

Data Visualization - 8. Polishing and Presenting Plots

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Code Horizons

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Polishing your plots
and Presenting them

Load our packages

```
library(here)      # manage file paths
library(tidyverse) # your friend and mine
library(socviz)    # data and some useful functions
library(ggrepel)   # Text and labels
library(colorspace) # luminance-balanced palettes
library(scales)     # scale adjustments and enhancements
library(ggforce)   # useful enhancements to ggplot
```

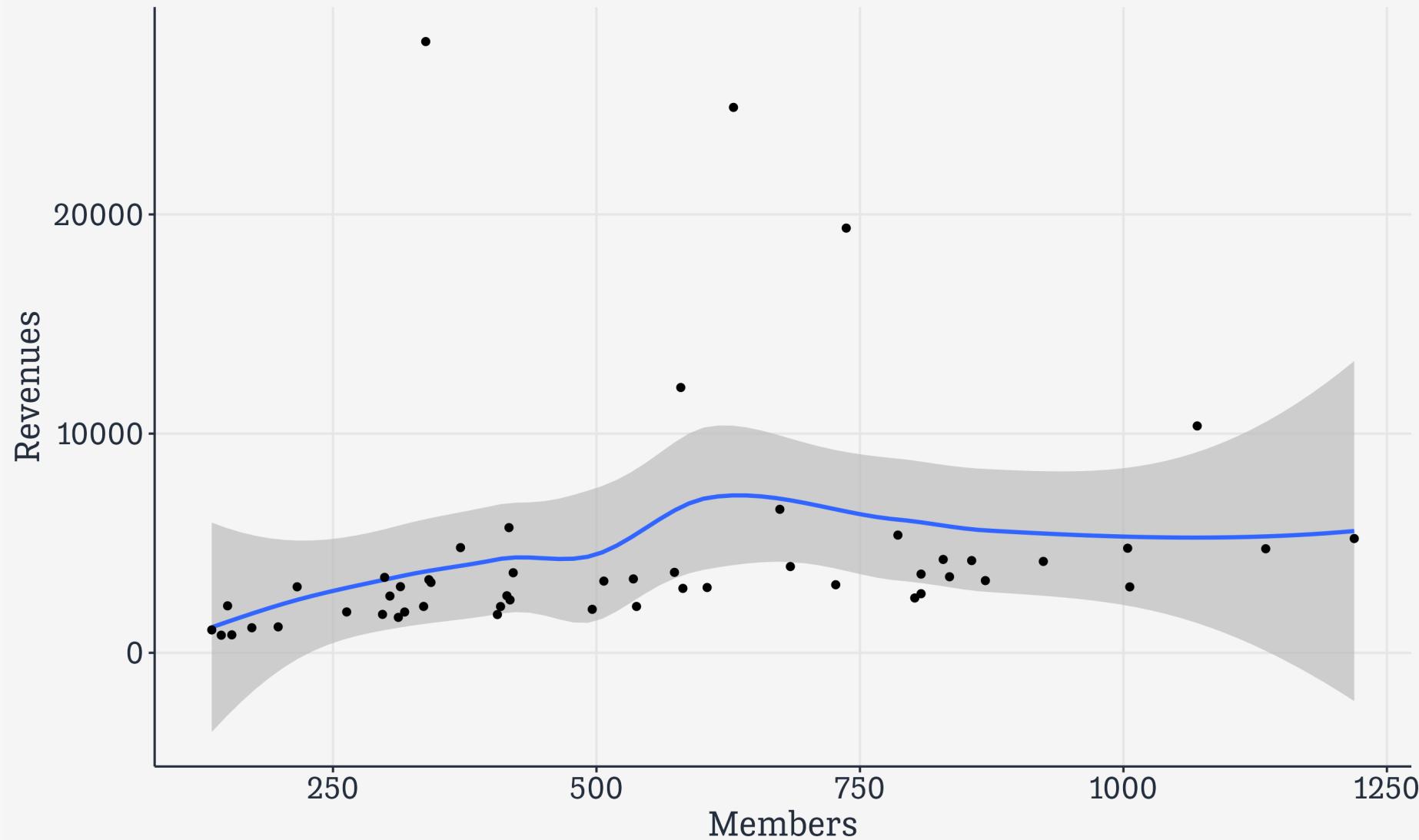
**Piece by piece,
Layer by layer**

Build your plots a piece at a time

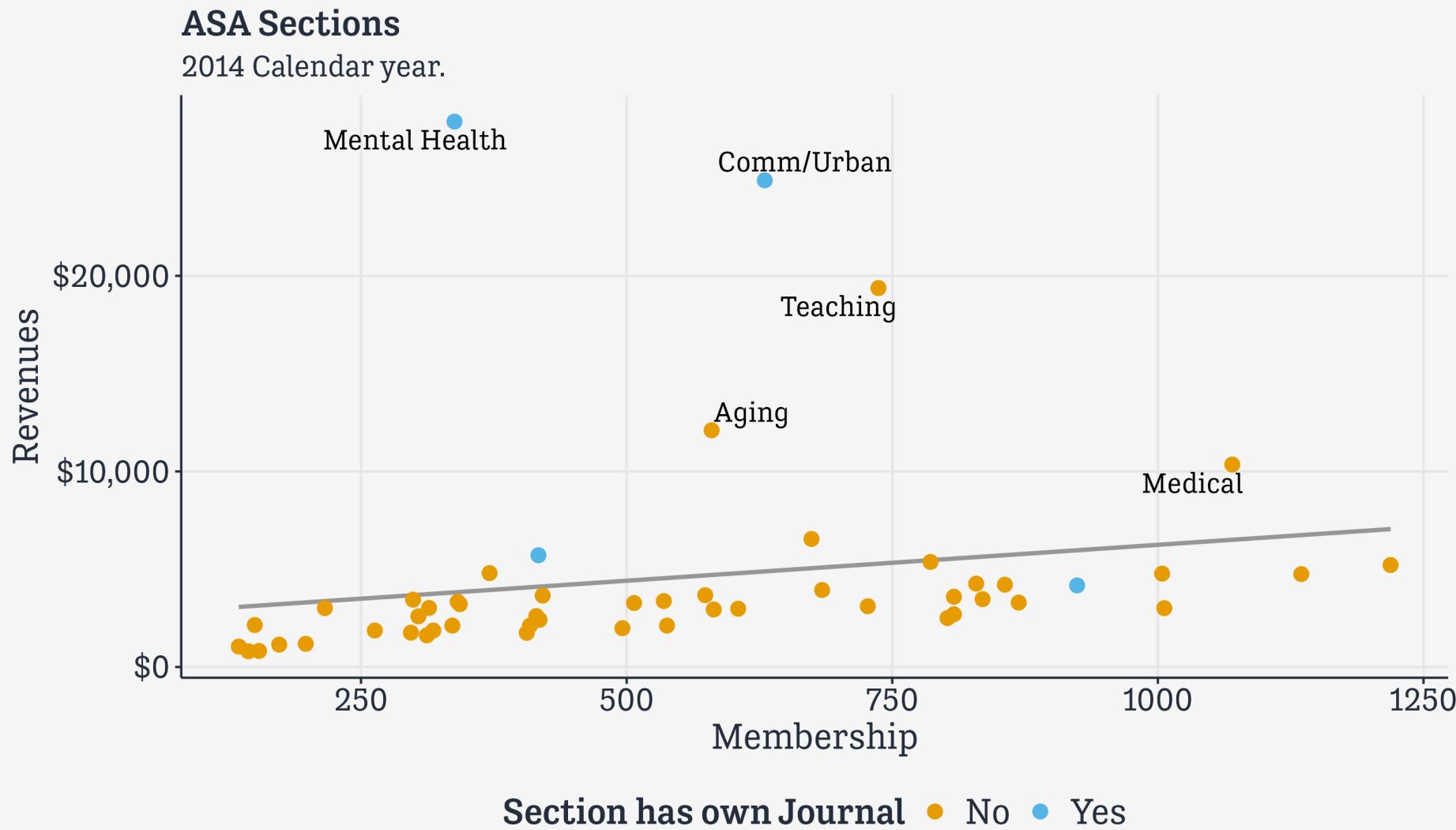
```
asasec ← as_tibble(asasec)
asasec
```

```
# A tibble: 572 × 9
  Section      Sname Beginning Revenues Expenses Ending Journal Year Members
  <fct>       <fct>    <int>     <int>    <int>   <int> <fct>    <int>    <int>
1 Aging and the... Aging     12752    12104    12007   12849 No        2005      598
2 Alcohol, Drug... Alco...    11933     1144      400    12677 No        2005      301
3 Altruism and ... Altr...    1139      1862     1875    1126 No        2005      NA
4 Animals and S... Anim...     473       820     1116     177 No        2005      209
5 Asia/Asian Am... Asia      9056      2116     1710    9462 No        2005      365
6 Body and Embo... Body     3408      1618     1920    3106 No        2005      NA
7 Children and ... Chil...    3692      3653     3713    3632 No        2005      418
8 Coll Behavior... CBSM     8127      3470     2704    8893 No        2005      708
9 Communication... CITA...   17093     4800     4804   17089 No        2005      301
10 Community and... Comm...   26598    24883    23379   28102 Yes       2005      721
# i 562 more rows
```

Build your plots a piece at a time



Build your plots a piece at a time



Source: ASA annual report.

Build your plots a piece at a time

asasec

| | Section | Sname | Beginning | Revenues | Expenses | Ending | Journal | Year | Members |
|----|------------------|---------|-----------|----------|----------|--------|---------|-------|---------|
| | <fct> | <fct> | <int> | <int> | <int> | <int> | <fct> | <int> | <int> |
| 1 | Aging and the... | Aging | 12752 | 12104 | 12007 | 12849 | No | 2005 | 598 |
| 2 | Alcohol, Drug... | Alco... | 11933 | 1144 | 400 | 12677 | No | 2005 | 301 |
| 3 | Altruism and ... | Altr... | 1139 | 1862 | 1875 | 1126 | No | 2005 | NA |
| 4 | Animals and S... | Anim... | 473 | 820 | 1116 | 177 | No | 2005 | 209 |
| 5 | Asia/Asian Am... | Asia | 9056 | 2116 | 1710 | 9462 | No | 2005 | 365 |
| 6 | Body and Embo... | Body | 3408 | 1618 | 1920 | 3106 | No | 2005 | NA |
| 7 | Children and ... | Chil... | 3692 | 3653 | 3713 | 3632 | No | 2005 | 418 |
| 8 | Coll Behavior... | CBSM | 8127 | 3470 | 2704 | 8893 | No | 2005 | 708 |
| 9 | Communication... | CITA... | 17093 | 4800 | 4804 | 17089 | No | 2005 | 301 |
| 10 | Community and... | Comm... | 26598 | 24883 | 23379 | 28102 | Yes | 2005 | 721 |

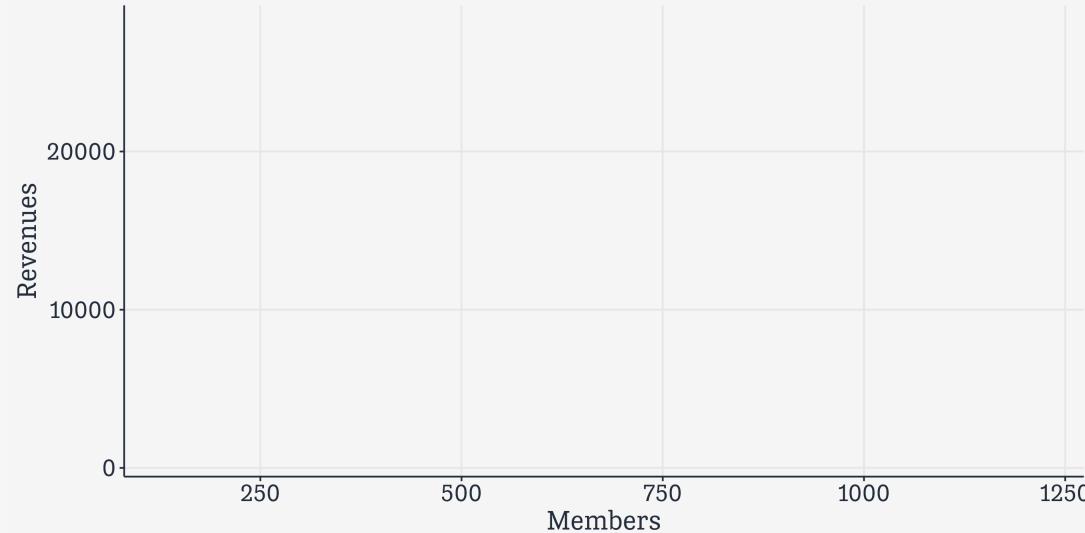
Build your plots a piece at a time

```
asasec >  
filter(Year == 2014)
```

| | Section | Sname | Beginning | Revenues | Expenses | Ending | Journal | Year | Members |
|----|--------------------------|-------|-----------|----------|----------|--------|---------|-------|---------|
| | <fct> | <fct> | <int> | <int> | <int> | <int> | <fct> | <int> | <int> |
| 1 | Aging and the... Aging | | 12752 | 12104 | 12007 | 12849 | No | 2014 | 580 |
| 2 | Alcohol, Drug... Alco... | | 11933 | 1144 | 400 | 12677 | No | 2014 | 173 |
| 3 | Altruism and ... Altr... | | 1139 | 1862 | 1875 | 1126 | No | 2014 | 318 |
| 4 | Animals and S... Anim... | | 473 | 820 | 1116 | 177 | No | 2014 | 154 |
| 5 | Asia/Asian Am... Asia | | 9056 | 2116 | 1710 | 9462 | No | 2014 | 336 |
| 6 | Body and Embo... Body | | 3408 | 1618 | 1920 | 3106 | No | 2014 | 312 |
| 7 | Children and ... Chil... | | 3692 | 3653 | 3713 | 3632 | No | 2014 | 421 |
| 8 | Coll Behavior... CBSM | | 8127 | 3470 | 2704 | 8893 | No | 2014 | 835 |
| 9 | Communication... CITA... | | 17093 | 4800 | 4804 | 17089 | No | 2014 | 371 |
| 10 | Community and... Comm... | | 26598 | 24883 | 23379 | 28102 | Yes | 2014 | 630 |

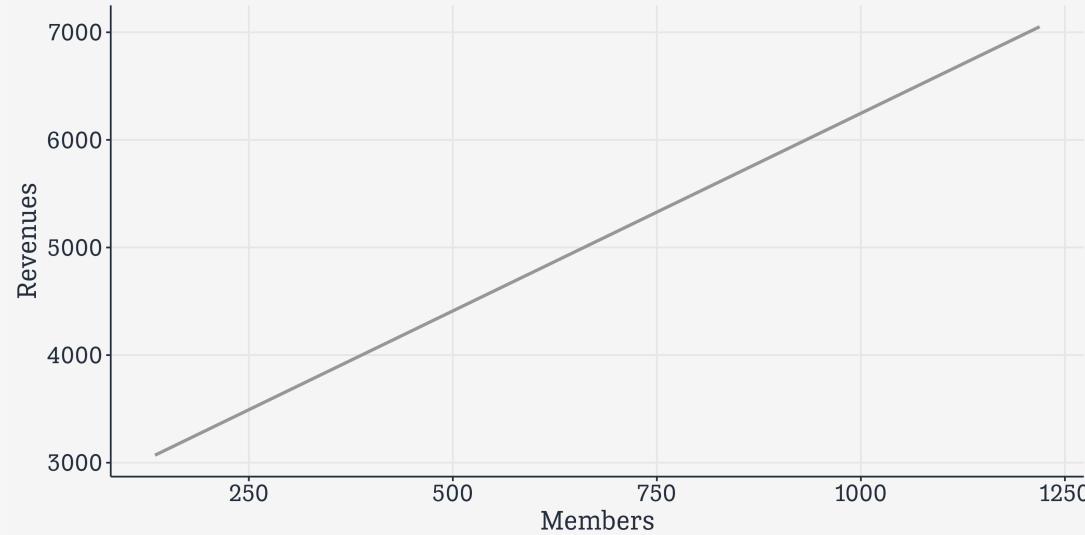
Build your plots a piece at a time

```
asasec %>  
  filter(Year == 2014) %>  
  ggplot(mapping = aes(x = Members,  
                      y = Revenues,  
                      label = Sname))
```



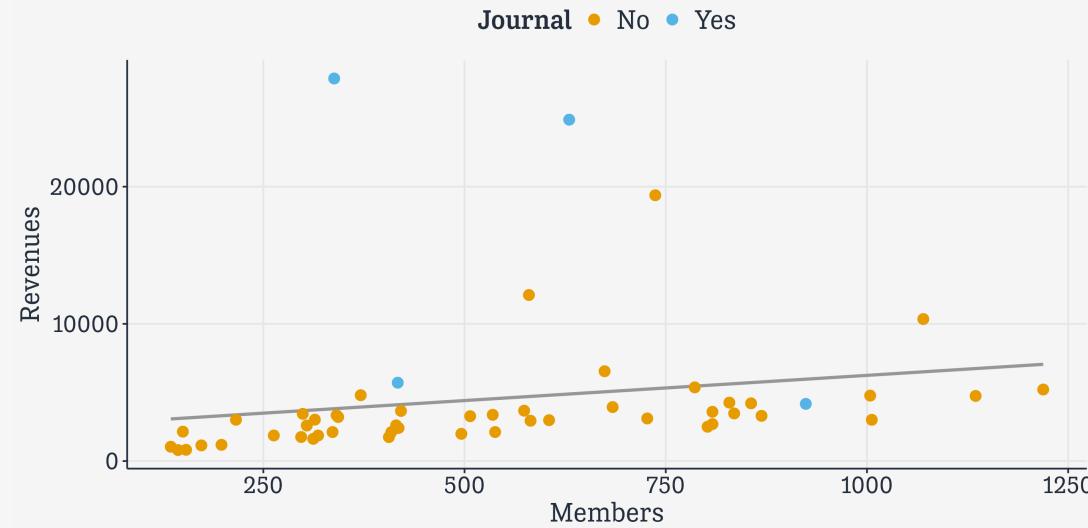
Build your plots a piece at a time

```
asasec %>  
  filter(Year == 2014) %>  
  ggplot(mapping = aes(x = Members,  
                        y = Revenues,  
                        label = Sname)) +  
  geom_smooth(method = "lm",  
              se = FALSE,  
              color = "gray60")
```



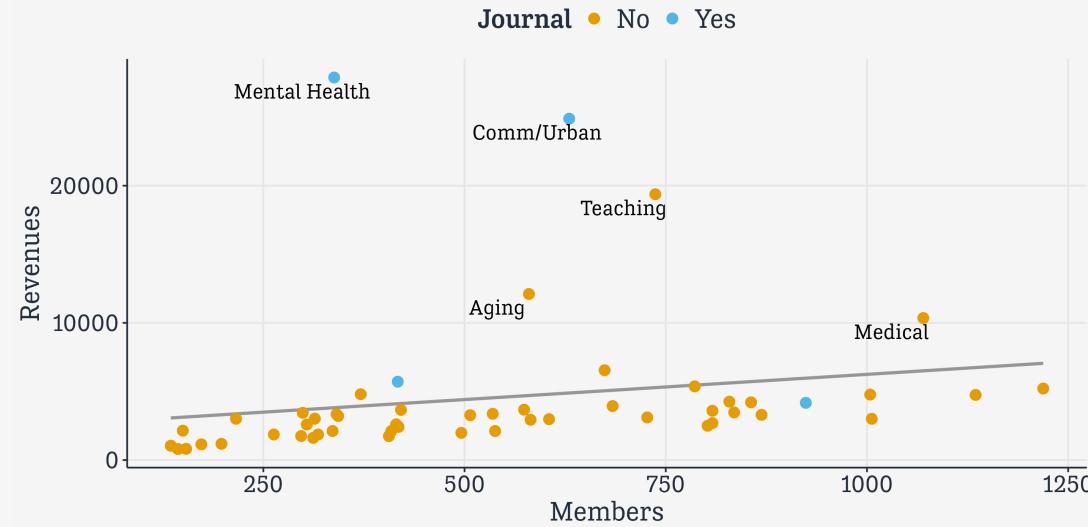
Build your plots a piece at a time

```
asasec %>  
  filter(Year == 2014) %>  
  ggplot(mapping = aes(x = Members,  
                      y = Revenues,  
                      label = Sname)) +  
  geom_smooth(method = "lm",  
              se = FALSE,  
              color = "gray60") +  
  geom_point(mapping = aes(color = Journal),  
             size = rel(3))
```



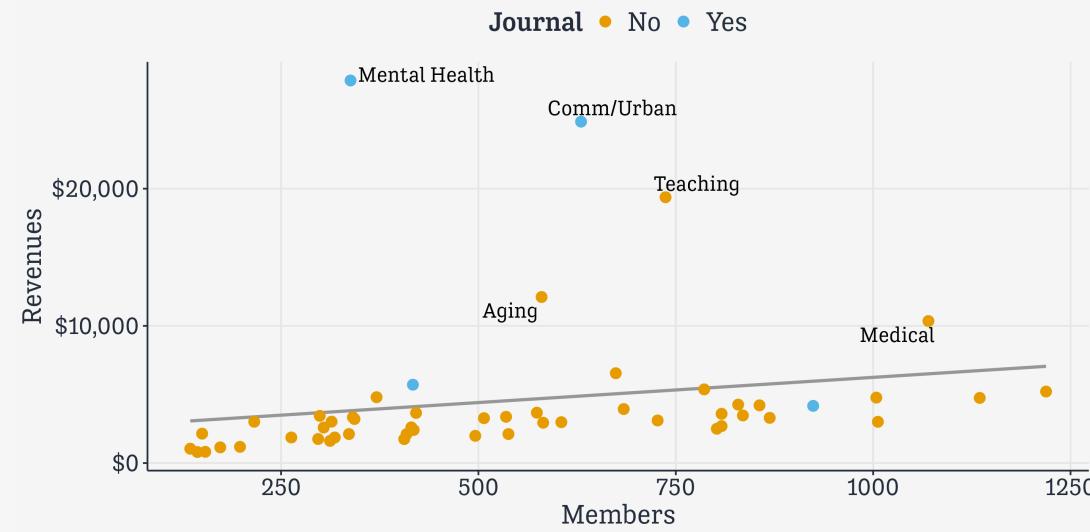
Build your plots a piece at a time

```
asasec %>  
  filter(Year == 2014) %>  
  ggplot(mapping = aes(x = Members,  
                        y = Revenues,  
                        label = Sname)) +  
  geom_smooth(method = "lm",  
              se = FALSE,  
              color = "gray60") +  
  geom_point(mapping = aes(color = Journal),  
             size = rel(3)) +  
  geom_text_repel(data=subset(asasec,  
                             Year == 2014 &  
                             Revenues > 7000),  
                 size = rel(5),  
                 mapping =  
                 aes(family = "Tenso Slide"))
```



