

Data Visualization - 8. Polishing and Presenting Plots

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Code Horizons

December 11, 2023

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
```



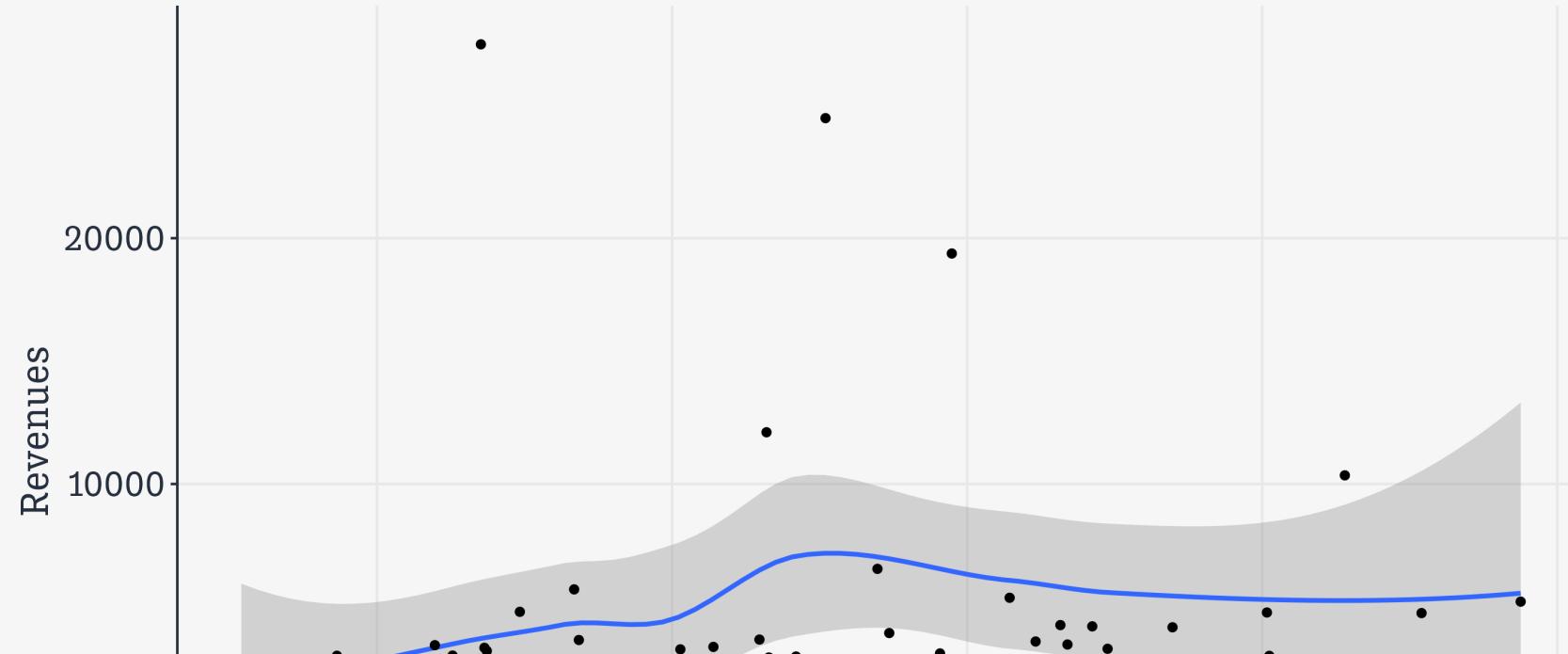
**Piece by piece,
Layer by layer**

Build your plots a piece at a time

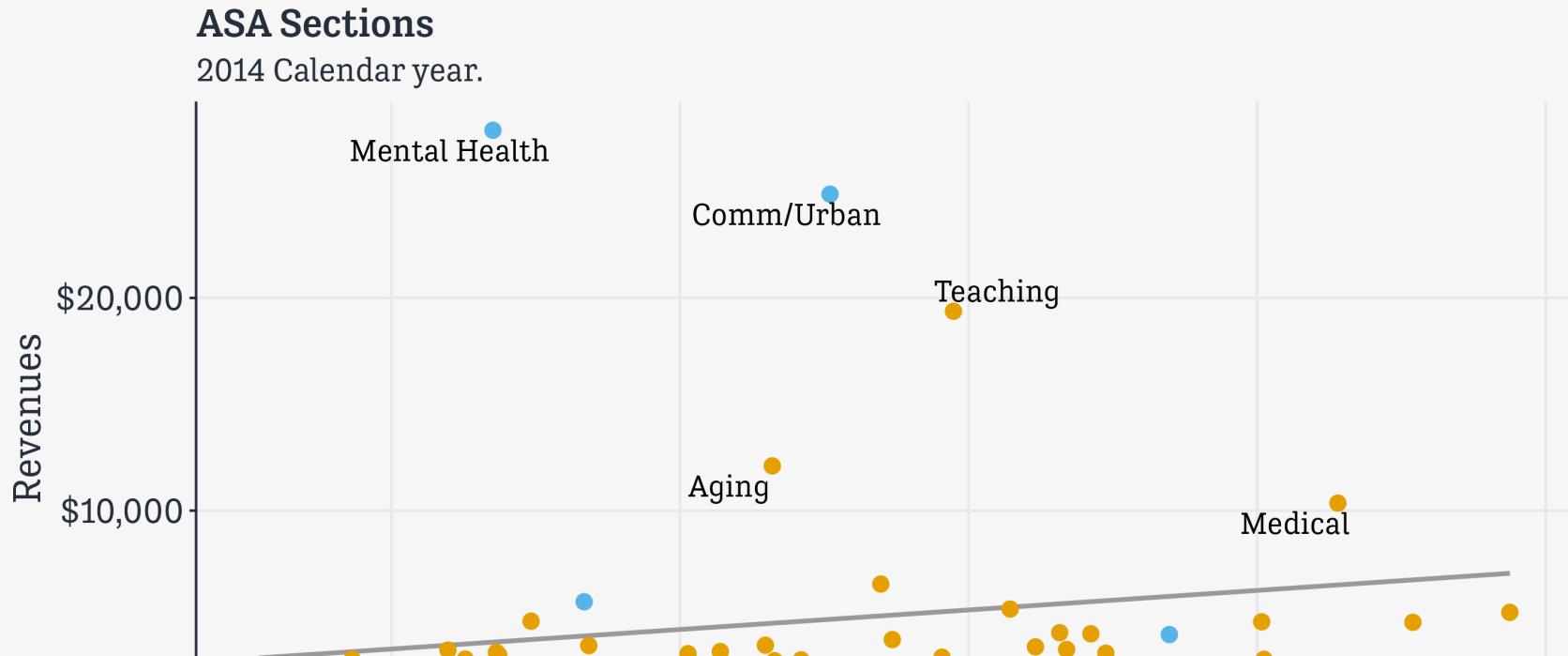
```
asasec ← as_tibble(asasec)
asasec
```

```
# 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



Build your plots a piece at a time

```
1 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
```

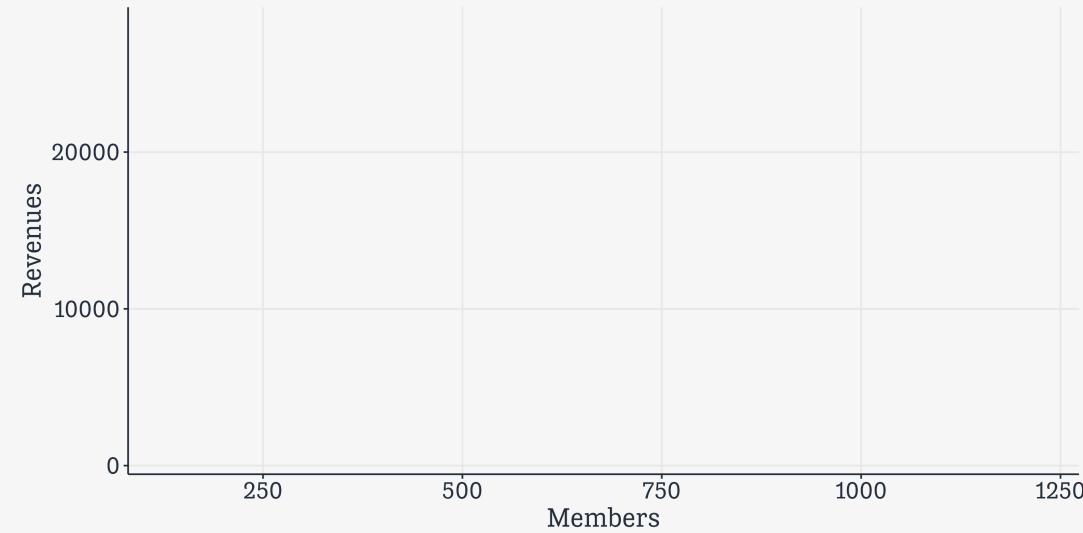
Build your plots a piece at a time

```
1 asasec ▶  
2   filter(Year == 2014)
```

```
# A tibble: 52 × 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      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  
# i 42 more rows
```

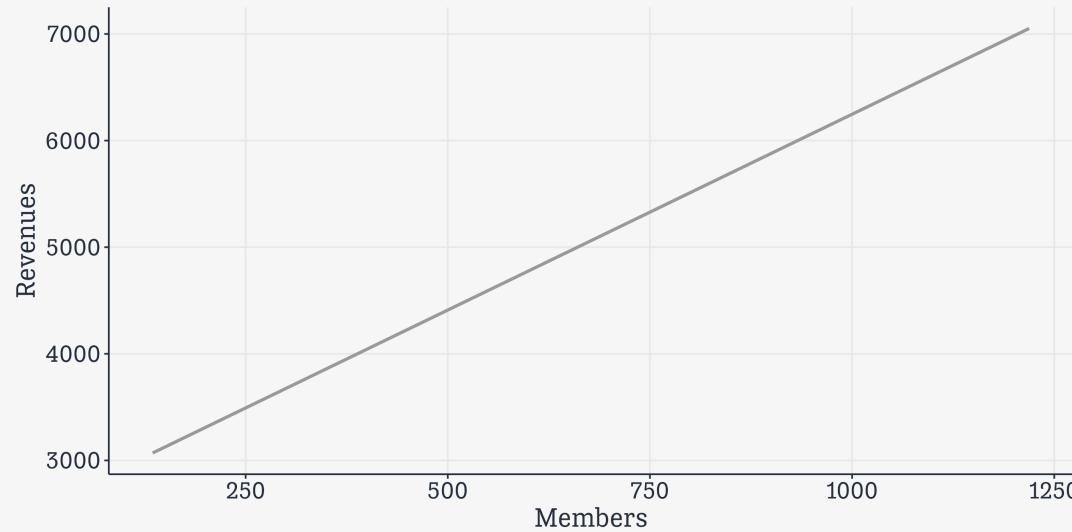
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3   ggplot(mapping = aes(x = Members,
4                       y = Revenues,
5                       label = Sname))
```



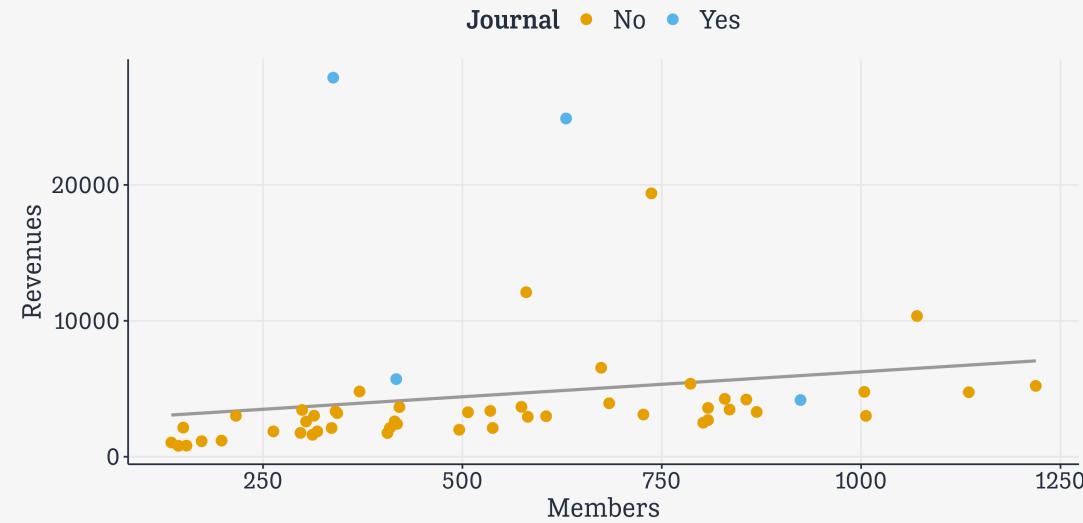
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3   ggplot(mapping = aes(x = Members,
4                         y = Revenues,
5                         label = Sname)) +
6   geom_smooth(method = "lm",
7               se = FALSE,
8               color = "gray60")
```



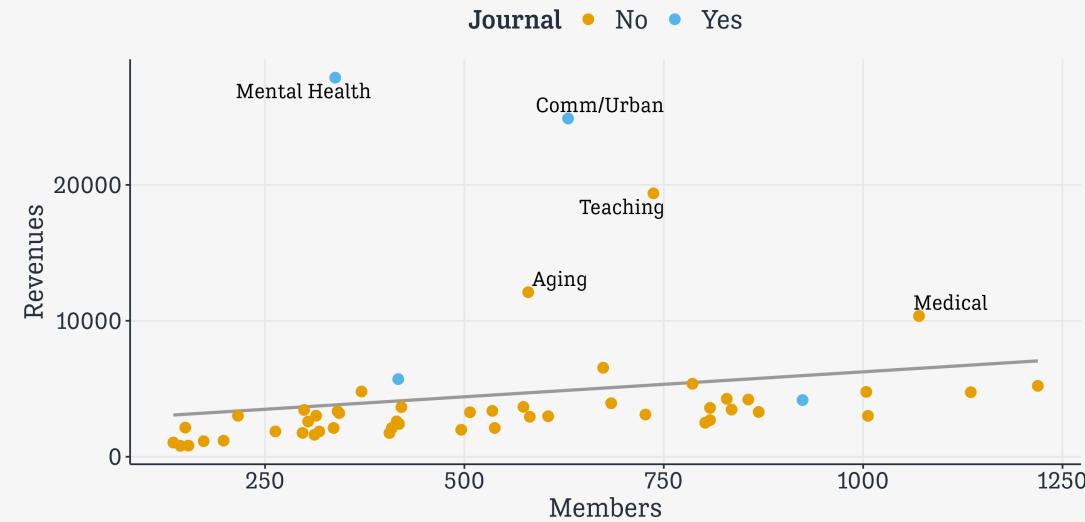
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3   ggplot(mapping = aes(x = Members,
4                         y = Revenues,
5                         label = Sname)) +
6   geom_smooth(method = "lm",
7               se = FALSE,
8               color = "gray60") +
9   geom_point(mapping = aes(color = Journal),
10              size = rel(3))
```



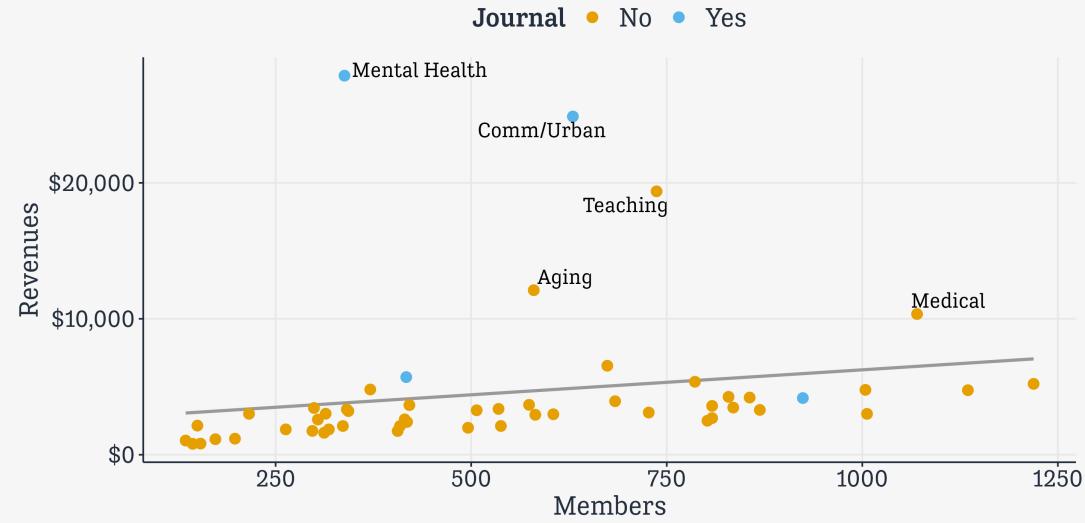
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3     ggplot(mapping = aes(x = Members,
4                           y = Revenues,
5                           label = Sname)) +
6       geom_smooth(method = "lm",
7                     se = FALSE,
8                     color = "gray60") +
9       geom_point(mapping = aes(color = Journal),
10                  size = rel(3)) +
11       geom_text_repel(data=subset(asasec,
12                               Year = 2014 &
13                               Revenues > 7000),
14                               size = rel(5),
15                               mapping =
16                               aes(family = "Tenso Slide"))
```



