

Some Case Studies

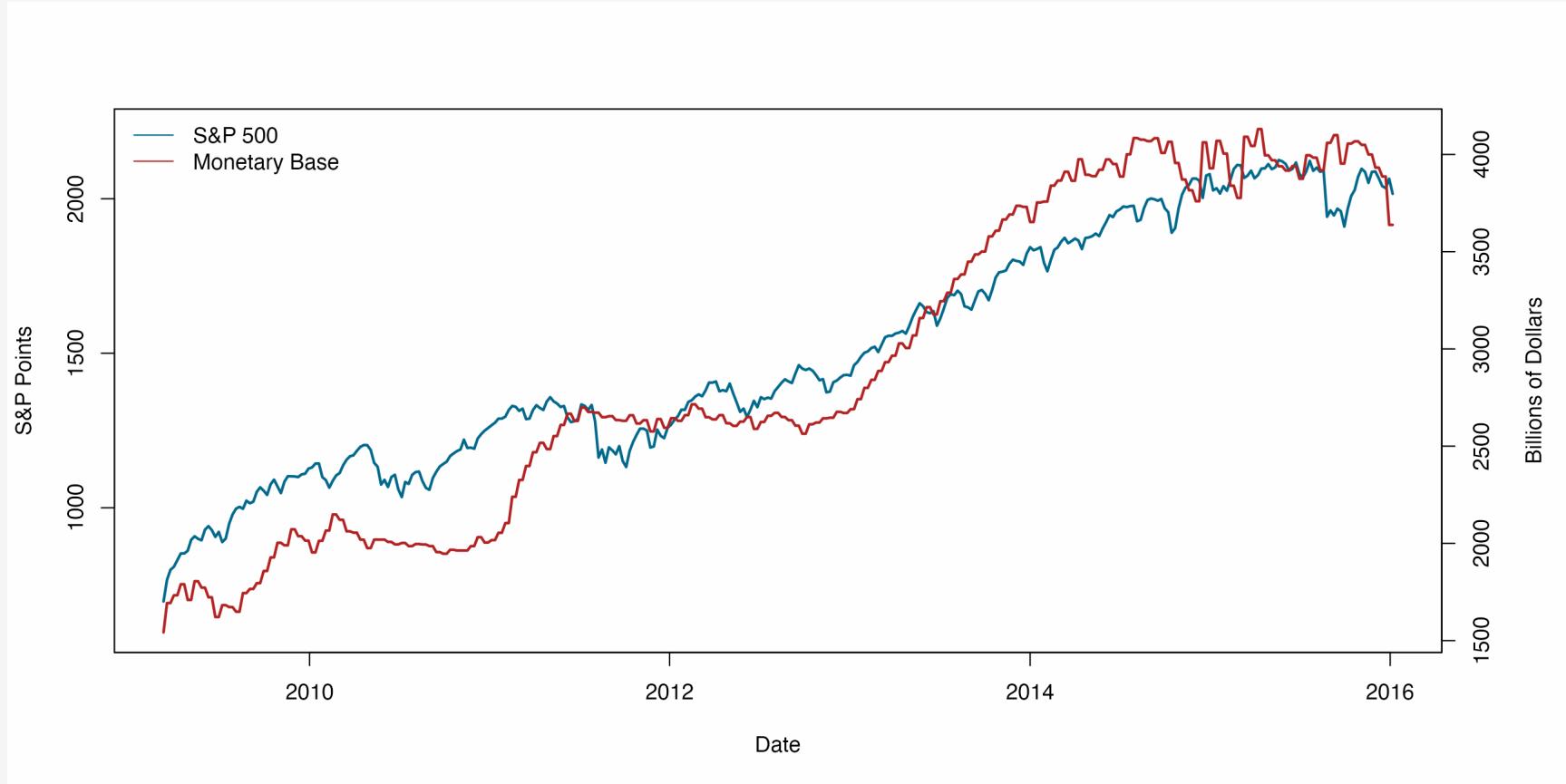
Data Visualization: Session 9

Kieran Healy

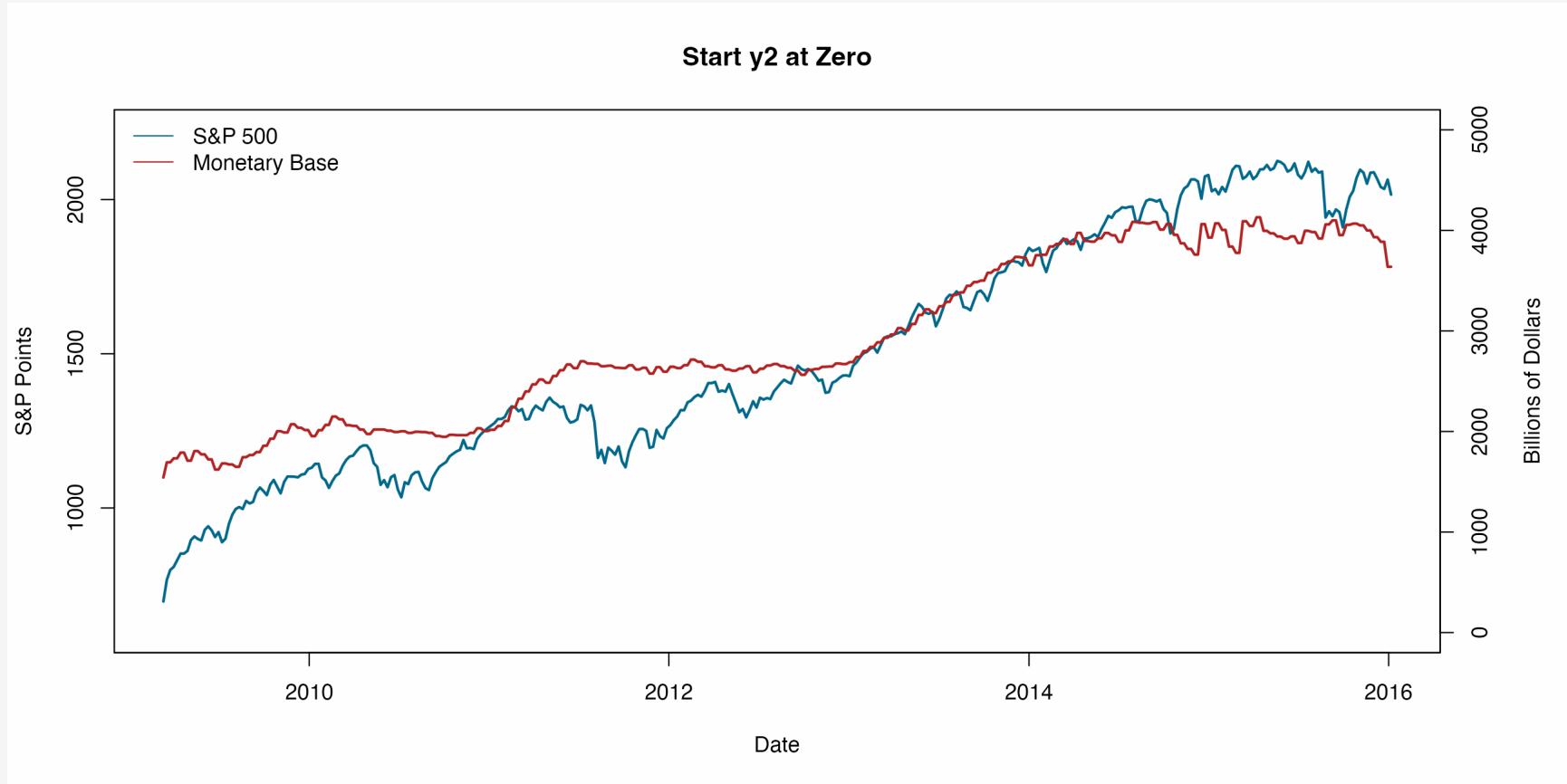
Code Horizons, May 2022

Working and Reworking

Two y-axes

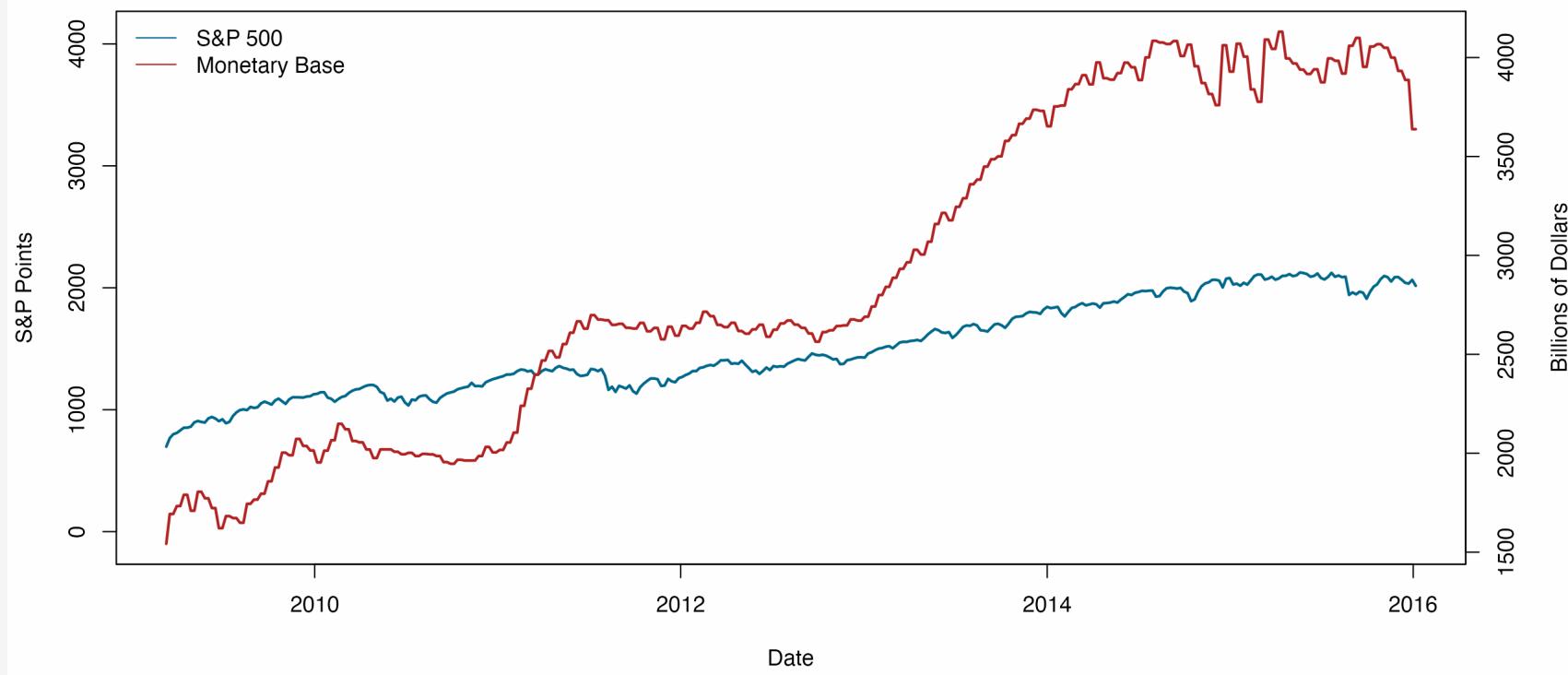


Have we found the secret key to the stock market?