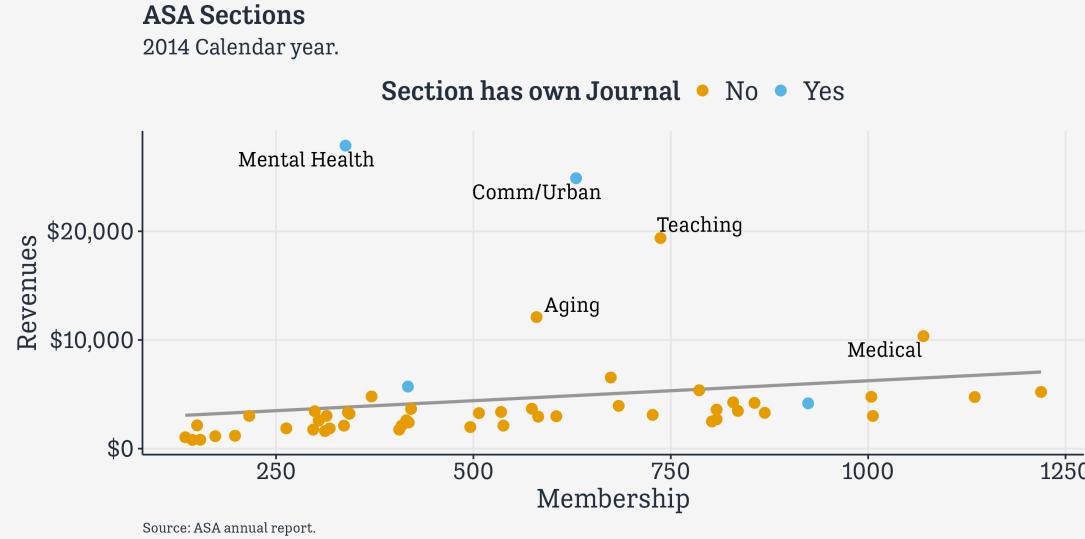
Build your plots a piece at a time

```
asasec %>
  filter(Year == 2014) %>
  ggplot(mapping = aes(x = Members,
                        y = Revenues,
                        label = Sname)) +
  geom_smooth(method = "lm",
              se = FALSE,
              color = "gray60") +
  geom_point(mapping = aes(color = Journal),
             size = rel(3)) +
  geom_text_repel(data=subset(asasec,
                             Year == 2014 &
                               Revenues > 7000),
                  size = rel(5),
                  mapping =
                    aes(family = "Tenso Slide")) +
  scale_y_continuous(labels =
    scales::label_dollar())
```



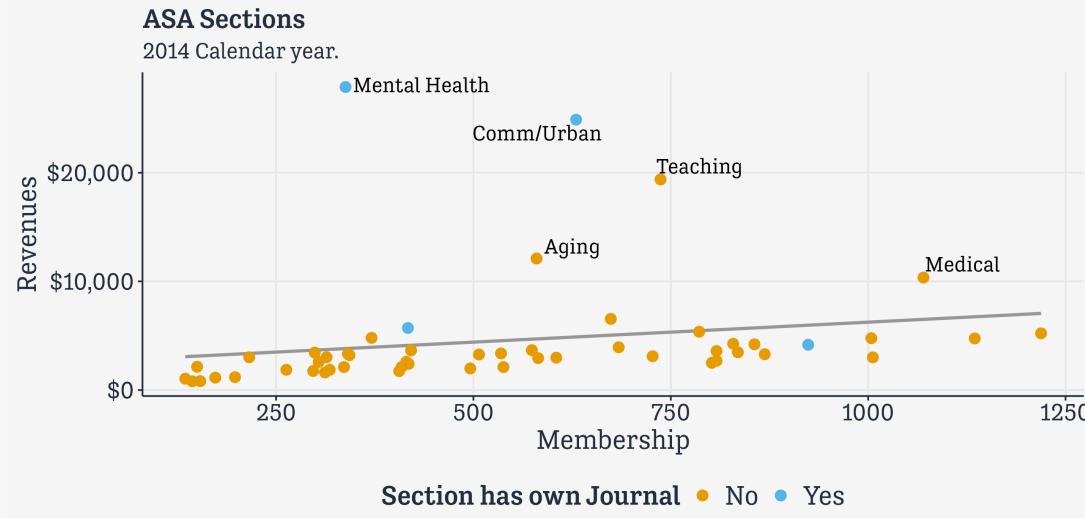
Build your plots a piece at a time

```
asasec %>
  filter(Year == 2014) %>
  ggplot(mapping = aes(x = Members,
                        y = Revenues,
                        label = Sname)) +
  geom_smooth(method = "lm",
              se = FALSE,
              color = "gray60") +
  geom_point(mapping = aes(color = Journal),
             size = rel(3)) +
  geom_text_repel(data=subset(asasec,
                             Year == 2014 &
                               Revenues > 7000),
                  size = rel(5),
                  mapping =
                    aes(family = "Tenso Slide")) +
  scale_y_continuous(labels =
    scales::label_dollar()) +
  labs(x="Membership", y="Revenues",
       color = "Section has own Journal",
       title = "ASA Sections",
       subtitle = "2014 Calendar year.",
       caption = "Source: ASA annual report.")
```



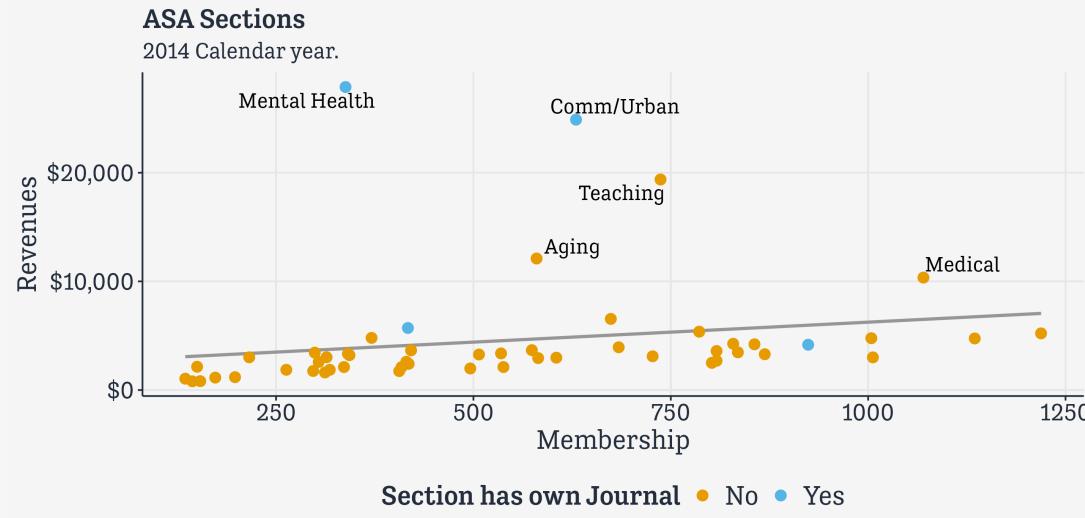
Build your plots a piece at a time

```
asasec %>
  filter(Year == 2014) %>
  ggplot(mapping = aes(x = Members,
                        y = Revenues,
                        label = Sname)) +
  geom_smooth(method = "lm",
              se = FALSE,
              color = "gray60") +
  geom_point(mapping = aes(color = Journal),
             size = rel(3)) +
  geom_text_repel(data=subset(asasec,
                             Year == 2014 &
                               Revenues > 7000),
                  size = rel(5),
                  mapping =
                    aes(family = "Tenso Slide")) +
  scale_y_continuous(labels =
    scales::label_dollar()) +
  labs(x="Membership", y="Revenues",
       color = "Section has own Journal",
       title = "ASA Sections",
       subtitle = "2014 Calendar year.",
       caption = "Source: ASA annual report.") +
  theme(legend.position = "bottom")
```



Build your plots a piece at a time

```
asasec %>
  filter(Year == 2014) %>
  ggplot(mapping = aes(x = Members,
                        y = Revenues,
                        label = Sname)) +
  geom_smooth(method = "lm",
              se = FALSE,
              color = "gray60") +
  geom_point(mapping = aes(color = Journal),
             size = rel(3)) +
  geom_text_repel(data=subset(asasec,
                             Year == 2014 &
                               Revenues > 7000),
                  size = rel(5),
                  mapping =
                    aes(family = "Tenso Slide")) +
  scale_y_continuous(labels =
    scales::label_dollar()) +
  labs(x="Membership", y="Revenues",
       color = "Section has own Journal",
       title = "ASA Sections",
       subtitle = "2014 Calendar year.",
       caption = "Source: ASA annual report.") +
  theme(legend.position = "bottom")
```



More about Scales

Working with `color` and `fill` scales

`scale_<MAPPING>_<KIND>()`

Scale functions control the display of the variables they map. So to change the colors for `color` or `fill` mappings, you adjust the corresponding `scale_` function, not the `theme()` function.

`ggplot` has several color palettes built in. A variety of packages provide others.

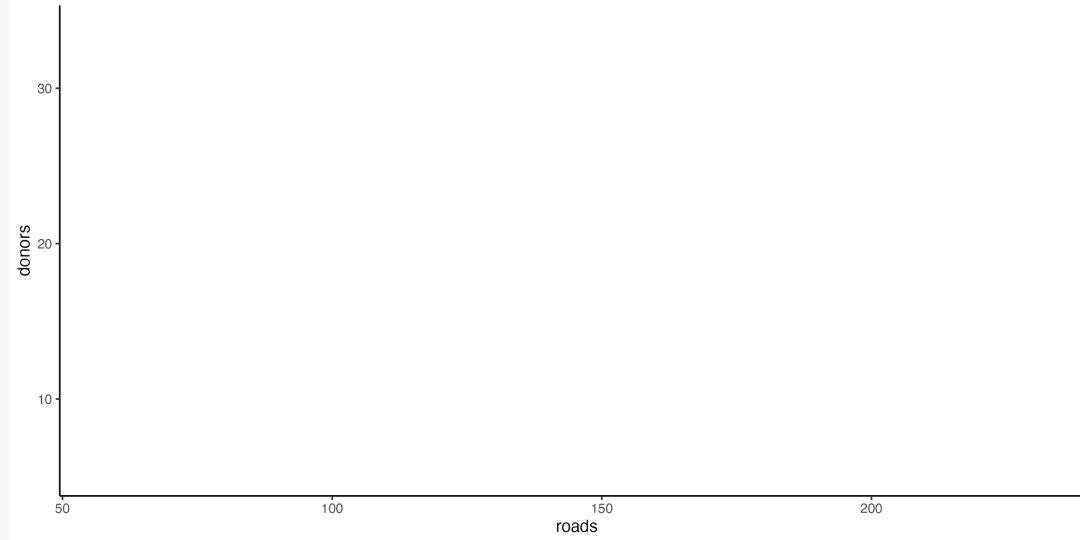
You can specify scales manually

```
organdata
```

```
# A tibble: 238 × 21
  country     year    donors    pop  pop_dens    gdp gdp_lag health health_lag
  <chr>     <date>   <dbl>   <int>    <dbl> <int>   <dbl>    <dbl>
1 Australia NA      NA     17065    0.220 16774  16591    1300    1224
2 Australia 1991-01-01 12.1    17284    0.223 17171  16774    1379    1300
3 Australia 1992-01-01 12.4    17495    0.226 17914  17171    1455    1379
4 Australia 1993-01-01 12.5    17667    0.228 18883  17914    1540    1455
5 Australia 1994-01-01 10.2    17855    0.231 19849  18883    1626    1540
6 Australia 1995-01-01 10.2    18072    0.233 21079  19849    1737    1626
7 Australia 1996-01-01 10.6    18311    0.237 21923  21079    1846    1737
8 Australia 1997-01-01 10.3    18518    0.239 22961  21923    1948    1846
9 Australia 1998-01-01 10.5    18711    0.242 24148  22961    2077    1948
10 Australia 1999-01-01 8.67    18926    0.244 25445  24148    2231   2077
# i 228 more rows
# i 12 more variables: pubhealth <dbl>, roads <dbl>, cerebvas <int>,
# assault <int>, external <int>, txp_pop <dbl>, world <chr>, opt <chr>,
# consent_law <chr>, consent_practice <chr>, consistent <chr>, ccode <chr>
```

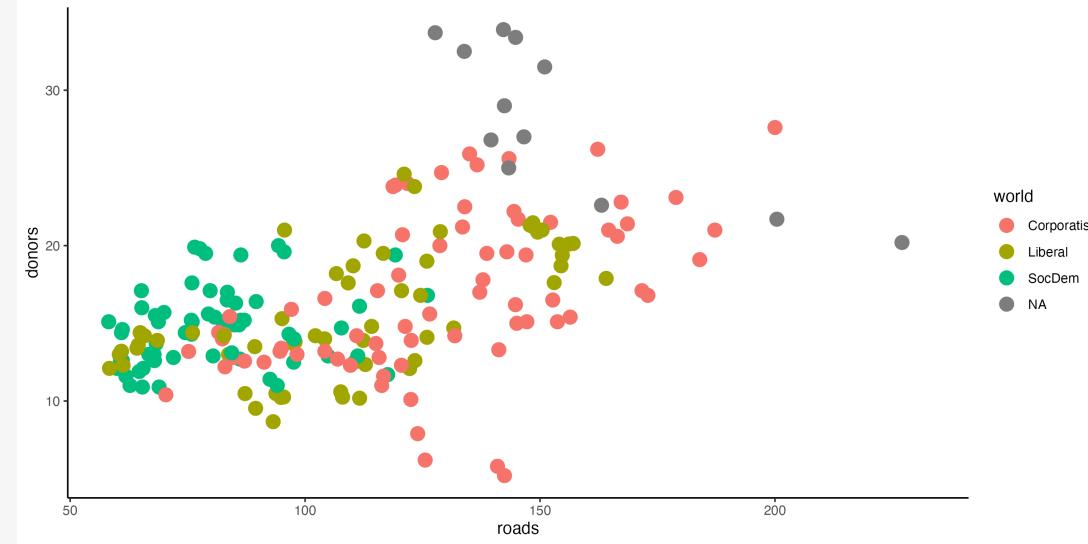
You can specify scales manually

```
organdata %>%  
  ggplot(mapping = aes(x = roads,  
                      y = donors,  
                      color = world))
```



You can specify scales manually

```
organdata %>%  
  ggplot(mapping = aes(x = roads,  
                      y = donors,  
                      color = world)) +  
  geom_point(size = 4)
```



You can specify scales manually

```
organdata %>  
  ggplot(mapping = aes(x = roads,  
                        y = donors,  
                        color = world)) +  
  geom_point(size = 4) →  
  p
```

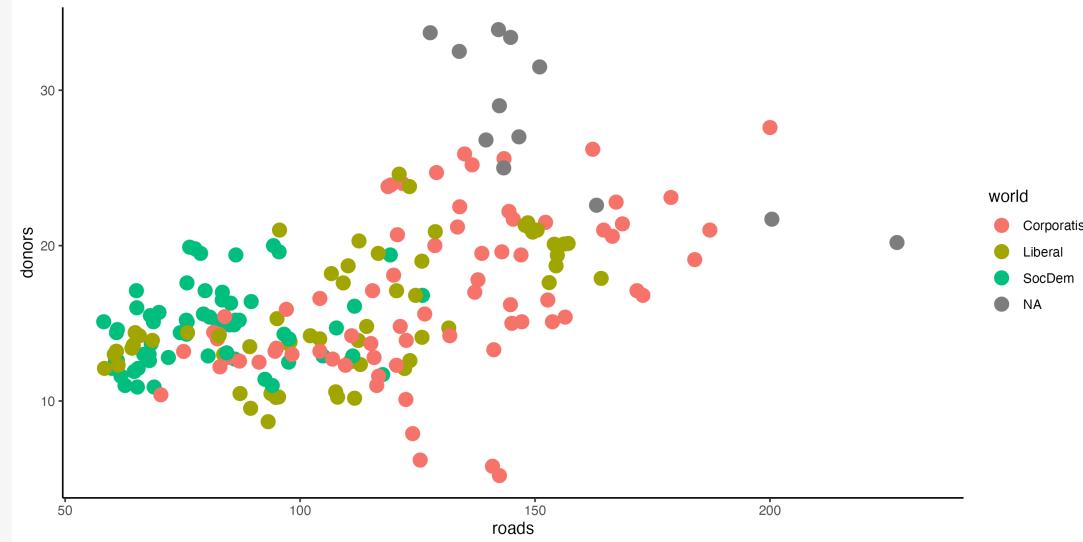
You can specify scales manually

```
organdata %>  
  ggplot(mapping = aes(x = roads,  
                        y = donors,  
                        color = world)) +  
  geom_point(size = 4) →  
  p
```

```
p ← organdata %>  
  ggplot(mapping = aes(x = roads,  
                        y = donors,  
                        color = world)) +  
  geom_point(size = 4)
```

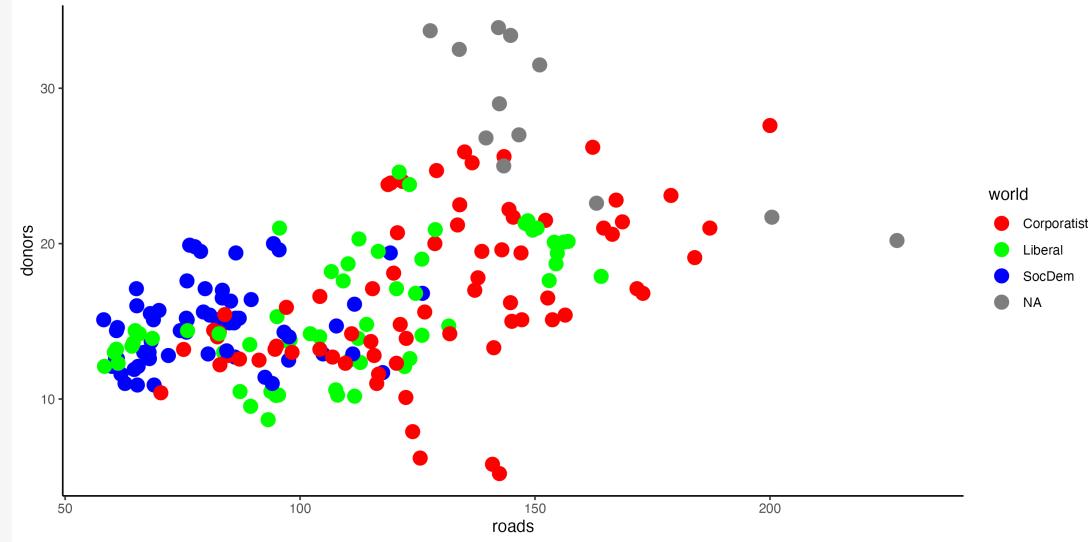
You can specify scales manually

p



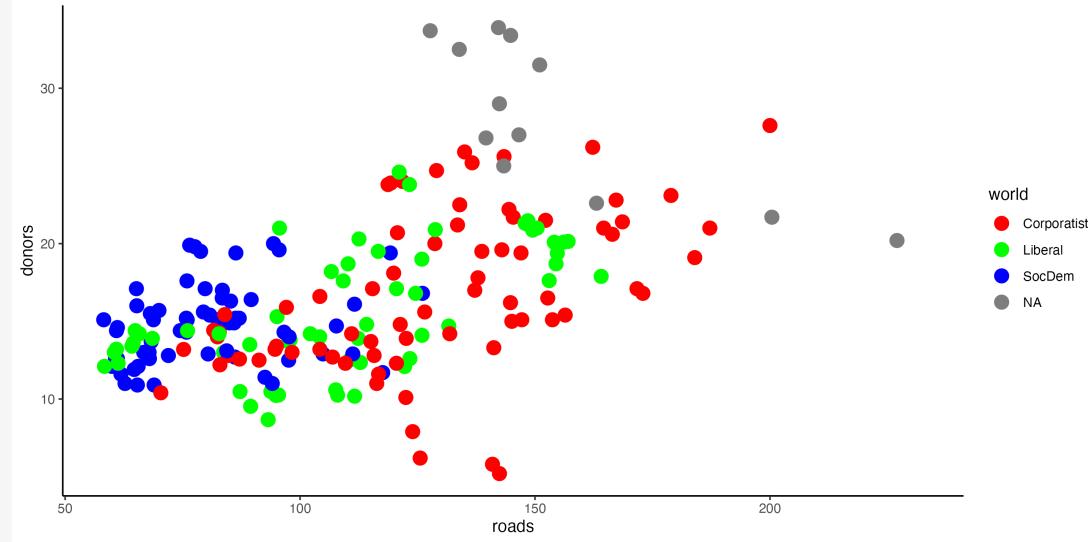
You can specify scales manually

```
p +  
  scale_color_manual(  
    values = c("red", "green", "blue"))
```



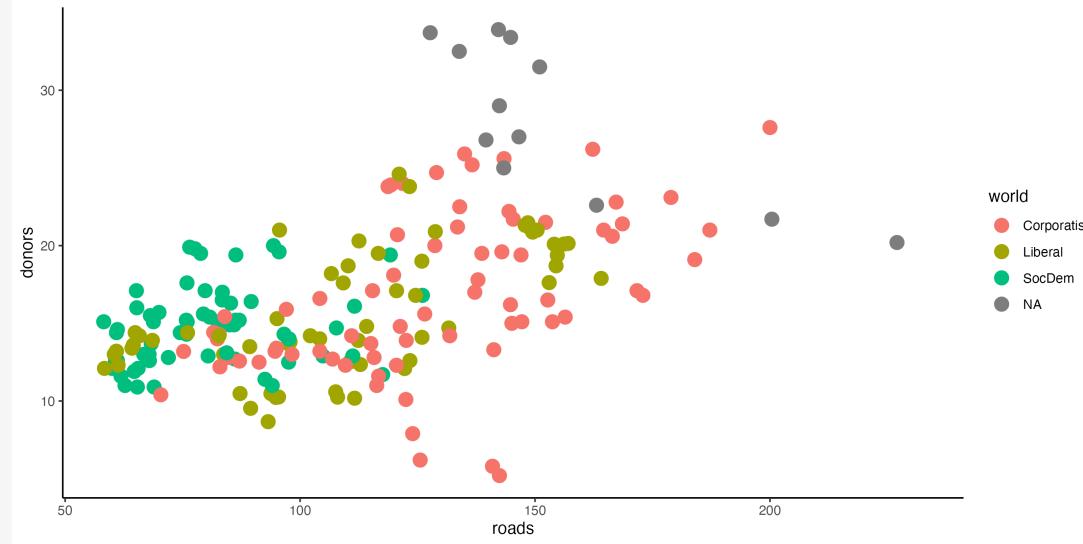
You can specify scales manually

```
p +  
  scale_color_manual(  
    values = c("red", "green", "blue"))
```