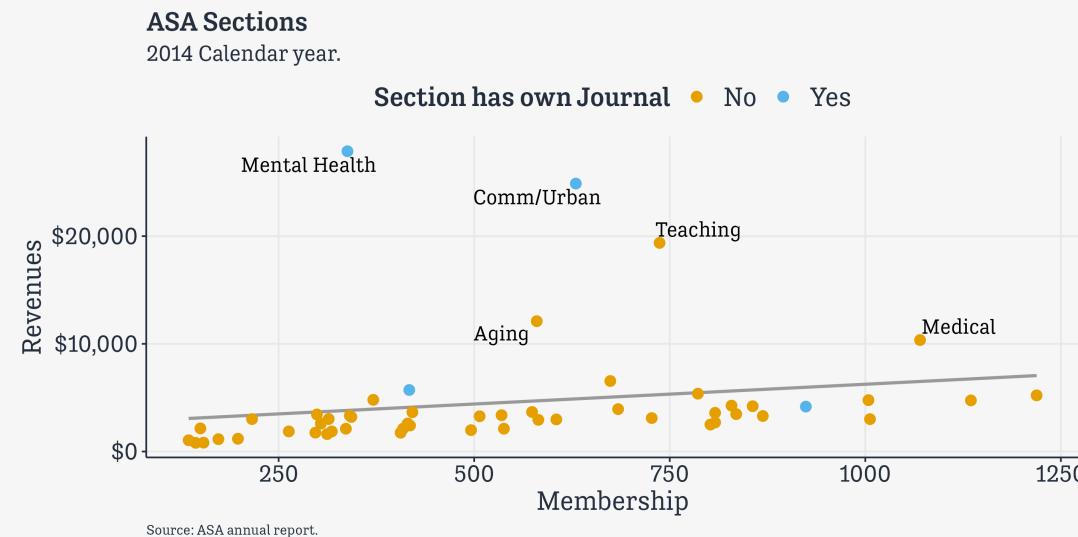
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3     ggplot(mapping = aes(x = Members,
4                           y = Revenues,
5                           label = Sname)) +
6     geom_smooth(method = "lm",
7                  se = FALSE,
8                  color = "gray60") +
9     geom_point(mapping = aes(color = Journal),
10                size = rel(3)) +
11     geom_text_repel(data=subset(asasec,
12                           Year = 2014 &
13                           Revenues > 7000),
14                           size = rel(5),
15                           mapping =
16                           aes(family = "Tenso Slide"))
17     scale_y_continuous(labels =
18                           scales::label_dollar())
```



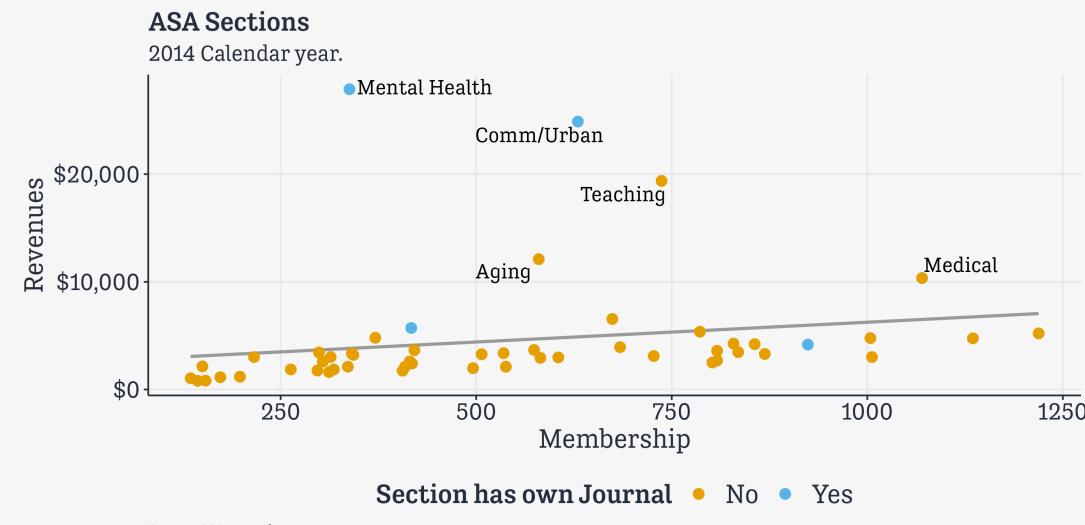
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3   ggplot(mapping = aes(x = Members,
4                         y = Revenues,
5                         label = Sname)) +
6   geom_smooth(method = "lm",
7               se = FALSE,
8               color = "gray60") +
9   geom_point(mapping = aes(color = Journal),
10            size = rel(3)) +
11   geom_text_repel(data=subset(asasec,
12                         Year = 2014 &
13                         Revenues > 7000),
14            size = rel(5),
15            mapping =
16            aes(family = "Tenso Slide"))
17   scale_y_continuous(labels =
18                     scales::label_dollar()) +
19   labs(x="Membership", y="Revenues",
20         color = "Section has own Journal",
21         title = "ASA Sections",
22         subtitle = "2014 Calendar year.",
23         caption = "Source: ASA annual report.")
```



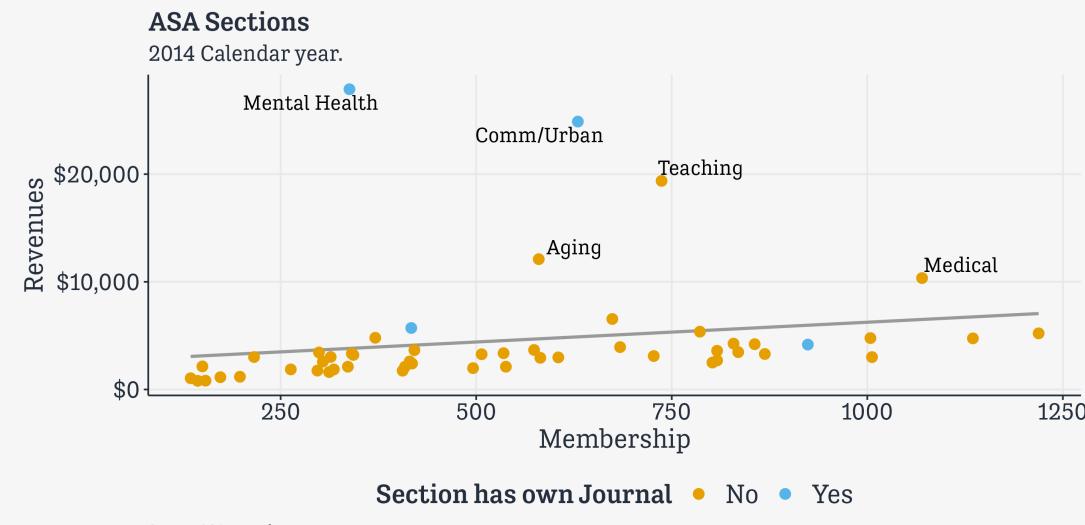
Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3     ggplot(mapping = aes(x = Members,
4                           y = Revenues,
5                           label = Sname)) +
6       geom_smooth(method = "lm",
7                     se = FALSE,
8                     color = "gray60") +
9       geom_point(mapping = aes(color = Journal),
10                  size = rel(3)) +
11       geom_text_repel(data=subset(asasec,
12                               Year = 2014 &
13                               Revenues > 7000),
14                               size = rel(5),
15                               mapping =
16                               aes(family = "Tenso Slide"))
17       scale_y_continuous(labels =
18                             scales::label_dollar()) +
19       labs(x="Membership", y="Revenues",
20             color = "Section has own Journal",
21             title = "ASA Sections",
22             subtitle = "2014 Calendar year.",
23             caption = "Source: ASA annual report.")
```



Build your plots a piece at a time

```
1 asasec >
2   filter(Year = 2014) >
3     ggplot(mapping = aes(x = Members,
4                           y = Revenues,
5                           label = Sname)) +
6       geom_smooth(method = "lm",
7                     se = FALSE,
8                     color = "gray60") +
9       geom_point(mapping = aes(color = Journal),
10                  size = rel(3)) +
11       geom_text_repel(data=subset(asasec,
12                               Year = 2014 &
13                               Revenues > 7000),
14                               size = rel(5),
15                               mapping =
16                               aes(family = "Tenso Slide"))
17       scale_y_continuous(labels =
18                             scales::label_dollar()) +
19       labs(x="Membership", y="Revenues",
20             color = "Section has own Journal",
21             title = "ASA Sections",
22             subtitle = "2014 Calendar year.",
23             caption = "Source: ASA annual report.")
```



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.

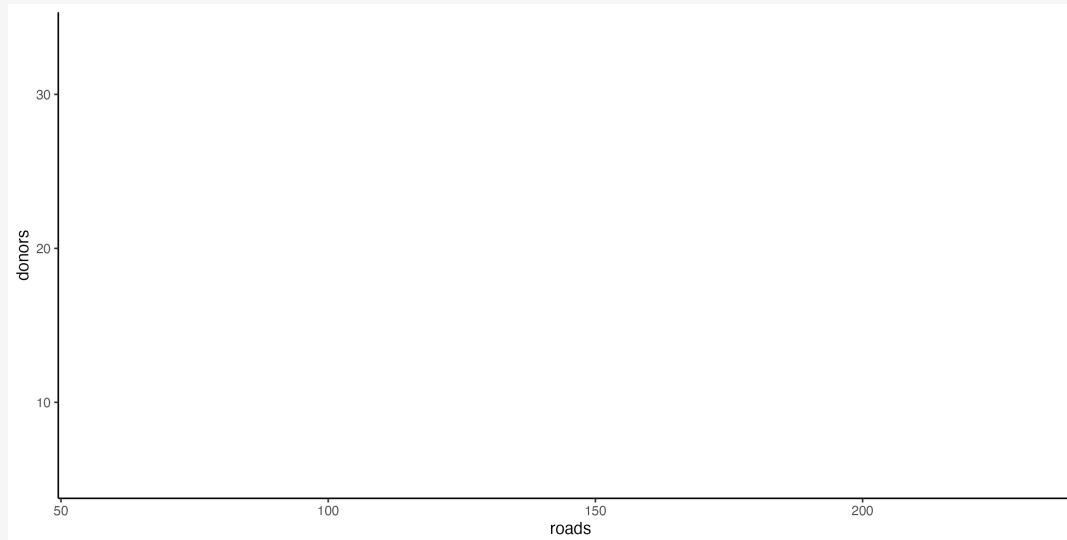
You can specify scales manually

```
1 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>
```

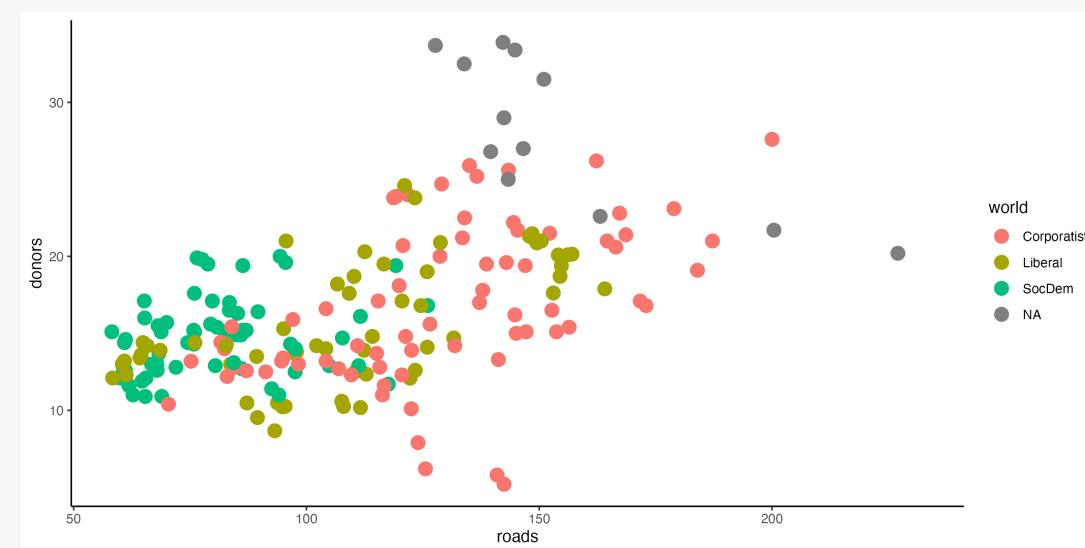
You can specify scales manually

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



You can specify scales manually

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



You can specify scales manually

```
1 organdata %>
2   ggplot(mapping = aes(x = roads,
3                         y = donors,
4                         color = world)) +
5   geom_point(size = 4) ->
6   p
```

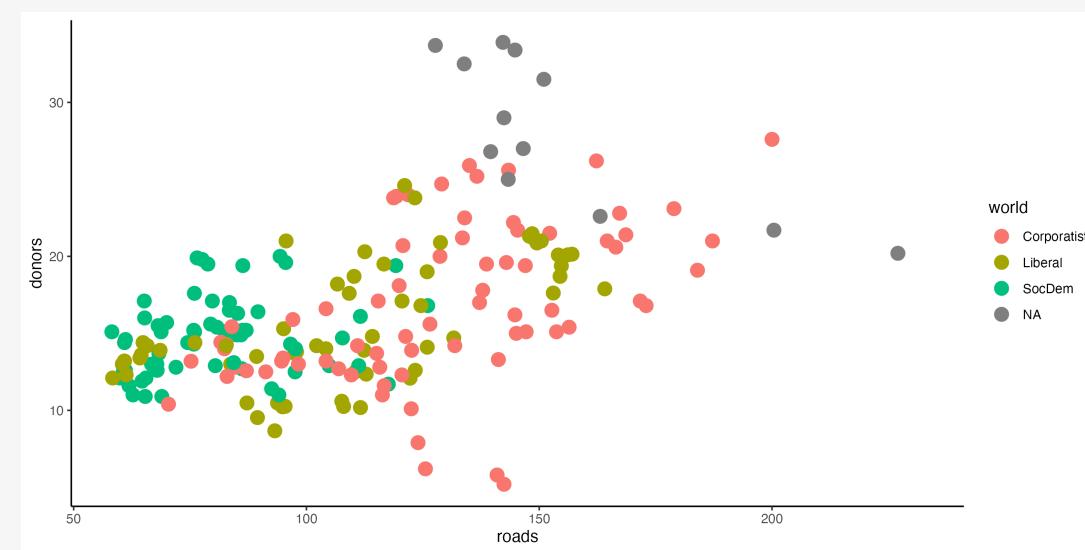
You can specify scales manually

