Lab 13.1 - Gerrymandering in Michigan?

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Notes:

- This is a rehash of the text's analysis of North Carolina. Michigan is a bit different in that its gerrymandering is harder to see due to the small, highly-populated Detroit districts.
- Cf. https://today.wayne.edu/news/2020/10/05/michigans-effort-to-end-gerrymandering-revives-a-practice-rooted-in-ancient-athens-39332

The goal of this exercise is build an analysis of potential gerrymandering in Michigan based on the model provided by the textbook for North Carolina.

Loading and Wrangling the Data

See install notes for fec12 in the text (https://github.com/baumer-lab/fec12).

```
library(fec12)

results_house
```

```
## # A tibble: 2,343 x 13
##    state distric~1 cand_id incum~2 party prima~3 prima~4 runof~5 runof~6 gener~7
##    <chr> <chr>     <chr>   <lgl>   <chr>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1 AL    01        H2AL01~ TRUE    R       48702  0.555       NA      NA  196374
##  2 AL    01        H2AL01~ FALSE   R       21308  0.243       NA      NA      NA
##  3 AL    01        H2AL01~ FALSE   R       13809  0.158       NA      NA      NA
##  4 AL    01        H0AL01~ FALSE   R        3854  0.0440      NA      NA      NA
##  5 AL    02        H0AL02~ TRUE    R          NA NA           NA      NA  180591
##  6 AL    02        H2AL02~ FALSE   D          NA NA           NA      NA  103092
##  7 AL    03        H2AL03~ TRUE    R          NA NA           NA      NA  175306
##  8 AL    03        H2AL03~ FALSE   D          NA NA           NA      NA   98141
##  9 AL    04        H6AL04~ TRUE    R          NA NA           NA      NA  199071
## 10 AL    04        H2AL04~ FALSE   D       10971  0.514       NA      NA   69706
## # ... with 2,333 more rows, 3 more variables: general_percent <dbl>, won <lgl>,
## #   footnotes <chr>, and abbreviated variable names 1: district_id,
## #   2: incumbent, 3: primary_votes, 4: primary_percent, 5: runoff_votes,
## #   6: runoff_percent, 7: general_votes
```

```
district_elections <- results_house %>%
  mutate(district = parse_number(district_id)) %>%
  group_by(state, district) %>%
  summarize(
    N = n(),
    total_votes = sum(general_votes, na.rm = TRUE),
    d_votes = sum(ifelse(party == "D", general_votes, 0), na.rm = TRUE),
    r_votes = sum(ifelse(party == "R", general_votes, 0), na.rm = TRUE)
  ) %>%
  mutate(
    other_votes = total_votes - d_votes - r_votes,
    r_prop = r_votes / total_votes,
    winner = ifelse(r_votes > d_votes, "Republican", "Democrat")
  )
```

```
## `summarise()` has grouped output by 'state'. You can override using the
## `.groups` argument.
```

```
mi_results <- district_elections %>%
  filter(state == "MI")
mi_results %>%
  select(-state)
```

```
## Adding missing grouping variables: `state`
```

```
## # A tibble: 14 x 9
## # Groups:   state [1]
##    state district     N total_votes d_votes r_votes other_votes r_prop winner
##    <chr>    <dbl> <int>       <dbl>   <dbl>   <dbl>       <dbl>  <dbl> <chr>
##  1 MI           1     4      347037  165179  167060       14798  0.481 Republic~
##  2 MI           2     5      318267       0  194653      123614  0.612 Republic~
##  3 MI           3     4      326281  144108  171675       10498  0.526 Republic~
##  4 MI           4     5      312949  104996  197386       10567  0.631 Republic~
##  5 MI           5     5      330146  214531  103931       11684  0.315 Democrat
##  6 MI           6     5      320475  136563  174955        8957  0.546 Republic~
##  7 MI           7     6      318069  136849  169668       11552  0.533 Republic~
##  8 MI           8     6      345054  128657  202217       14180  0.586 Republic~
##  9 MI           9     6      337316  208846  114760       13710  0.340 Democrat
## 10 MI          10     4      328612   97734  226075        4803  0.688 Republic~
## 11 MI          11    15      687253  318137  333524       35592  0.485 Republic~
## 12 MI          12     5      319223  216884   92472        9867  0.290 Democrat
## 13 MI          13     8      284270  235336   38769       10165  0.136 Democrat
## 14 MI          14     8      328792  270450   51395        6947  0.156 Democrat
```