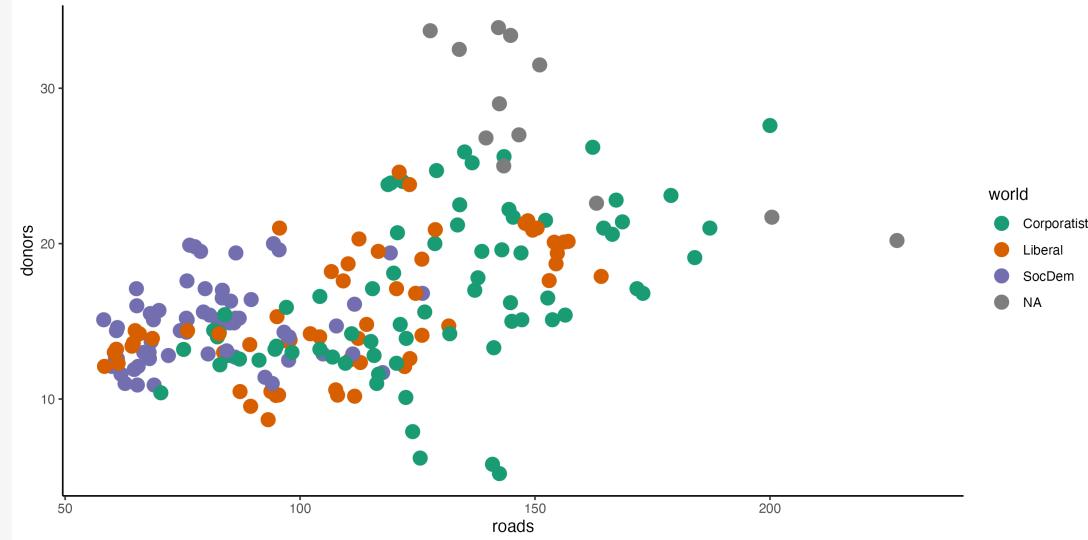
You can specify scales manually

p



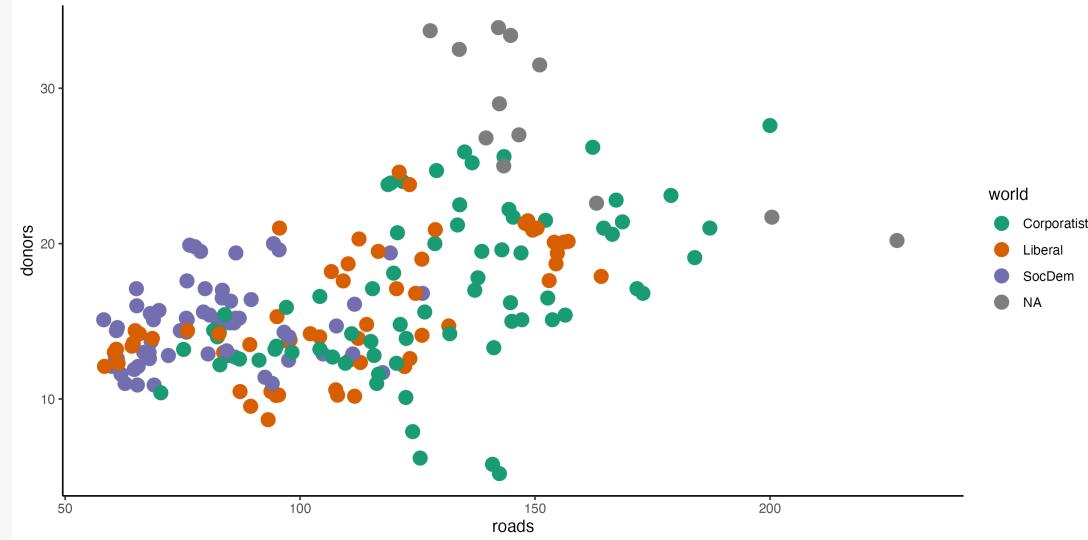
You can specify scales manually

```
p +  
  scale_color_manual(  
    values = c("#1B9E77", "#D95F02", "#7570B3"))
```



You can specify scales manually

```
p +  
  scale_color_manual(  
    values = c("#1B9E77", "#D95F02", "#7570B3"))
```



You can specify scales manually

```
colkey <- c("Corporatist" = "pink",
          "Liberal" = "goldenrod",
          "SocDem" = "firebrick")
```

You can specify scales manually

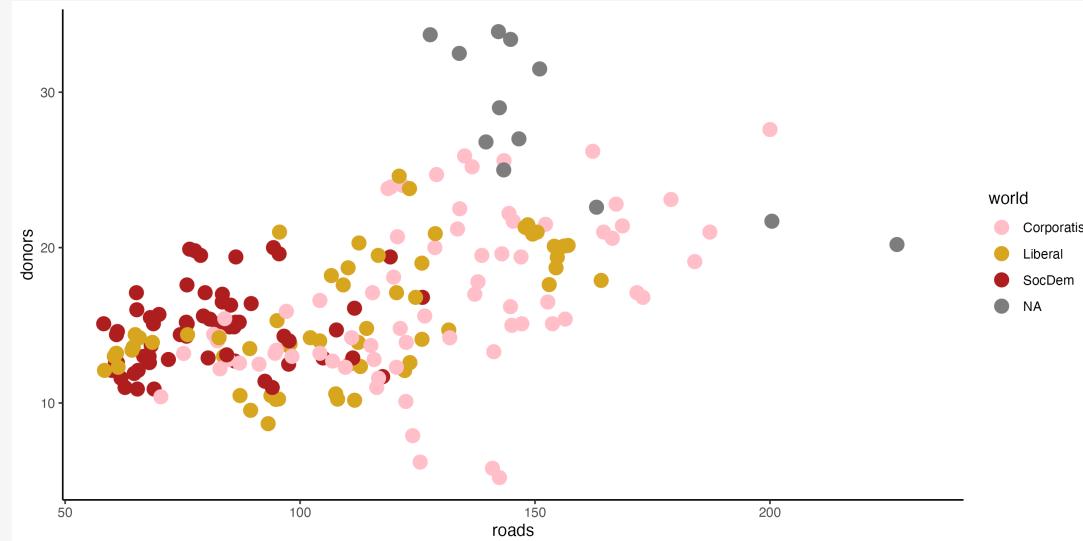
```
colkey <- c("Corporatist" = "pink",
          "Liberal" = "goldenrod",
          "SocDem" = "firebrick")  
colkey
```

```
Corporatist      Liberal      SocDem  
"pink" "goldenrod" "firebrick"
```

You can specify scales manually

```
colkey <- c("Corporatist" = "pink",
          "Liberal" = "goldenrod",
          "SocDem" = "firebrick")
colkey
p + scale_color_manual(
  values = colkey)
```

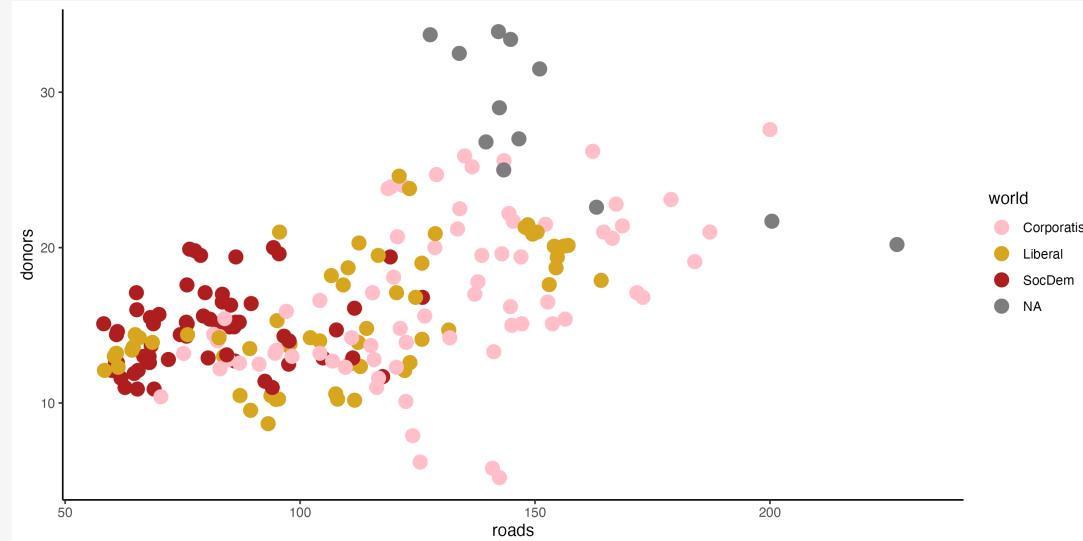
```
Corporatist      Liberal      SocDem
"pink" "goldenrod" "firebrick"
```



You can specify scales manually

```
colkey <- c("Corporatist" = "pink",
          "Liberal" = "goldenrod",
          "SocDem" = "firebrick")
colkey
p + scale_color_manual(
  values = colkey)
```

```
Corporatist      Liberal      SocDem
"pink" "goldenrod" "firebrick"
```



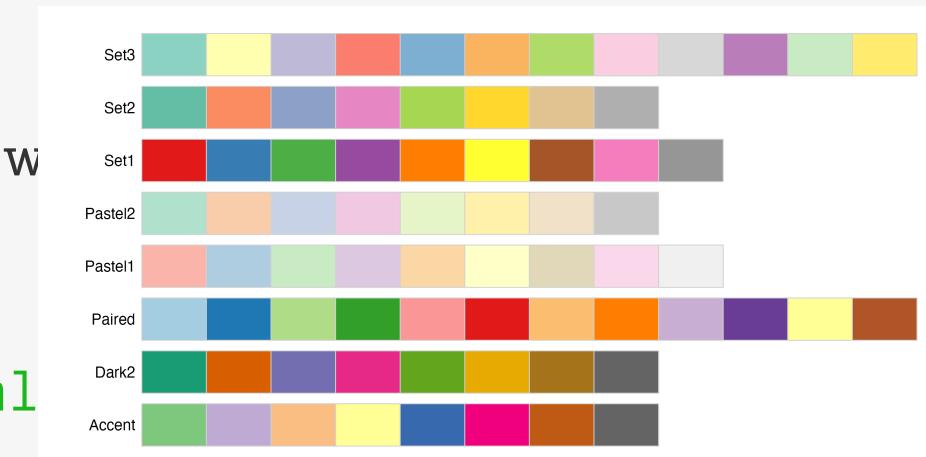
Use balanced palettes

E.g., the `RColorBrewer` Palettes

These are available through the `scale_color-brewer()` and `scale_fill_brewer()` functions, as well as independently.

See the palettes with
`RColorBrewer::display.brewer.all()`

Qualitative palettes



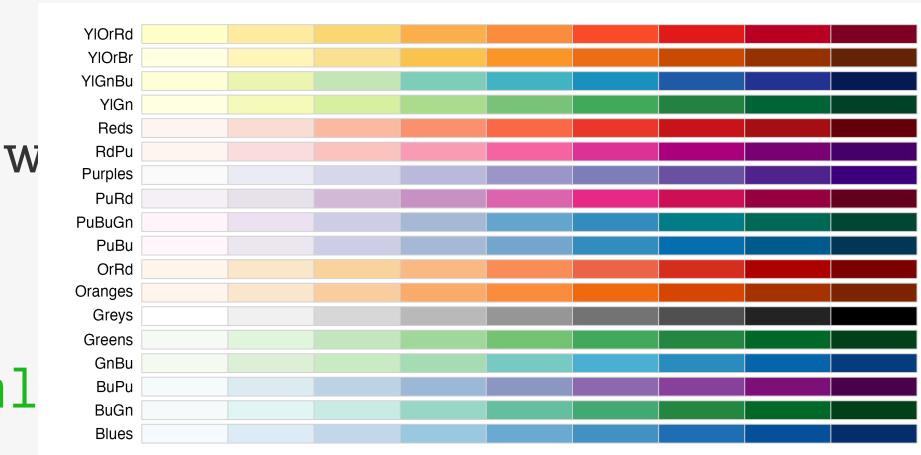
Use balanced palettes

E.g., the `RColorBrewer` Palettes

These are available through the `scale_color-brewer()` and `scale_fill_brewer()` functions, as well as independently.

See the palettes with
`RColorBrewer::display.brewer.all()`

Sequential palettes



Use balanced palettes

E.g., the `RColorBrewer` Palettes

These are available through the `scale_color-brewer()` and `scale_fill_brewer()` functions, as well as independently.

See the palettes with
`RColorBrewer::display.brewer.all()`

Diverging palettes



Qualitative Brewer Palettes

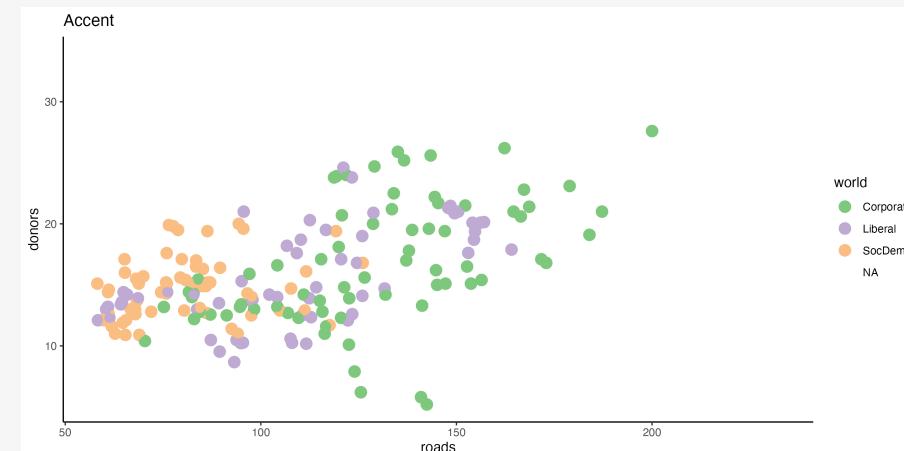
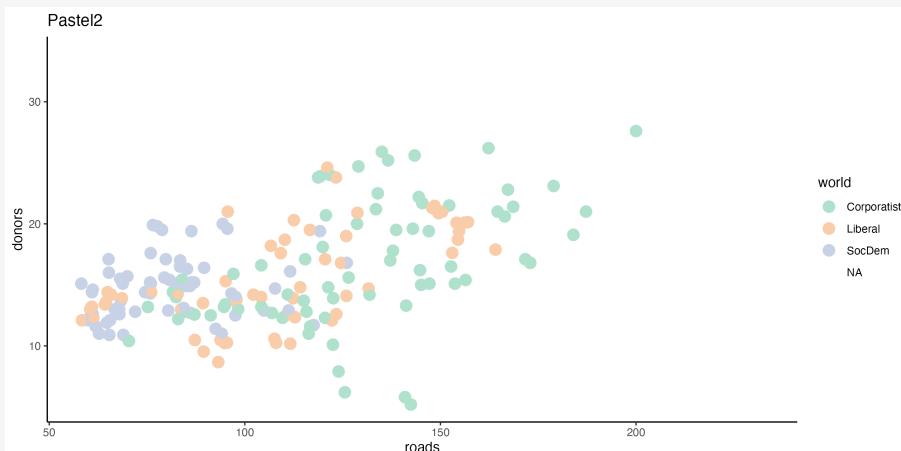
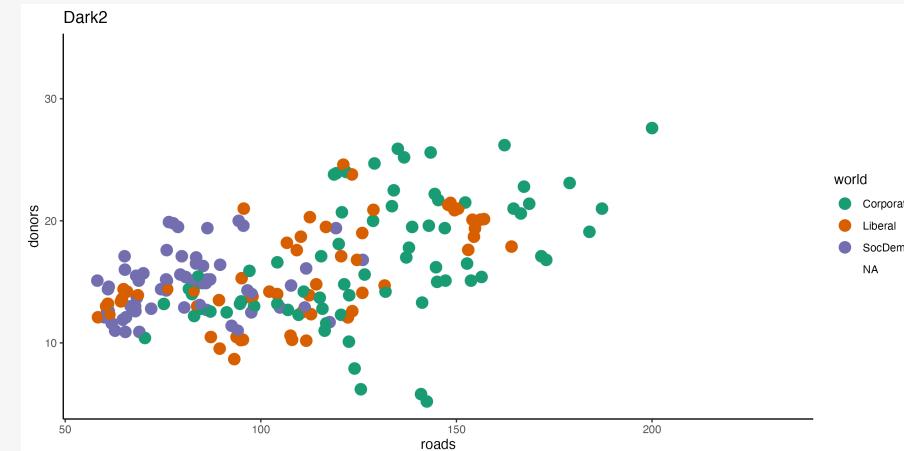
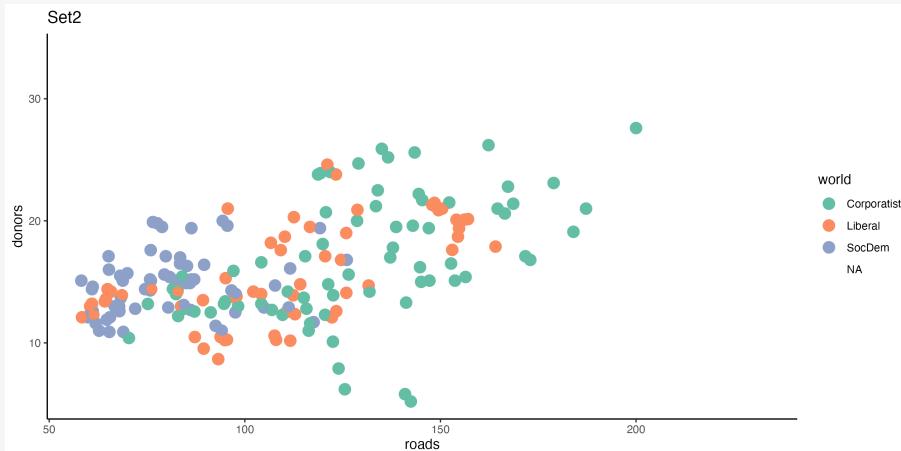
```
p + geom_point(size = 2) +
  scale_color_brewer(palette = "Set2") +
  labs(title = "Set2")

p + geom_point(size = 2) +
  scale_color_brewer(palette = "Pastel2") +
  labs(title = "Pastel2")

p + geom_point(size = 2) +
  scale_color_brewer(palette = "Dark2") +
  labs(title = "Dark2")

p + geom_point(size = 2) +
  scale_color_brewer(palette = "Accent") +
  labs(title = "Accent")
```

Some color palettes

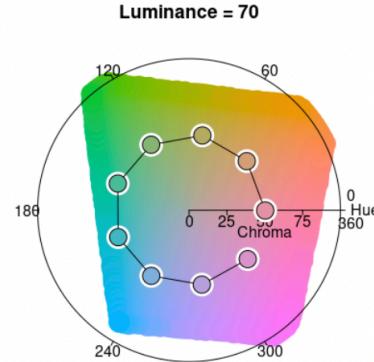


The `colorspace` package has more

[Get started](#)[Articles ▾](#)[Reference](#)[Changelog](#)[Contact](#)

A Toolbox for Manipulating and Assessing Colors and Palettes

Color spaces



HCL-based palettes

Qualitative

| | | | | | |
|----------|------------|--------------|------------|--------------|--------------|
| Pastel 1 | pink | orange | teal | purple | yellow |
| Dark 3 | dark pink | dark orange | dark teal | dark purple | dark yellow |
| Harmonic | light pink | light orange | light teal | light purple | light yellow |

Sequential (single-hue)

| | | | | |
|----------|------------|--------------|-------------|-------|
| Blues 3 | dark blue | medium blue | light blue | white |
| Reds 3 | dark red | medium red | light red | white |
| Greens 3 | dark green | medium green | light green | white |

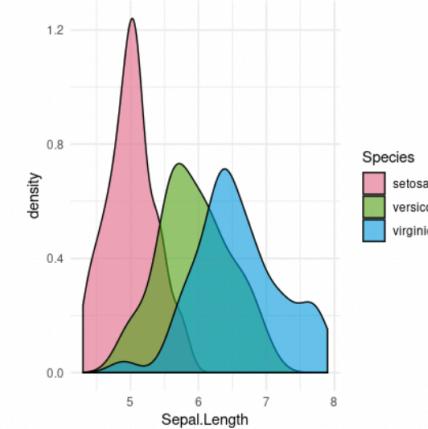
Sequential (multi-hue)

| | | | | | |
|-------------|-------------|-----------|-------|--------|-------|
| Purple-Blue | purple | blue | teal | yellow | white |
| Viridis | dark purple | dark teal | green | yellow | white |
| ag_Sunset | dark purple | dark teal | red | yellow | white |

Diverging

| | | | | |
|-------------|------------|------|-------|------------|
| Blue-Red | dark blue | grey | red | dark red |
| Green-Brown | dark green | grey | brown | dark brown |
| Tropic | dark teal | grey | pink | dark pink |

ggplot2 scales



Links

Download from CRAN at
[https://cloud.r-project.org/
package=colorspace](https://cloud.r-project.org/package=colorspace)

Report a bug at
[https://colorspace.R-Forge.R-project.org/
contact.html](https://colorspace.R-Forge.R-project.org/contact.html)

Online color apps at
<https://hclwizard.org/>

License

[BSD_3_clause](#) + file [LICENSE](#)

Citation

[Citing colorspace](#)

Developers

Ross Ihaka

Author

Many palettes



So many colors

The `colorspace` function convention

`scale_<MAPPING>_<KIND><COLORSCALE>()`

`scale_color_binned_diverging()`

`scale_color_binned_qualitative()`

`scale_color_binned_sequential()`

`scale_color_continuous_diverging()`

`scale_color_continuous_qualitative()`

`scale_color_continuous_sequential()`

`scale_color_discrete_diverging()`

`scale_color_discrete_qualitative()`

`scale_color_discrete_sequential()`

`scale_fill_binned_diverging()`

`scale_fill_binned_divergingx()`

`scale_fill_binned_qualitative()`

`scale_fill_binned_sequential()`

`scale_fill_continuous_diverging()`

`scale_fill_continuous_qualitative()`

`scale_fill_continuous_sequential()`

`scale_fill_discrete_diverging()`

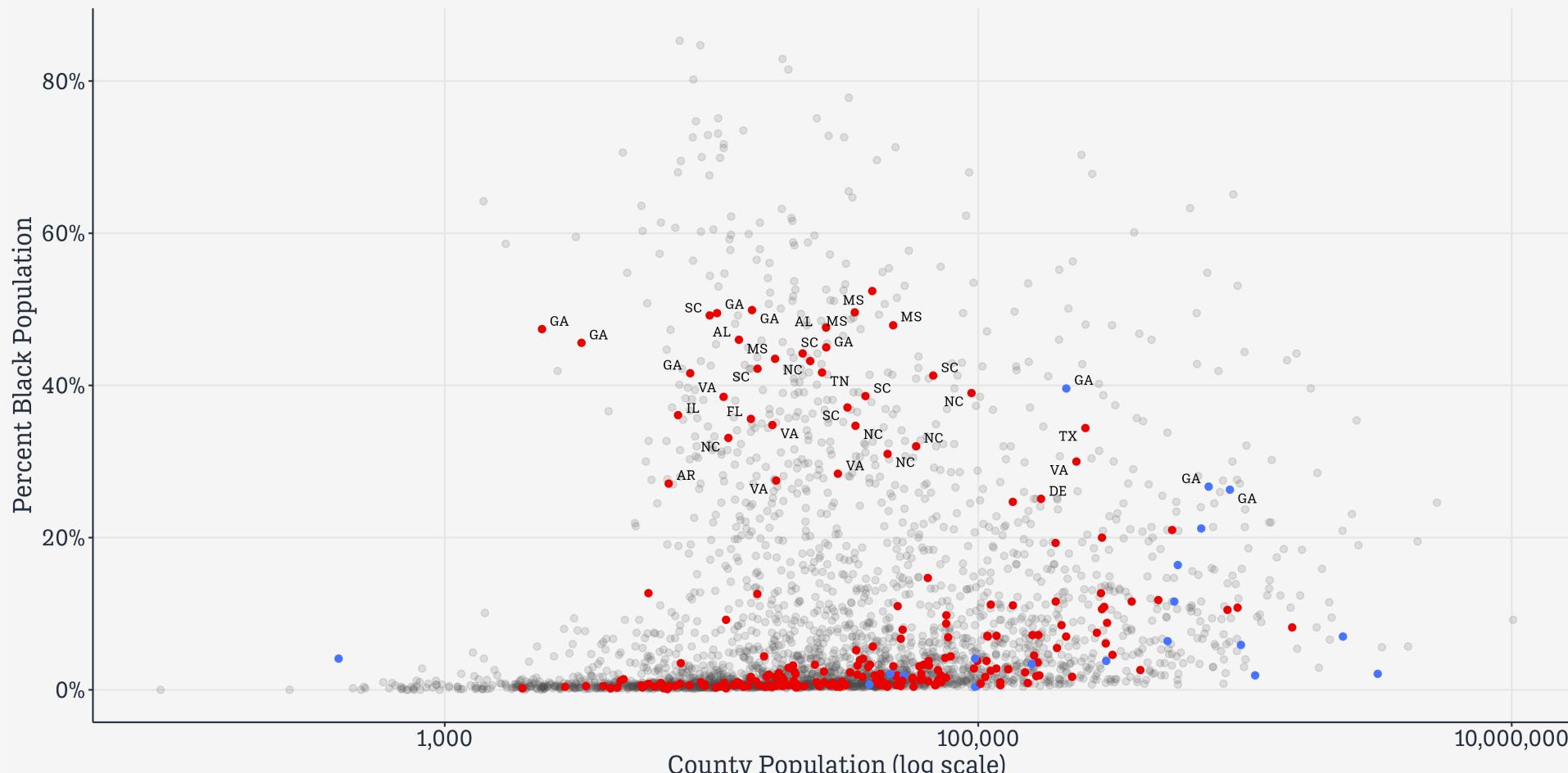
`scale_fill_discrete_qualitative()`

`scale_fill_discrete_sequential()`

**Layer color and text
to your advantage**

Flipped counties, 2016

County flipped to ... • Democrat • Republican



Counties in gray did not flip.