```
1 organdata %>
2   ggplot(mapping = aes(x = roads,
3                         y = donors,
4                         color = world)) +
5   geom_point(size = 4) ->
6   p
```

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

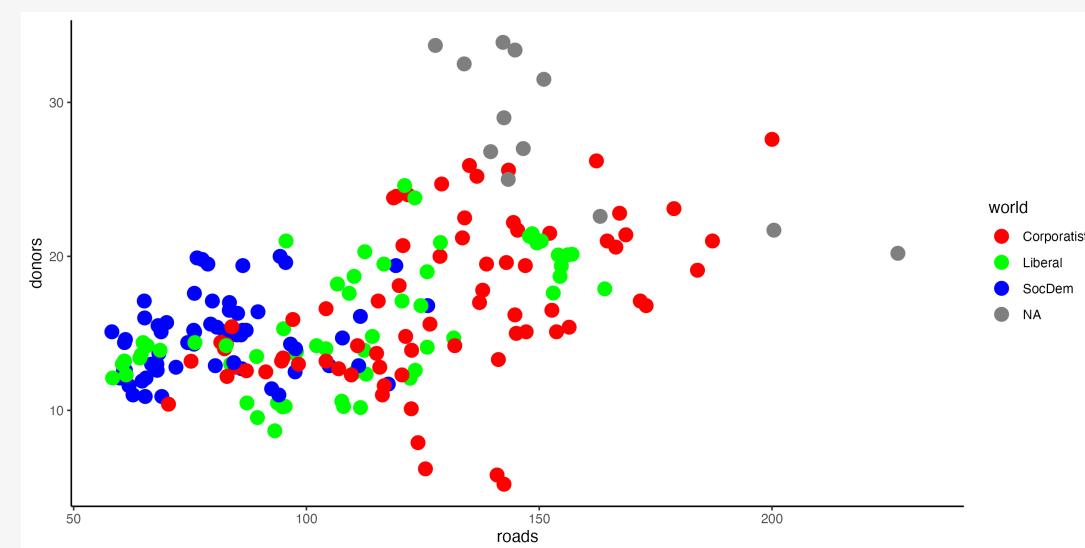
You can specify scales manually

1 p



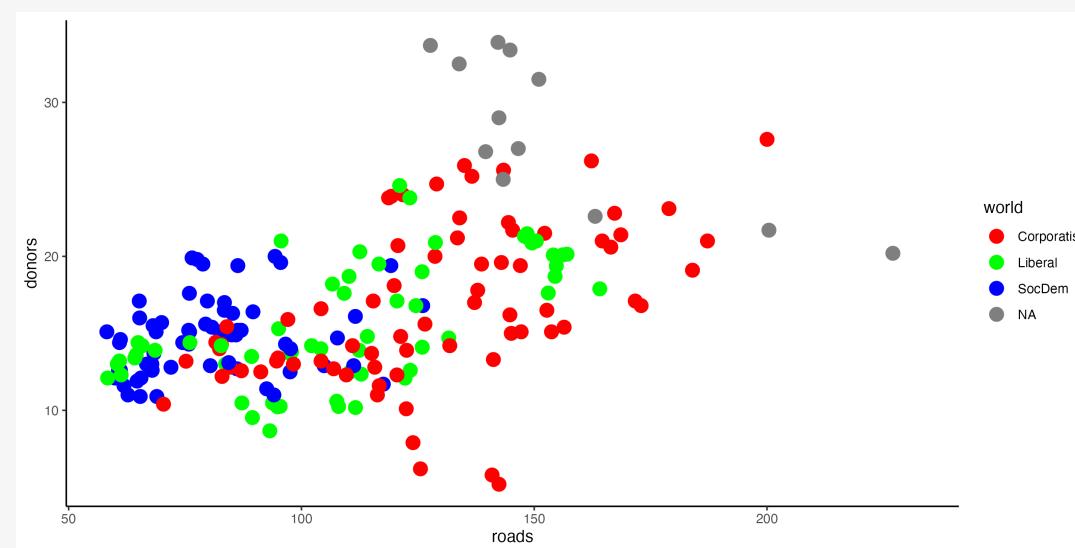
You can specify scales manually

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



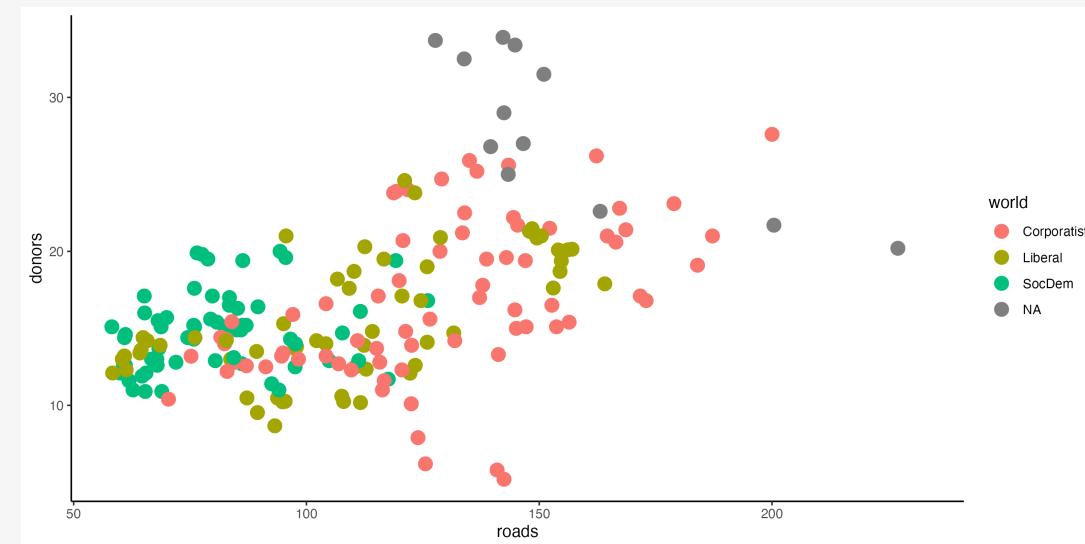
You can specify scales manually

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



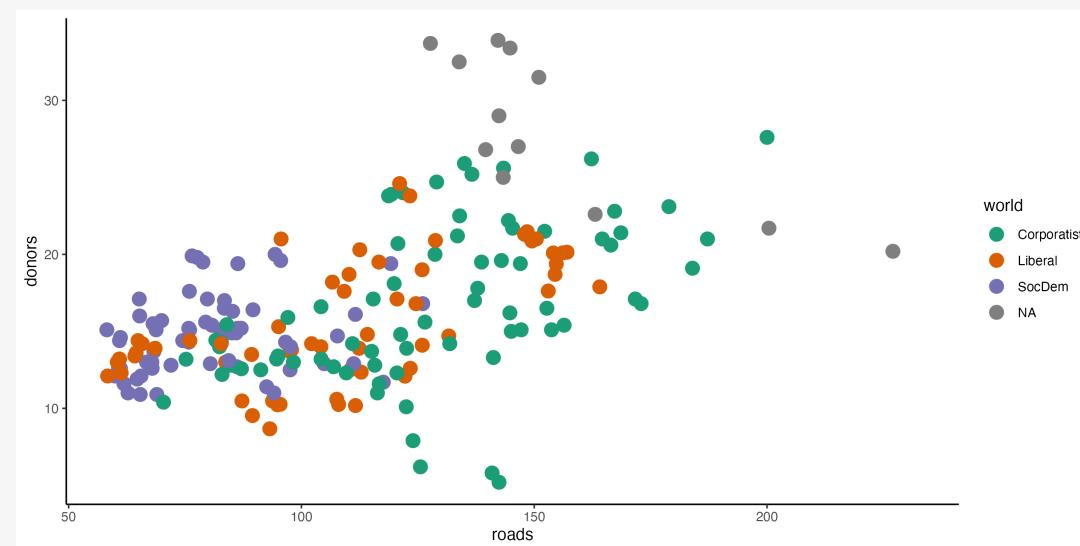
You can specify scales manually

1 p



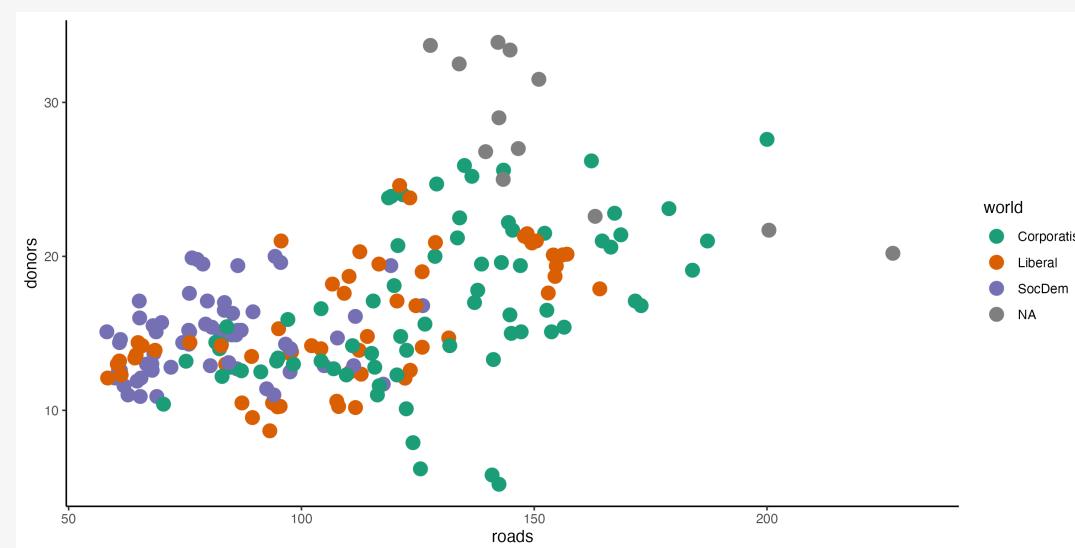
You can specify scales manually

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



You can specify scales manually

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



You can specify scales manually

```
1 colkey ← c("Corporatist" = "pink",
2           "Liberal" = "goldenrod",
3           "SocDem" = "firebrick")
```

You can specify scales manually

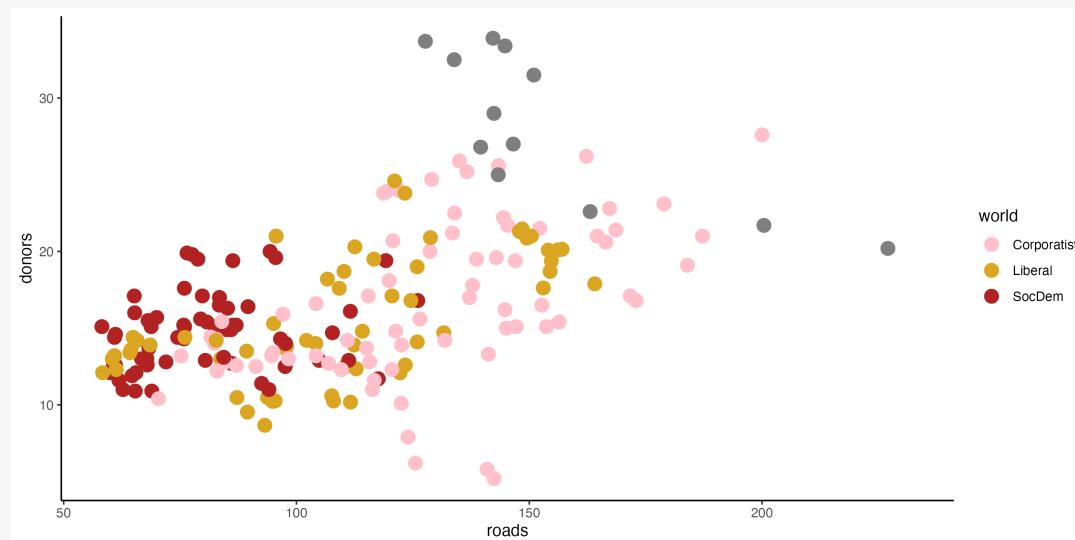
```
1 colkey ← c("Corporatist" = "pink",
2           "Liberal" = "goldenrod",
3           "SocDem" = "firebrick")
4 colkey
```

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

You can specify scales manually

```
1 colkey <- c("Corporatist" = "pink",
2           "Liberal" = "goldenrod",
3           "SocDem" = "firebrick")
4 colkey
5
6 p + scale_color_manual(
7   values = colkey)
```

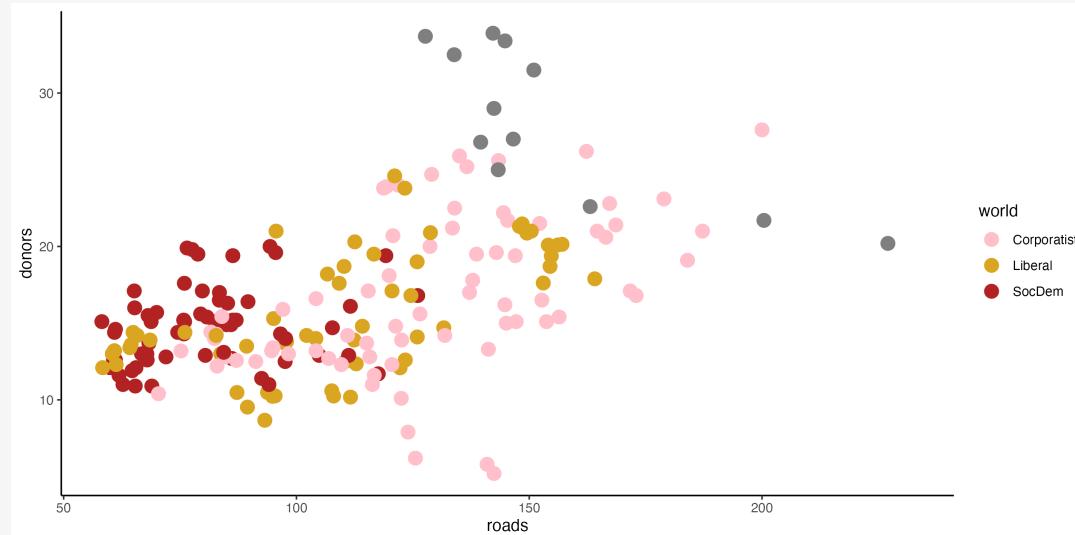
```
Corporatist      Liberal      SocDem
"pink" "goldenrod" "firebrick"
```



You can specify scales manually

```
1 colkey <- c("Corporatist" = "pink",
2           "Liberal" = "goldenrod",
3           "SocDem" = "firebrick")
4 colkey
5
6 p + scale_color_manual(
7   values = colkey)
```

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



Use balanced palettes

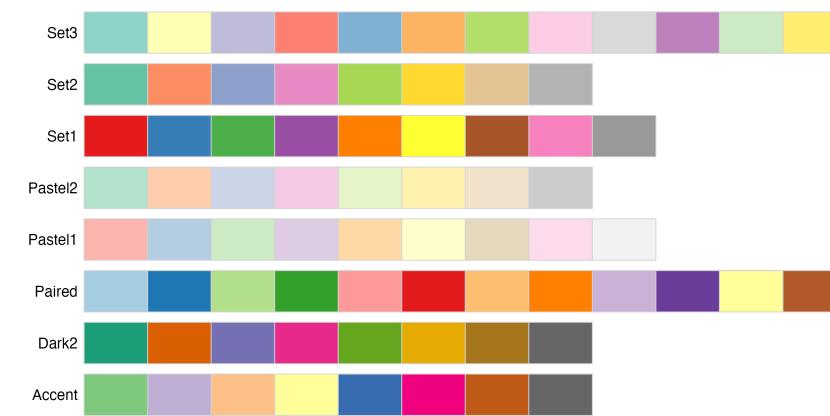
E.g., the `RColorBrewer` Palettes

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

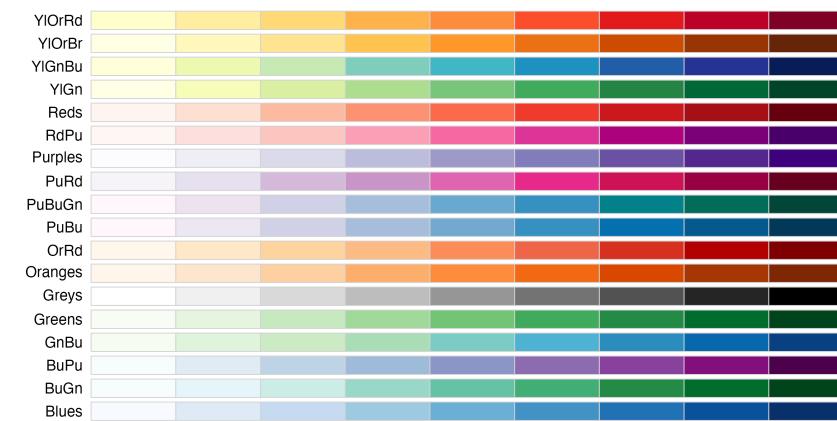
E.g., the `RColorBrewer` Palettes

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

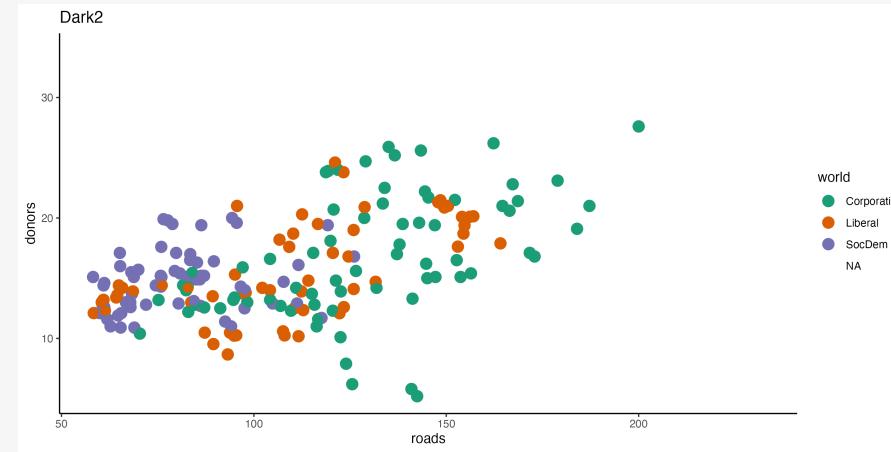
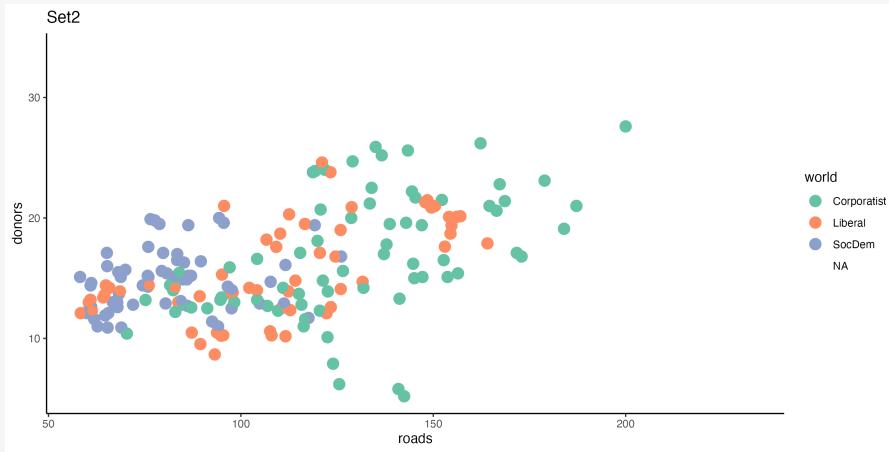
```
p + geom_point(size = 2) +
  scale_color_brewer(palette = "Set2") +
  labs(title = "Set2")