This is a bigger vote distribution than in North Carolina, and yet, Republicans won 9 of the 14 districts.

```
mi_results %>%
  skim(total_votes) %>%
  select(-na)
```

Variable type: numeric

var	state	n	mean	sd	p0	p25	p50	p75	p100
total_votes	MI	14	350267.4	98189.55	284270	318506	327446.5	335523.5	687253

Here is the key data. Districts 12&ndash14 are heavily democratic and are the three most concentrated districts for either party. Then come districtics 10 (Republican) and 5 (Democratic).

```
mi_results %>%
  select(district, r_prop, winner) %>%
  arrange(desc(r_prop))
```

```
## Adding missing grouping variables: `state`
```

```
## # A tibble: 14 x 4
## # Groups:   state [1]
##    state district r_prop winner
##    <chr>    <dbl>  <dbl> <chr>
##  1 MI          10  0.688 Republican
##  2 MI           4  0.631 Republican
##  3 MI           2  0.612 Republican
##  4 MI           8  0.586 Republican
##  5 MI           6  0.546 Republican
##  6 MI           7  0.533 Republican
##  7 MI           3  0.526 Republican
##  8 MI          11  0.485 Republican
##  9 MI           1  0.481 Republican
## 10 MI           9  0.340 Democrat
## 11 MI           5  0.315 Democrat
## 12 MI          12  0.290 Democrat
## 13 MI          14  0.156 Democrat
## 14 MI          13  0.136 Democrat
```

The democratic winning margin in raw votes was higher in Michigan.

```
mi_results %>%
  summarize(
    N = n(),
    state_votes = sum(total_votes),
    state_d = sum(d_votes),
    state_r = sum(r_votes)
  ) %>%
  mutate(
    d_prop = state_d / state_votes,
    r_prop = state_r / state_votes
  )
```

```
## # A tibble: 1 x 7
##   state     N state_votes state_d state_r d_prop r_prop
##   <chr> <int>       <dbl>   <dbl>   <dbl>  <dbl>  <dbl>
## 1 MI       14     4903744 2378270 2238540  0.485  0.456
```

Presenting the Data

```
library(sf)
```

```
## Linking to GEOS 3.9.3, GDAL 3.5.2, PROJ 8.2.1; sf_use_s2() is TRUE
```

```
fs::path("data")
```

```
## data
```

This code downloads and unzips the district data file used in the text. Note that the sub-directory named by the fs::path() argument must exit.

```
# Can't get this to run, so just download and unzip manually.
# src <- "http://cdmaps.polisci.ucla.edu/shp/districts113.zip"
# dsn_districts <- usethis::use_zip(src, destdir = fs::path("data"))
```

When the data is downloaded/unzipped into data/districtShapes/, this code reads it more quickly.

```
dsn_districts <- fs::path(fs::path_wd(), "data", "districtShapes")

st_layers(dsn_districts)
```

```
## Driver: ESRI Shapefile
## Available layers:
##     layer_name geometry_type features fields crs_name
## 1 districts113       Polygon      436     15    NAD83
```

```
districts <- st_read(dsn_districts, layer = "districts113") %>%
  mutate(DISTRICT = parse_number(as.character(DISTRICT))) %>%
  janitor::clean_names()
```