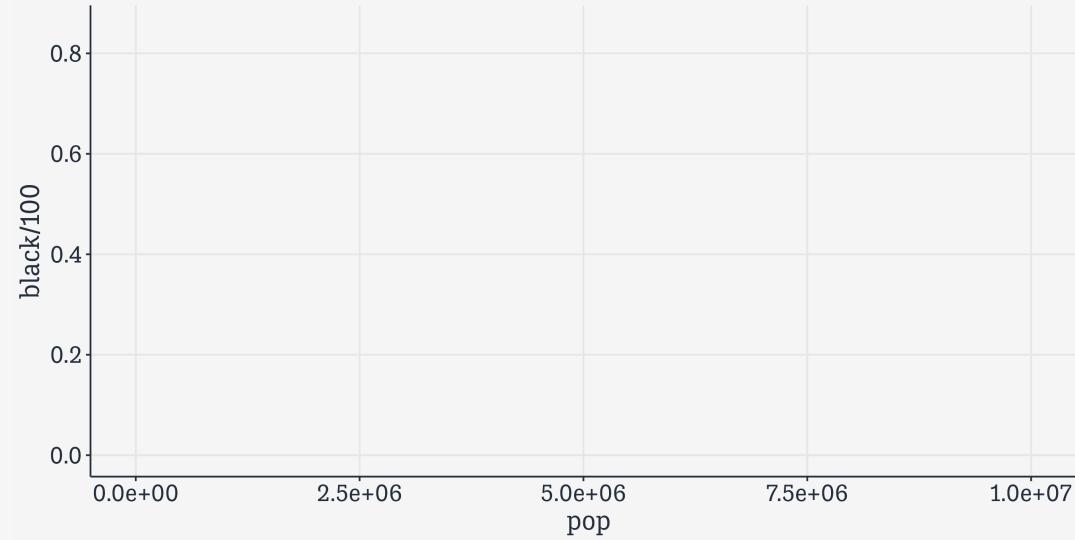
We know how to build this

```
## Brighter Blue and Red  
party_colors ← c("royalblue1", "red2")
```

We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

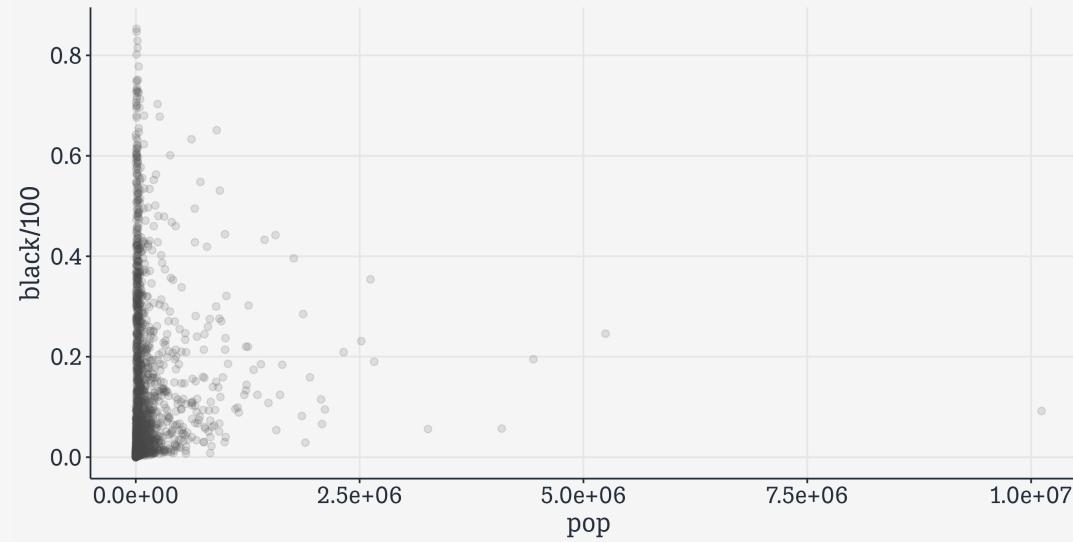
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                     y = black/100))
```



We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

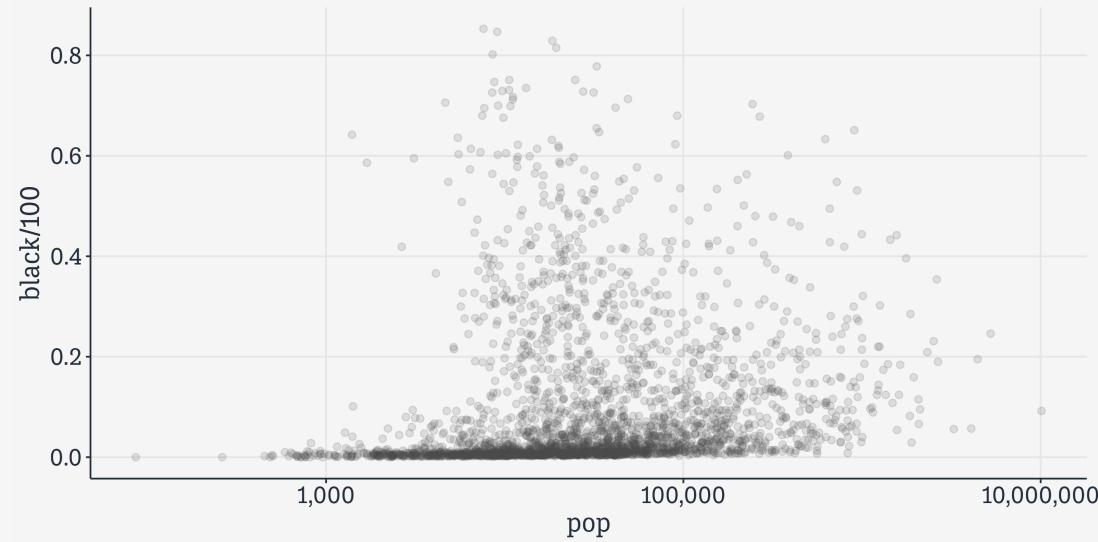
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                     y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2))
```



We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

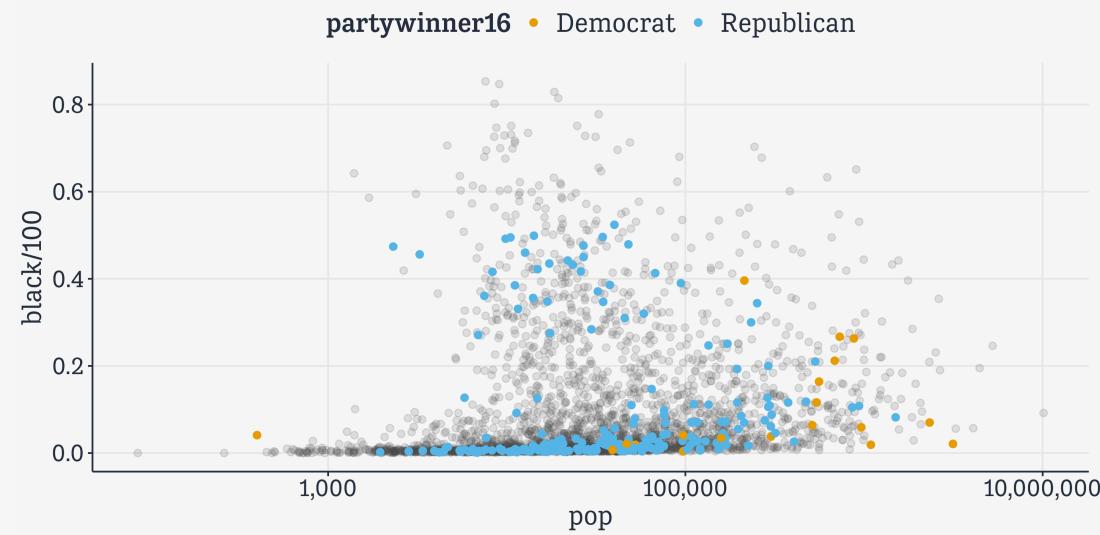
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                     y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2)) +
  scale_x_log10(labels = label_comma())
```



We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

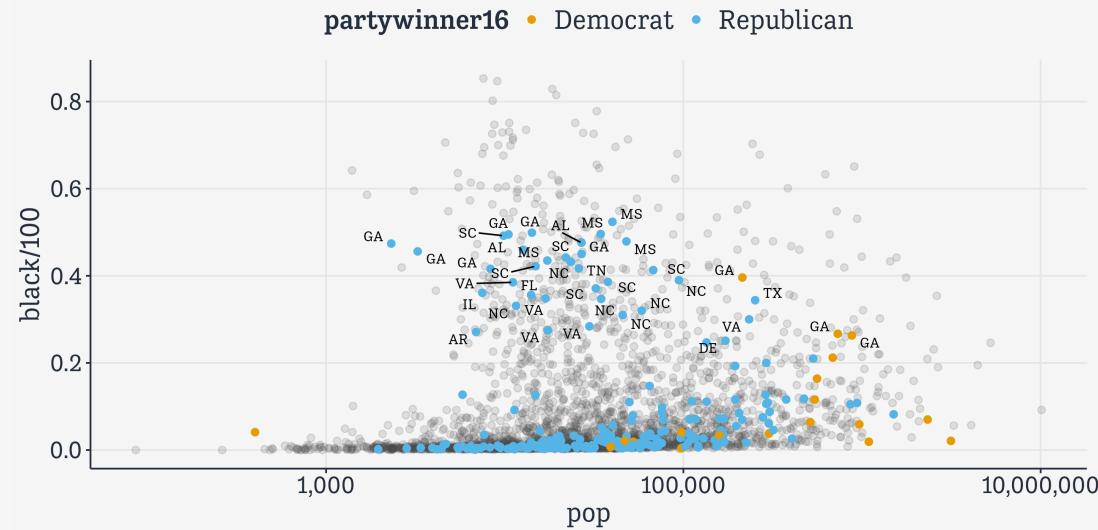
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                     y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2)) +
  scale_x_log10(labels = label_comma()) +
  geom_point(data = subset(county_data,
                           flipped = "Yes"),
             mapping = aes(x = pop, y = black/100,
                           color = partywinner16),
             size = rel(2))
```



We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

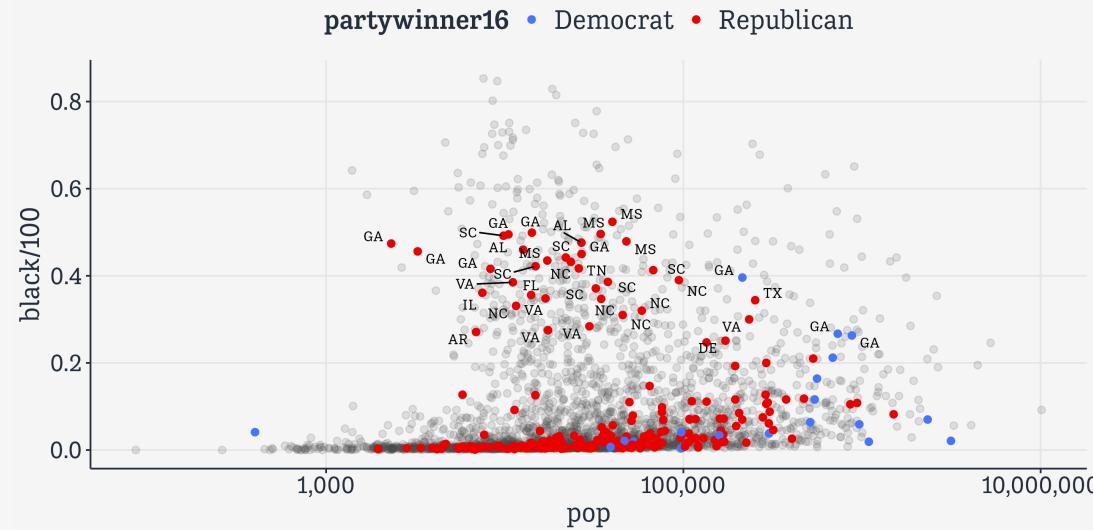
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                      y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2)) +
  scale_x_log10(labels = label_comma()) +
  geom_point(data = subset(county_data,
                           flipped = "Yes"),
             mapping = aes(x = pop, y = black/100,
                            color = partywinner16),
             size = rel(2)) +
  geom_text_repel(data = subset(county_data,
                               flipped = "Yes" & black > 25),
                  mapping = aes(x = pop,
                                 y = black/100, label = state,
                                 family = "Tenso Slide",
                                 face = "bold"), size = rel(3.5))
```



We know how to build this

```
## Brighter Blue and Red
party_colors ← c("royalblue1", "red2")

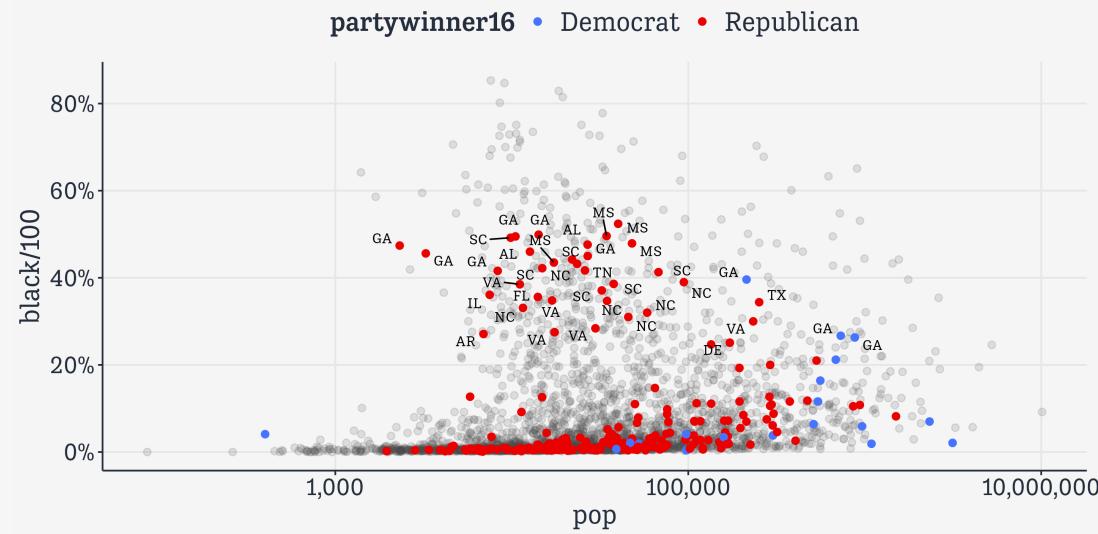
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                     y = black/100)) +
  geom_point(alpha = 0.15, color = "gray50",
             size = rel(2)) +
  scale_x_log10(labels = label_comma()) +
  geom_point(data = subset(county_data,
                           flipped = "Yes"),
             mapping = aes(x = pop, y = black/100,
                           color = partywinner16),
             size = rel(2)) +
  geom_text_repel(data = subset(county_data,
                               flipped = "Yes" & black > 25),
                  mapping = aes(x = pop,
                                y = black/100, label = state,
                                family = "Tenso Slide",
                                face = "bold"), size = rel(3.5)) +
  scale_color_manual(values = party_colors)
```



We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

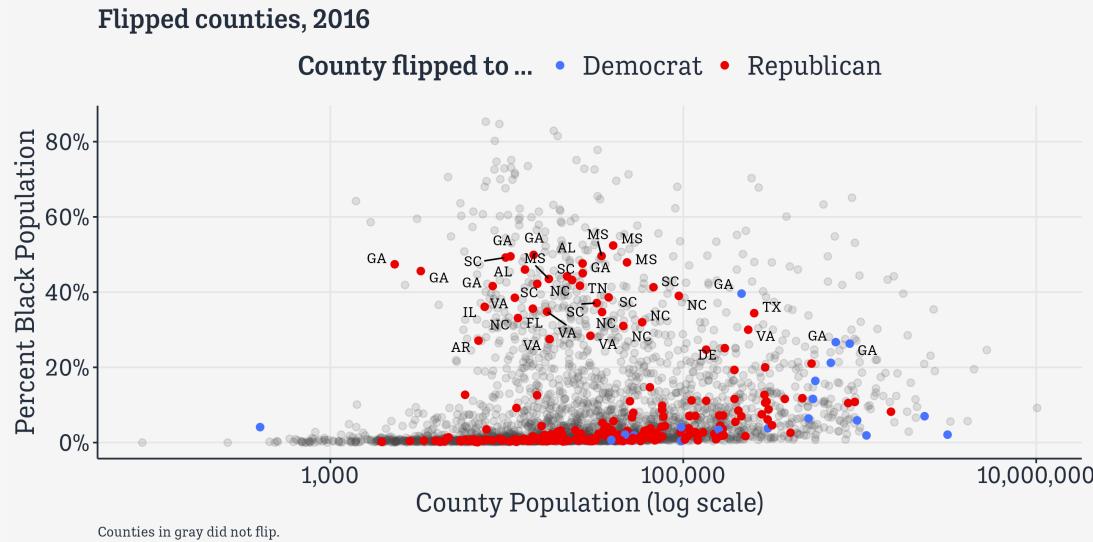
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                      y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2)) +
  scale_x_log10(labels = label_comma()) +
  geom_point(data = subset(county_data,
                           flipped = "Yes"),
             mapping = aes(x = pop, y = black/100,
                            color = partywinner16),
             size = rel(2)) +
  geom_text_repel(data = subset(county_data,
                               flipped = "Yes" & black > 25),
                  mapping = aes(x = pop,
                                 y = black/100, label = state,
                                 family = "Tenso Slide",
                                 face = "bold"), size = rel(3.5)) +
  scale_color_manual(values = party_colors) +
  scale_y_continuous(labels = label_percent())
```



We know how to build this

```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

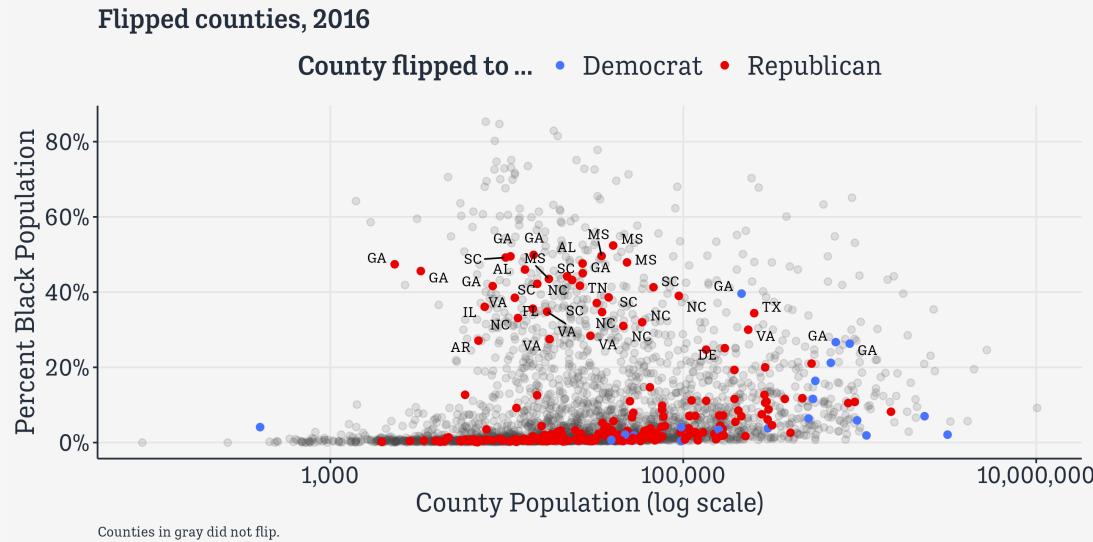
ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                      y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2)) +
  scale_x_log10(labels = label_comma()) +
  geom_point(data = subset(county_data,
                           flipped = "Yes"),
             mapping = aes(x = pop, y = black/100,
                            color = partywinner16),
             size = rel(2)) +
  geom_text_repel(data = subset(county_data,
                                flipped = "Yes" & black > 25),
                  mapping = aes(x = pop,
                                 y = black/100, label = state,
                                 family = "Tenso Slide",
                                 face = "bold"), size = rel(3.5)) +
  scale_color_manual(values = party_colors) +
  scale_y_continuous(labels = label_percent()) +
  labs(color = "County flipped to ... ",
       x = "County Population (log scale)",
       y = "Percent Black Population",
       title = "Flipped counties, 2016",
       caption = "Counties in gray did not flip.")
```