No, no we have not.

Start y1 at Zero; Max both at Max y2



credit

What to do instead?

```
fredts <- as_tibble(fredts)
fredts

## # A tibble: 357 × 5
##   date      sp500 monbase sp500_i monbase_i
##   <date>    <dbl>   <int>   <dbl>     <dbl>
## 1 2009-03-11  697. 1542228    100     100
## 2 2009-03-18  767. 1693133    110.    110.
## 3 2009-03-25  799. 1693133    115.    110.
## 4 2009-04-01  809. 1733017    116.    112.
## 5 2009-04-08  831. 1733017    119.    112.
## 6 2009-04-15  852. 1789878    122.    116.
## 7 2009-04-22  852. 1789878    122.    116.
## 8 2009-04-29  861. 1709369    124.    111.
## 9 2009-05-06  896. 1709369    129.    111.
## 10 2009-05-13 908. 1805373   130.    117.
## # ... with 347 more rows
```

Pivot the data

```
fredts  
## # A tibble: 357 × 5  
##   date      sp500 monbase sp500_i monbase_i  
##   <date>     <dbl>   <int>    <dbl>     <dbl>  
## 1 2009-03-11  697. 1542228     100      100  
## 2 2009-03-18  767. 1693133     110.     110.  
## 3 2009-03-25  799. 1693133     115.     110.  
## 4 2009-04-01  809. 1733017     116.     112.  
## 5 2009-04-08  831. 1733017     119.     112.  
## 6 2009-04-15  852. 1789878     122.     116.  
## 7 2009-04-22  852. 1789878     122.     116.  
## 8 2009-04-29  861. 1709369     124.     111.  
## 9 2009-05-06  896. 1709369     129.     111.  
## 10 2009-05-13 908. 1805373     130.     117.  
## # ... with 347 more rows
```

Pivot the data

```
fredts |>  
  select(date, sp500_i, monbase_i)  
  
## # A tibble: 357 × 3  
##   date      sp500_i monbase_i  
##   <date>     <dbl>    <dbl>  
## 1 2009-03-11     100     100  
## 2 2009-03-18     110.    110.  
## 3 2009-03-25     115.    110.  
## 4 2009-04-01     116.    112.  
## 5 2009-04-08     119.    112.  
## 6 2009-04-15     122.    116.  
## 7 2009-04-22     122.    116.  
## 8 2009-04-29     124.    111.  
## 9 2009-05-06     129.    111.  
## 10 2009-05-13    130.    117.  
## # ... with 347 more rows
```

Pivot the data

```
fredts |>
  select(date, sp500_i, monbase_i) |>
  pivot_longer(sp500_i:monbase_i,
               names_to = "series",
               values_to = "score")  
  
## # A tibble: 714 × 3
##   date      series   score
##   <date>    <chr>     <dbl>
## 1 2009-03-11 sp500_i    100
## 2 2009-03-11 monbase_i  100
## 3 2009-03-18 sp500_i    110.
## 4 2009-03-18 monbase_i  110.
## 5 2009-03-25 sp500_i    115.
## 6 2009-03-25 monbase_i  110.
## 7 2009-04-01 sp500_i    116.
## 8 2009-04-01 monbase_i  112.
## 9 2009-04-08 sp500_i    119.
## 10 2009-04-08 monbase_i 112.
## # ... with 704 more rows
```

Pivot the data

```
fredts |>  
  select(date, sp500_i, monbase_i)  |>  
  pivot_longer(sp500_i:monbase_i,  
               names_to = "series",  
               values_to = "score") ->  
  fredts_m
```

Pivot the data

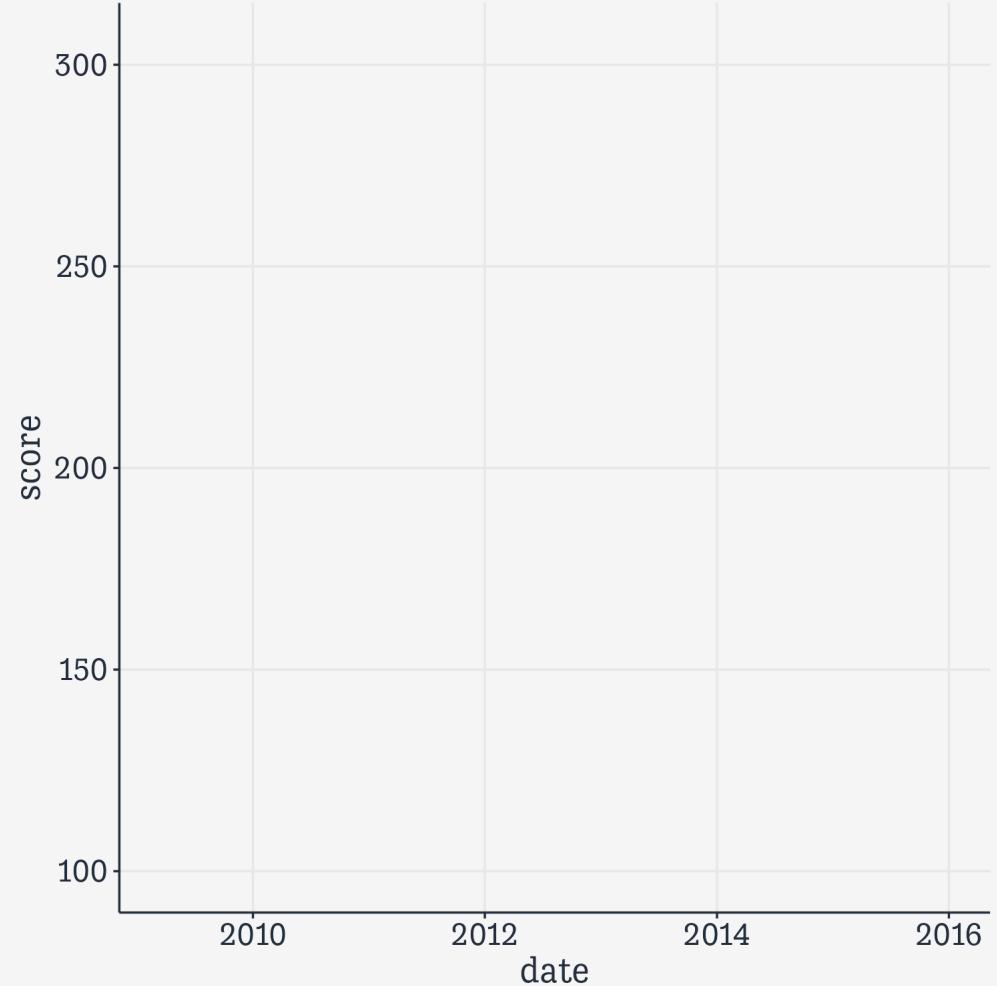
```
fredts |>  
  select(date, sp500_i, monbase_i)  |>  
  pivot_longer(sp500_i:monbase_i,  
               names_to = "series",  
               values_to = "score") ->  
fredts_m
```


Make two plots

```
fredts_m  
## # A tibble: 714 × 3  
##   date      series    score  
##   <date>     <chr>     <dbl>  
## 1 2009-03-11 sp500_i     100  
## 2 2009-03-11 monbase_i   100  
## 3 2009-03-18 sp500_i    110.  
## 4 2009-03-18 monbase_i   110.  
## 5 2009-03-25 sp500_i    115.  
## 6 2009-03-25 monbase_i   110.  
## 7 2009-04-01 sp500_i    116.  
## 8 2009-04-01 monbase_i   112.  
## 9 2009-04-08 sp500_i    119.  
## 10 2009-04-08 monbase_i  112.  
## # ... with 704 more rows
```