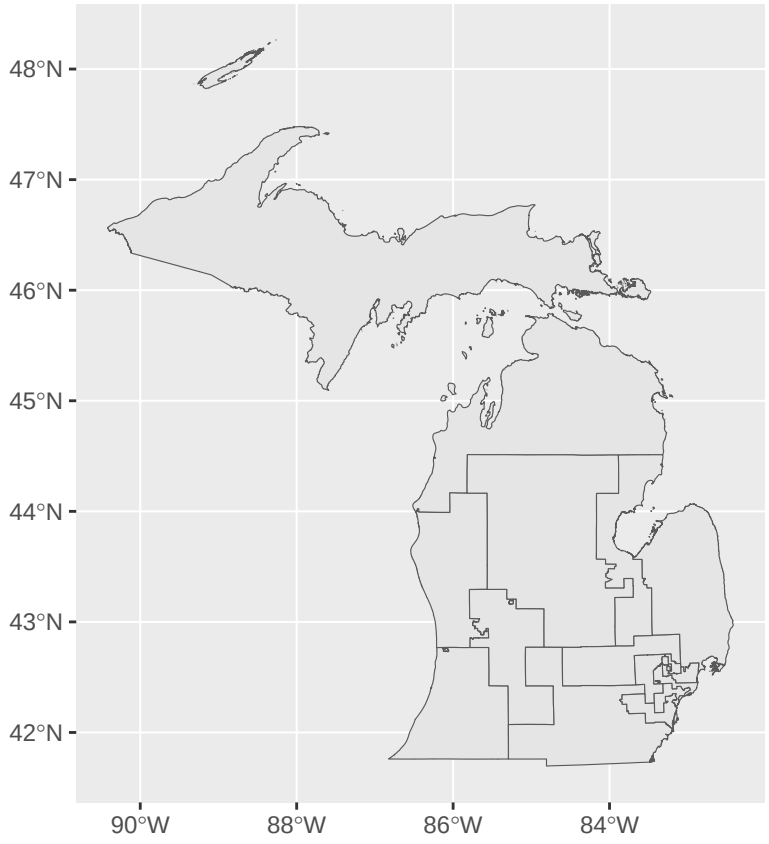
```
## Reading layer `districts113' from data source
##   `C:\projects\info601\info601\docs\13geospatial\lab\data\districtShapes'
##   using driver `ESRI Shapefile'
## Simple feature collection with 436 features and 15 fields (with 1 geometry empty)
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: -179.1473 ymin: 18.91383 xmax: 179.7785 ymax: 71.35256
## Geodetic CRS:  NAD83
```

```
glimpse(districts)
```

```
## Rows: 436
## Columns: 16
## $ statename  <chr> "Louisiana", "Maine", "Maine", "Maryland", "Maryland", "Mar~
## $ id         <chr> "022113114006", "023113114001", "023113114002", "0241131140~
## $ district   <dbl> 6, 1, 2, 1, 2, 3, 4, 5, 6, 7, 8, 1, 2, 3, 4, 5, 6, 7, 8, 9,~
## $ startcong  <chr> "113", "113", "113", "113", "113", "113", "113", "113", "11~
```

```
## $ endcong    <chr> "114", "114", "114", "114", "114", "114", "114", "114", "11~
## $ districtsi <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ county     <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ page       <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ law        <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ note       <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ bestdec    <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ finalnote  <chr> "{\"From US Census website\"}", "{\"From US Census website\~
## $ rnote      <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ lastchange <chr> "2016-05-29 16:44:10.857626", "2016-05-29 16:44:10.857626",~
## $ fromcounty <chr> "F", "F", "F", "F", "F", "F", "F", "F", "F", "F", "F", "F",~
## $ geometry   <MULTIPOLYGON [°]> MULTIPOLYGON (((-91.82288 3..., MULTIPOLYGON (~
```

```
library(sf)
library(ggspatial)

mi_shp <- districts %>%
 filter(statename == "Michigan")

mi_shp %>%
  ggplot() +
  geom_sf()
```




```
# Not sure what this non-standard stuff did for us.
# mi_shp %>%
```

```
#  st_geometry() %>%
#  plot(col = gray.colors(nrow(mi_shp)))
```

```
mi_merged <- mi_shp %>%
  st_transform(4326) %>%
  inner_join(mi_results, by = c("district" = "district"))
glimpse(mi_merged)
```