We know how to build this

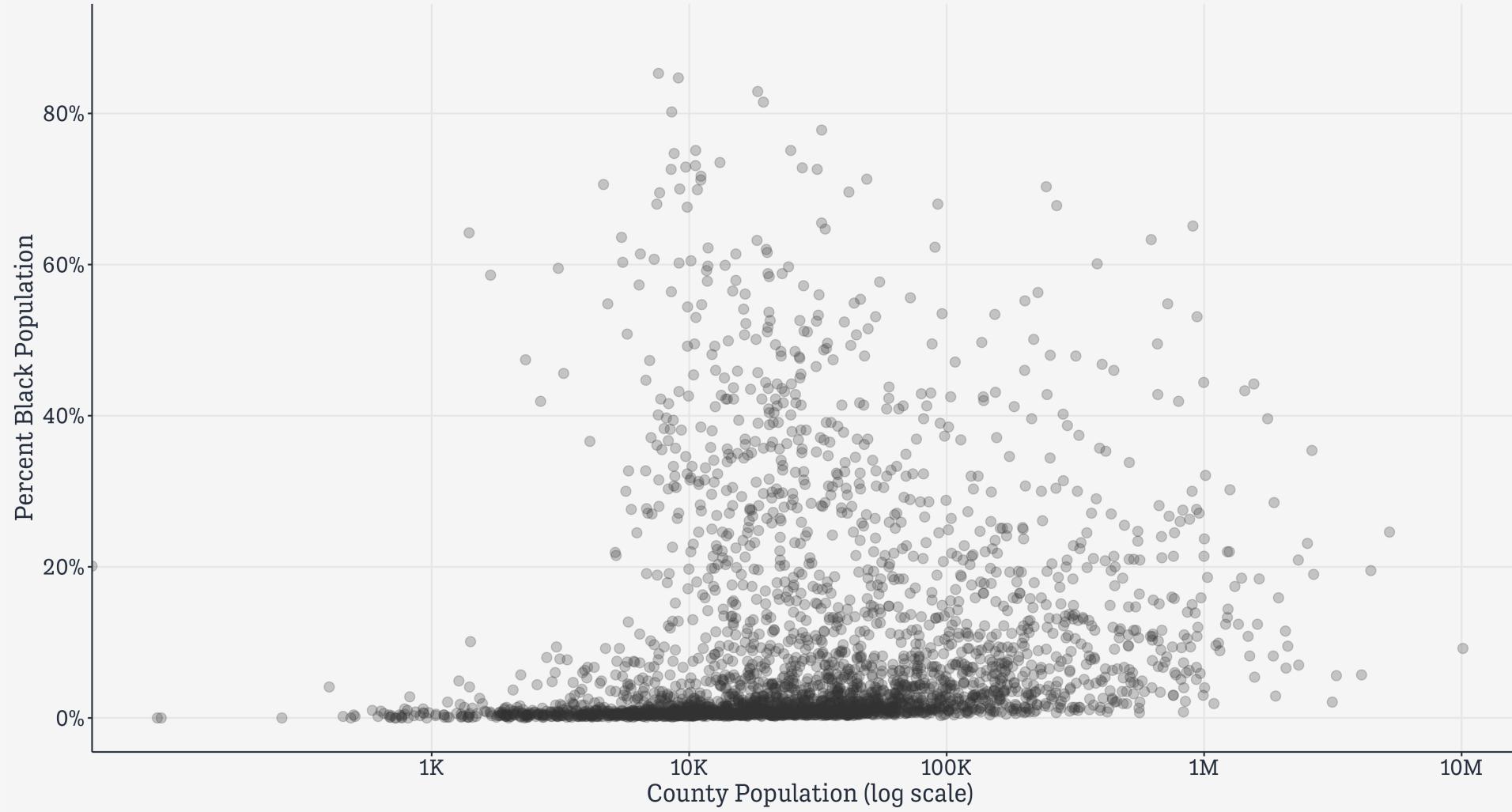
```
## Brighter Blue and Red
party_colors <- c("royalblue1", "red2")

ggplot(data = subset(county_data,
                     flipped = "No"),
       mapping = aes(x = pop,
                      y = black/100)) +
  geom_point(alpha = 0.15, color = "gray30",
             size = rel(2)) +
  scale_x_log10(labels = label_comma()) +
  geom_point(data = subset(county_data,
                           flipped = "Yes"),
             mapping = aes(x = pop, y = black/100,
                            color = partywinner16),
             size = rel(2)) +
  geom_text_repel(data = subset(county_data,
                                flipped = "Yes" & black > 25),
                  mapping = aes(x = pop,
                                 y = black/100, label = state,
                                 family = "Tenso Slide",
                                 face = "bold"), size = rel(3.5)) +
  scale_color_manual(values = party_colors) +
  scale_y_continuous(labels = label_percent()) +
  labs(color = "County flipped to ... ",
       x = "County Population (log scale)",
       y = "Percent Black Population",
       title = "Flipped counties, 2016",
       caption = "Counties in gray did not flip.")
```

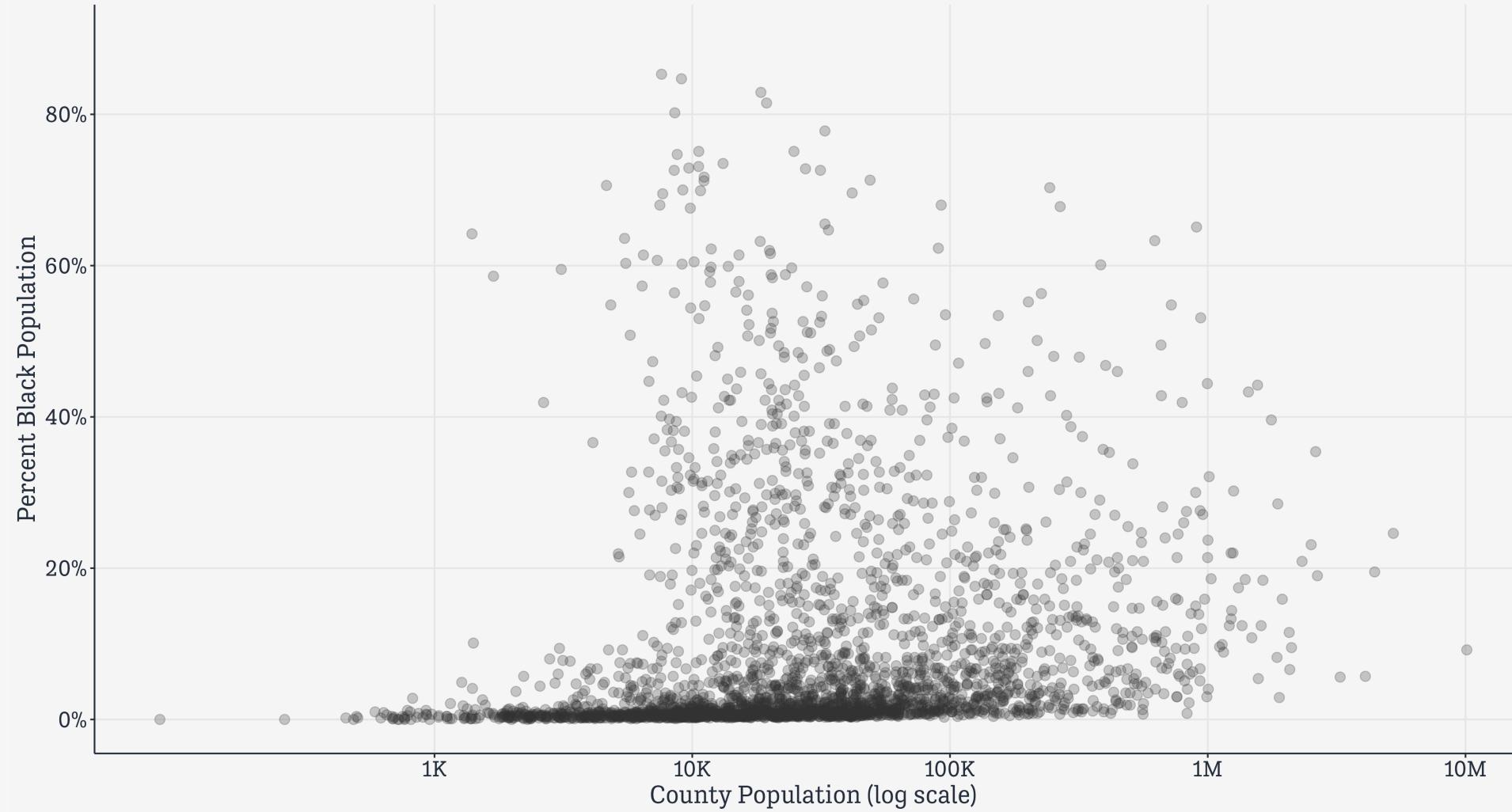


Leverage ggplot's
layered approach

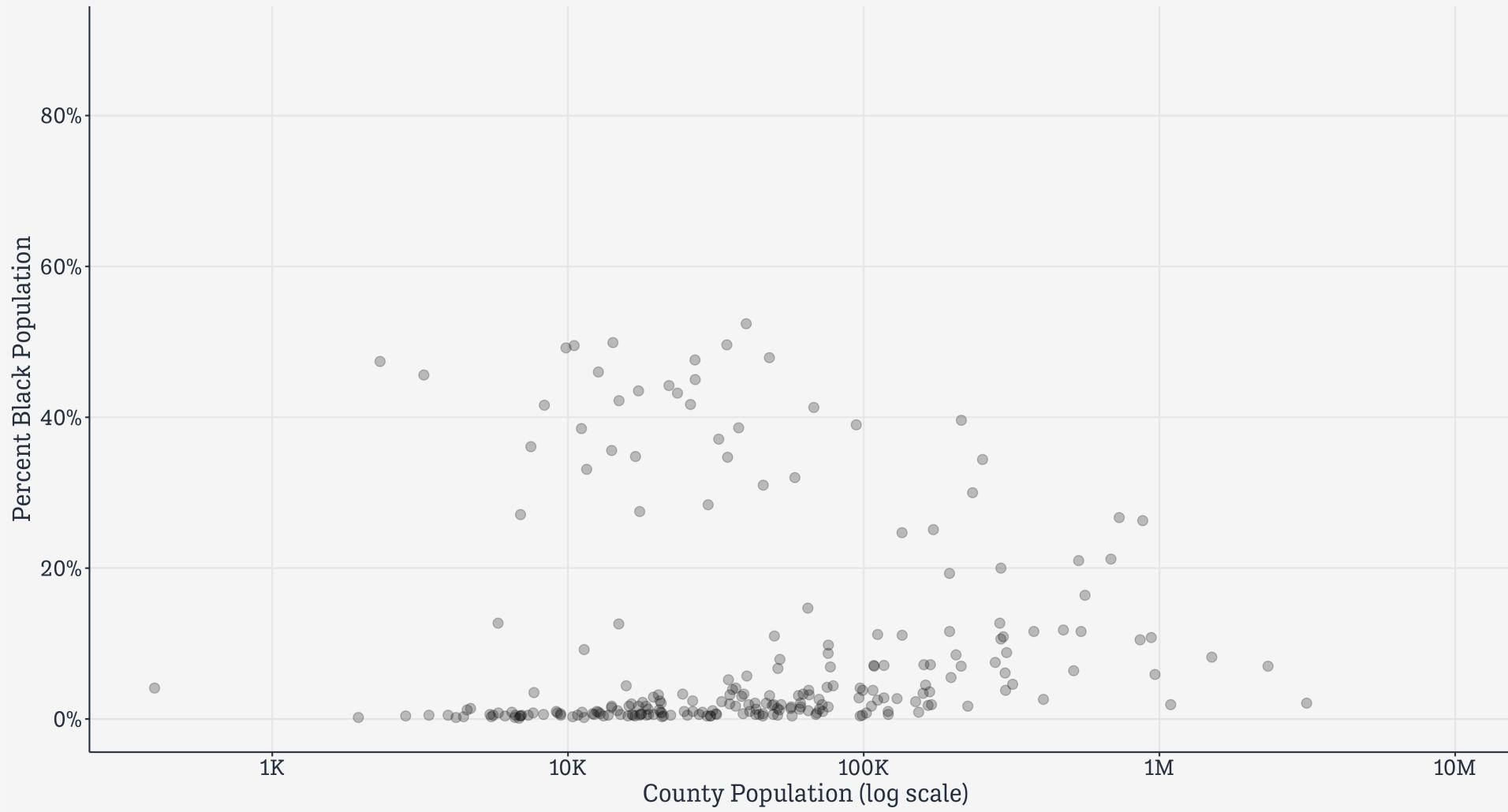
U.S. Counties by Population and Percent Black



These counties did not flip in 2016

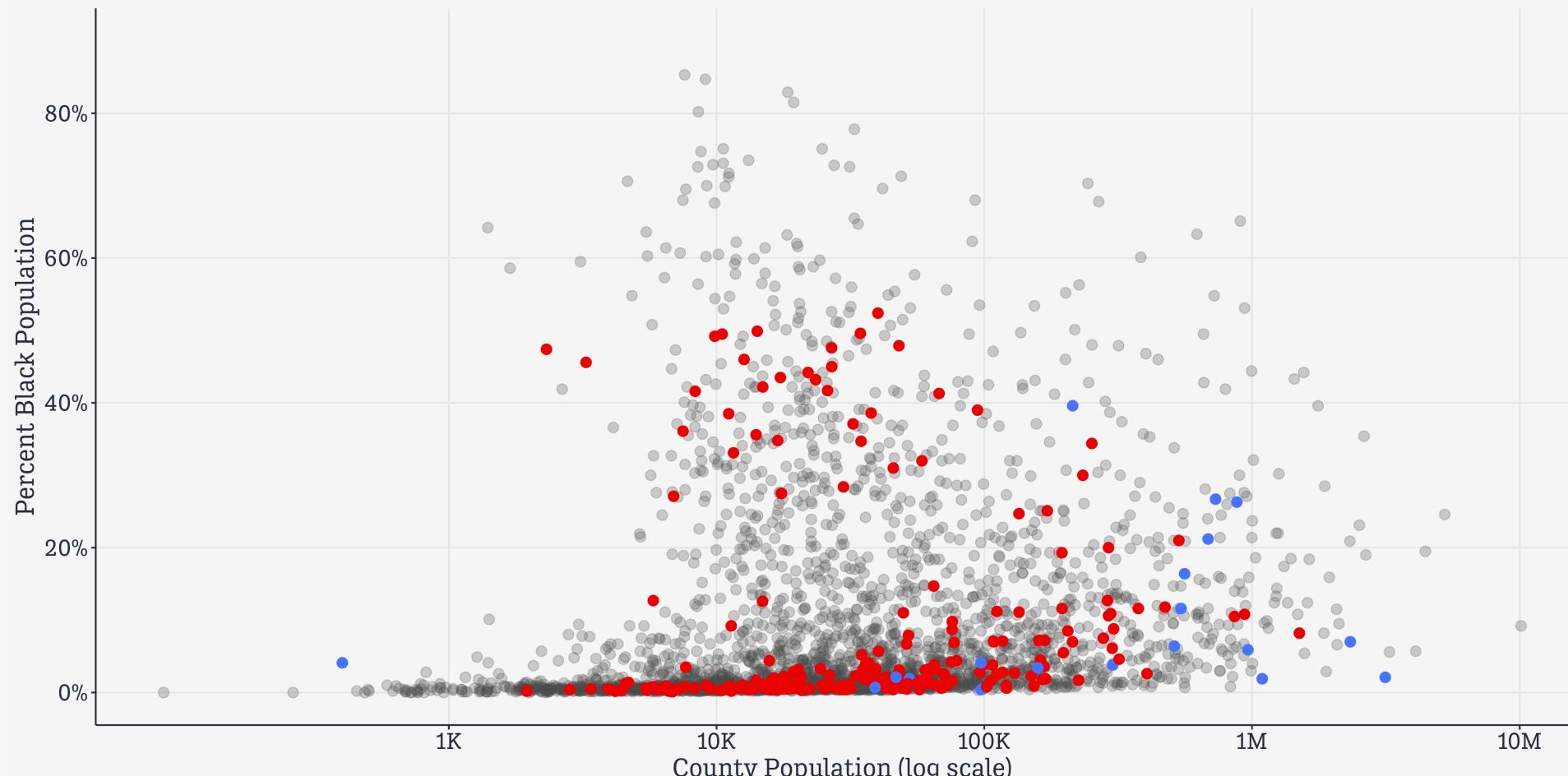


These counties did



Counties that flipped shown by party color

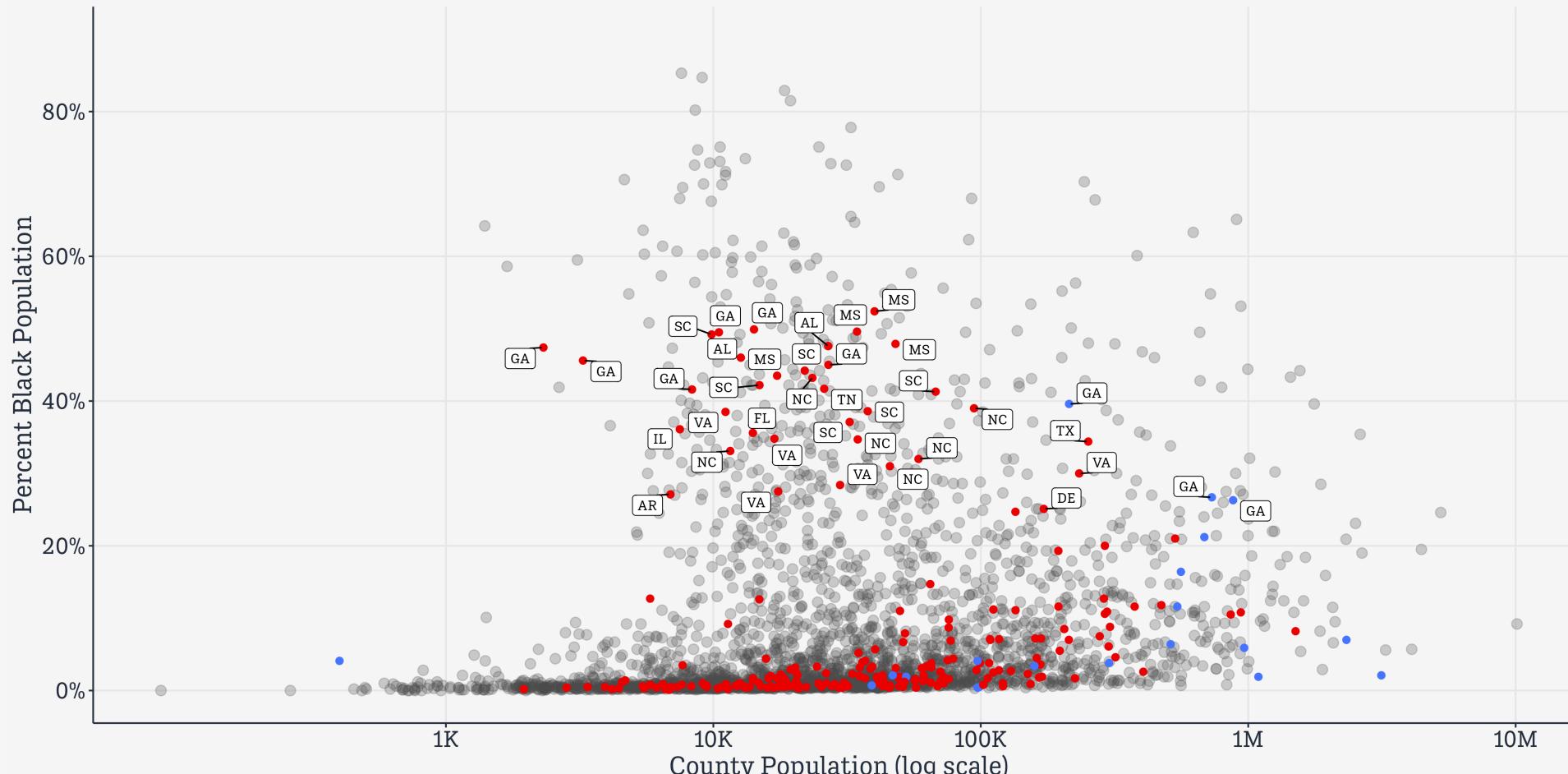
Flipped to • Democrat • Republican



Counties in gray did not flip.

Counties that flipped shown by party color, and labeled by state

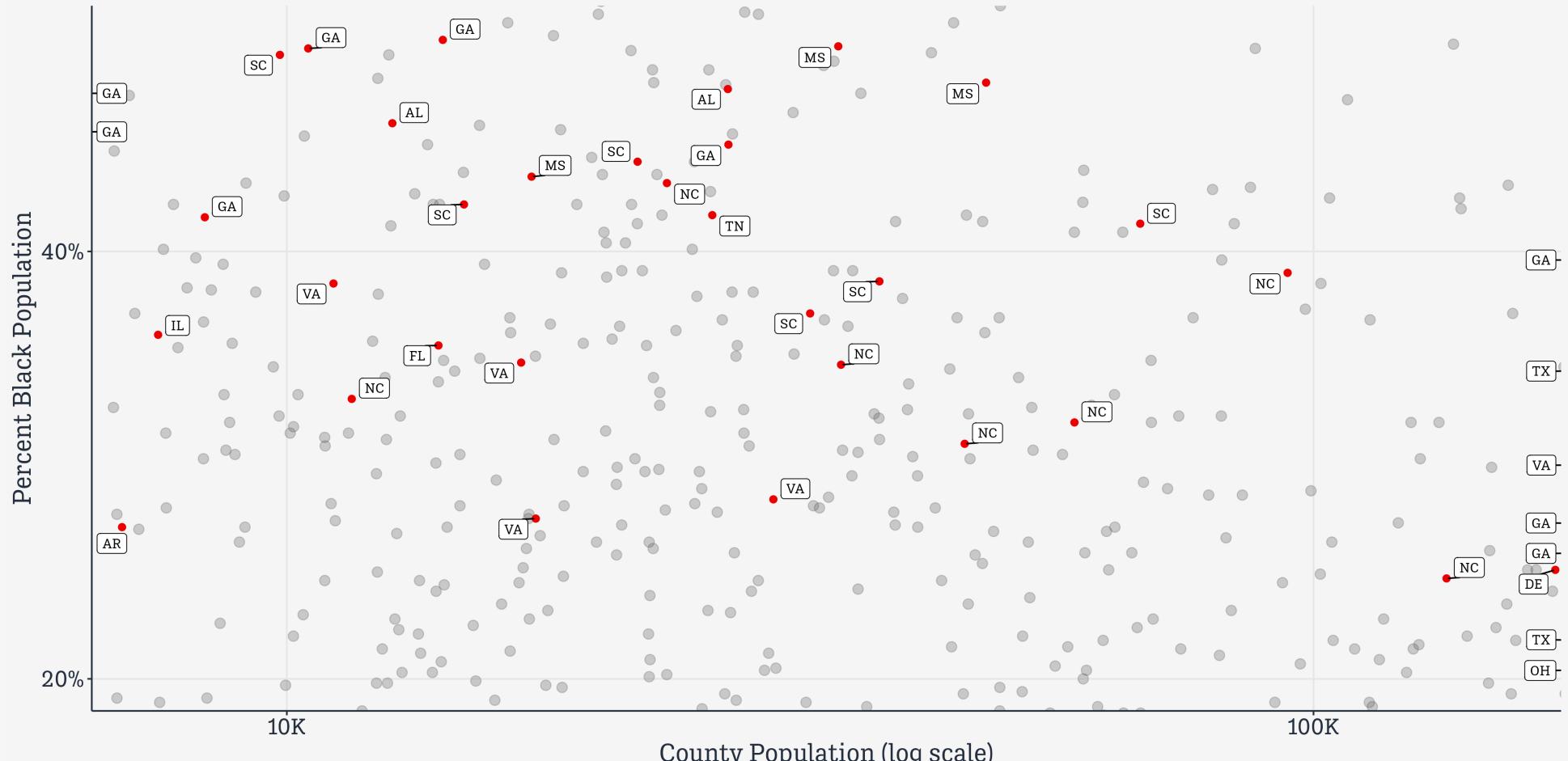
Flipped to • Democrat • Republican



Counties in gray did not flip.