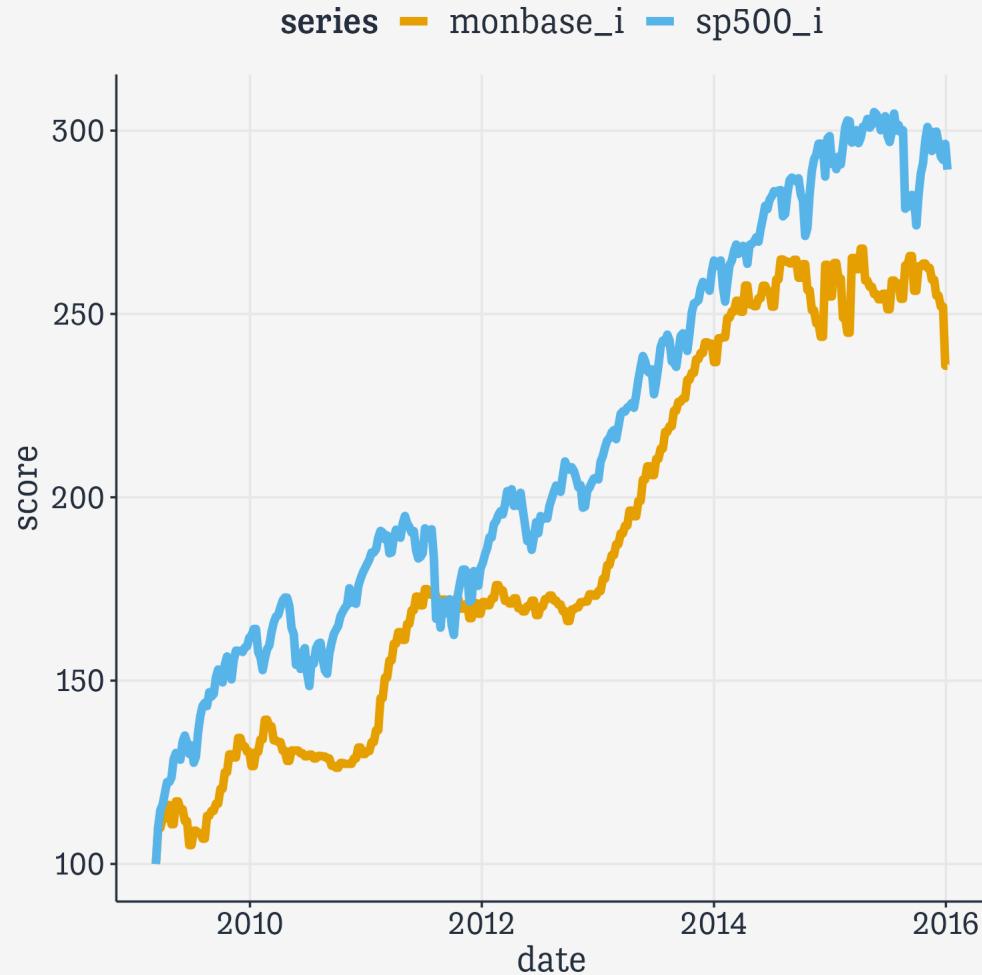
Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series))
```



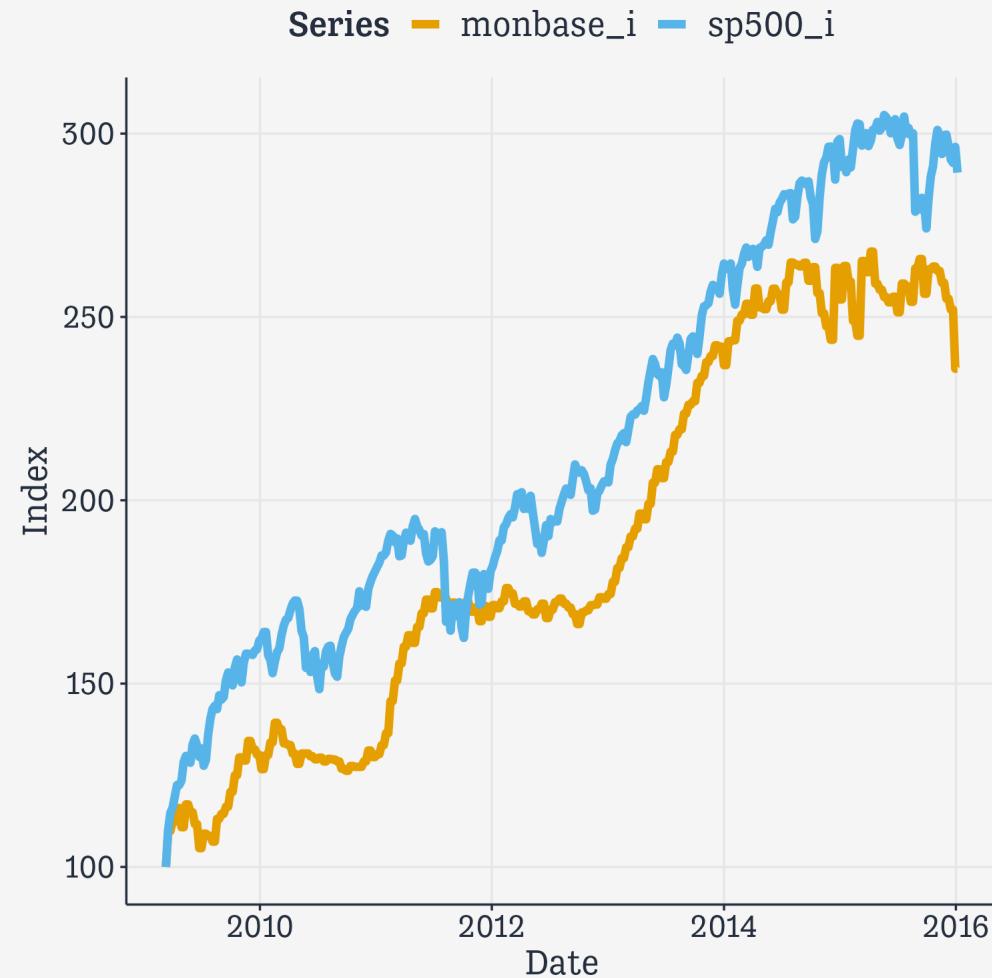
Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2)
```



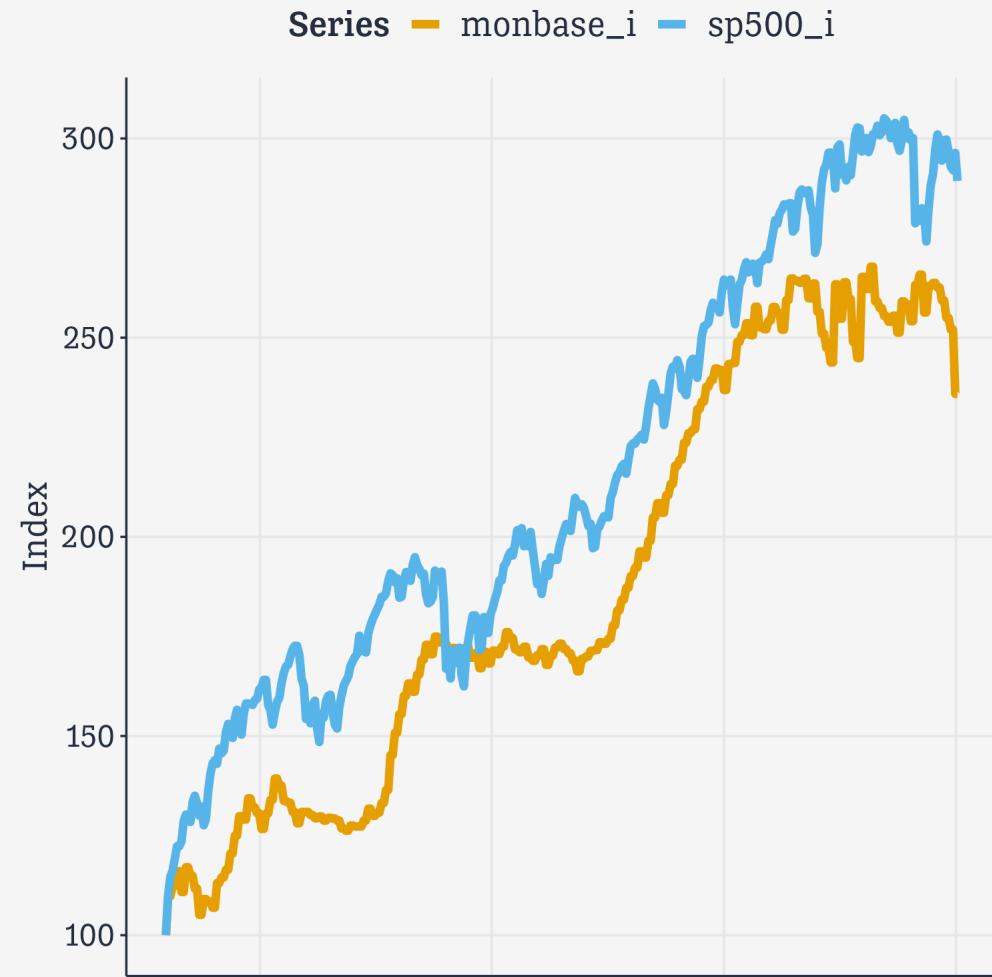
Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
       color = "Series")
```



Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
       color = "Series") +  
  theme(axis.title.x = element_blank(),  
        axis.text.x = element_blank(),  
        axis.ticks.x = element_blank())
```



Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
    color = "Series") +  
  theme(axis.title.x = element_blank(),  
    axis.text.x = element_blank(),  
    axis.ticks.x = element_blank()) ->  
  p1
```

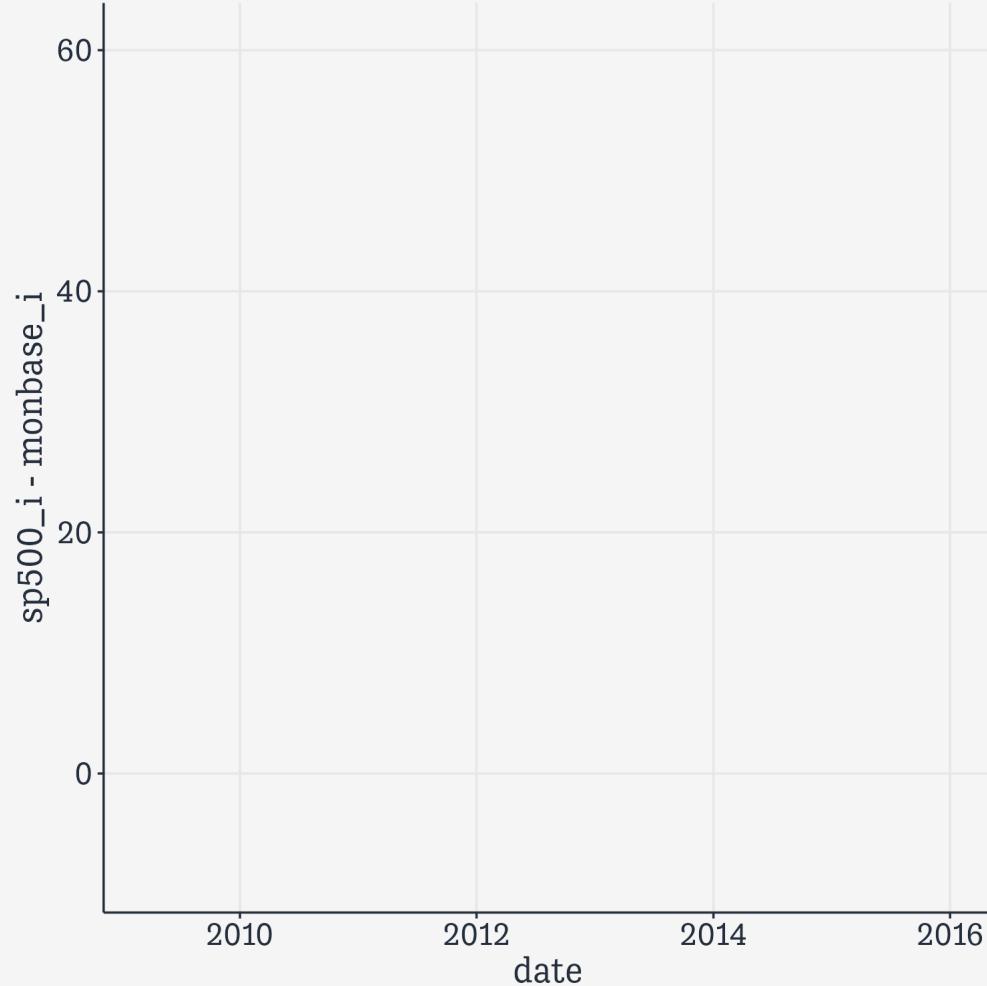
Make two plots