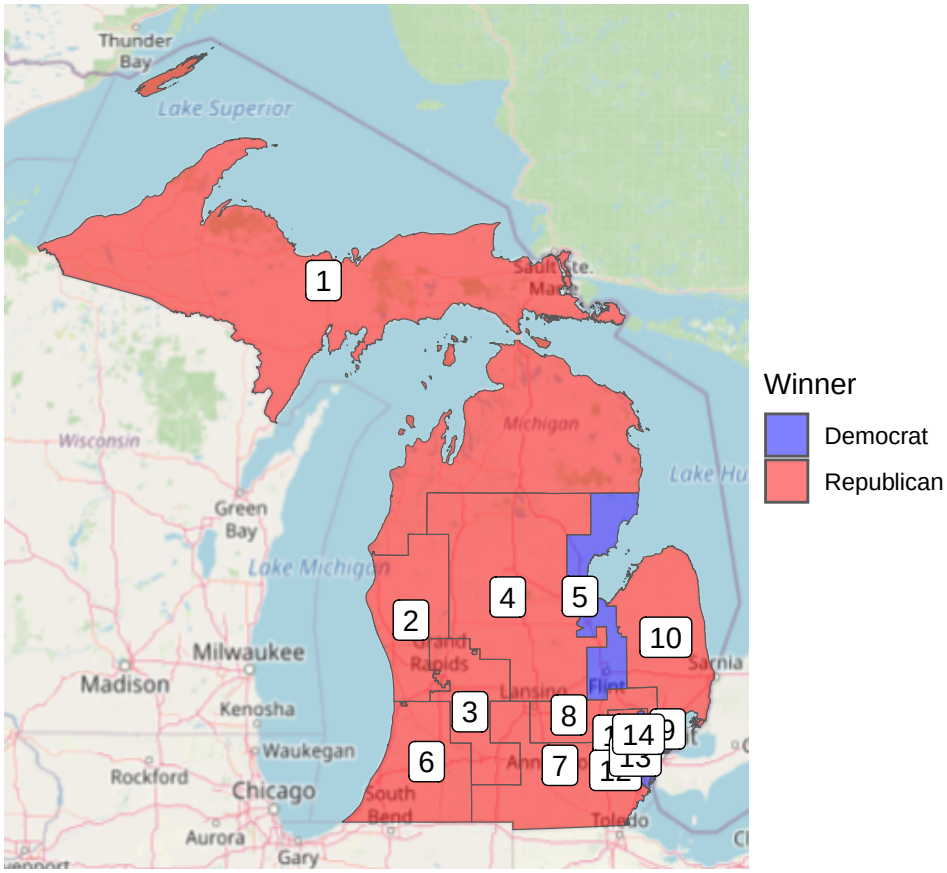
```
## Rows: 14
## Columns: 24
## $ statename   <chr> "Michigan", "Michigan", "Michigan", "Michigan", "Michigan"~
## $ id          <chr> "026113114001", "026113114002", "026113114003", "026113114~
## $ district    <dbl> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
## $ startcong   <chr> "113", "113", "113", "113", "113", "113", "113", "113", "1~
## $ endcong     <chr> "114", "114", "114", "114", "114", "114", "114", "114", "1~
## $ districtsi  <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ county      <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ page        <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ law         <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ note        <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ bestdec     <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ finalnote   <chr> "{\"From US Census website\"}", "{\"From US Census website~
## $ rnote       <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
## $ lastchange  <chr> "2016-05-29 16:44:10.857626", "2016-05-29 16:44:10.857626"~
## $ fromcounty  <chr> "F", "F", "F", "F", "F", "F", "F", "F", "F", "F", "F", "F"~
## $ state       <chr> "MI", "MI", "MI", "MI", "MI", "MI", "MI", "MI", "MI", "MI"~
## $ N           <int> 4, 5, 4, 5, 5, 5, 6, 6, 6, 4, 15, 5, 8, 8
## $ total_votes <dbl> 347037, 318267, 326281, 312949, 330146, 320475, 318069, 34~
## $ d_votes     <dbl> 165179, 0, 144108, 104996, 214531, 136563, 136849, 128657,~
## $ r_votes     <dbl> 167060, 194653, 171675, 197386, 103931, 174955, 169668, 20~
## $ other_votes <dbl> 14798, 123614, 10498, 10567, 11684, 8957, 11552, 14180, 13~
## $ r_prop      <dbl> 0.4813896, 0.6116028, 0.5261569, 0.6307290, 0.3148031, 0.5~
## $ winner      <chr> "Republican", "Republican", "Republican", "Republican", "D~
## $ geometry    <MULTIPOLYGON [°]> MULTIPOLYGON (((-84.26702 4..., MULTIPOLYGON (((-86.43104 ~
```

```
mi <- mi_merged %>%
  ggplot() +
  aes(fill = winner) +
  annotation_map_tile(zoom = 6, type = "osm") +
  geom_sf(alpha = 0.5) +
  scale_fill_manual("Winner", values = c("blue", "red")) +
  geom_sf_label(aes(label = district), fill = "white") +
  theme_void()
mi
```

```
## Warning in st_point_on_surface.sfc(sf::st_zm(x)): st_point_on_surface may not
## give correct results for longitude/latitude data
```

```
## Loading required namespace: raster
```

```
## Zoom: 6
```