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 ▾

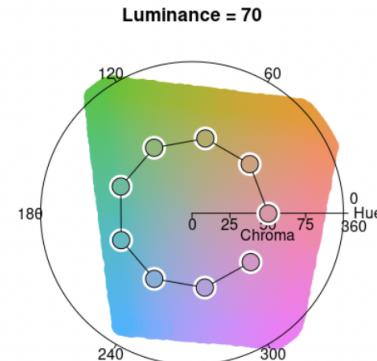
Reference

Changelog

Contact

A Toolbox for Manipulating and Assessing Colors and Palettes

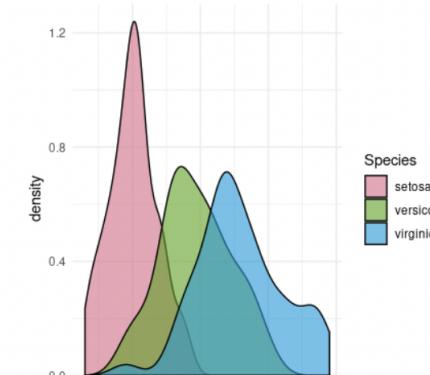
Color spaces



HCL-based palettes

Qualitative	
Pastel 1	
Dark 3	
Harmonic	
Sequential (single-hue)	
Blues 3	
Reds 3	
Greens 3	
Sequential (multi-hue)	
Purple-Blue	
Viridis	
ag_Sunset	
Diverging	
Blue-Red	
Green-Brown	

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](#)



The `colorspace` function convention

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

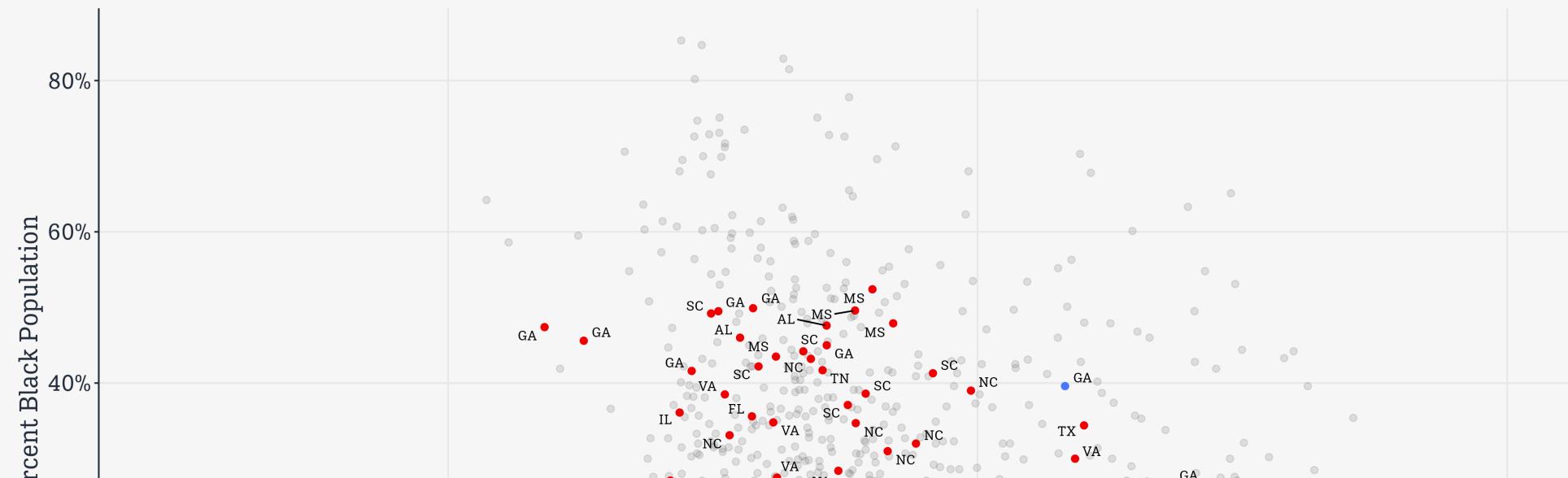
`scale_color_binned_diverging()`
`scale_color_binned_qualitative()`
`scale_color_binned_sequential()`
`scale_color_continuous_diverging()`
`scale_color_continuous_qualitative()`
`scale_color_continuous_sequential()`
`scale_color_discrete_diverging()`
`scale_color_discrete_qualitative()`
`scale_color_discrete_sequential()`

`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()`

**Layer color and text
to your advantage**

Flipped counties, 2016

County flipped to ... • Democrat • Republican



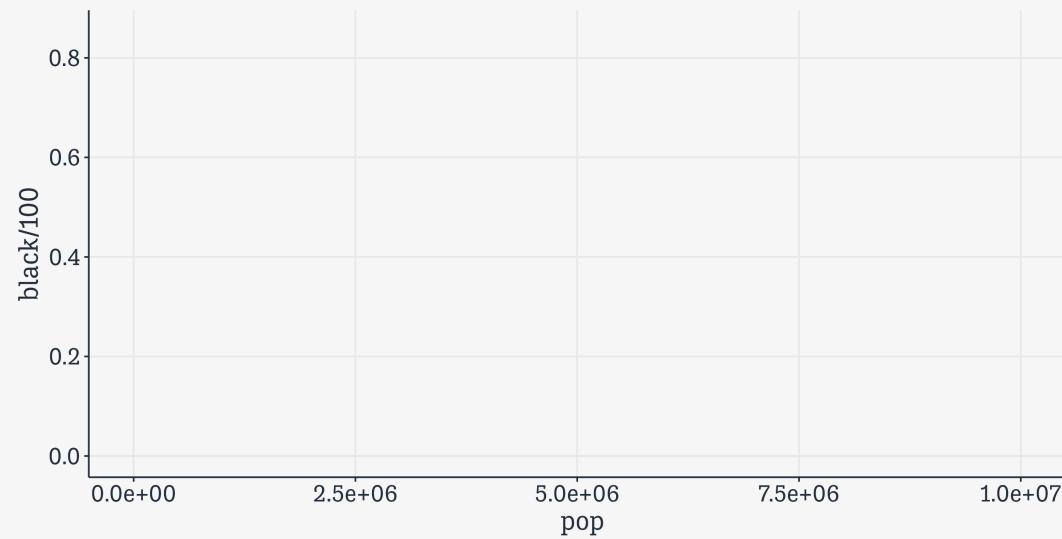
We know how to build this

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



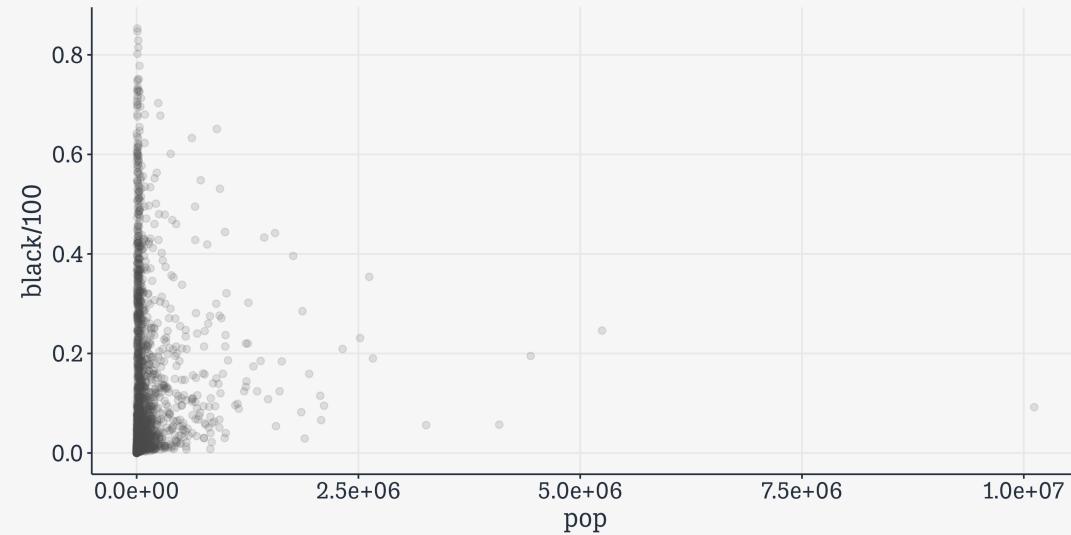
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors ← c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                     flipped = "No"),
6         mapping = aes(x = pop,
7                     y = black/100))
```



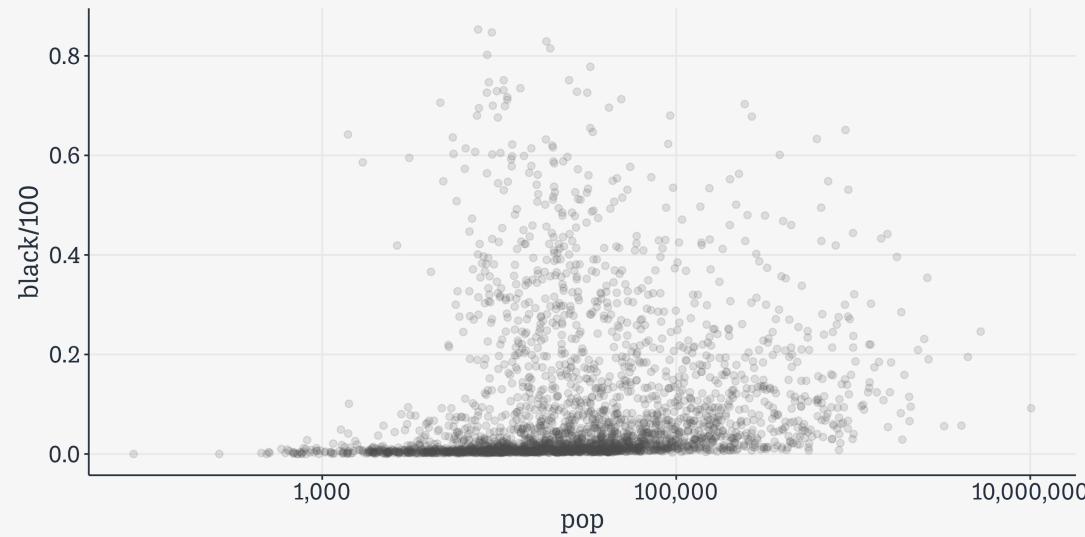
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors ← c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                   flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2))
```



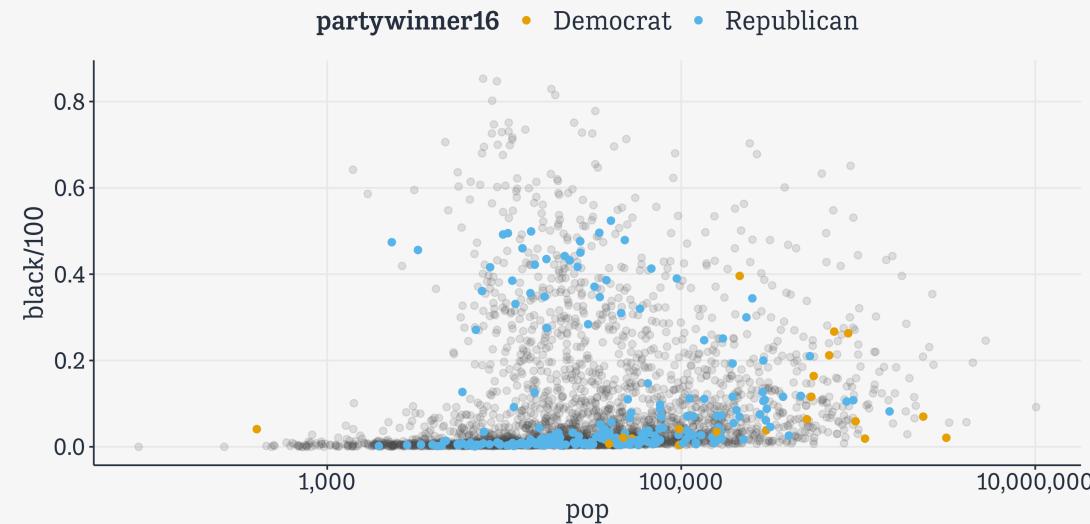
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors ← c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                   flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma())
```



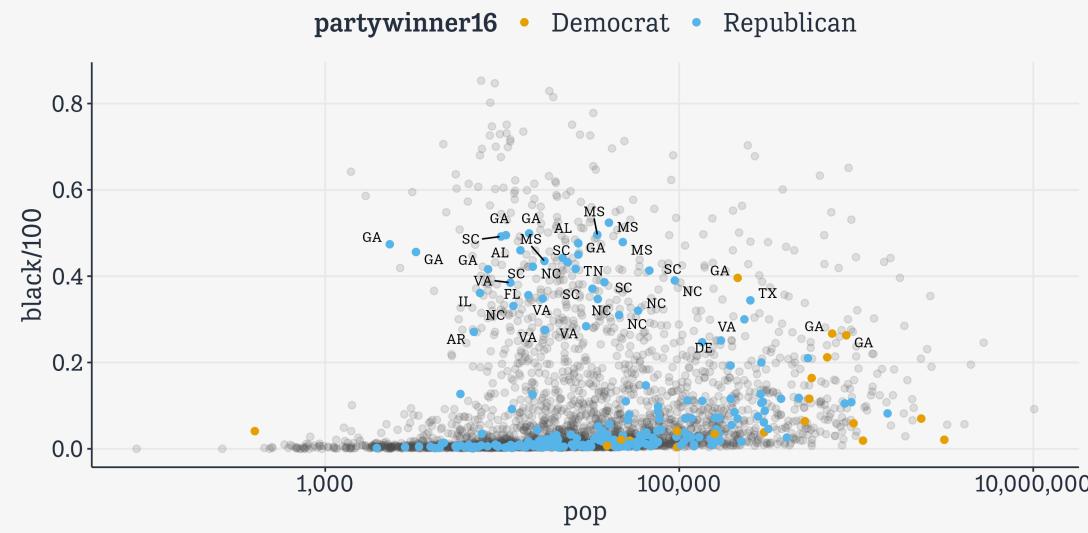
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors <- c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                         flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma()) +
11    geom_point(data = subset(county_data,
12                         flipped = "Yes"),
13                mapping = aes(x = pop, y = black/100,
14                               color = partywinner16,
15                               size = rel(2)))
```



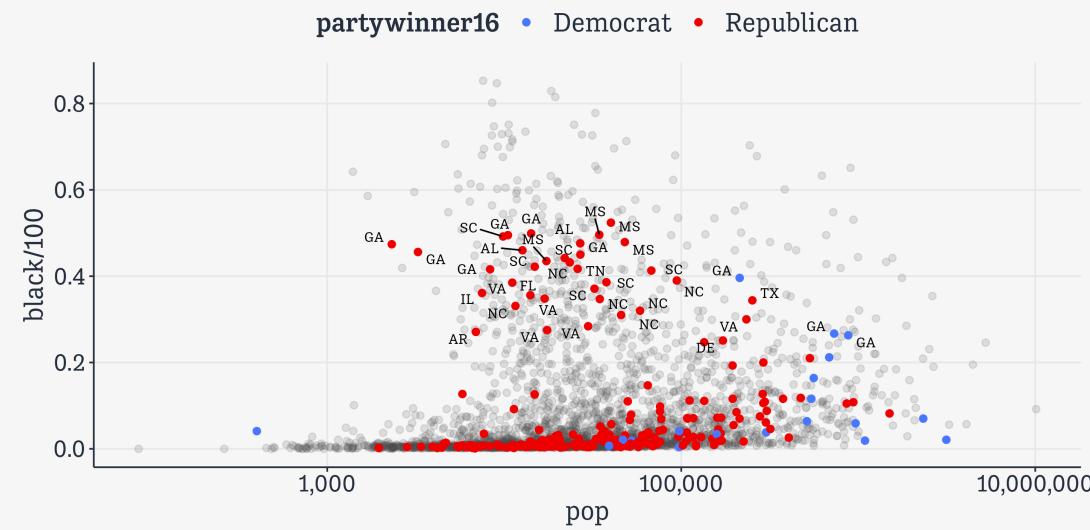
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors <- c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                         flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma()) +
11    geom_point(data = subset(county_data,
12                         flipped = "Yes"),
13                mapping = aes(x = pop, y = black/100,
14                               color = partywinner16,
15                               size = rel(2)) +
16    geom_text_repel(data = subset(county_data,
17                         flipped = "Yes" & black > 25),
18                    mapping = aes(x = pop,
19                                  y = black/100, label = state,
20                                  family = "Tenso Slide",
21                                  face = "bold"), size = rel(3
```



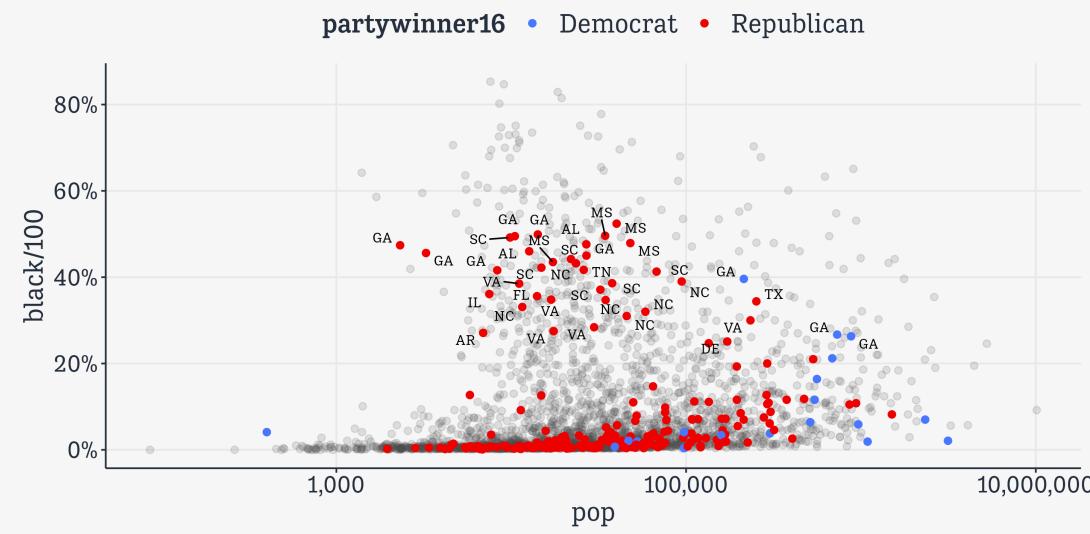
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors <- c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                         flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma()) +
11    geom_point(data = subset(county_data,
12                  flipped = "Yes"),
13                mapping = aes(x = pop, y = black/100,
14                               color = partywinner16),
15                size = rel(2)) +
16    geom_text_repel(data = subset(county_data,
17                      flipped = "Yes" & black > 25),
18                      mapping = aes(x = pop,
19                                     y = black/100, label = state,
20                                     family = "Tenso Slide",
21                                     face = "bold"), size = rel(3))
22    scale_color_manual(values = party_colors)
```