```
fredts_m |>
  ggplot(mapping =
    aes(x = date,
        y = score,
        color = series)) +
  geom_line(size = 2) +
  labs(x = "Date", y = "Index",
       color = "Series") +
  theme(axis.title.x = element_blank(),
        axis.text.x = element_blank(),
        axis.ticks.x = element_blank()) ->
  p1
# The original df
fredts
```

```
## # A tibble: 357 × 5
##   date      sp500 monbase sp500_i monbase_i
##   <date>     <dbl>   <int>    <dbl>    <dbl>
## 1 2009-03-11  697.  1542228     100     100
## 2 2009-03-18  767.  1693133     110.    110.
## 3 2009-03-25  799.  1693133     115.    110.
## 4 2009-04-01  809.  1733017     116.    112.
## 5 2009-04-08  831.  1733017     119.    112.
## 6 2009-04-15  852.  1789878     122.    116.
## 7 2009-04-22  852.  1789878     122.    116.
## 8 2009-04-29  861.  1709369     124.    111.
## 9 2009-05-06  896.  1709369     129.    111.
## 10 2009-05-13 908.  1805373     130.    117.
## # ... with 347 more rows
```

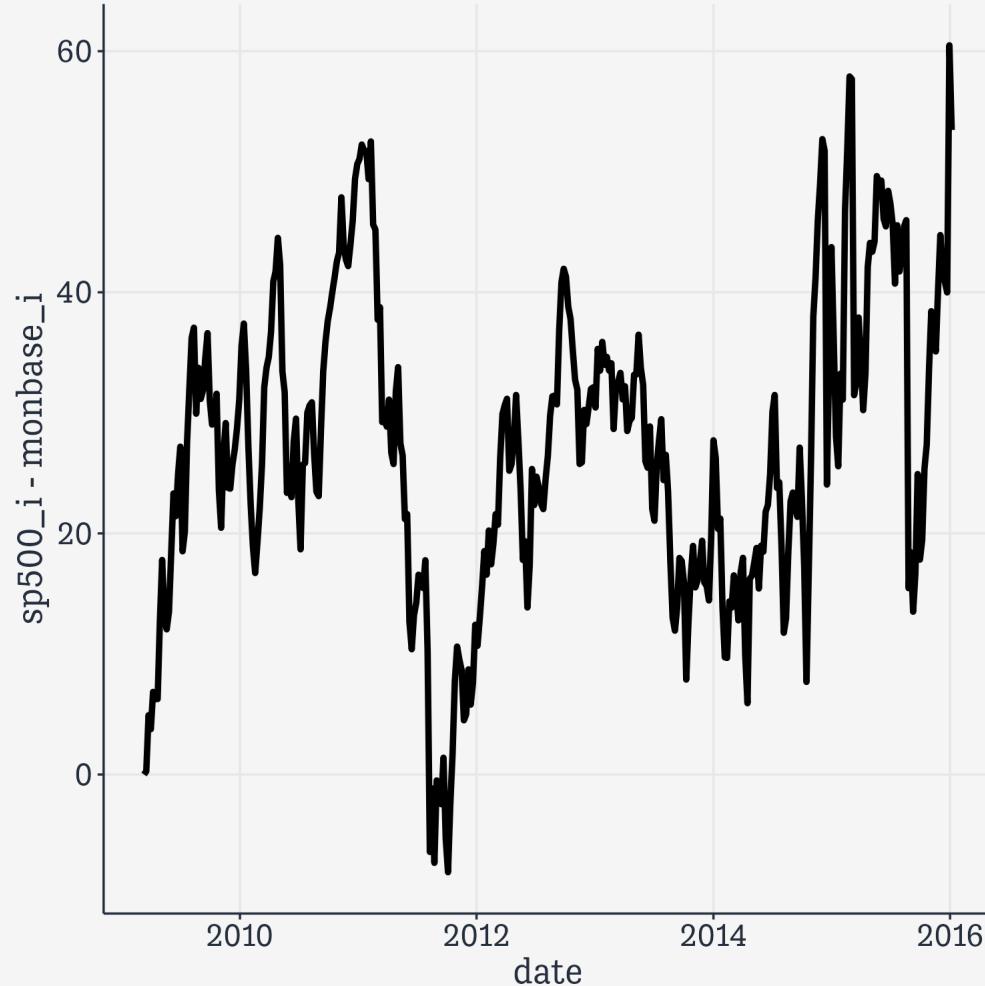
Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
       color = "Series") +  
  theme(axis.title.x = element_blank(),  
        axis.text.x = element_blank(),  
        axis.ticks.x = element_blank()) ->  
p1  
  
# The original df  
fredts |>  
  ggplot(mapping =  
    aes(x = date,  
        y = sp500_i - monbase_i))
```



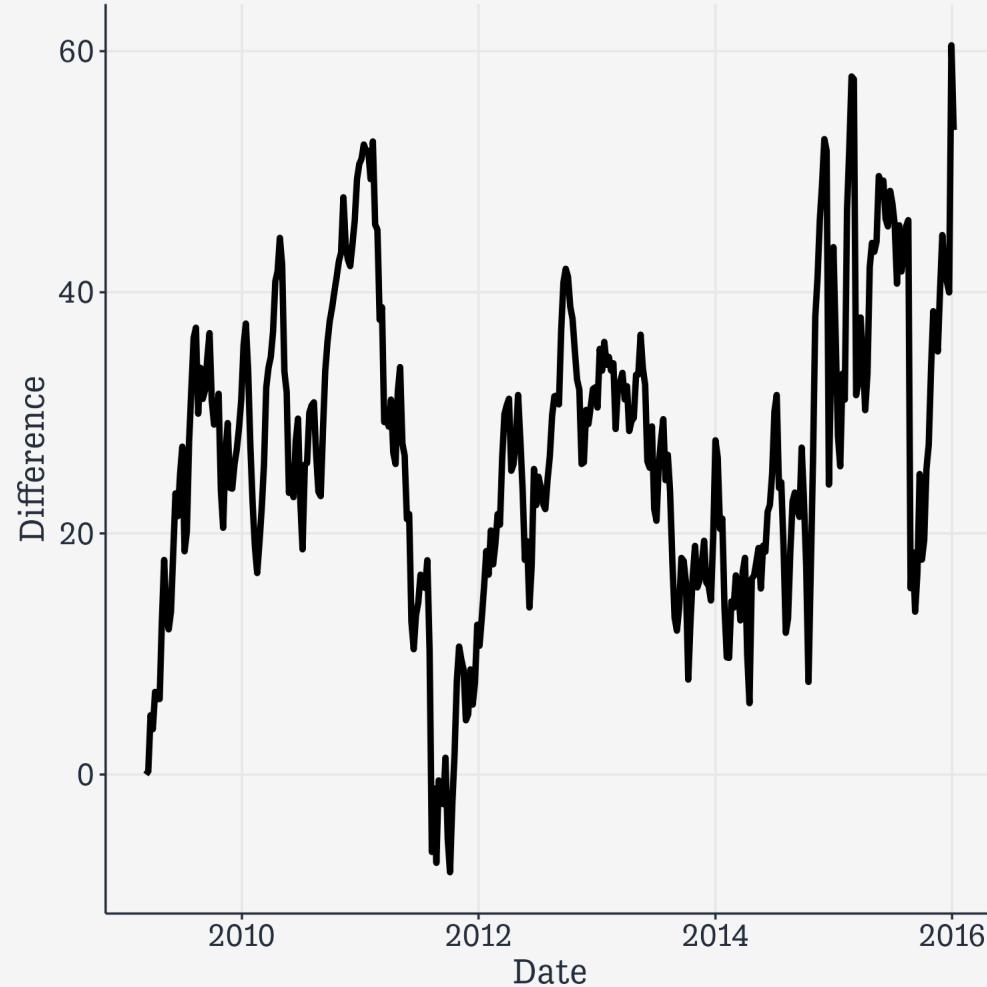
Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
       color = "Series") +  
  theme(axis.title.x = element_blank(),  
        axis.text.x = element_blank(),  
        axis.ticks.x = element_blank()) ->  
p1  
  
# The original df  
fredts |>  
  ggplot(mapping =  
    aes(x = date,  
        y = sp500_i - monbase_i)) +  
  geom_line(size = 1.5)
```



Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
       color = "Series") +  
  theme(axis.title.x = element_blank(),  
        axis.text.x = element_blank(),  
        axis.ticks.x = element_blank()) ->  
p1  
  
# The original df  
fredts |>  
  ggplot(mapping =  
    aes(x = date,  
        y = sp500_i - monbase_i)) +  
  geom_line(size = 1.5) +  
  labs(x = "Date", y = "Difference")
```



Make two plots

```
fredts_m |>  
  ggplot(mapping =  
    aes(x = date,  
        y = score,  
        color = series)) +  
  geom_line(size = 2) +  
  labs(x = "Date", y = "Index",  
       color = "Series") +  
  theme(axis.title.x = element_blank(),  
        axis.text.x = element_blank(),  
        axis.ticks.x = element_blank()) ->  
p1  
  
# The original df  
fredts |>  
  ggplot(mapping =  
    aes(x = date,  
        y = sp500_i - monbase_i)) +  
  geom_line(size = 1.5) +  
  labs(x = "Date", y = "Difference") ->  
p2
```