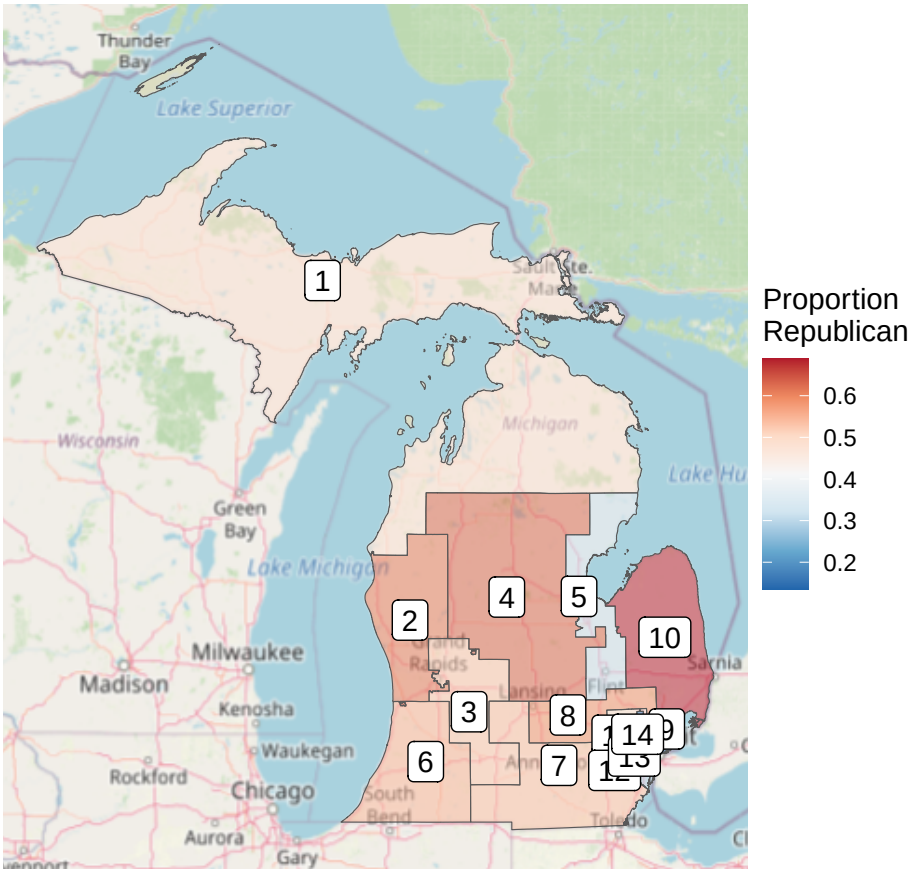
Here's a map showing proportions.

```
mi +
  aes(fill = r_prop) +
  scale_fill_distiller(
    "Proportion\nRepublican",
    palette = "RdBu"
#     limits = c(0.2, 0.8)
  )
```

```
## Scale for fill is already present.
## Adding another scale for fill, which will replace the existing scale.
```

```
## Warning in st_point_on_surface.sfc(sf::st_zm(x)): st_point_on_surface may not
## give correct results for longitude/latitude data
```

```
## Zoom: 6
```