Counties that flipped shown by party color, and labeled by state; zoomed-in

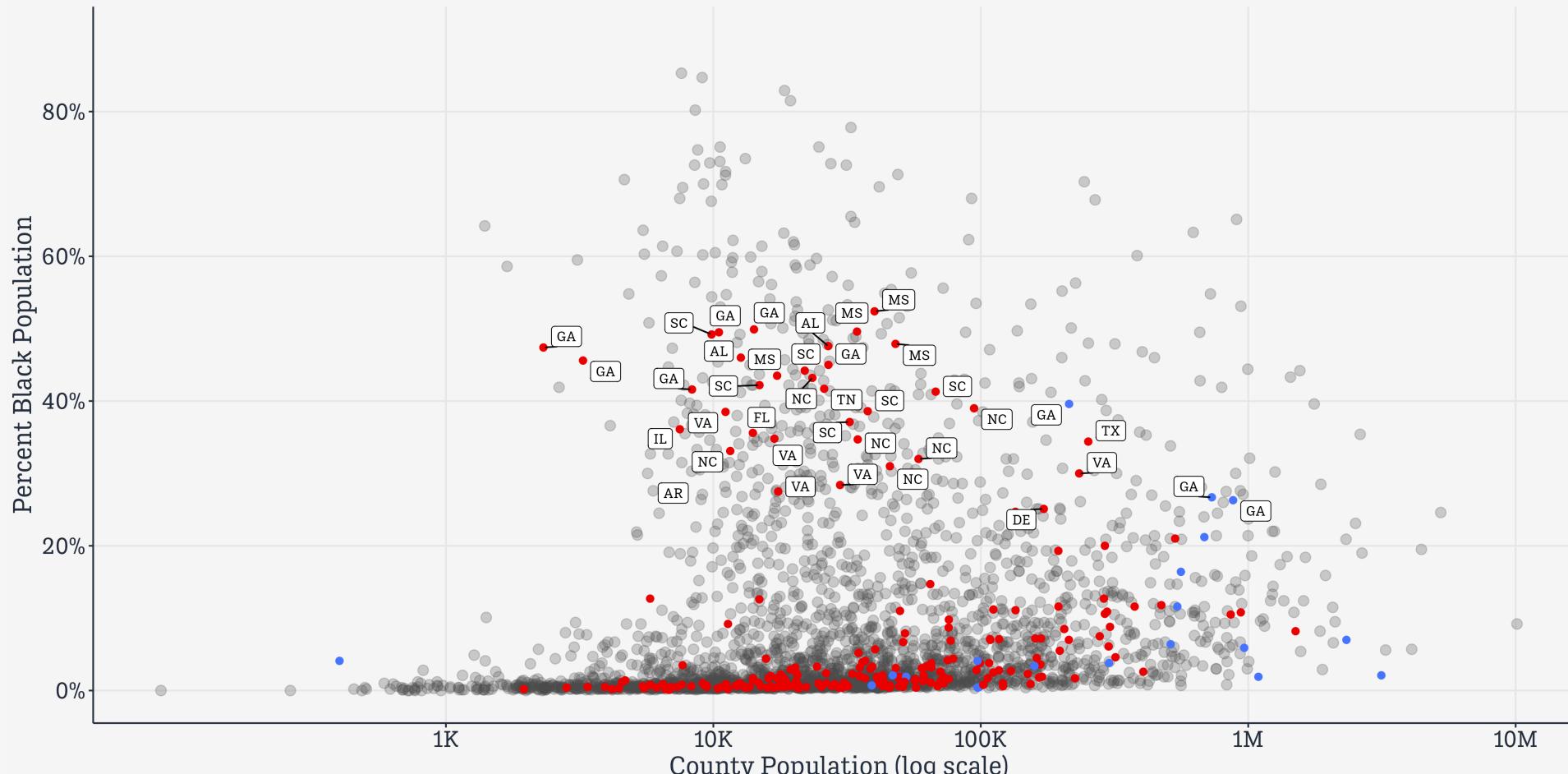
Flipped to • Democrat • Republican



Counties in gray did not flip.

Counties that flipped shown by party color, and labeled by state

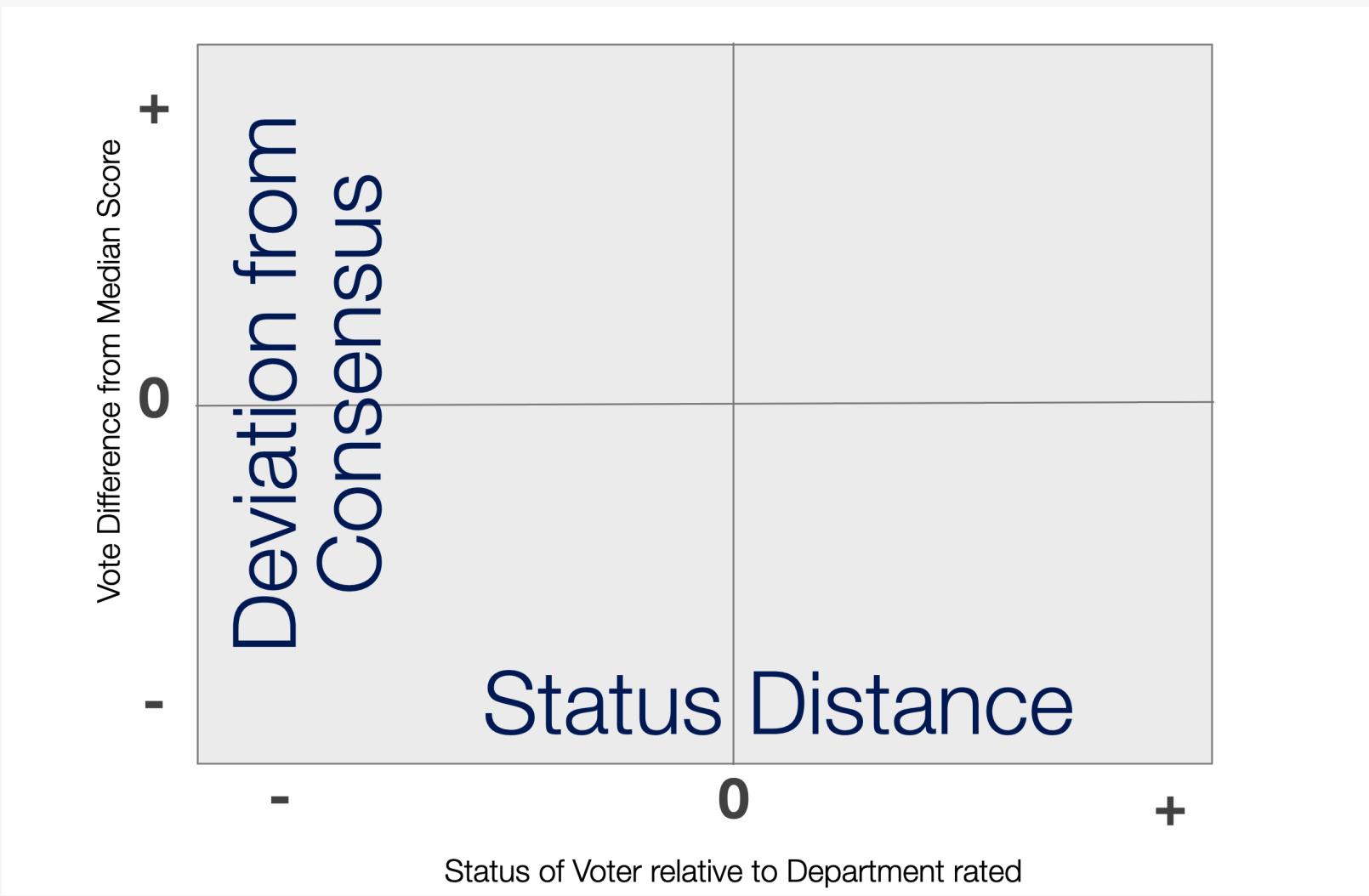
Flipped to • Democrat • Republican



Counties in gray did not flip.

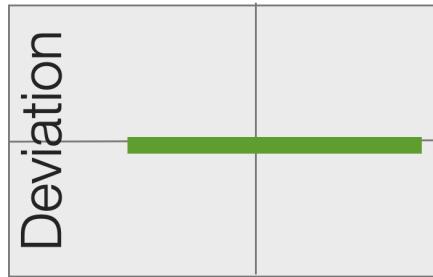
Layer,
Highlight,
Repeat

Build from ideas to data



The relationship of interest

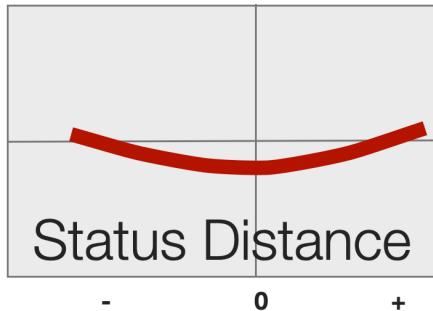
Build from ideas to data



1. Pure Objectivity



2. Distant Envy

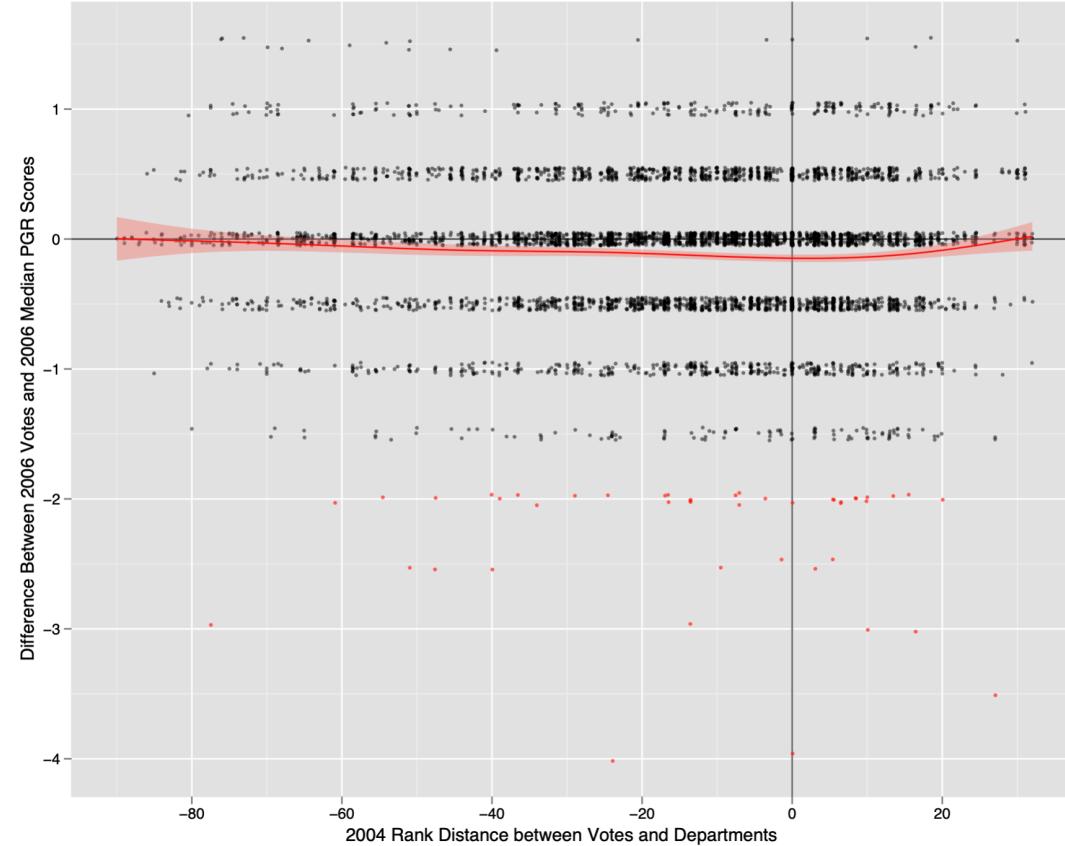


3. Local Competition

Theory says ...

Build from ideas to data

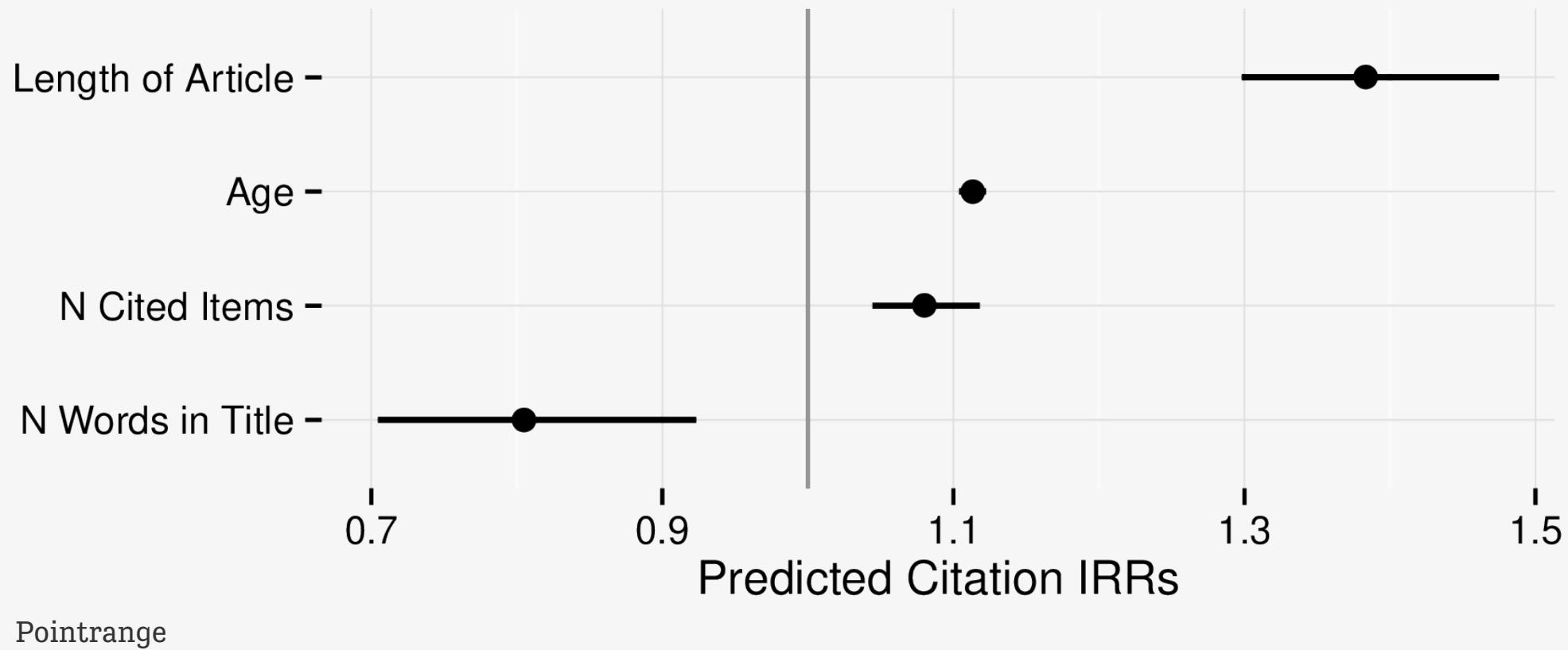
Deviation



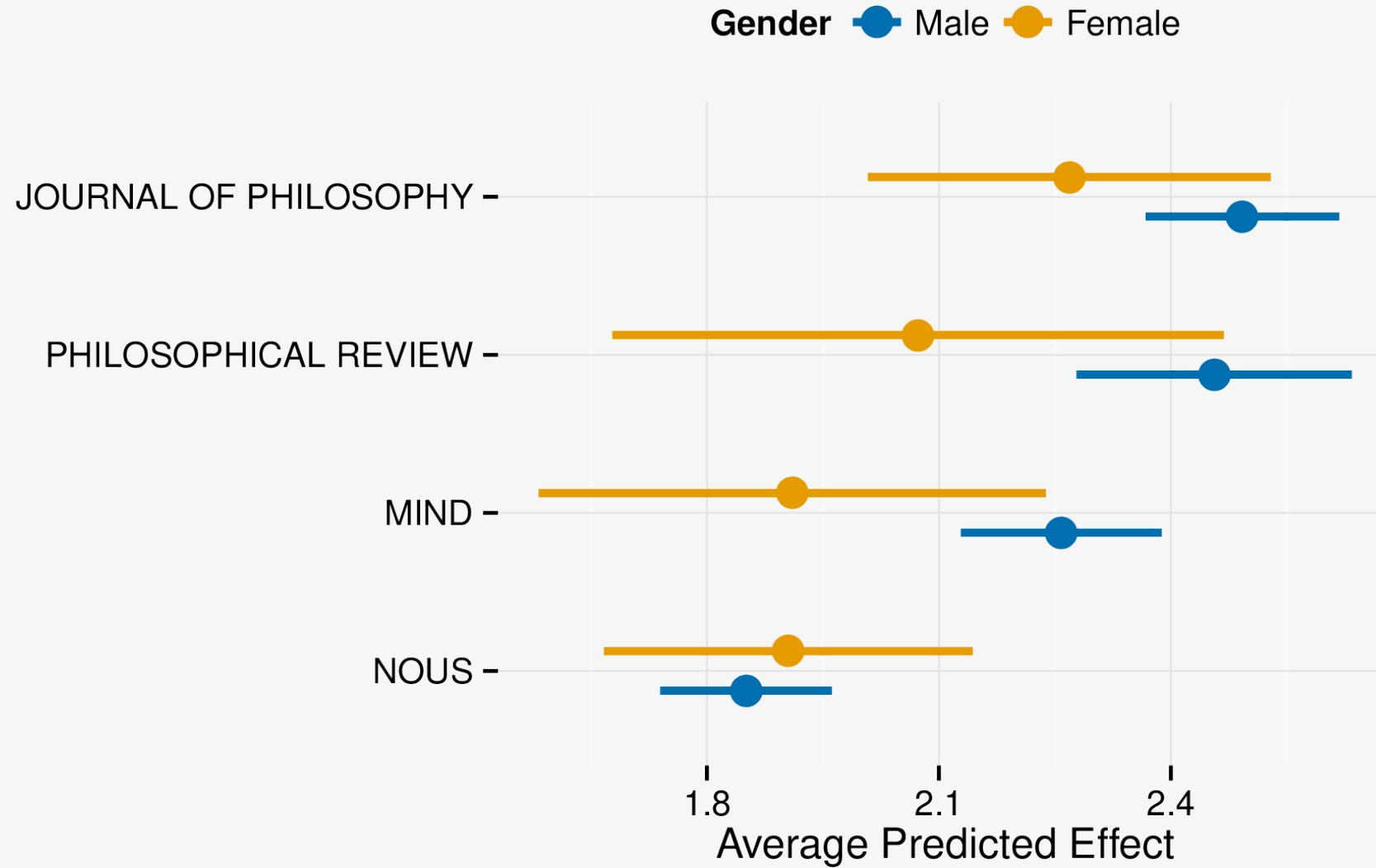
Status Distance

Data suggests ...

Repeat to differentiate



Repeat to differentiate

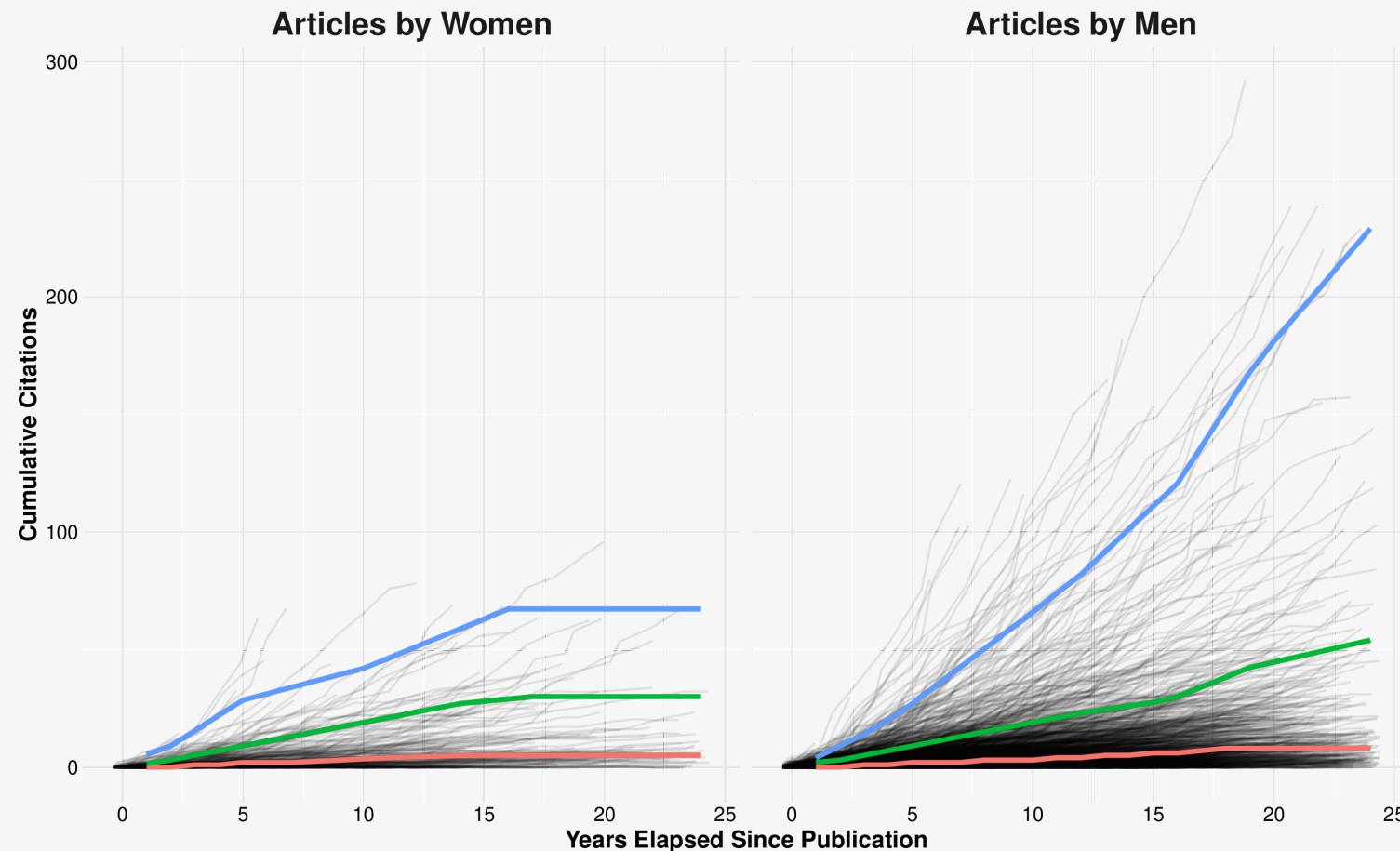


Add a comparison group

Layer and repeat with facets

Citation Growth Curves for all Articles

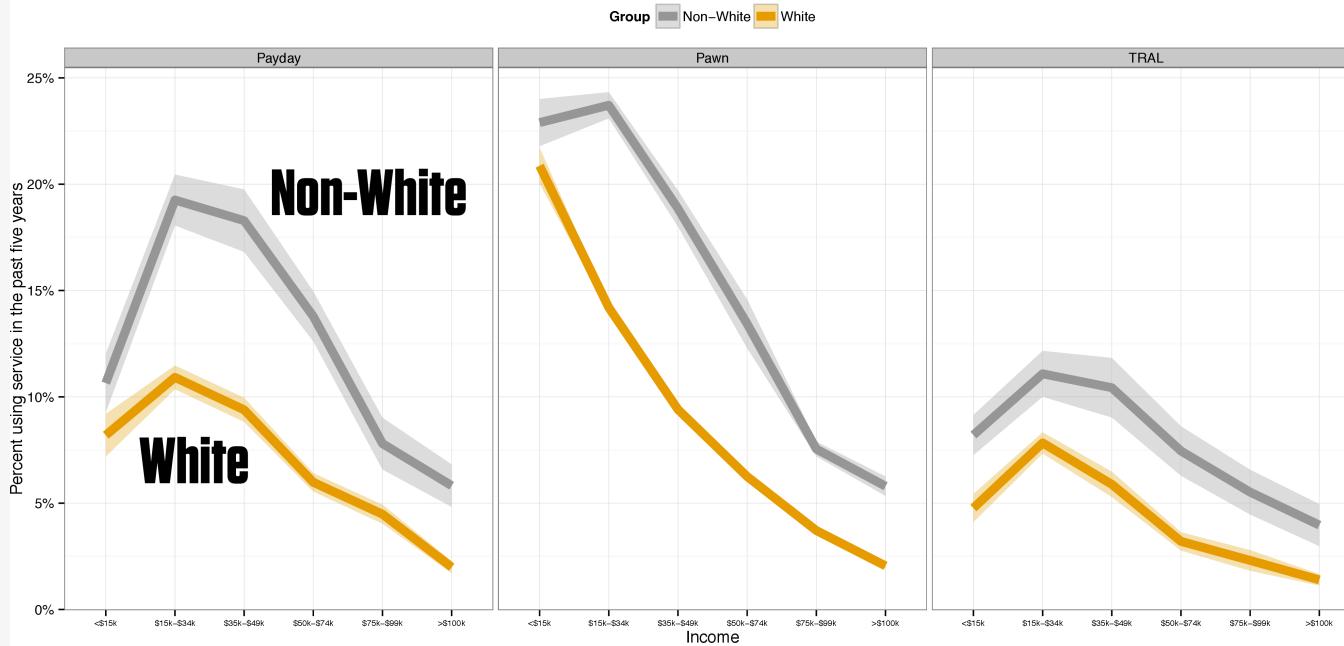
Percentile — at the Median — at the 90th Percentile — in the top One Percent