Make two plots

```
fredts_m |>
  ggplot(mapping =
    aes(x = date,
        y = score,
        color = series)) +
  geom_line(size = 2) +
  labs(x = "Date", y = "Index",
       color = "Series") +
  theme(axis.title.x = element_blank(),
        axis.text.x = element_blank(),
        axis.ticks.x = element_blank()) ->
  p1

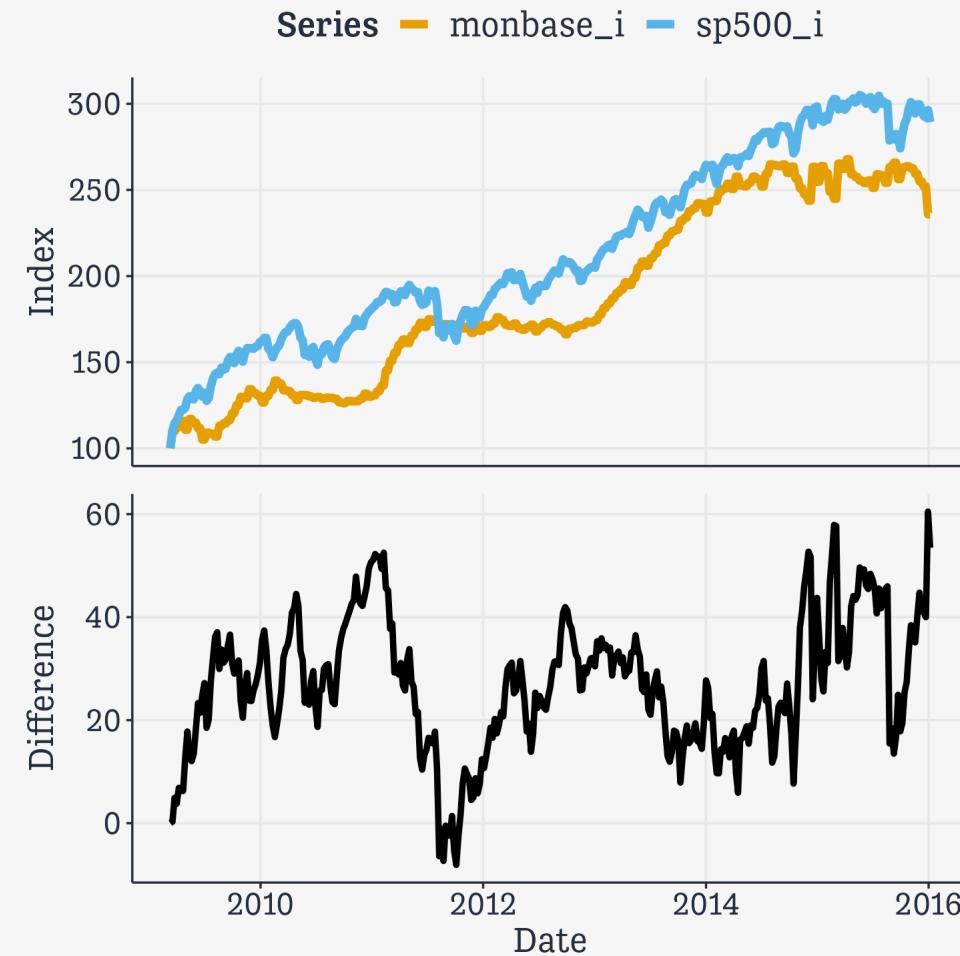
# The original df
fredts |>
  ggplot(mapping =
    aes(x = date,
        y = sp500_i - monbase_i)) +
  geom_line(size = 1.5) +
  labs(x = "Date", y = "Difference") ->
  p2
```


Combine with patchwork

```
library(patchwork)
```

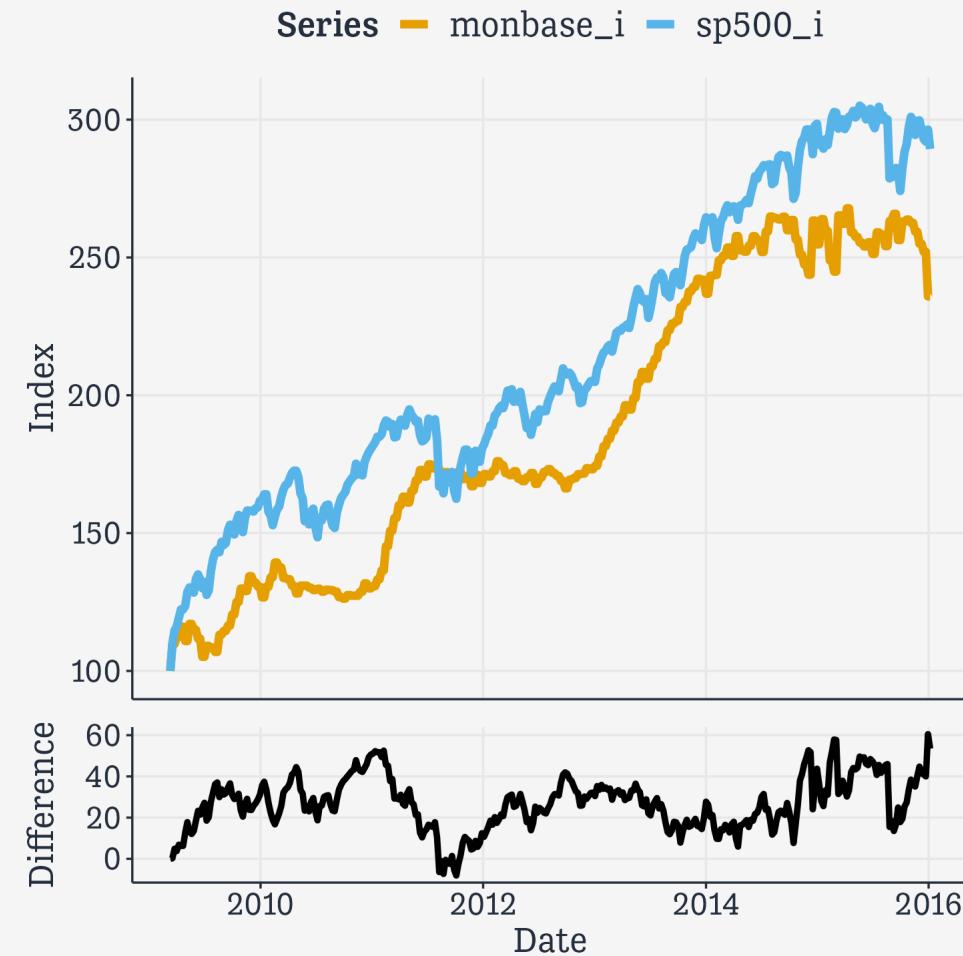
Combine with patchwork

```
library(patchwork)  
(p1 / p2)
```



Combine with patchwork

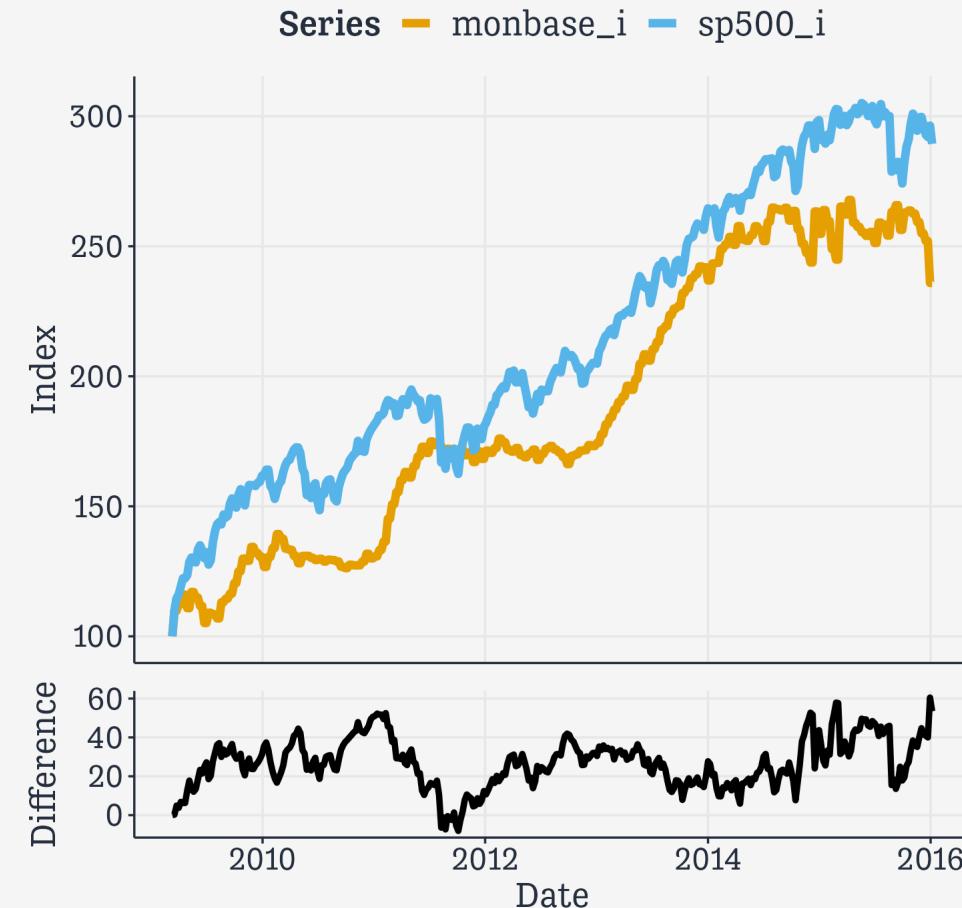
```
library(patchwork)  
  
(p1 / p2) +  
  plot_layout(heights = c(4, 1))
```



Combine with patchwork

```
library(patchwork)  
  
(p1 / p2) +  
  plot_layout(heights = c(4, 1)) +  
  plot_annotation(title = "Index and Differen
```