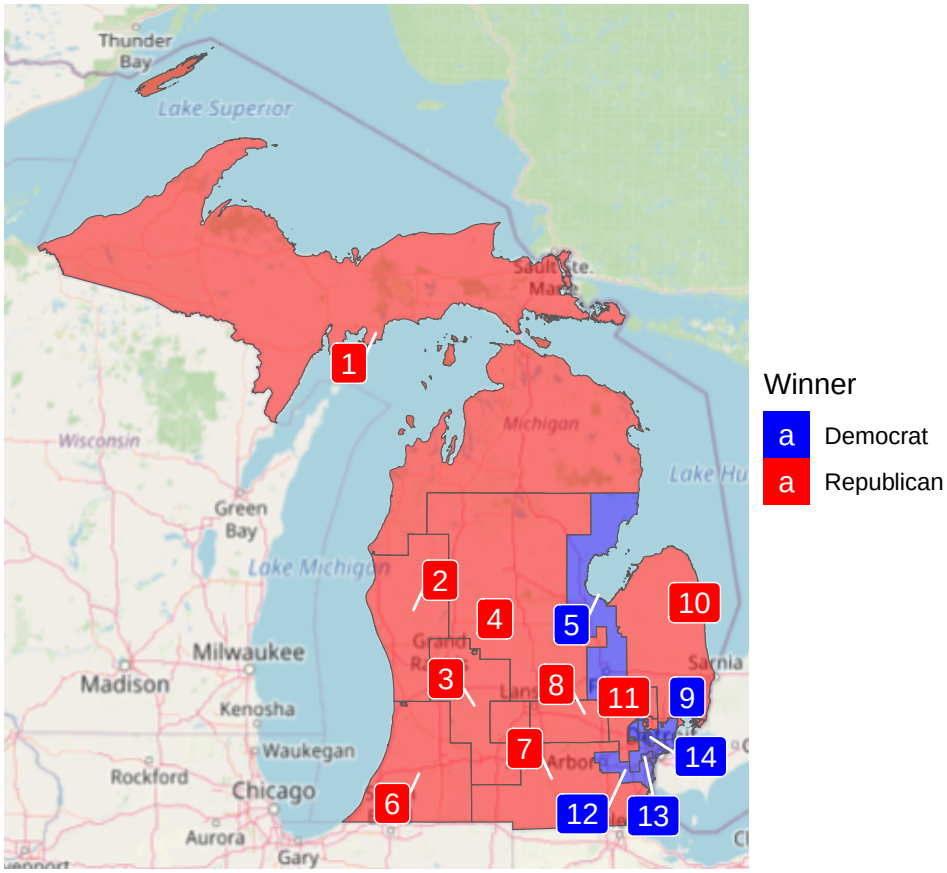
Here are versions of these maps with better labels (N. Tammenga, Spring 2022).

```
library(ggspatial)
library(ggrepel)

mi <- ggplot(data = mi_merged,
             aes(fill = winner)) +
  annotation_map_tile(zoom = 6,
                      type = "osm") +
  geom_sf(alpha = 0.5) +
  scale_fill_manual("Winner",
                    values = c("blue", "red")) +
  theme_void()


mi1 <- mi + ggrepel::geom_label_repel(data = mi_merged %>%
                                      sf::st_set_geometry(NULL) %>%
                                      bind_cols(mi_merged %>%
                                           sf::st_centroid() %>%
                                           sf::st_coordinates() %>% as_tibble()),
                                    aes(label = district, x = X, y = Y), color = 'white')
```

```
## Warning in st_centroid.sf(.): st_centroid assumes attributes are constant over
## geometries of x
```

```
mi1
```

```
## Zoom: 6
```