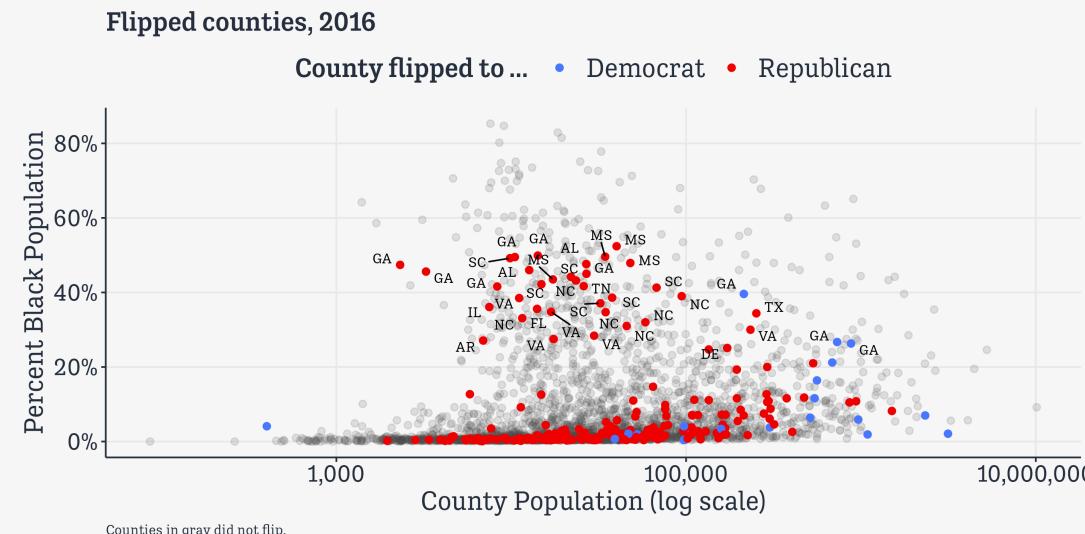
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors <- c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                         flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma()) +
11    geom_point(data = subset(county_data,
12                         flipped = "Yes"),
13                mapping = aes(x = pop, y = black/100,
14                               color = partywinner16,
15                               size = rel(2)) +
16    geom_text_repel(data = subset(county_data,
17                         flipped = "Yes" & black > 25),
18                    mapping = aes(x = pop,
19                                  y = black/100, label = state,
20                                  family = "Tenso Slide",
21                                  face = "bold"), size = rel(3)
22    scale_color_manual(values = party_colors) +
23    scale_y_continuous(labels = label_percent())
```



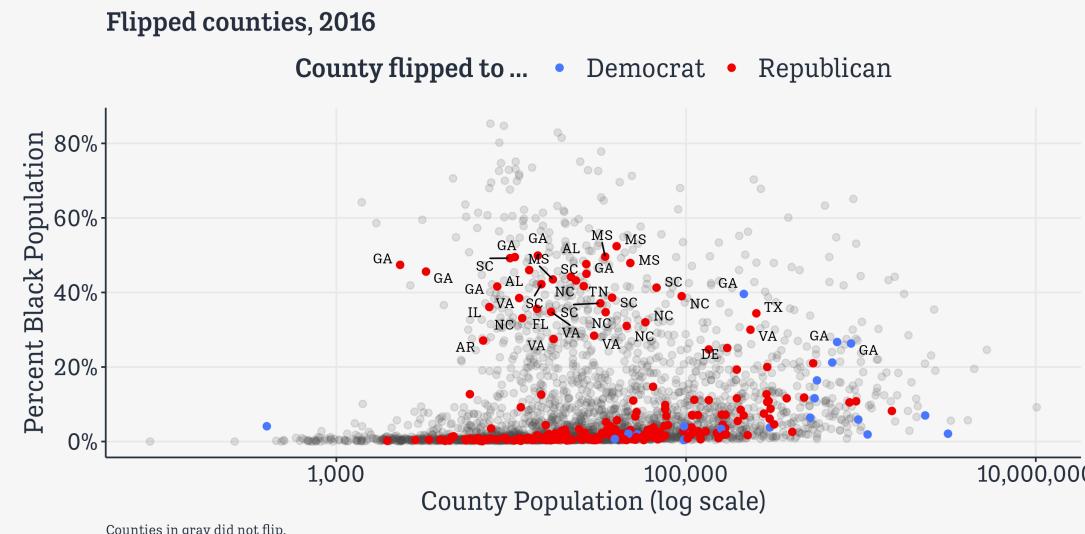
We know how to build this