Index and Difference

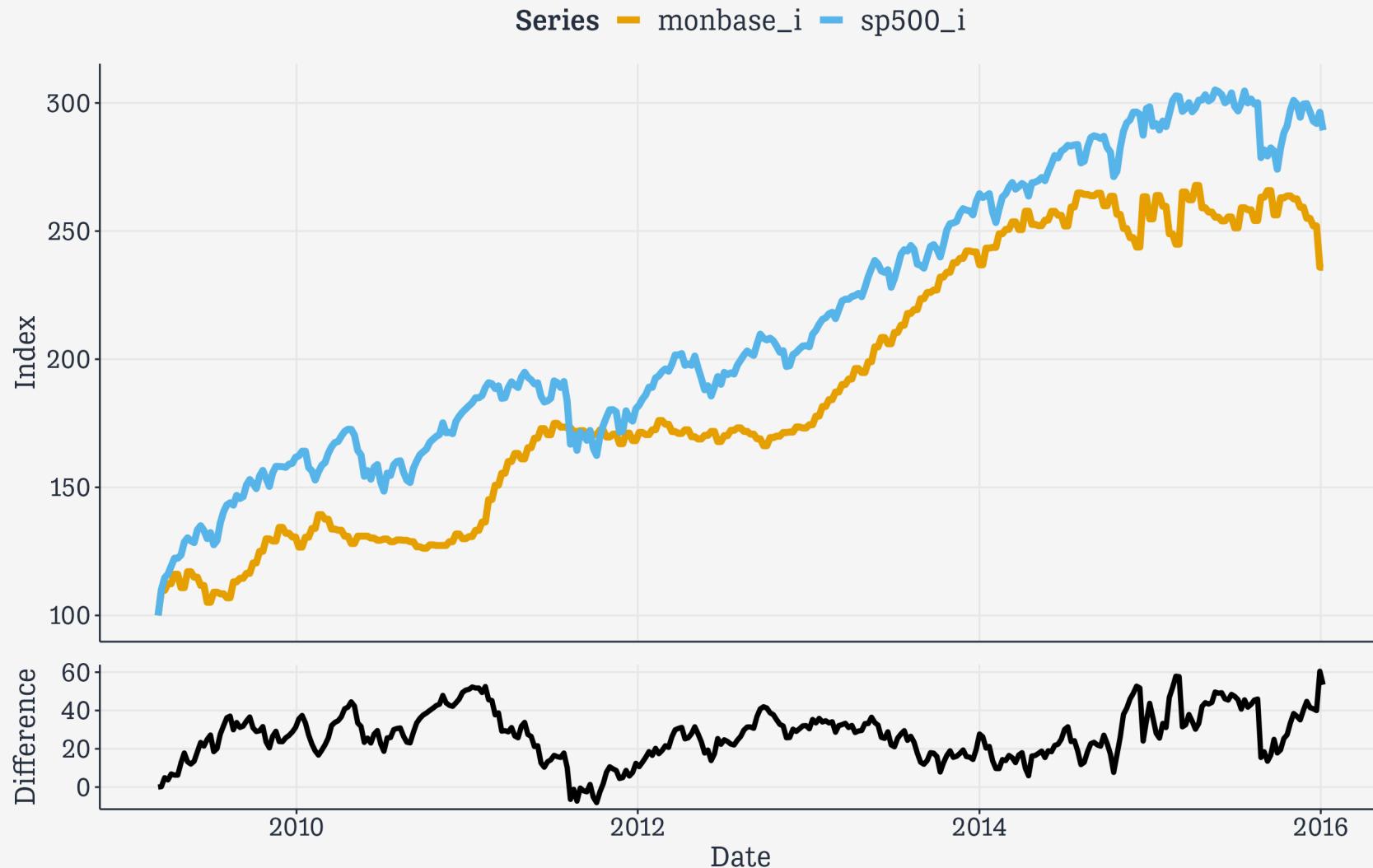


Combine with patchwork

```
library(patchwork)

(p1 / p2) +
  plot_layout(heights = c(4, 1)) +
  plot_annotation(title = "Index and Differ
p_patch
```

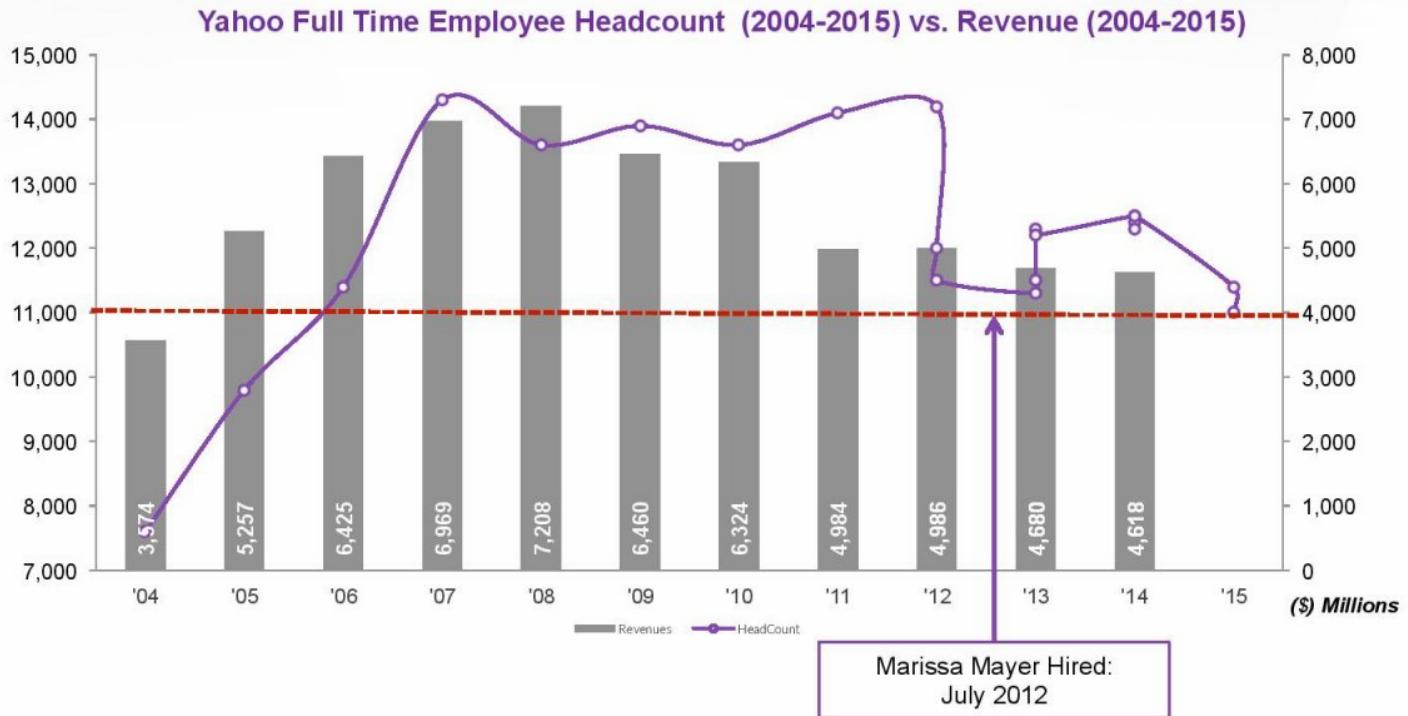
Index and Difference



Patchwork plot.

Redrawing a bad slide

Yahoo's Headcount Still Excessively High Given Revenues:



Source: Company Filings (10K), Analyst calls



Confidential | For Discussion Purposes Only | 13

What can one say, really

The data

yahoo

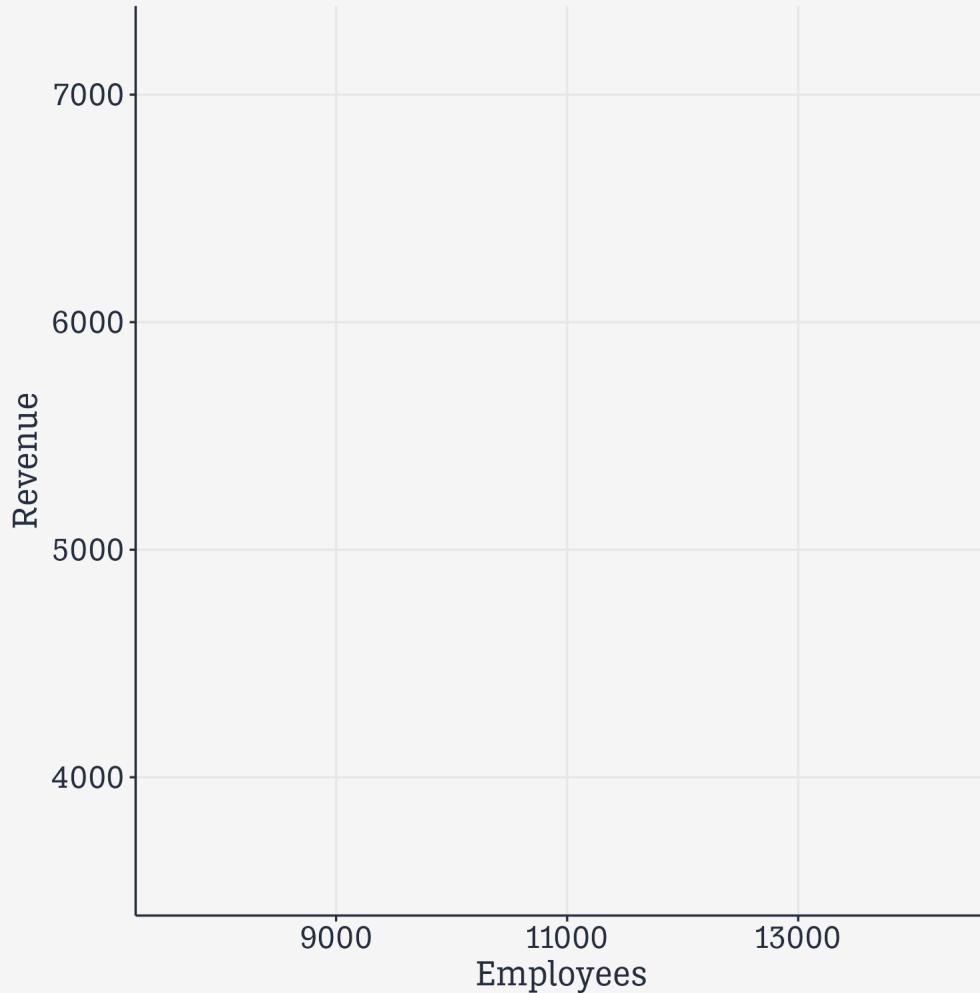
```
## # A tibble: 12 × 4
##   Year Revenue Employees Mayer
##   <dbl>    <dbl>      <dbl> <chr>
## 1 2004     3574      7600 No
## 2 2005     5257      9800 No
## 3 2006     6425     11400 No
## 4 2007     6969     14300 No
## 5 2008     7208     13600 No
## 6 2009     6460     13900 No
## 7 2010     6324     13600 No
## 8 2011     4984     14100 No
## 9 2012     4986     12000 No
## 10 2012    4986     11500 Yes
## 11 2013    4680     12200 Yes
## 12 2014    4618     12500 Yes
```

Option 1

```
yahoo
## # A tibble: 12 × 4
##   Year Revenue Employees Mayer
##   <dbl>    <dbl>      <dbl> <chr>
## 1 2004     3574       7600 No
## 2 2005     5257       9800 No
## 3 2006     6425      11400 No
## 4 2007     6969      14300 No
## 5 2008     7208      13600 No
## 6 2009     6460      13900 No
## 7 2010     6324      13600 No
## 8 2011     4984      14100 No
## 9 2012     4986      12000 No
## 10 2012    4986      11500 Yes
## 11 2013    4680      12200 Yes
## 12 2014    4618      12500 Yes
```