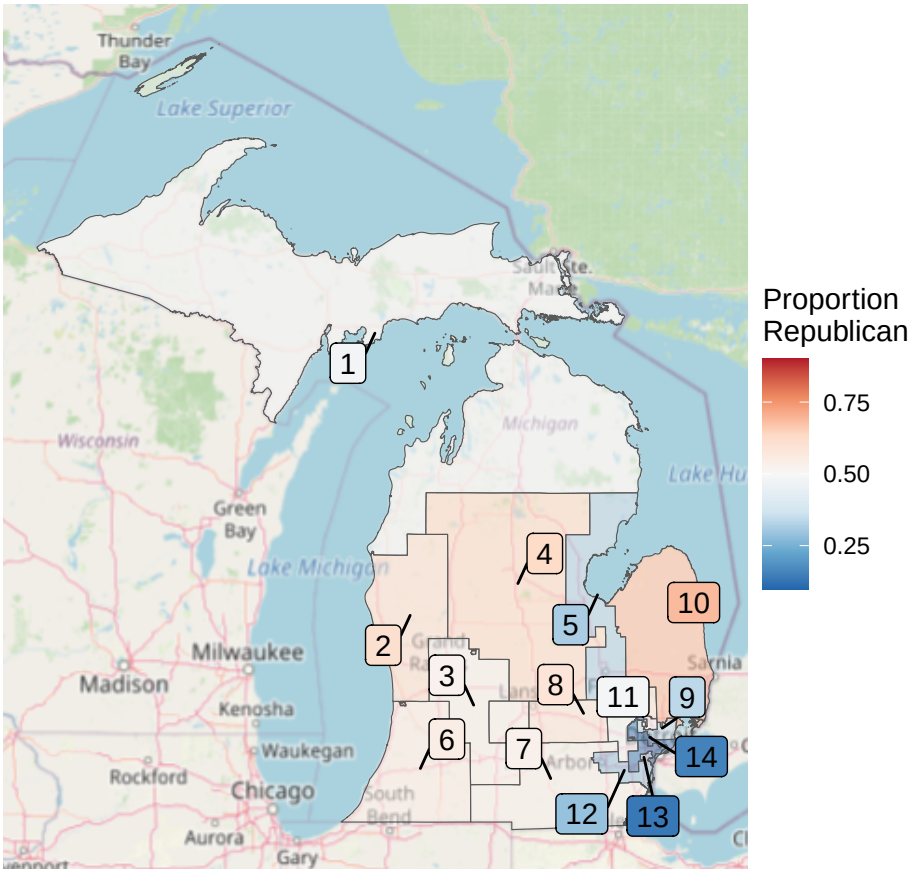

```
mi2 <- mi +
  aes(fill = r_prop) +
  scale_fill_distiller(
    "Proportion\nRepublican",
    palette = "RdBu",
    limits = c(0.1, 0.9)
  ) +
  ggrepel::geom_label_repel(data = mi_merged %>%
                              sf::st_set_geometry(NULL) %>%
                              bind_cols(mi_merged %>%
                                          sf::st_centroid() %>%
                                          sf::st_coordinates() %>% as_tibble()),
                              aes(label = district, x = X, y = Y)
  )
```

```
## Scale for fill is already present.
## Adding another scale for fill, which will replace the existing scale.
```

```
## Warning in st_centroid.sf(.): st_centroid assumes attributes are constant over
## geometries of x
```

```
mi2
```

```
## Zoom: 6
```



Conclusions

There is gerrymandering, but it can be hard to see in the previous maps because of the small size of the packed democratic districts.

See `lab131-election-solution.Rmd` for the Leaflet solution.