Compare across facets

Layer and repeat across facets

Categorical Gaps: Alternative Financial Services



Payday Loan

Pawn Shop

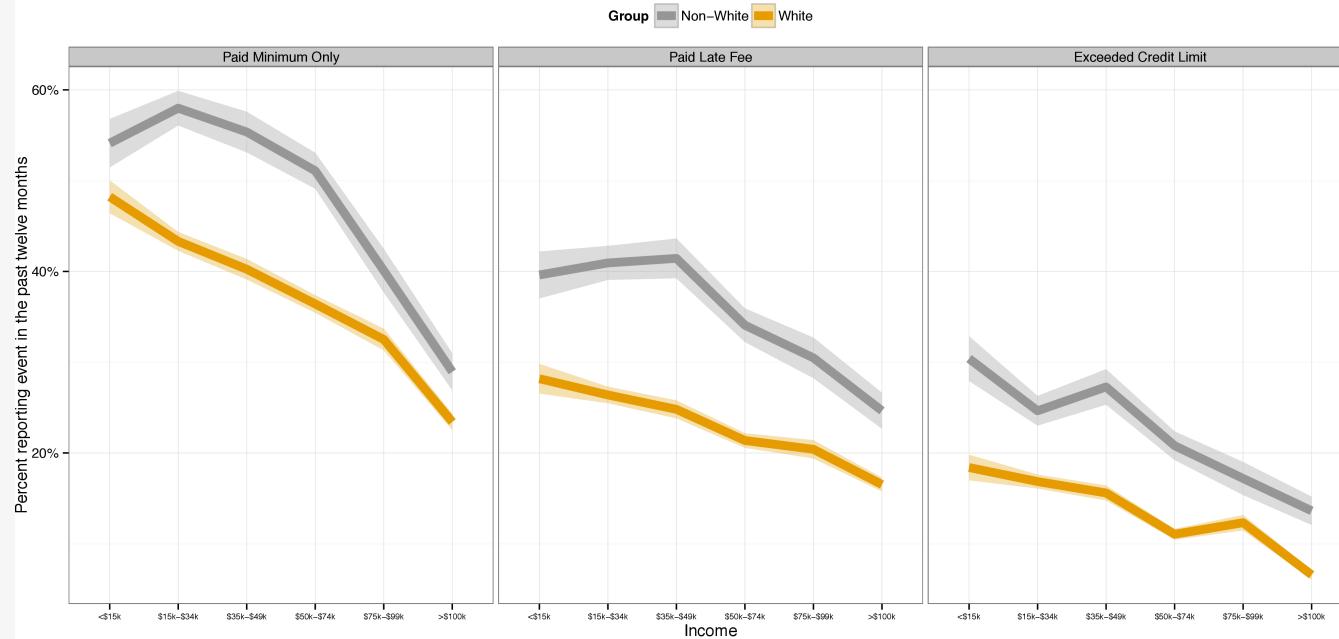
TRAL

8

Layer to compare

Layer and repeat across facets

Categorical Gaps: Adverse Credit Events



Minimum Only

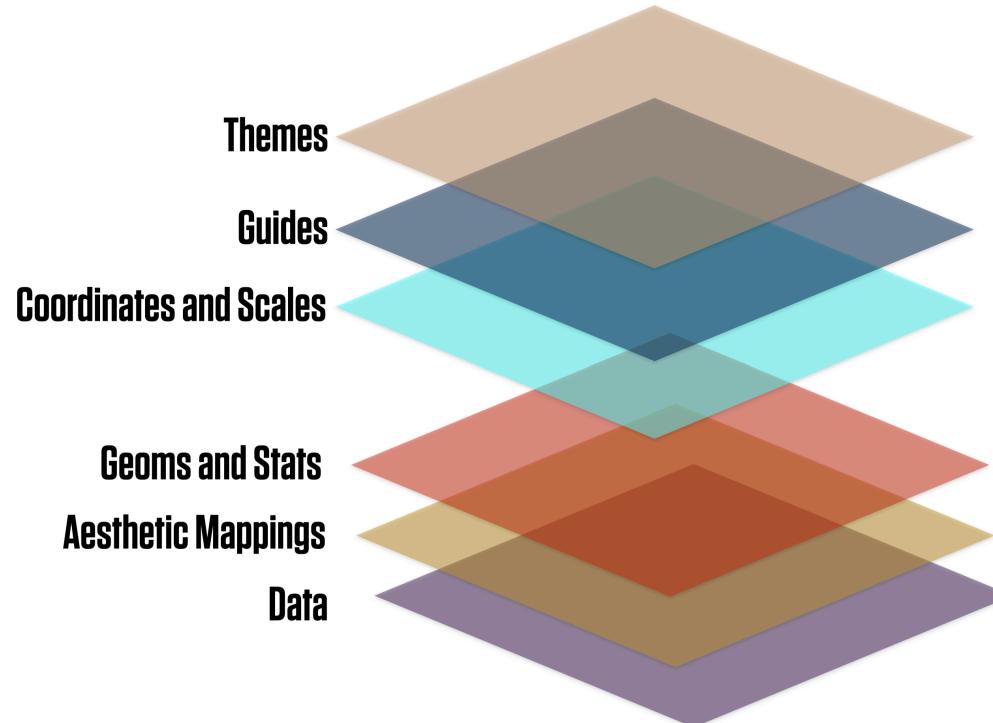
Late Fee

Over Limit

9

Layer to compare

X-Ray Vision



Seeing through it

Themes

Themes ...

are controlled by the `theme()` function

can be bundled into functions of their own, like `theme_bw()` or
`theme_minimal()`

can be set for the duration of a file or project with `theme_set()`

make changes that are applied *additively*

and most importantly ...

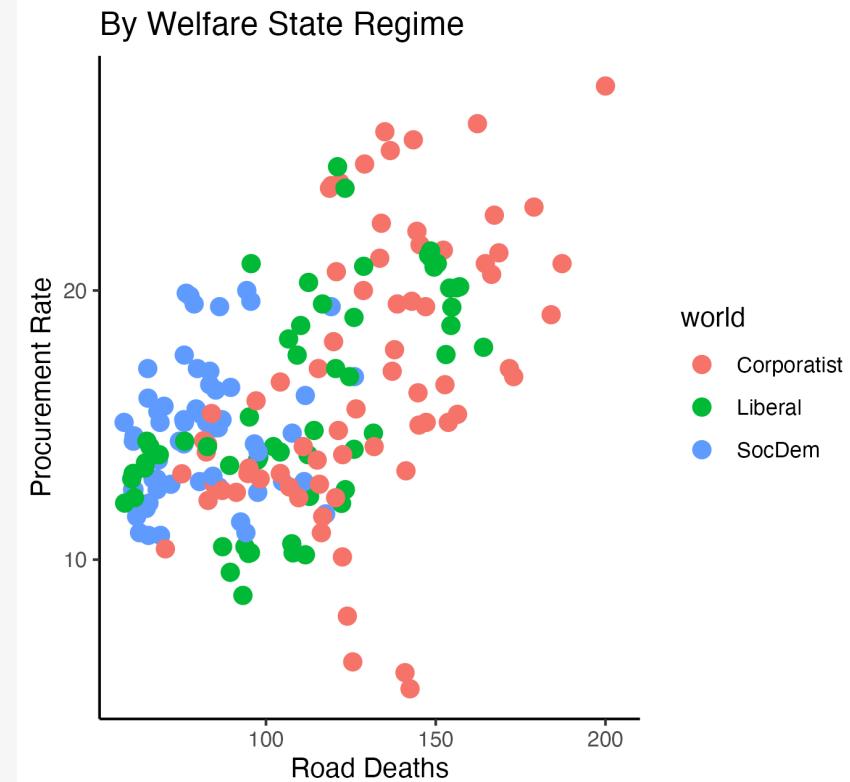
**Thematic elements
do not represent
data directly**

Make a plot

```
kjh_set_classic_theme(3)
```

```
p <- organdata %>
  drop_na(world) %>
  ggplot(mapping = aes(x = roads, y = donors,
                        color = world)) +
  geom_point(size = 3) +
  labs(x = "Road Deaths",
       y = "Procurement Rate",
       title = "By Welfare State Regime")
```

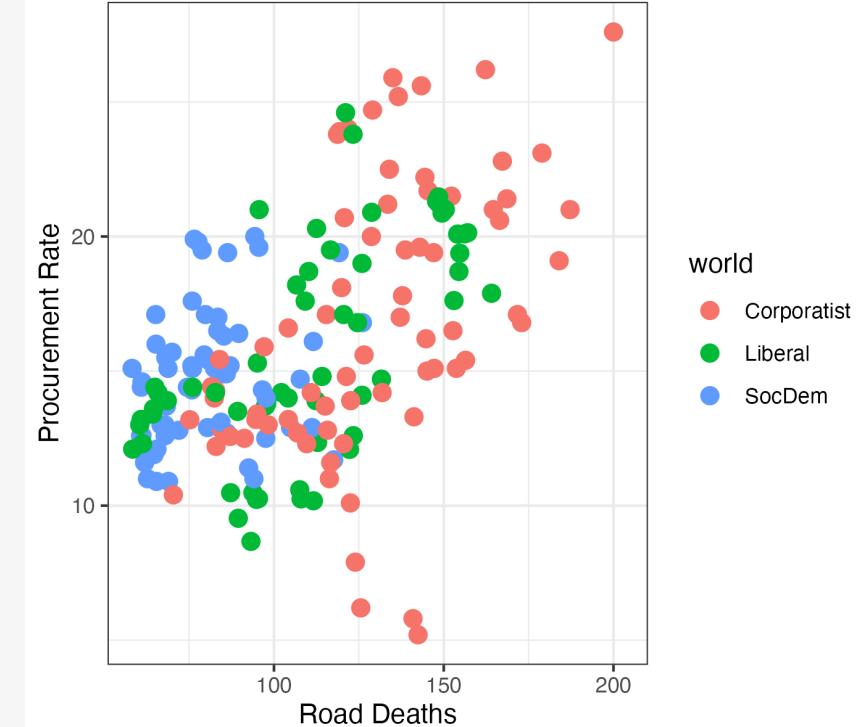
```
p
```



Add a theme ... `theme_bw()`

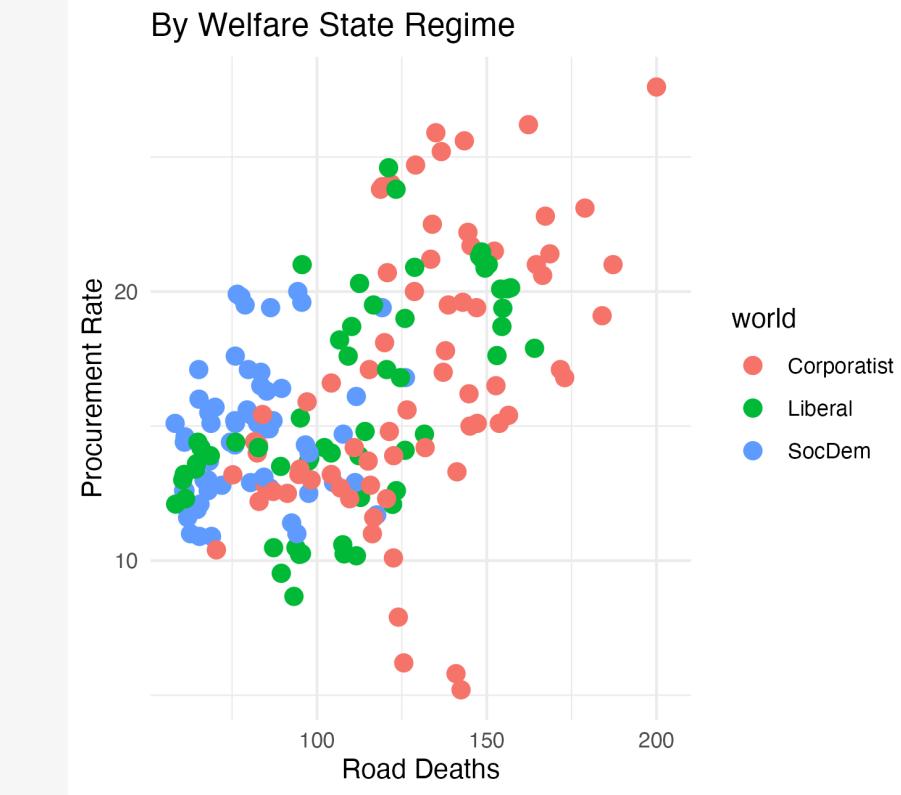
```
p + theme_bw()
```

By Welfare State Regime



Add a theme ... `theme_minimal()`

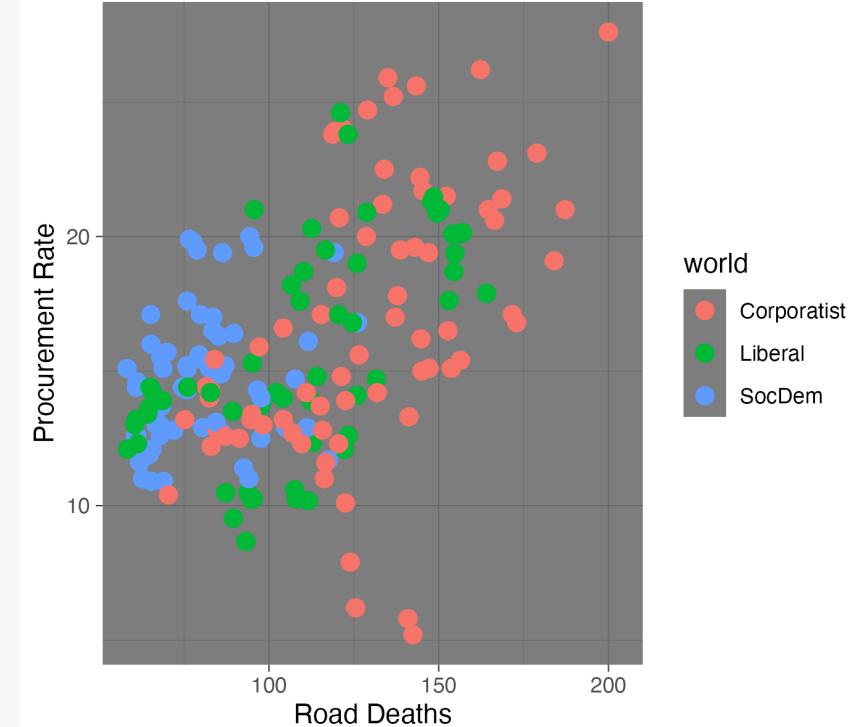
```
p + theme_minimal()
```



Add a theme ... `theme_dark()`

```
p + theme_dark()
```

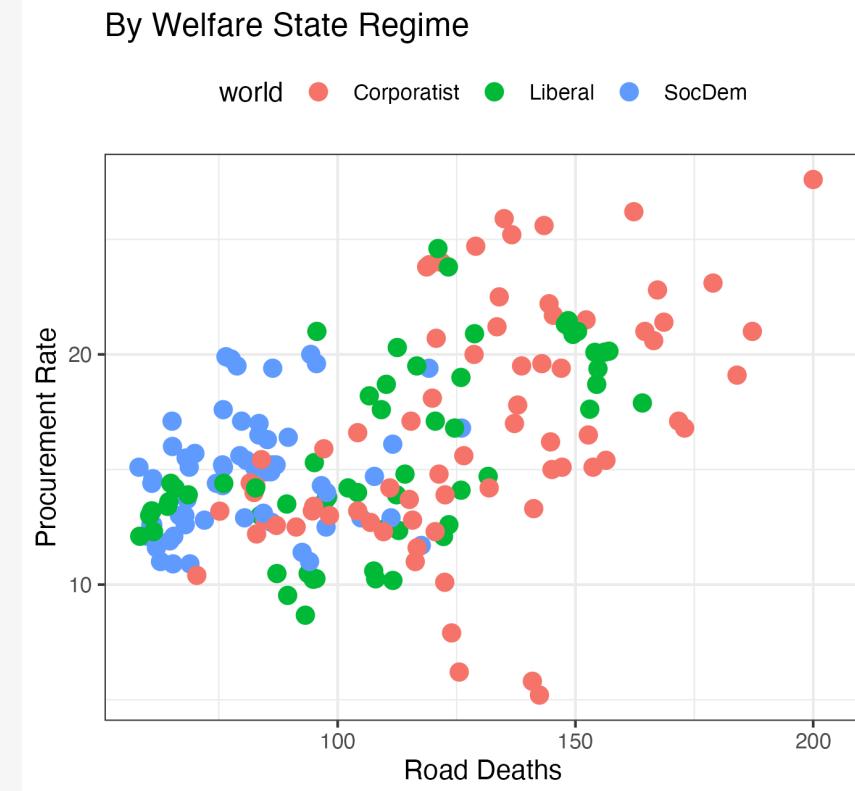
By Welfare State Regime



Adjust with the `theme()` function

None of this directly touches the parts of the plot that are representing your data—i.e. the visual parts that are mapped to a variable, and thus have a scale. Adjusting those is the job of the `scale_` and `guide()` functions.

```
p + theme_bw() +  
  theme(legend.position = "top")
```



There are *many* theme elements

line rect text title aspect.ratio
axis.title axis.title.x axis.title.x.top axis.title.x.bottom
axis.title.y axis.title.y.left axis.title.y.right axis.text
axis.text.x axis.text.x.top axis.text.x.bottom axis.text.y
axis.text.y.left axis.text.y.right axis.ticks axis.ticks.x
axis.ticks.x.top axis.ticks.x.bottom axis.ticks.y
axis.ticks.y.left axis.ticks.y.right axis.ticks.length
axis.ticks.length.x axis.ticks.length.x.top
axis.ticks.length.x.bottom axis.ticks.length.y
axis.ticks.length.y.left axis.ticks.length.y.right axis.line
axis.line.x axis.line.x.top axis.line.x.bottom axis.line.y
axis.line.y.left axis.line.y.right

legend.background legend.margin legend.spacing
legend.spacing.x legend.spacing.y legend.key
legend.key.size legend.key.height legend.key.width
legend.text legend.text.align legend.title
legend.title.align legend.position legend.direction
legend.justification legend.box legend.box.just
legend.box.margin legend.box.background
legend.box.spacing

panel.background panel.border panel.spacing
panel.spacing.x panel.spacing.y panel.grid
panel.grid.major panel.grid.minor panel.grid.major.x
panel.grid.major.y panel.grid.minor.x panel.grid.minor.y
panel.on top plot.background

plot.title plot.title.position plot.subtitle plot.caption
plot.caption.position plot.tag plot.tag.position
plot.margin

strip.background strip.background.x strip.background.y
strip.placement strip.text strip.text.x strip.text.y
strip.switch.pad.grid strip.switch.pad.wrap

But they are structured

line rect text title aspect.ratio

axis.title axis.title.x axis.title.x.top axis.title.x.bottom
axis.title.y axis.title.y.left axis.title.y.right axis.text
axis.text.x axis.text.x.top axis.text.x.bottom axis.text.y
axis.text.y.left axis.text.y.right axis.ticks axis.ticks.x
axis.ticks.x.top axis.ticks.x.bottom axis.ticks.y
axis.ticks.y.left axis.ticks.y.right axis.ticks.length
axis.ticks.length.x axis.ticks.length.x.top
axis.ticks.length.x.bottom axis.ticks.length.y
axis.ticks.length.y.left axis.ticks.length.y.right axis.line
axis.line.x axis.line.x.top axis.line.x.bottom axis.line.y
axis.line.y.left axis.line.y.right

legend.background legend.margin legend.spacing
legend.spacing.x legend.spacing.y legend.key
legend.key.size legend.key.height legend.key.width
legend.text legend.text.align legend.title
legend.title.align legend.position legend.direction
legend.justification legend.box legend.box.just
legend.box.margin legend.box.background
legend.box.spacing

panel.background panel.border panel.spacing
panel.spacing.x panel.spacing.y panel.grid
panel.grid.major panel.grid.minor panel.grid.major.x
panel.grid.major.y panel.grid.minor.x panel.grid.minor.y
panel.on top

plot.background plot.title plot.title.position plot.subtitle
plot.caption plot.caption.position plot.tag
plot.tag.position plot.margin

strip.background strip.background.x strip.background.y
strip.placement strip.text strip.text.x strip.text.y
strip.switch.pad.grid strip.switch.pad.wrap

And *inherit*

line rect text title aspect.ratio

axis.title axis.title.x axis.title.x.top axis.title.x.bottom
axis.title.y axis.title.y.left axis.title.y.right axis.text
axis.text.x axis.text.x.top axis.text.x.bottom axis.text.y
axis.text.y.left axis.text.y.right axis.ticks axis.ticks.x
axis.ticks.x.top axis.ticks.x.bottom axis.ticks.y
axis.ticks.y.left axis.ticks.y.right axis.ticks.length
axis.ticks.length.x axis.ticks.length.x.top
axis.ticks.length.x.bottom axis.ticks.length.y
axis.ticks.length.y.left axis.ticks.length.y.right axis.line
axis.line.x axis.line.x.top axis.line.x.bottom axis.line.y
axis.line.y.left axis.line.y.right

legend.background legend.margin legend.spacing
legend.spacing.x legend.spacing.y legend.key
legend.key.size legend.key.height legend.key.width
legend.text legend.text.align legend.title
legend.title.align legend.position legend.direction
legend.justification legend.box legend.box.just
legend.box.margin legend.box.background
legend.box.spacing

panel.background panel.border panel.spacing
panel.spacing.x panel.spacing.y panel.grid
panel.grid.major panel.grid.minor panel.grid.major.x
panel.grid.major.y panel.grid.minor.x panel.grid.minor.y
panel.on top

plot.background plot.title plot.title.position
plot.subtitle plot.caption plot.caption.position plot.tag
plot.tag.position plot.margin

strip.background strip.background.x
strip.background.y strip.placement strip.text
strip.text.x strip.text.y strip.switch.pad.grid
strip.switch.pad.wrap

Two kinds of adjustment

It's a single setting.