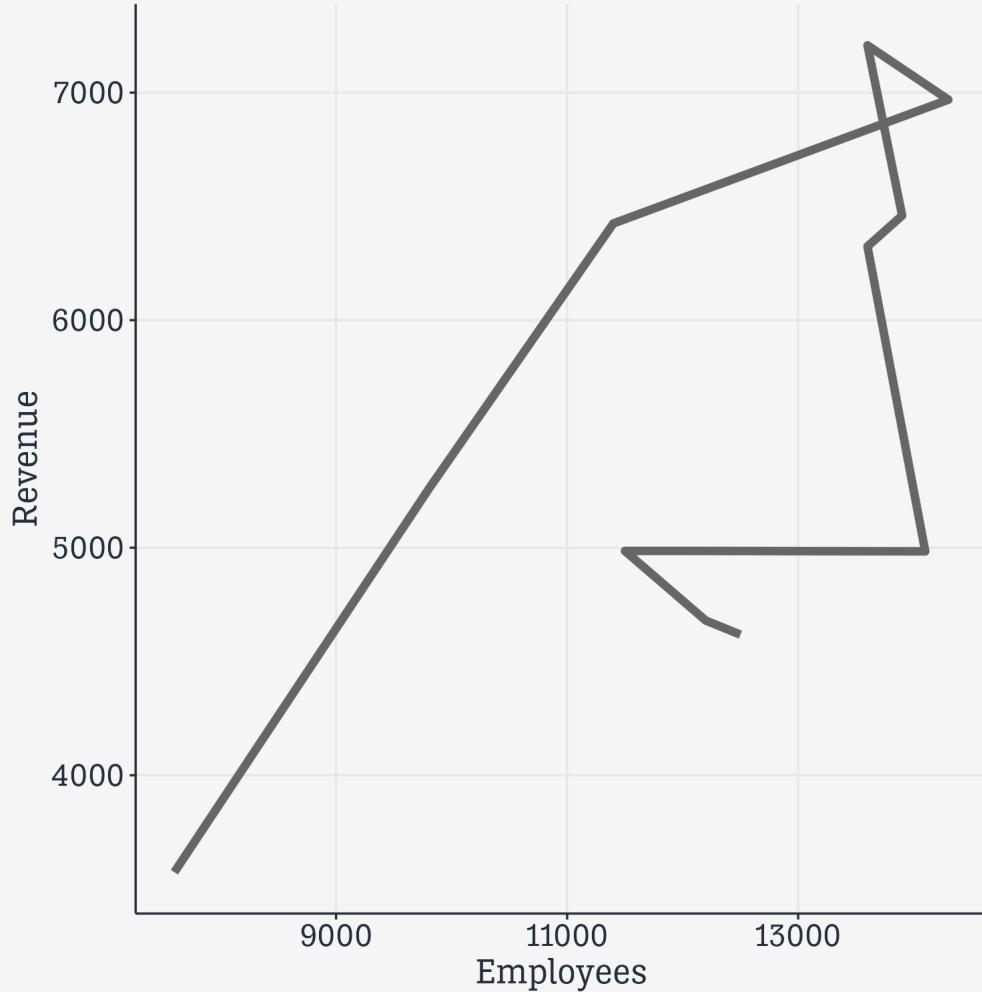
Option 1

```
yahoo |>  
ggplot(mapping =  
       aes(x = Employees,  
            y = Revenue))
```



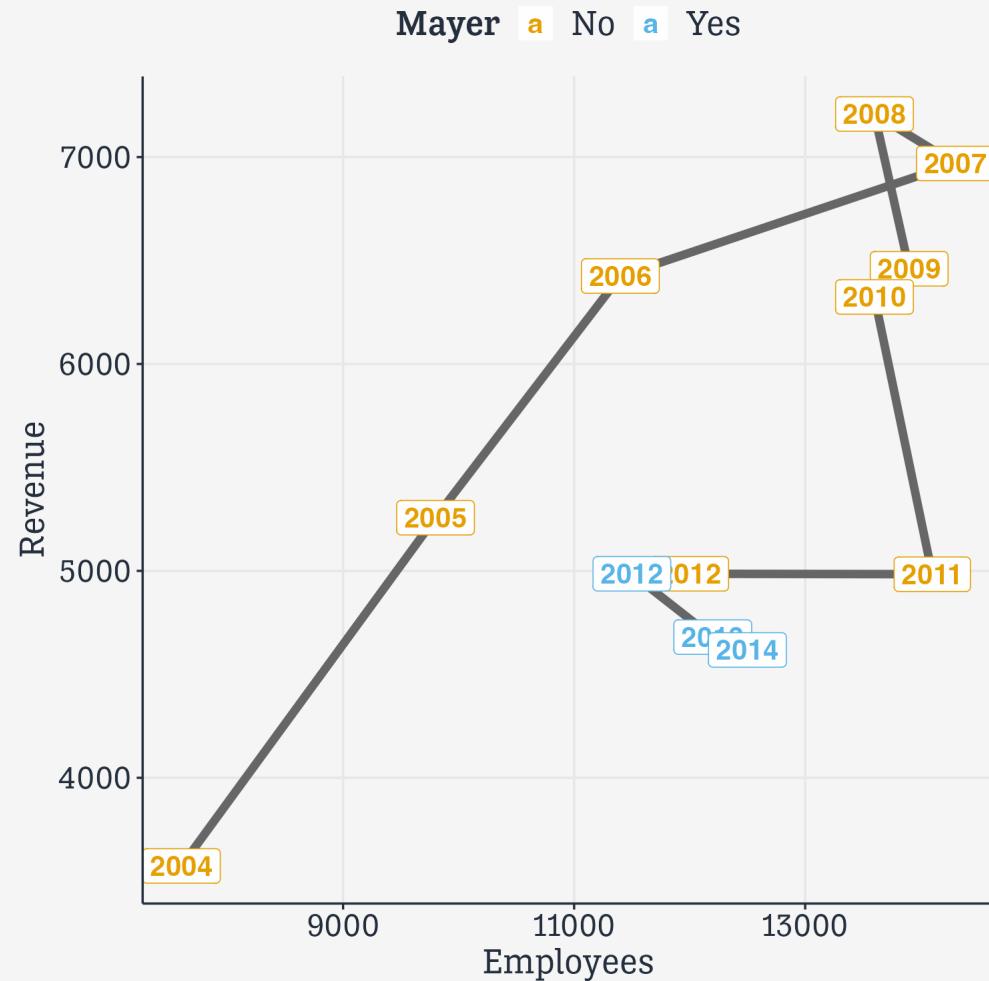
Option 1

```
yahoo |>  
ggplot(mapping =  
       aes(x = Employees,  
             y = Revenue)) +  
geom_path(color = "gray40",  
         size = rel(2))
```



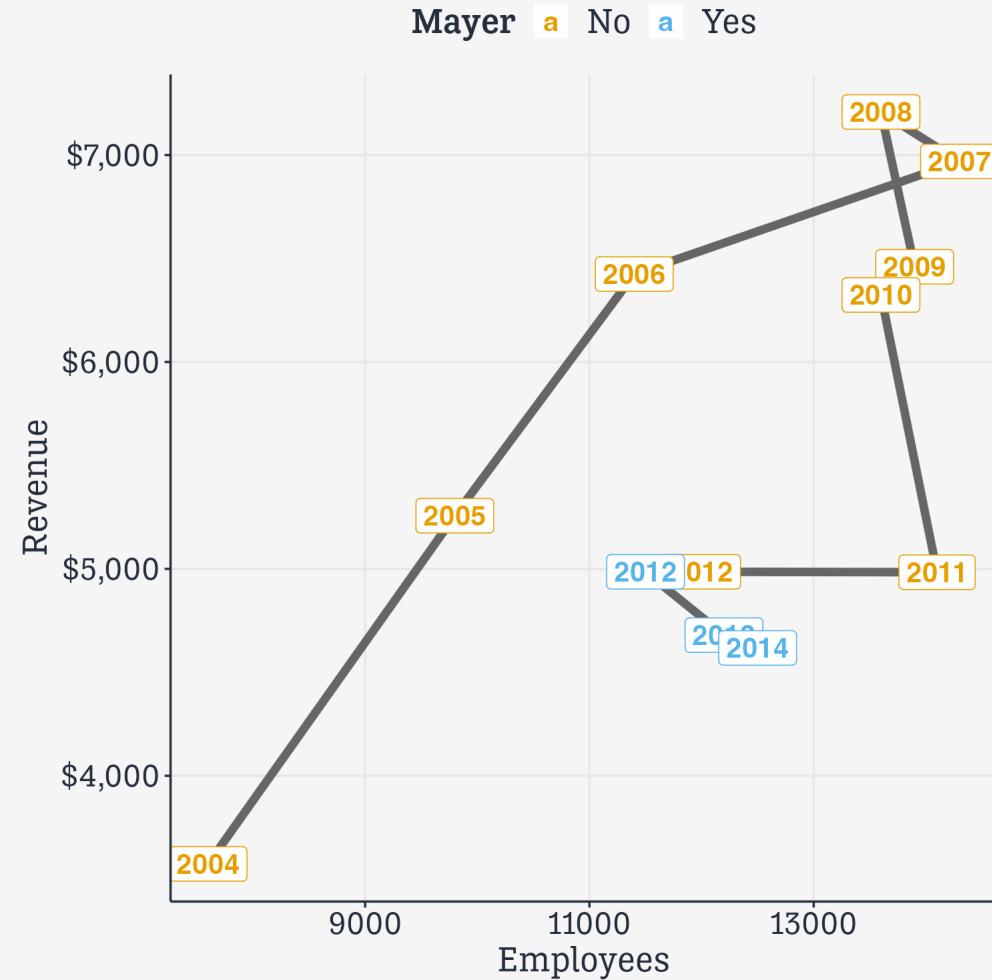
Option 1

```
yahoo |>  
ggplot(mapping =  
       aes(x = Employees,  
             y = Revenue)) +  
geom_path(color = "gray40",  
          size = rel(2)) +  
geom_label(aes(color = Mayer,  
              label = Year),  
           size = rel(5),  
           fontface = "bold")
```