```
1 # Brighter Blue and Red
2 party_colors <- c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                         flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma()) +
11    geom_point(data = subset(county_data,
12                         flipped = "Yes"),
13                mapping = aes(x = pop, y = black/100,
14                               color = partywinner16,
15                               size = rel(2)) +
16    geom_text_repel(data = subset(county_data,
17                         flipped = "Yes" & black > 25),
18                    mapping = aes(x = pop,
19                                 y = black/100, label = state,
20                                 family = "Tenso Slide",
21                                 face = "bold"), size = rel(3)
22    scale_color_manual(values = party_colors) +
23    scale_y_continuous(labels = label_percent()) +
```

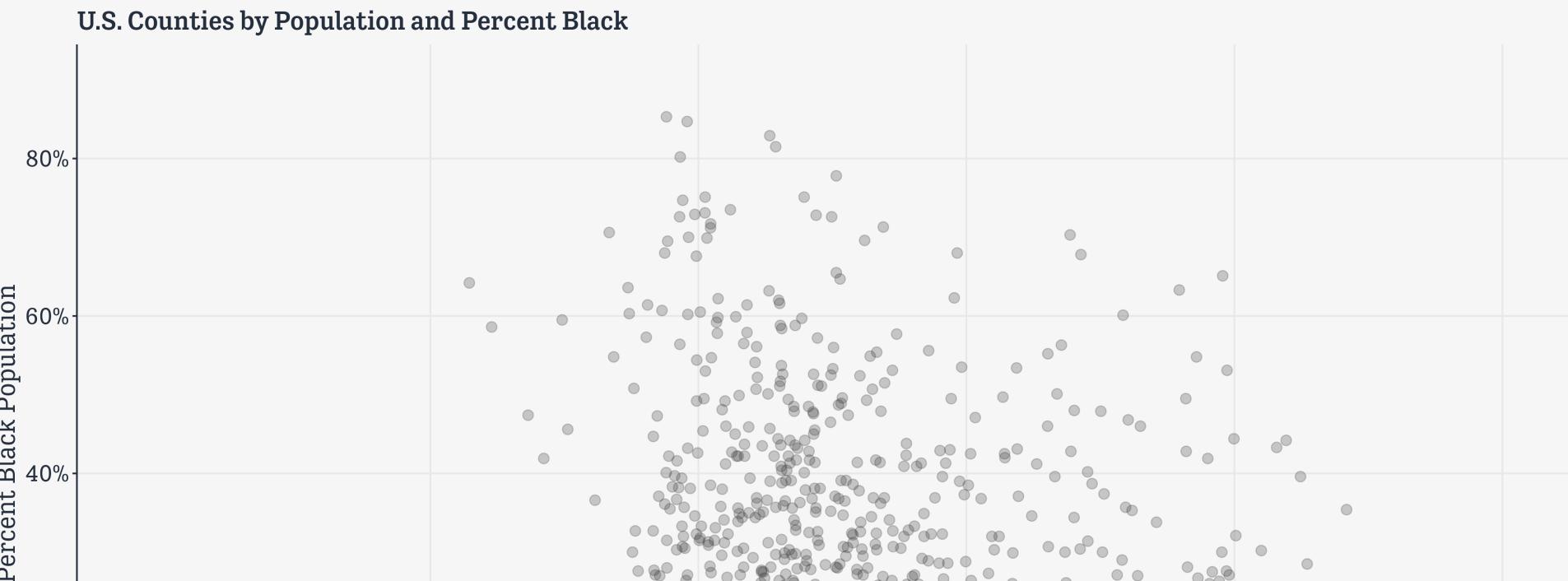


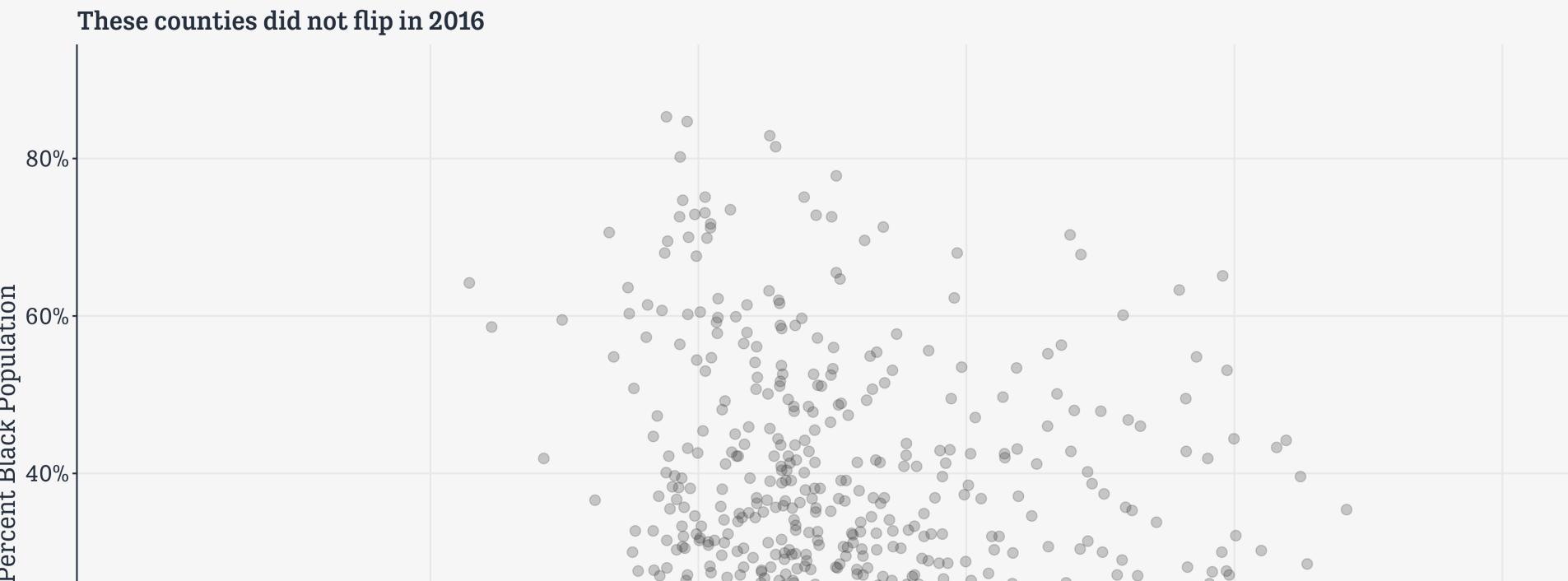
We know how to build this

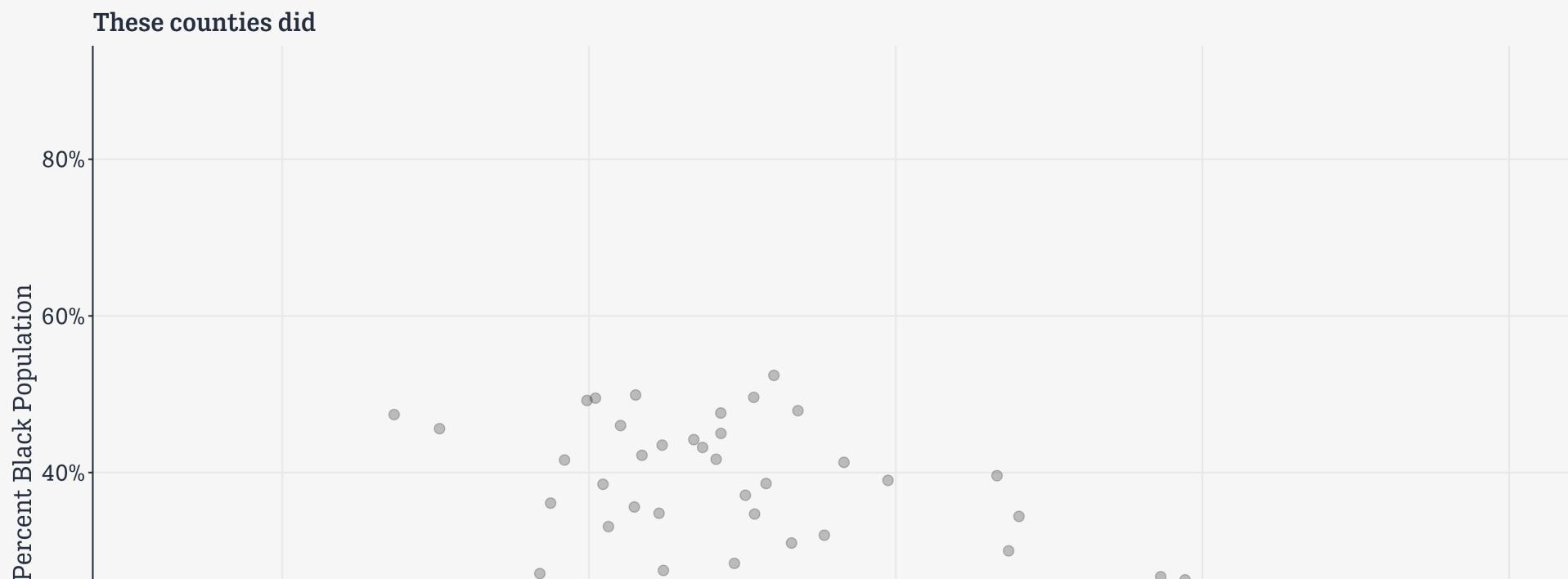
```
1 # Brighter Blue and Red
2 party_colors <- c("royalblue1", "red2")
3
4 ggplot(data = subset(county_data,
5                         flipped = "No"),
6         mapping = aes(x = pop,
7                         y = black/100)) +
8     geom_point(alpha = 0.15, color = "gray30",
9                 size = rel(2)) +
10    scale_x_log10(labels = label_comma()) +
11    geom_point(data = subset(county_data,
12                         flipped = "Yes"),
13                mapping = aes(x = pop, y = black/100,
14                               color = partywinner16,
15                               size = rel(2)) +
16    geom_text_repel(data = subset(county_data,
17                         flipped = "Yes" & black > 25),
18                    mapping = aes(x = pop,
19                                 y = black/100, label = state,
20                                 family = "Tenso Slide",
21                                 face = "bold"), size = rel(3)
22    scale_color_manual(values = party_colors) +
23    scale_y_continuous(labels = label_percent()) +
```



Leverage ggplot's
layered approach

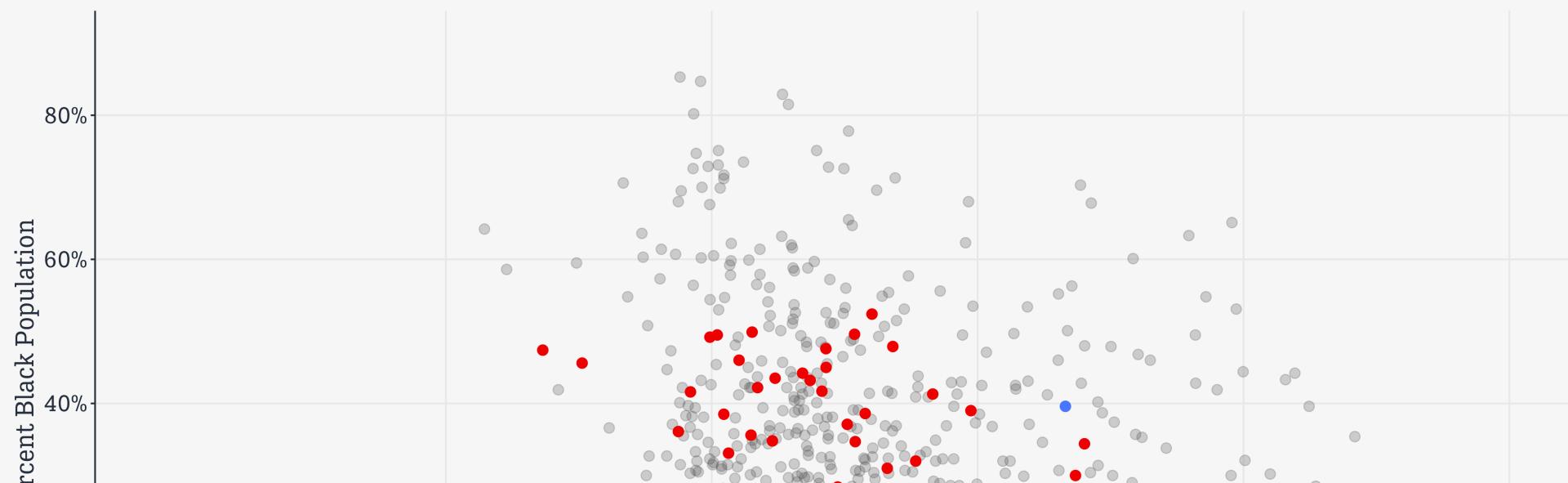


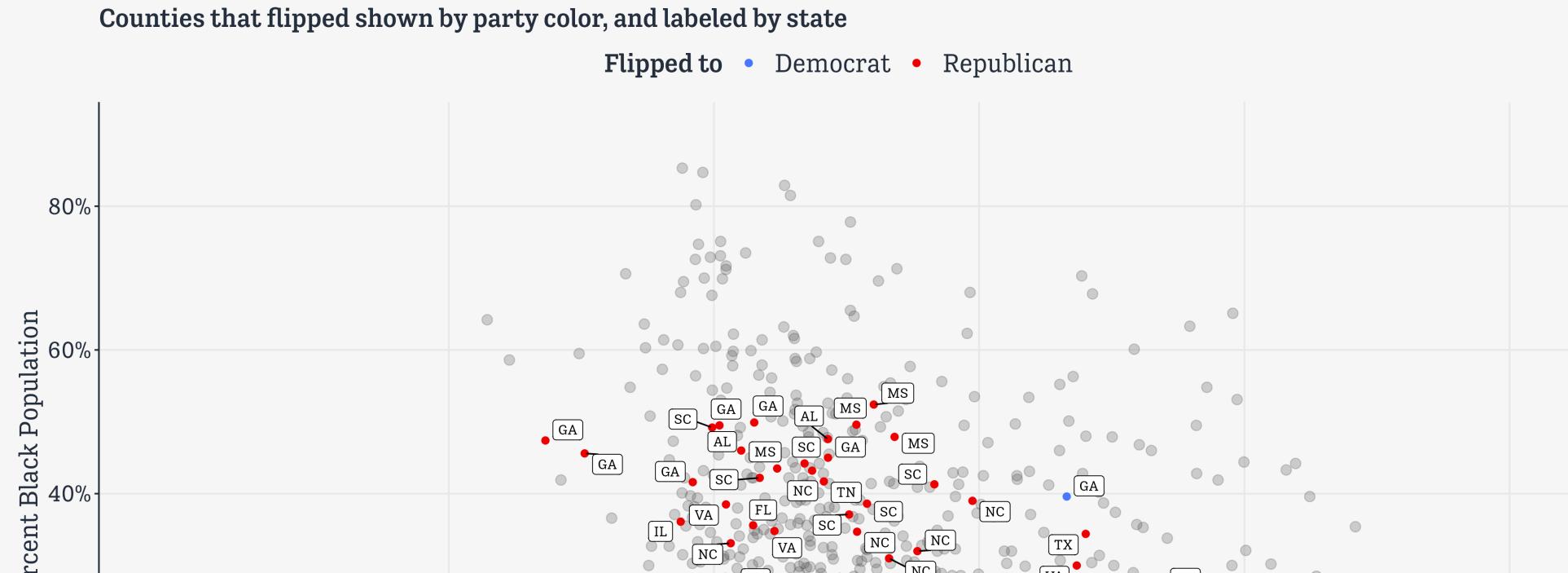




Counties that flipped shown by party color

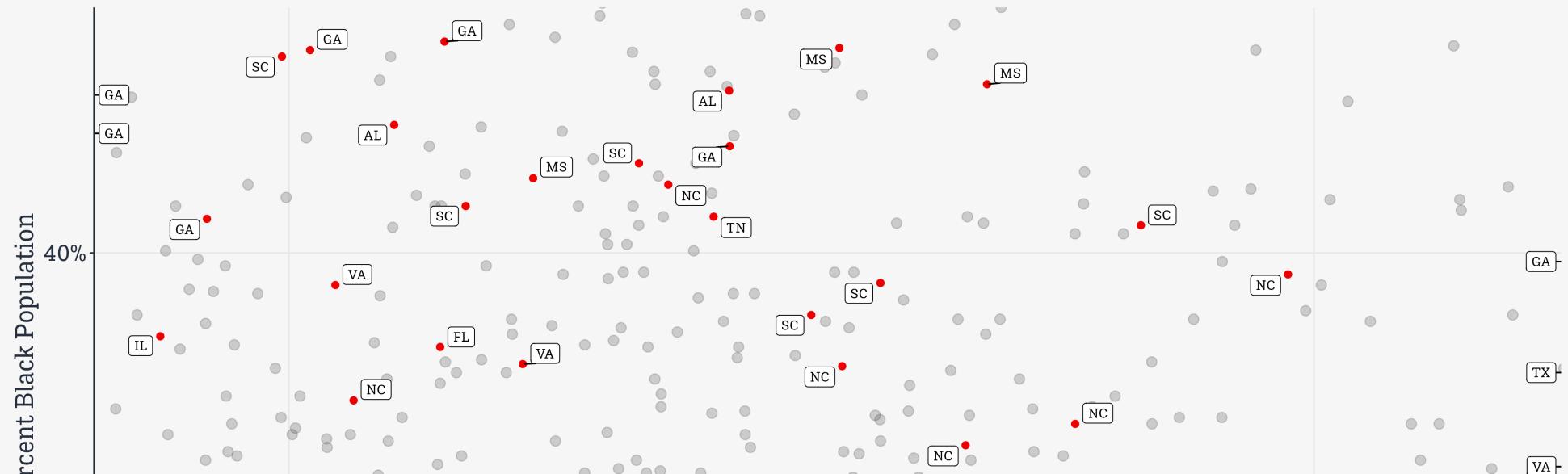
Flipped to • Democrat • Republican

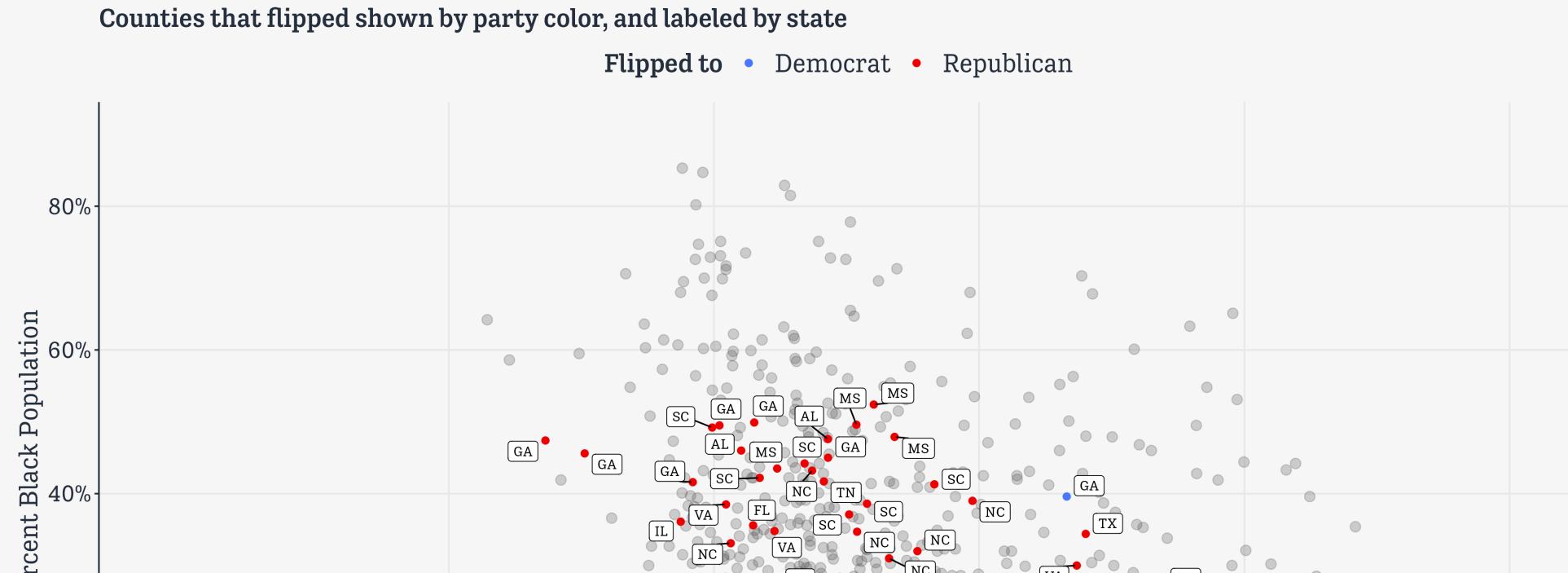




Counties that flipped shown by party color, and labeled by state; zoomed-in

Flipped to • Democrat • Republican





Layer,
Highlight,
Repeat

Build from ideas to data

III

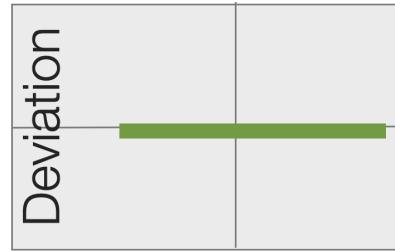
Vote Difference from Median Score

+

0

Deviation from
Consensus

Build from ideas to data



1. Pure Objectivity



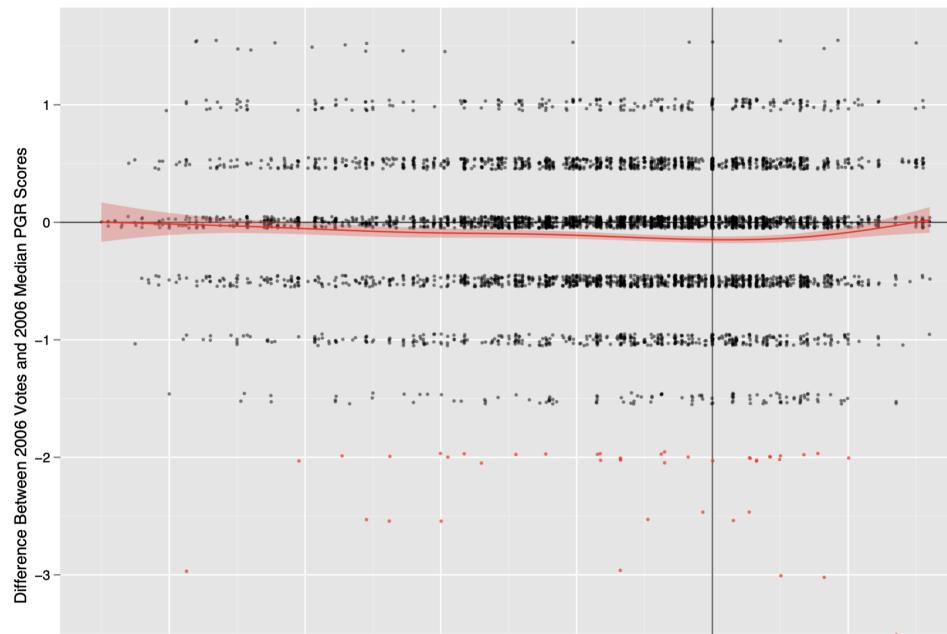
2. Distant Envy



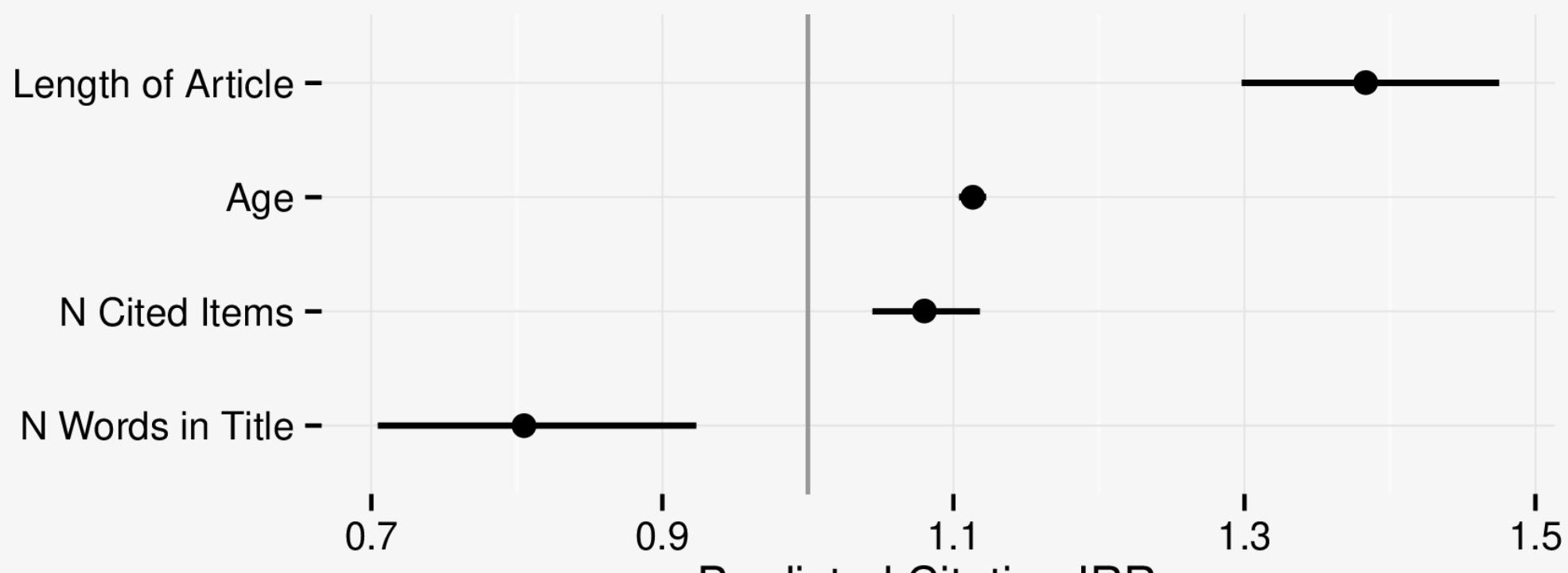
3. Local Envy

Build from ideas to data

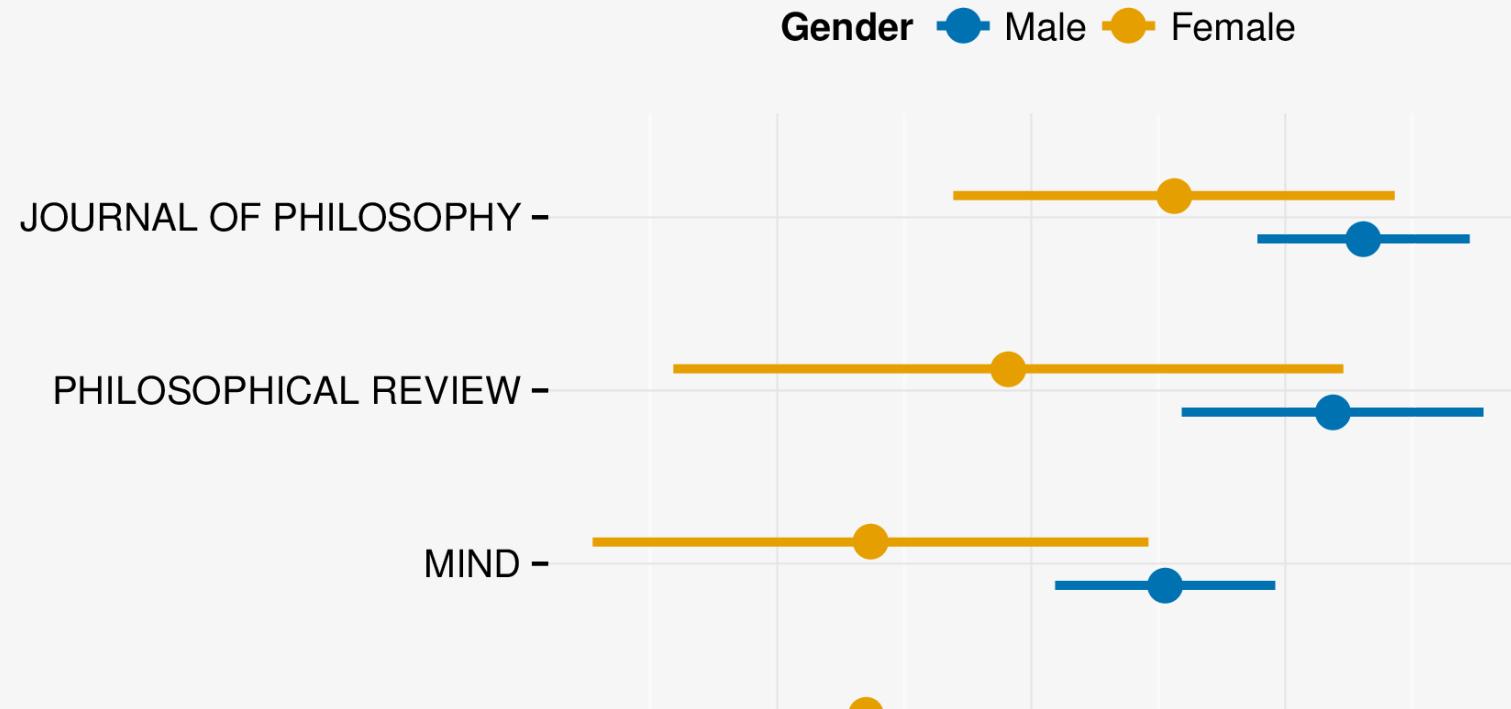
Deviation



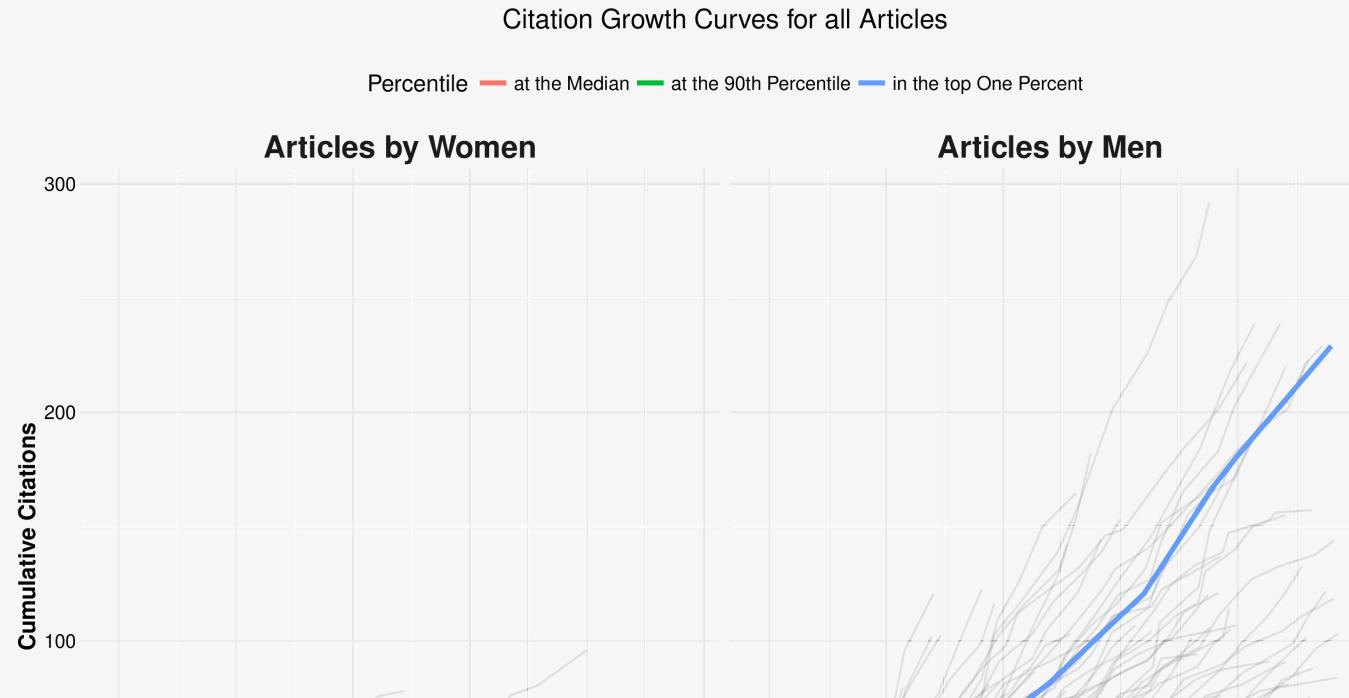
Repeat to differentiate



Repeat to differentiate

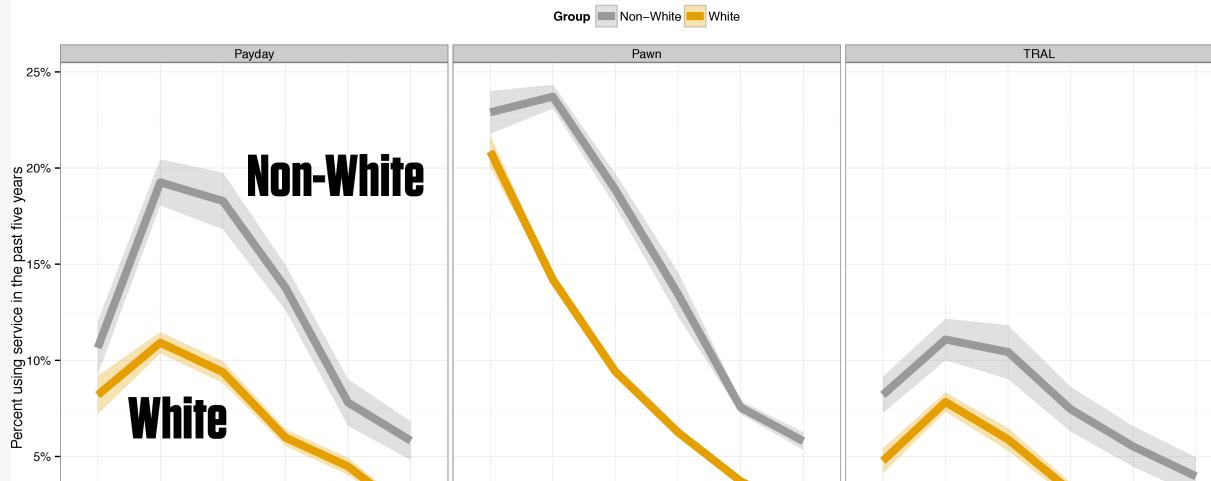


Layer and repeat with facets



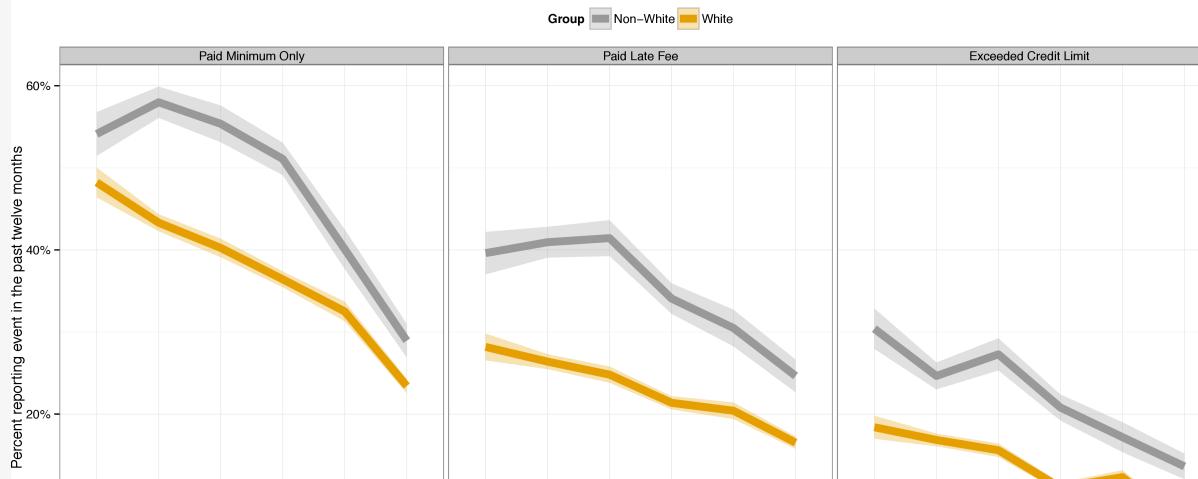
Layer and repeat across facets

Categorical Gaps: Alternative Financial Services



Layer and repeat across facets

Categorical Gaps: Adverse Credit Events



X-Ray Vision



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

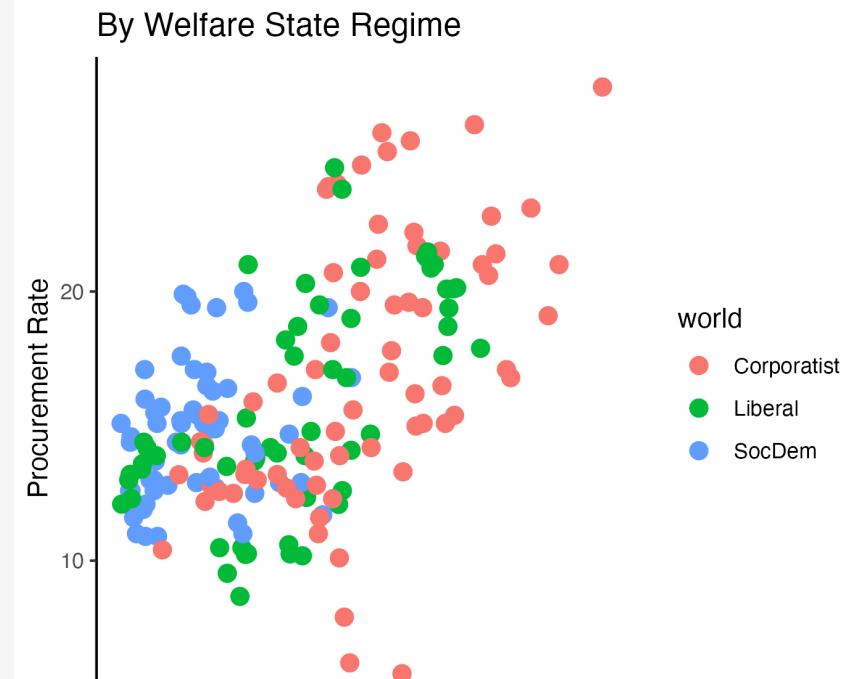
represent data
directly

Make a plot