E.g., `legend.position` can be "none", "left", "right", "bottom", or "top"

Hence, e.g., `theme(legend.position = "top")`, which we have seen several times. Similarly for e.g. `legend.direction` (can be "horizontal" or "vertical").

It's a component of the plot that might be styled in several ways. E.g., The text on the axes, or the lines in the plot panel.

If the latter ...

If adjusting a thematic element ask...

Where on the plot is it?

If adjusting a thematic element ask...

Where on the plot is it?

Is it part of an *axis*, part of the *panel*, the *strip* (facet title) box, or the *legend*?
This will help you find the name of the thing you want to adjust.

If adjusting a thematic element ask...

Where on the plot is it?

Is it part of an *axis*, part of the *panel*, the *strip* (facet title) box, or the *legend*?

This will help you find the name of the thing you want to adjust.

E.g. “I want to adjust the text for the markings on the x-axis”

You want `axis.ticks.x`

E.g. “I want to adjust the styling of the main y-axis grid lines inside the plot”

You want `panel.grid.major.y`

If adjusting a thematic element, ask...

What *kind* of element is it?

If adjusting a thematic element, ask...

What *kind* of element is it?

Is it *text*, or a *line*, or a *rectangle*?

This will tell you what function to use to make the adjustment to the named element.

If adjusting a thematic element, ask...

What *kind* of element is it?

Is it *text*, or a *line*, or a *rectangle*?

This will tell you what function to use to make the adjustment to the named element.

If it's text, adjust the element with `element_text()`

If adjusting a thematic element, ask...

What *kind* of element is it?

Is it *text*, or a *line*, or a *rectangle*?

This will tell you what function to use to make the adjustment to the named element.

If it's text, adjust the element with `element_text()`

If it's a line, adjust it with `element_line()`

If adjusting a thematic element, ask...

What *kind* of element is it?

Is it *text*, or a *line*, or a *rectangle*?

This will tell you what function to use to make the adjustment to the named element.

If it's text, adjust the element with `element_text()`

If it's a line, adjust it with `element_line()`

If it's a rectangle, with `element_rect()`

If adjusting a thematic element, ask...

What *kind* of element is it?

Is it *text*, or a *line*, or a *rectangle*?

This will tell you what function to use to make the adjustment to the named element.

If it's text, adjust the element with `element_text()`

If it's a line, adjust it with `element_line()`

If it's a rectangle, with `element_rect()`

If you want to *fully turn off* an element, use `element_blank()`

For example ...

“I want to adjust the styling of the plot title”

For example ...

“I want to adjust the styling of the plot title”

The relevant element is `plot.title`.

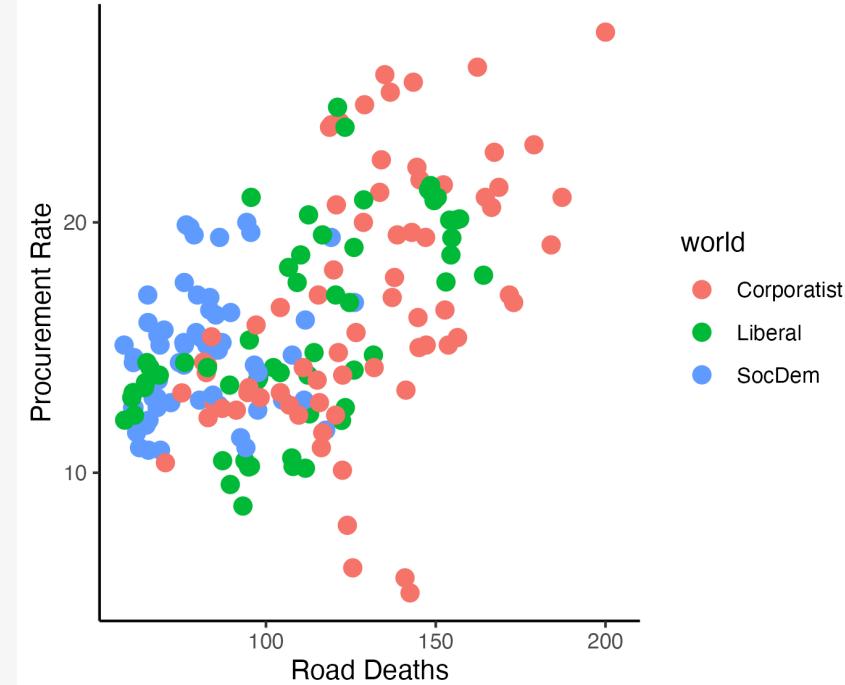
It's *text*.

Inside the theme function, adjust it with `element_text()`.

For example ...

```
p + theme(plot.title =  
          element_text(size = rel(3),  
                      face = "bold",  
                      color = "orange"))
```

By Welfare State Re



For example ...

“I want to adjust y axis grid lines on the plot”

For example ...

“I want to adjust y axis grid lines on the plot”

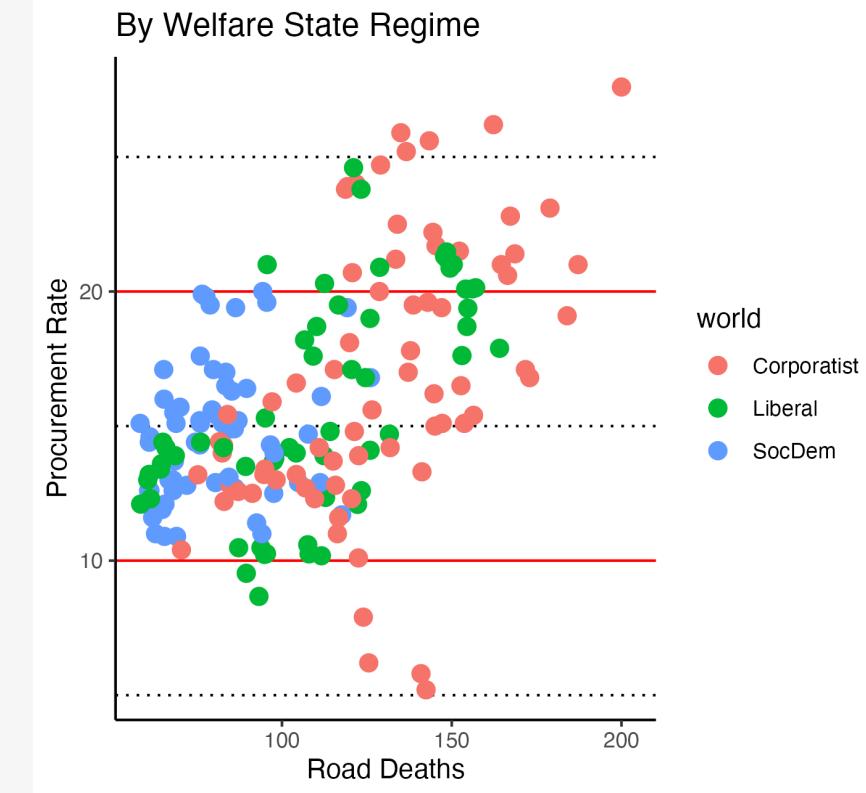
The relevant elements are `panel.grid.major.y` and `panel.grid.minor.y`.

These are *lines*.

Inside the theme function, adjust it with `element_line()`.

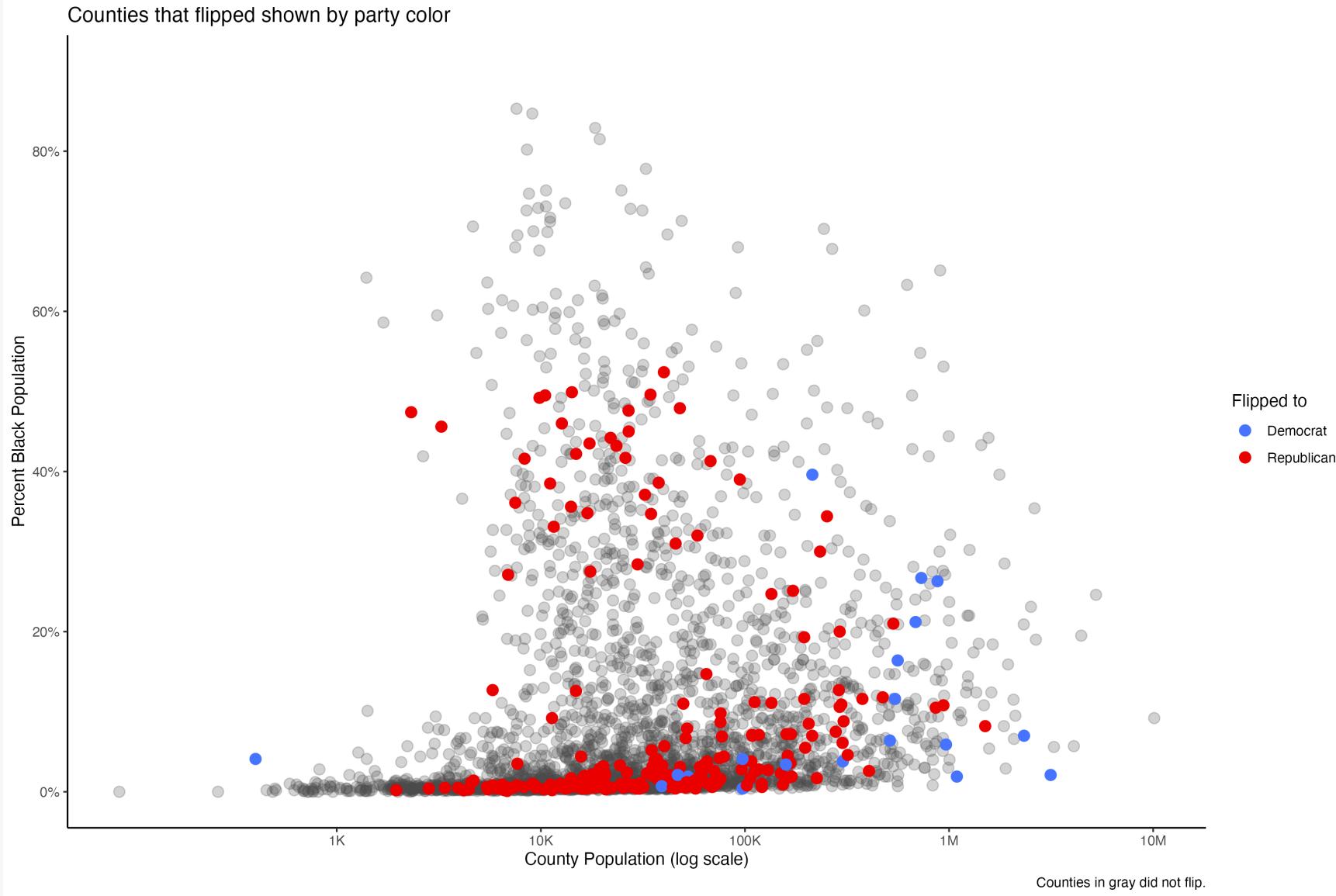
For example ...

```
p + theme(panel.grid.major.y =  
          element_line(color = "red"),  
          panel.grid.minor.y =  
          element_line(color = "black",  
                      linetype = "dotted"))
```



The ggthemes package

Counties that flipped shown by party color



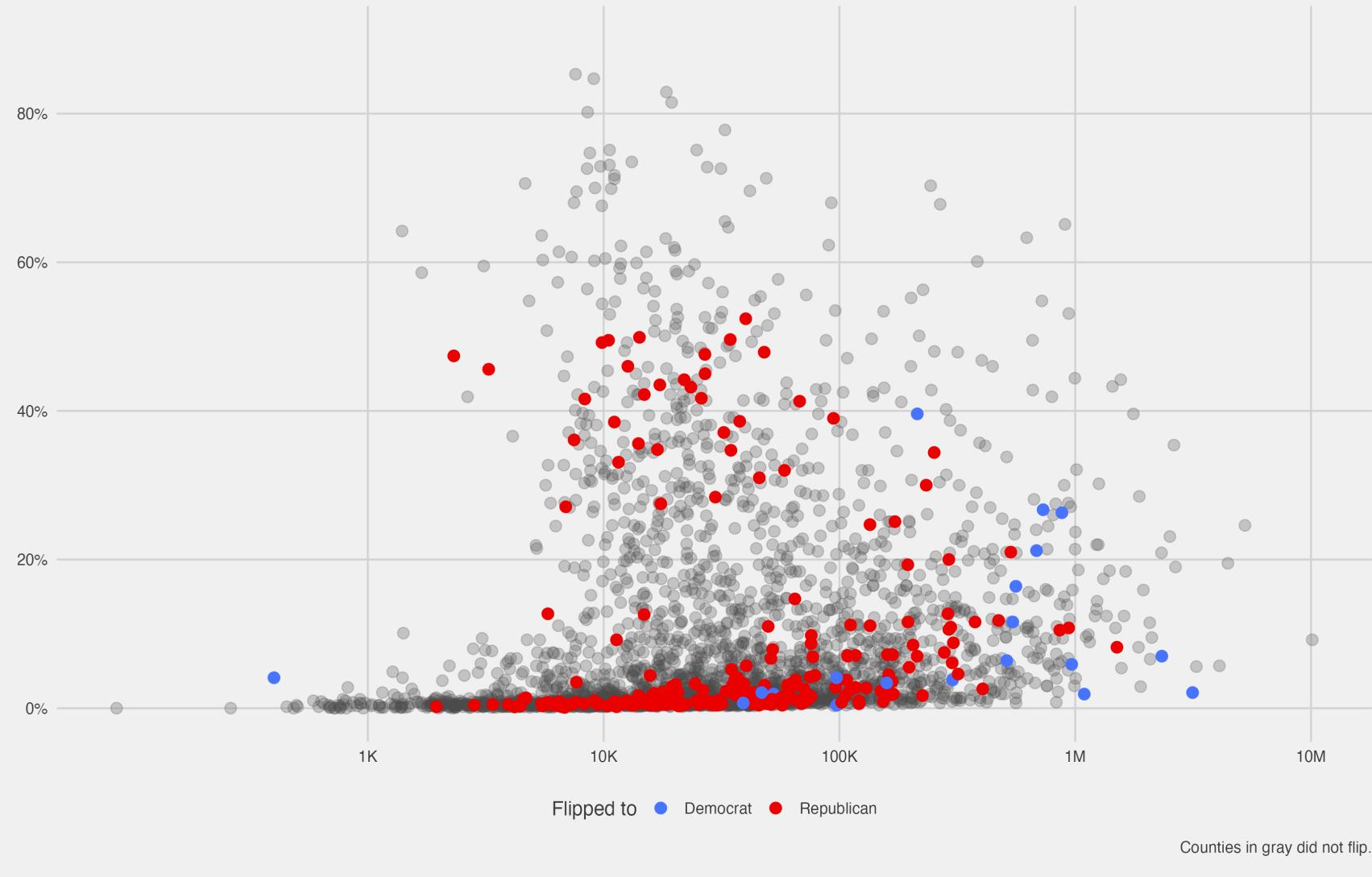
We made this earlier. Here it is in a default theme.

Theming a plot

```
library(ggthemes)
theme_set(theme_fivethirtyeight())
```

See how the full function call goes inside `theme_set()`, including the parentheses, because we are actually running that function to set all the elements.

Counties that flipped shown by party color



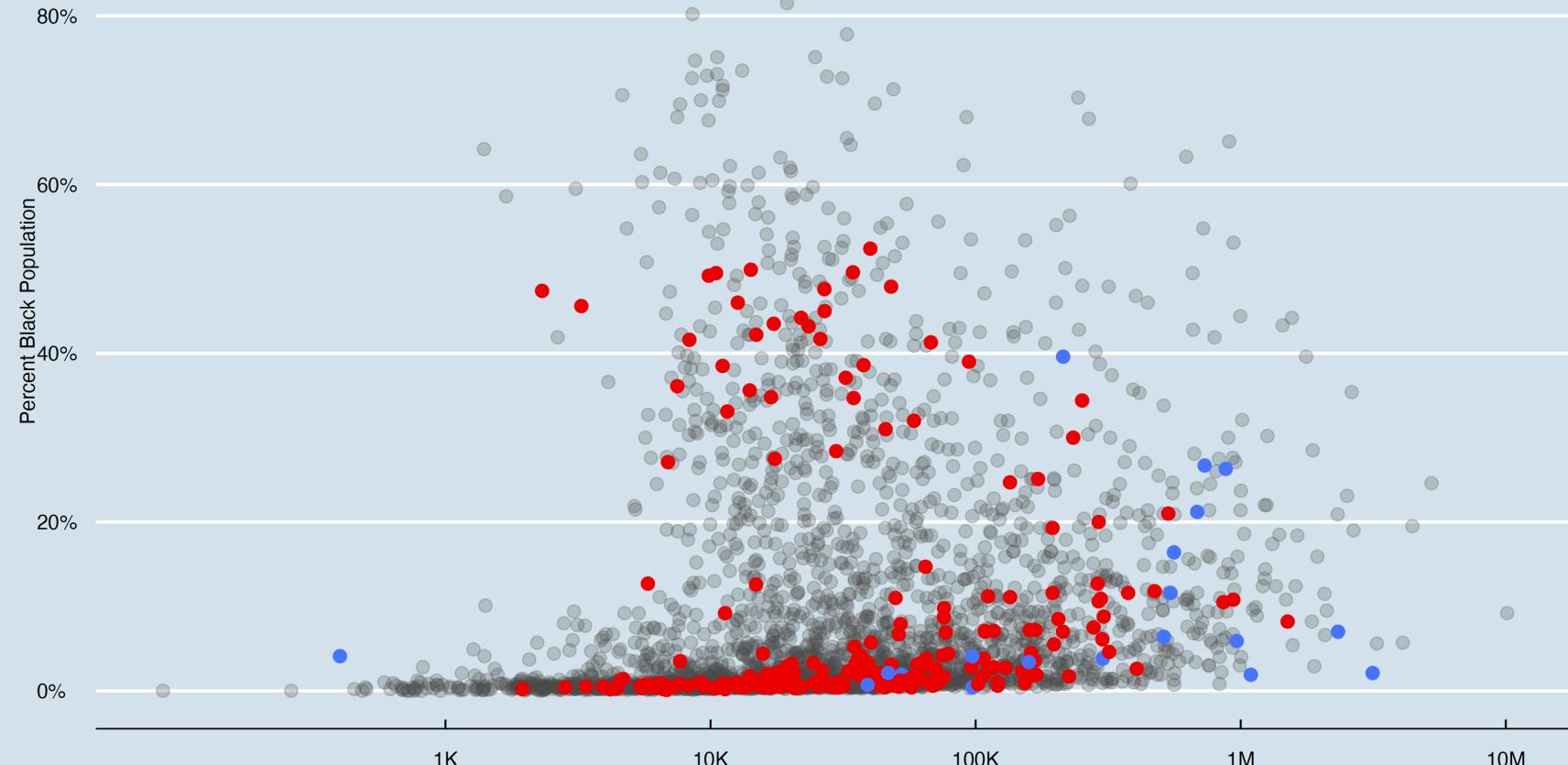
Calling the object now draws the plot with the thematic elements added.

Theming a plot

```
theme_set(theme_economist())
```

Counties that flipped shown by party color

Flipped to ● Democrat ● Republican

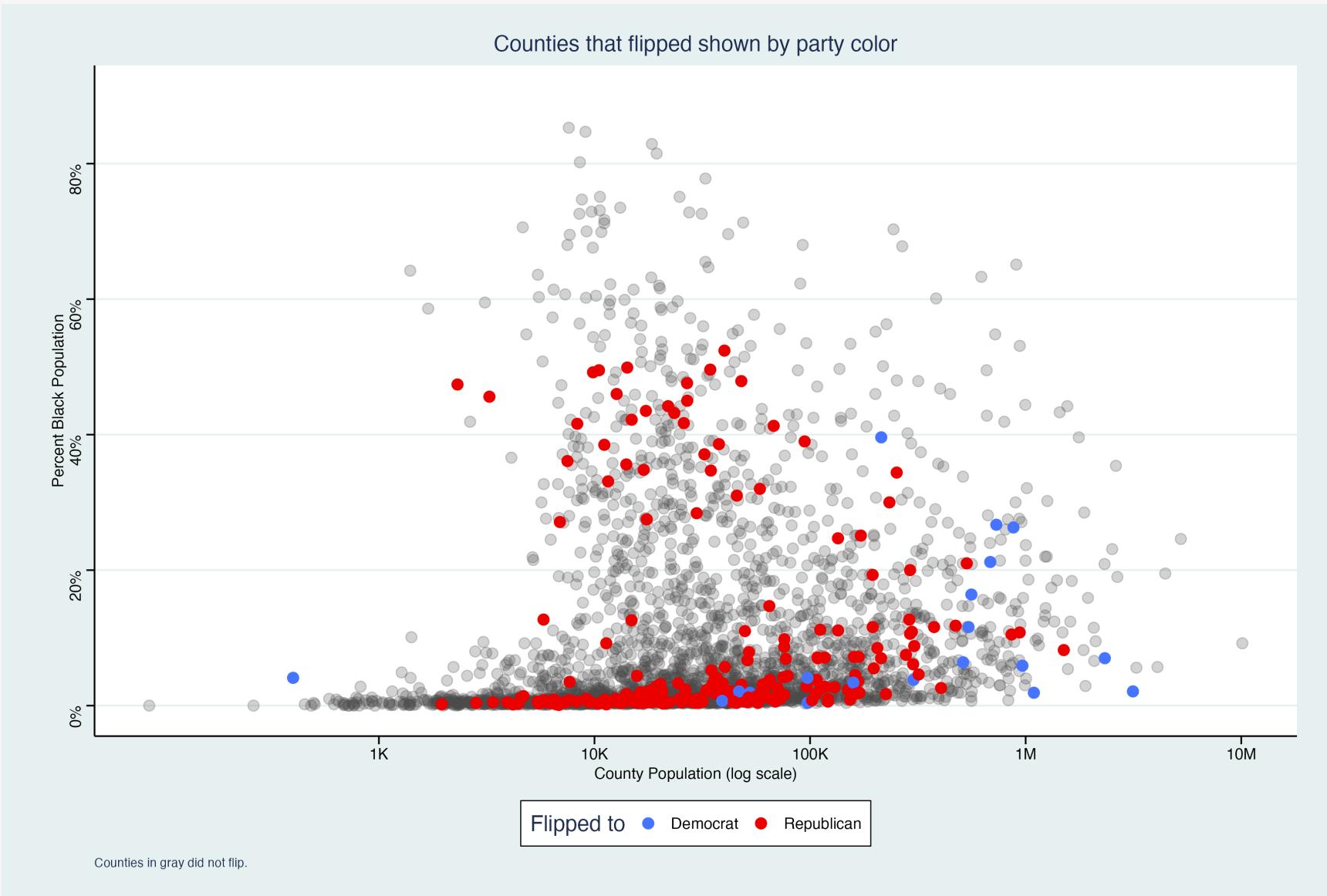


Counties in gray did not flip.

Calling the object now draws the plot with the thematic elements added.

This seems morally wrong

```
theme_set(theme_stata())
```



Why would you do this to yourself?

**Pick a theme
and stick with it**