_*
## Franklin                              0.00_*
## Cassia                                0.00
## Hampshire                             0.00_*
## Suffolk                               0.00_*
## Franklin                              0.00_*
## Blaine                                0.00_*
## Box Elder                             0.00
## Rich                                  0.00
## Arthur                                0.00_*
## Geauga                                0.00
## Banner                                0.00
## Cuyahoga                              0.00_*
## Dukes                                 0.00_*
## Weber                                 0.00
## Lincoln                               0.00
```

```
## Nantucket                    0.00
## Morgan                       0.00
## Summit                       0.00
## Mahoning                     0.00
## Bergen                       0.00
## Bronx                        0.00_*
## Salt Lake                    0.00
## Nassau                       0.00
## Essex                        0.00_*
## New York                     0.00
## Uintah                       0.00
## Duchesne                     0.00
## Hudson                       0.00
## Queens                       0.00_*
## Kings                        0.00
## Hayes                        0.00
## Richmond                     0.00
## Utah                         0.00
## Philadelphia                 0.00_*
## Marion                       0.00
## Carbon                       0.00
## Denver                       0.00_*
## Pitkin                       0.00_*
## Montgomery                   0.00
## Monroe                       0.00
## Anne Arundel                 0.00
## Prince Georges               0.00_*
## Washington                   0.01_*
## St. Louis                    0.00_*
## Sonoma                       0.00_*
## Monroe                       0.00
## Marin                        0.00_*
## Elliott                      0.00_*
## San Miguel                   0.00_*
## Garfield                     0.00
## Dolores                      0.00
## Alameda                      0.00_*
## San Francisco                0.00_*
## San Mateo                    0.00_*
## Costilla                     0.00_*
## Jackson                      0.00
## Knott                        0.00
## Santa Clara                  0.00
```

```
## Santa Cruz                  0.00_*
## San Juan                    0.00
## Rio Arriba                  0.00
## Apache                      0.00
## Taos                        0.00_*
## Hertford                    0.00
## Warren                      0.00
## Person                      0.00
## Ochiltree                   0.00_*
## Orange                      0.00
## Durham                      0.00_*
## Kingfisher                  0.00
## Roberts                     0.00_*
## Santa Fe                    0.00_*
## McKinley                    0.00
## Los Alamos                  0.00
## San Miguel                  0.00_*
## Tipton                      0.00
## Potter                      0.00
## Oldham                      0.00
## St. Francis                 0.00
## Torrance                    0.00
## De Soto                     0.00
## Tunica                      0.00_*
## Parmer                      0.00
## Catron                      0.00
## Grant                       0.00
## Florence                    0.00
## Foard                       0.00
## Fulton                      0.00
## Clarke                      0.00
## Jefferson                   0.00
## Taliaferro                  0.00
## Carroll                     0.00
## Clayton                     0.00_*
## Chicot                      0.00
## Fayette                     0.00
## Hancock                     0.00_*
## Bamberg                     0.00
## Holmes                      0.00_*
## Dorchester                  0.00
## Glascock                    0.00
## Noxubee                     0.00_*
```

```
## Greene                          0.00_*
## Allendale                       0.00_*
## West Carroll                    0.00
## Dallas                          0.00
## Sumter                          0.00_*
## Shackelford                     0.00
## Perry                           0.00_*
## Warren                          0.00
## Macon                           0.00_*
## Effingham                       0.00
## Marengo                         0.00
## Schley                          0.00
## Lowndes                         0.00_*
## Bullock                         0.00_*
## Wilcox                          0.00
## Beaufort                        0.00
## Jasper                          0.00
## Claiborne                       0.00_*
## Sterling                        0.00
## Glasscock                       0.00_*
## Loving                          0.00
## Lee                             0.00
## Jefferson Davis                 0.00_*
## Crane                           0.00
## Miller                          0.00
## Decatur                         0.00_*
## Grady                           0.00
## Gadsden                         0.00_*
## Livingston                      0.00
## Duval                           0.00
## Jefferson                       0.00
## Orleans                         0.00_*
## St. Bernard                     0.00
## Alachua                         0.00
## LaFourche                       0.00
## Bexar                           0.00
## Zavala                          0.00_*
## McMullen                        0.00
## Dimmit                          0.00
## Duval                           0.00_*
## Brooks                          0.00_*
## Starr                           0.00_*
## Willacy                         0.00
```

```
## Menominee           0.00_*
## Orleans             0.00
## Monroe              0.00_*
## Wayne               0.00
## Dane                0.00
## Milwaukee           0.00
## Livingston          0.00
## Wayne               0.00_*
## Washtenaw           0.00
## Broome              0.00_*
## Cook                0.00_*
## Monroe              0.00
## Lagrange            0.00
## Baltimore City      0.00_*
## Fairfax             0.00
## Arlington           0.00_*
## Alexandria          0.00
## Harrisonburg        0.00
## Staunton            0.00
## Charlottesville     0.00_*
## Clifton Forge       0.01_*
## Richmond City       0.00_*
## Colonial Heights    0.00
## Petersburg          0.00_*
## Poquoson City       0.00
## South Boston        0.01_*
```