```
kjh_set_classic_theme(3)
```

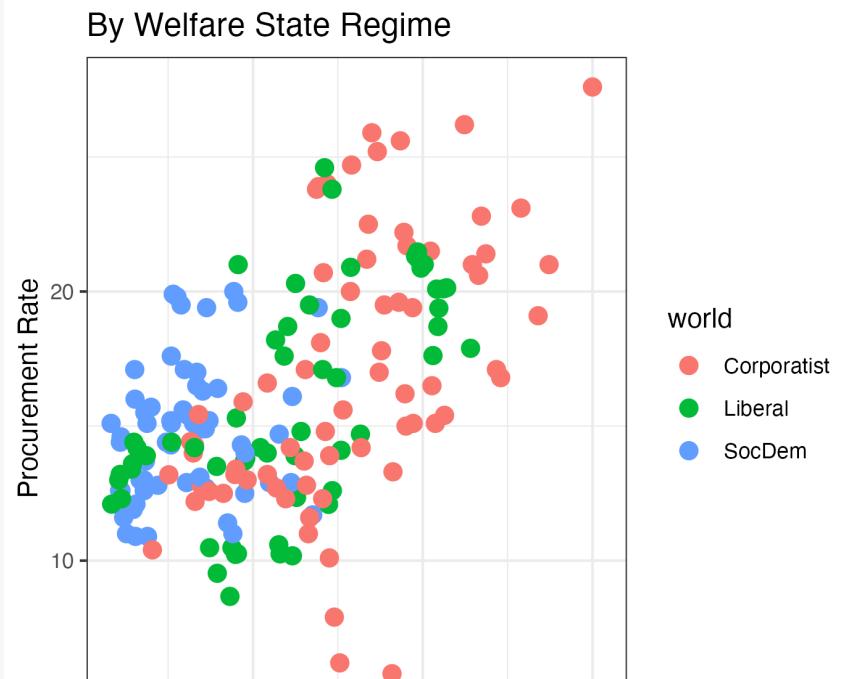
```
p ← organdata %>%  
  drop_na(world) %>%  
  ggplot(mapping = aes(x = roads, y = donors,  
                      color = world)) +  
  geom_point(size = 3) +  
  labs(x = "Road Deaths",  
  
       y = "Procurement Rate",  
       title = "By Welfare State Regime")
```

```
p
```



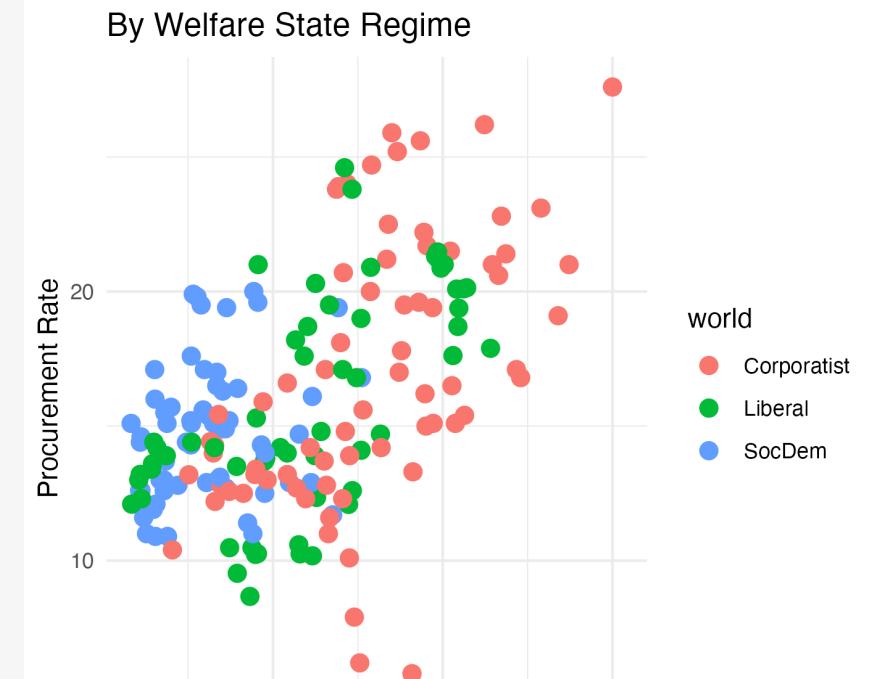
Add a theme ... `theme_bw()`

```
p + theme_bw()
```



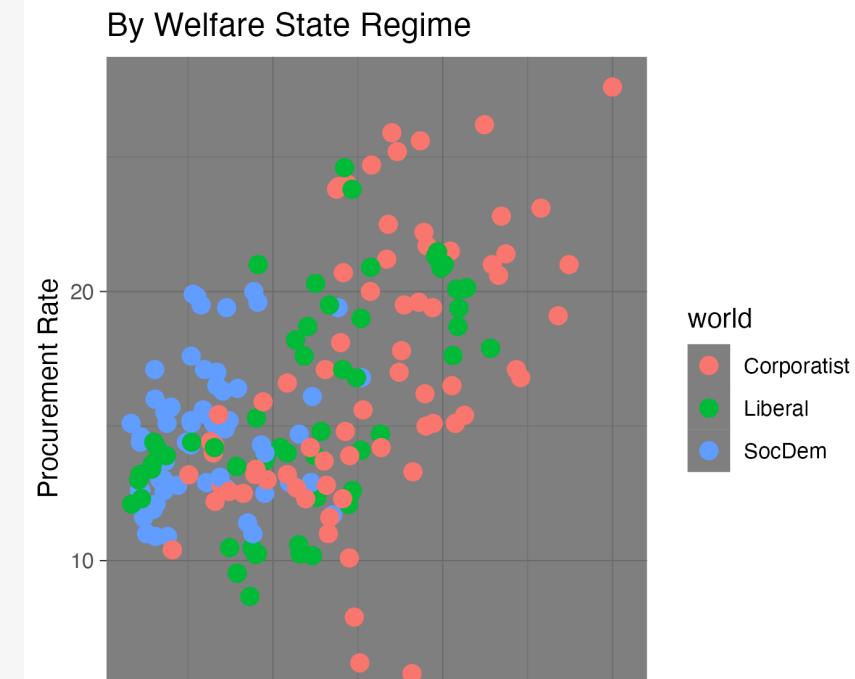
Add a theme ... `theme_minimal()`

```
p + theme_minimal()
```



Add a theme ... `theme_dark()`

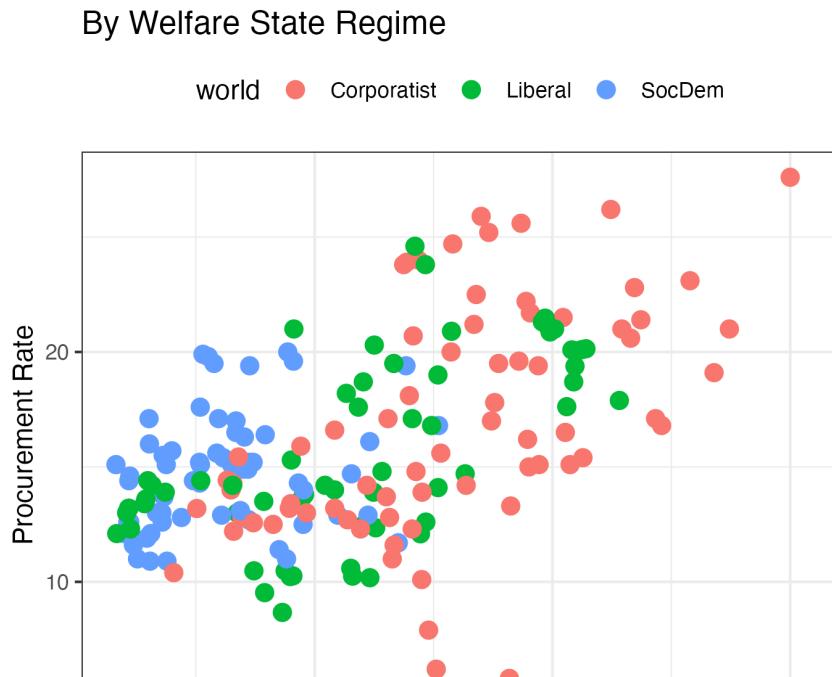
```
p + theme_dark()
```



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.ontop plot.background
```

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
```



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
```



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?

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?

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”

The relevant element is `plot.title`.

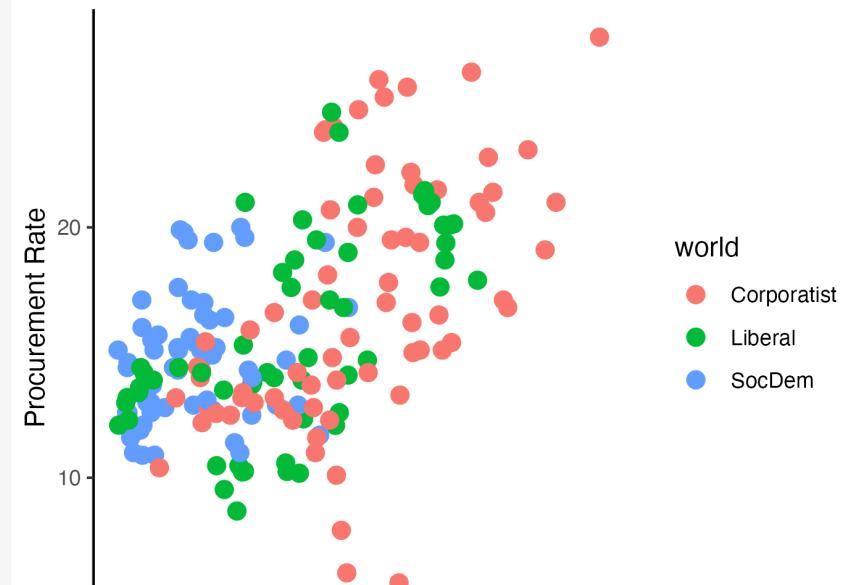
It's *text*.

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”

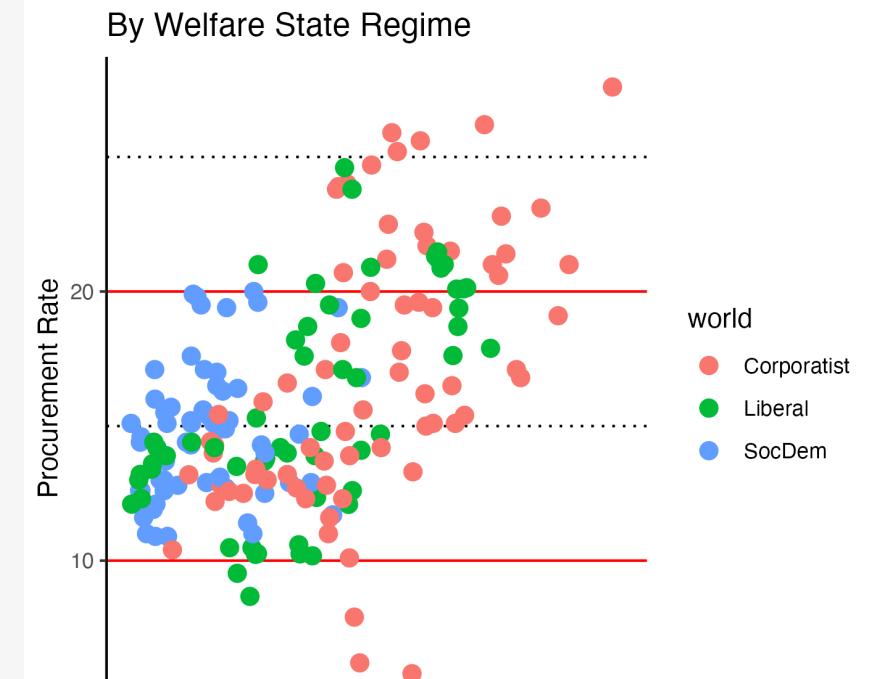
The relevant elements are `panel.grid.major.y` and `panel.grid.minor.y`.

These are *lines*.

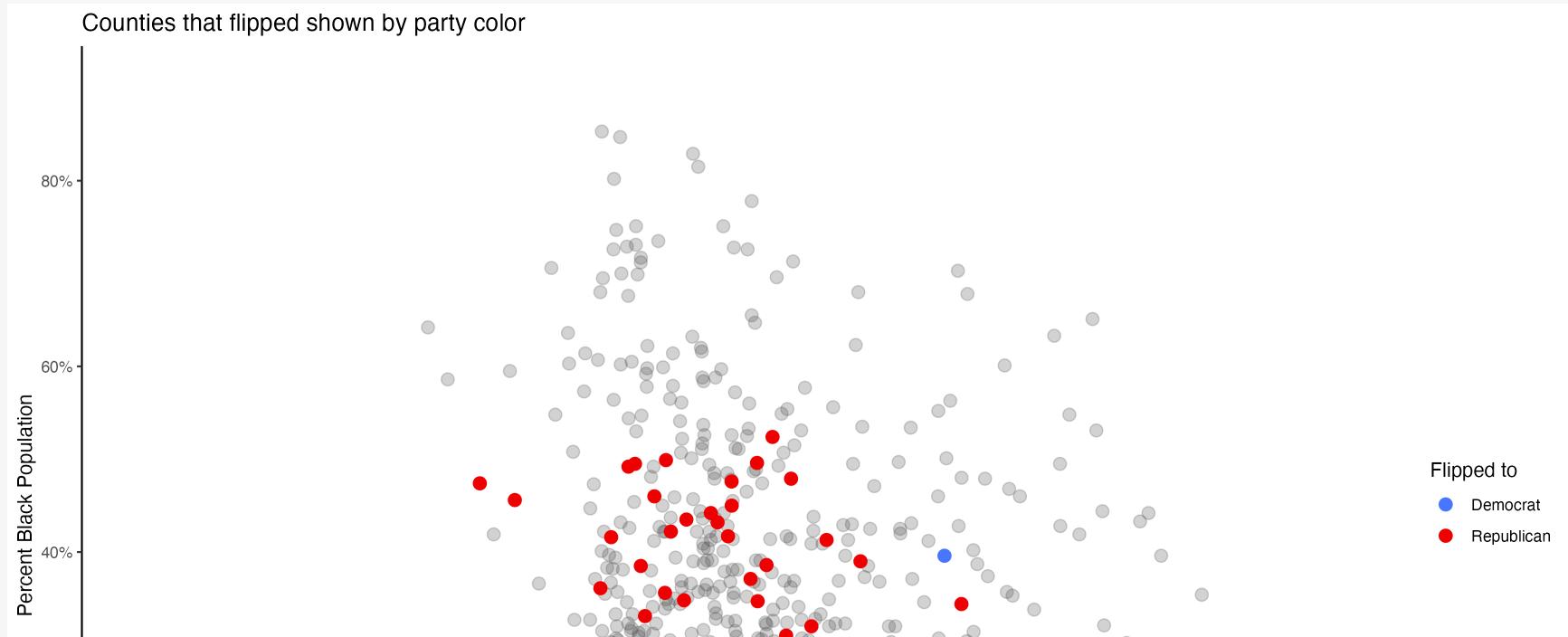
Inside the theme function, adjust it with `element_line()`.

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

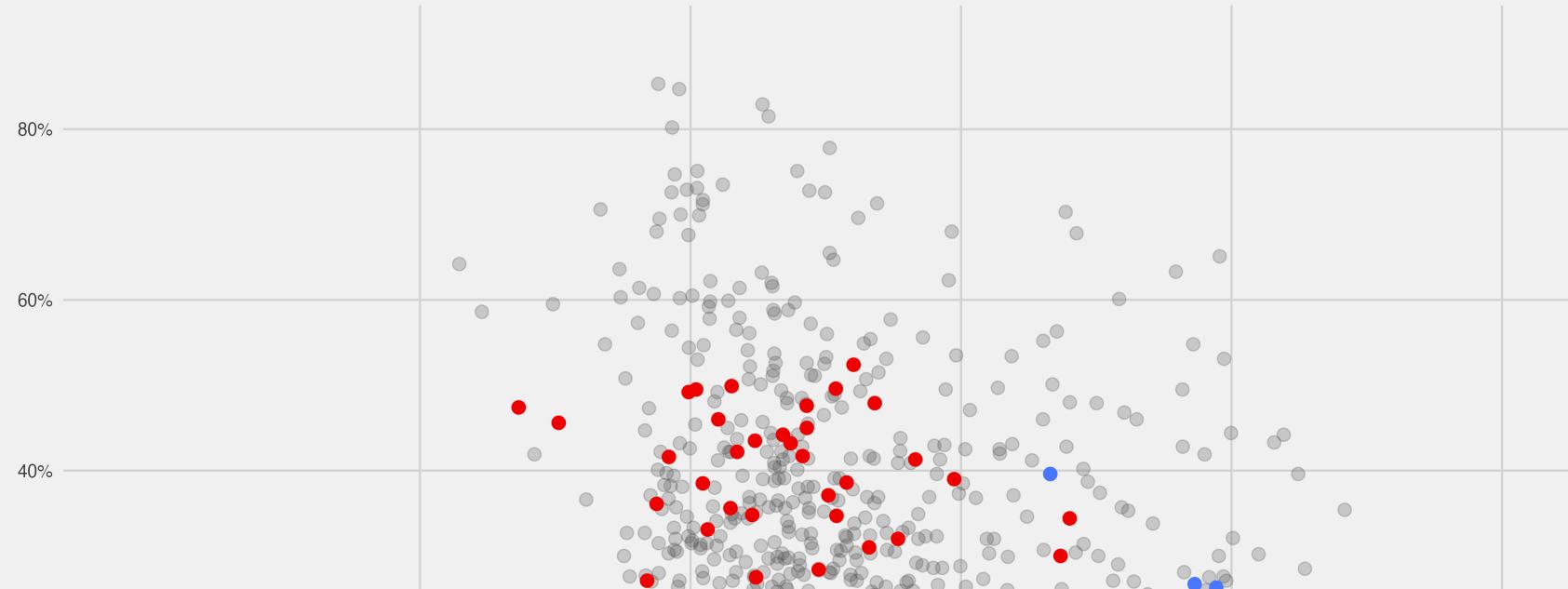


Theming a plot

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

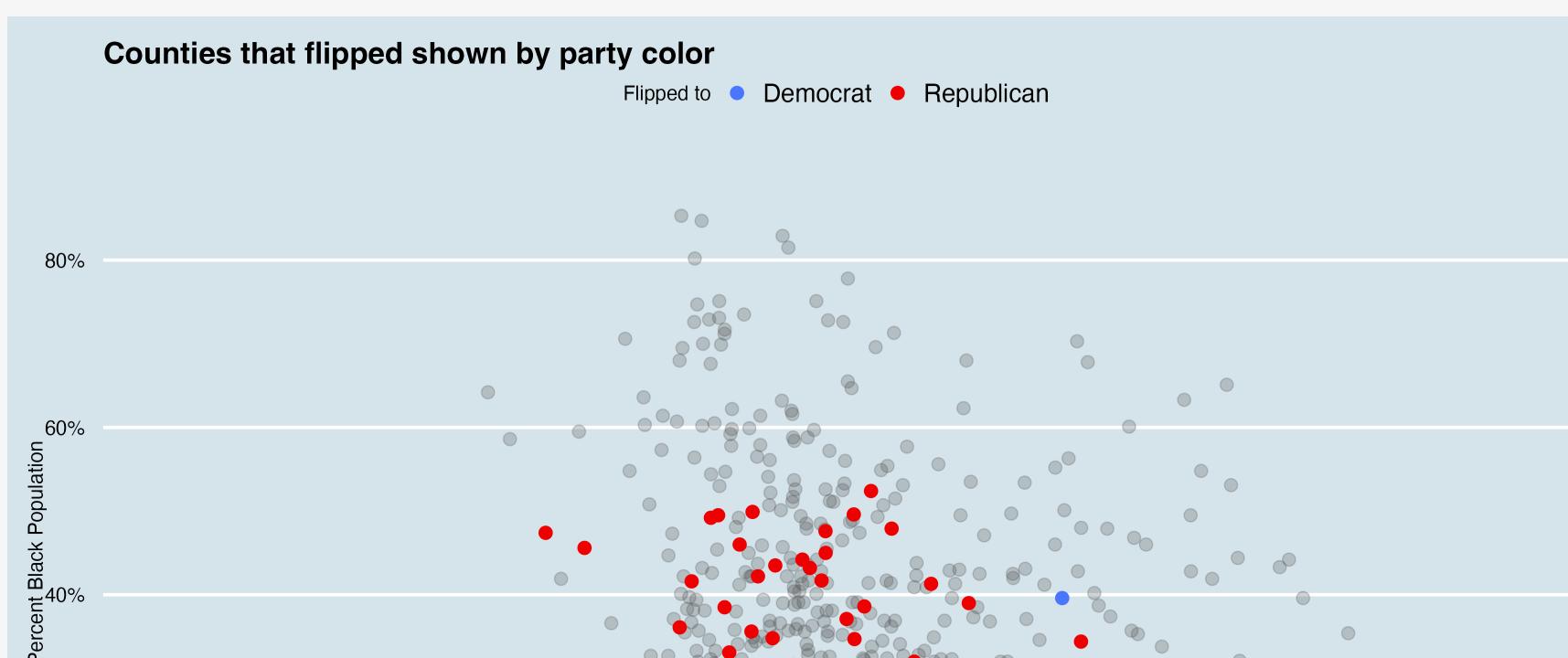
See how the full function call goes inside `theme_set()`, including the parentheses, because we are actually running that function to set all the elements.

Counties that flipped shown by party color



Theming a plot

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

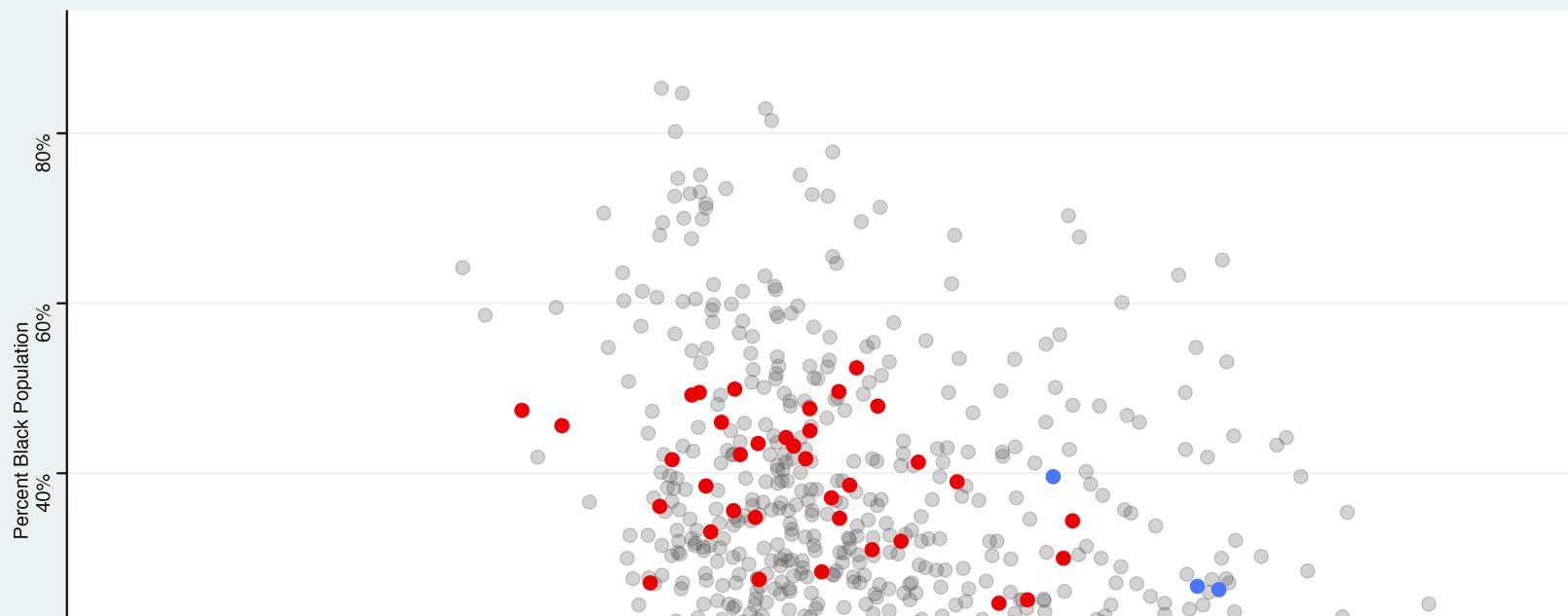


This seems morally wrong

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



Counties that flipped shown by party color



Pick a theme
and stick with it