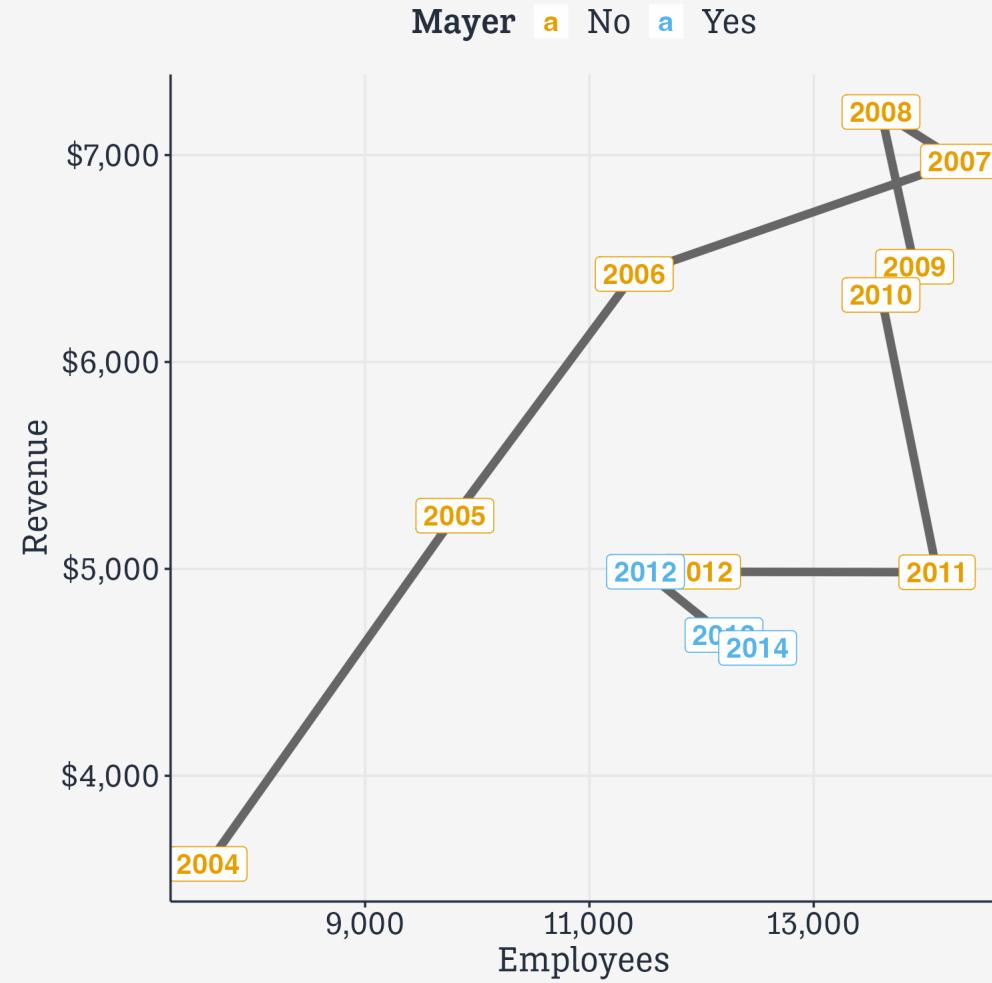
Option 1

```
yahoo |>  
ggplot(mapping =  
        aes(x = Employees,  
              y = Revenue)) +  
geom_path(color = "gray40",  
          size = rel(2)) +  
geom_label(aes(color = Mayer,  
               label = Year),  
          size = rel(5),  
          fontface = "bold") +  
scale_y_continuous(labels = label_dollar(
```



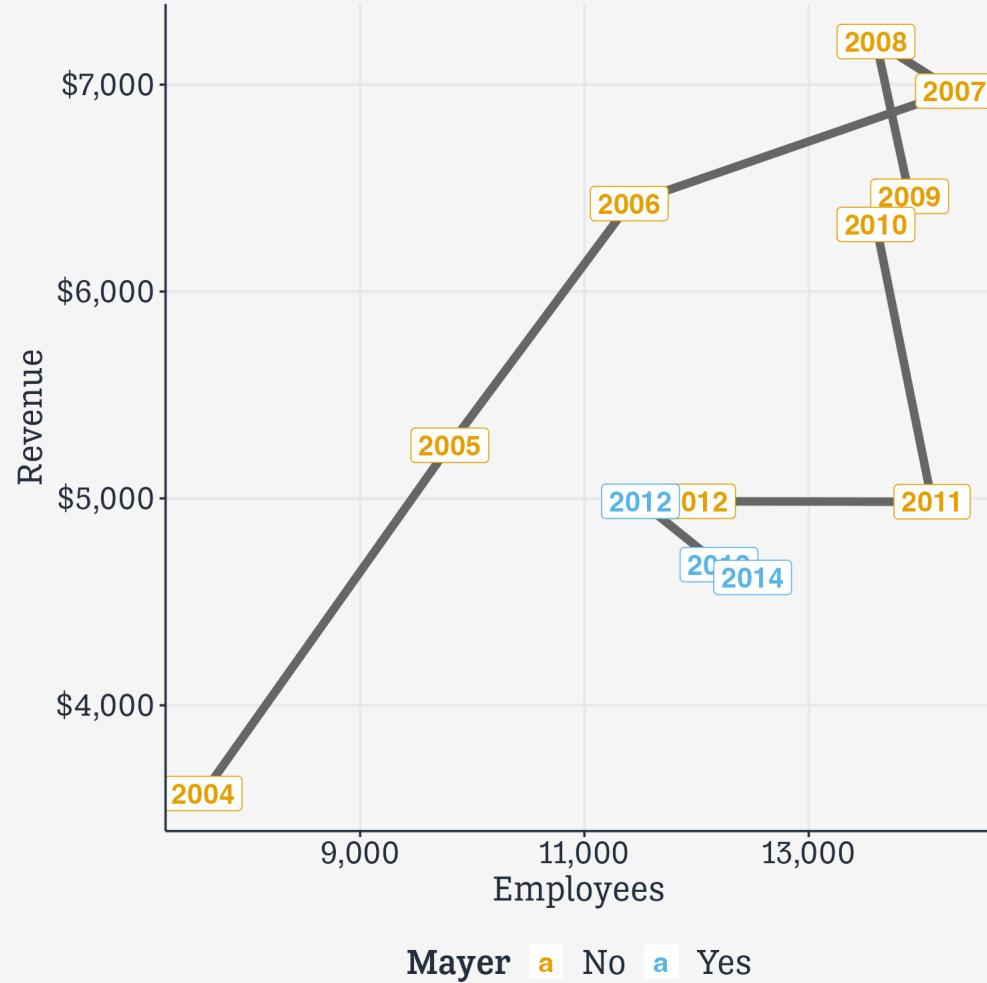
Option 1

```
yahoo |>  
ggplot(mapping =  
        aes(x = Employees,  
             y = Revenue)) +  
  geom_path(color = "gray40",  
            size = rel(2)) +  
  geom_label(aes(color = Mayer,  
                 label = Year),  
             size = rel(5),  
             fontface = "bold") +  
  scale_y_continuous(labels = label_dollar()  
  scale_x_continuous(labels = label_comma())
```



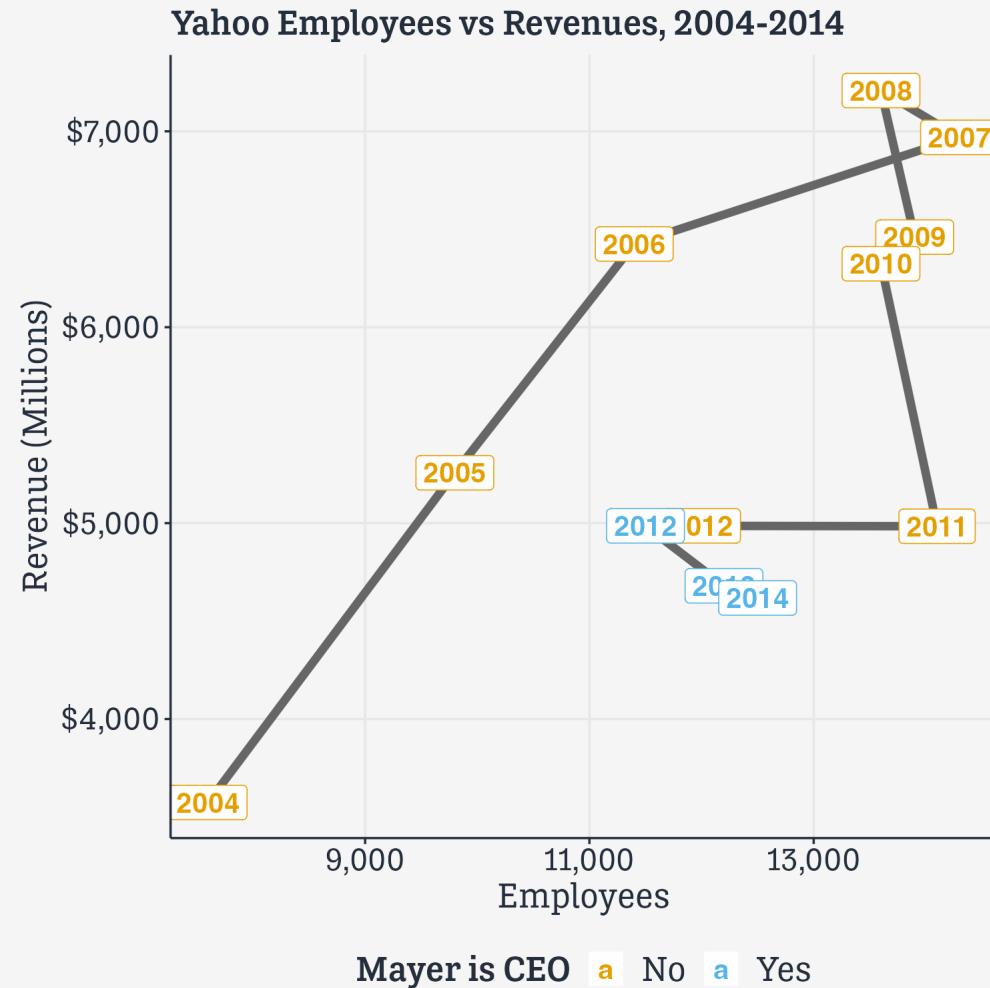
Option 1

```
yahoo |>  
ggplot(mapping =  
        aes(x = Employees,  
             y = Revenue)) +  
geom_path(color = "gray40",  
          size = rel(2)) +  
geom_label(aes(color = Mayer,  
              label = Year),  
          size = rel(5),  
          fontface = "bold") +  
scale_y_continuous(labels = label_dollar()  
scale_x_continuous(labels = label_comma())  
theme(legend.position = "bottom")
```



Option 1

```
yahoo |>  
ggplot(mapping =  
       aes(x = Employees,  
             y = Revenue)) +  
geom_path(color = "gray40",  
          size = rel(2)) +  
geom_label(aes(color = Mayer,  
              label = Year),  
          size = rel(5),  
          fontface = "bold") +  
scale_y_continuous(labels = label_dollar()  
scale_x_continuous(labels = label_comma())  
theme(legend.position = "bottom") +  
labs(color = "Mayer is CEO",  
     x = "Employees", y = "Revenue (Millions)",  
     title = "Yahoo Employees vs Revenues")
```



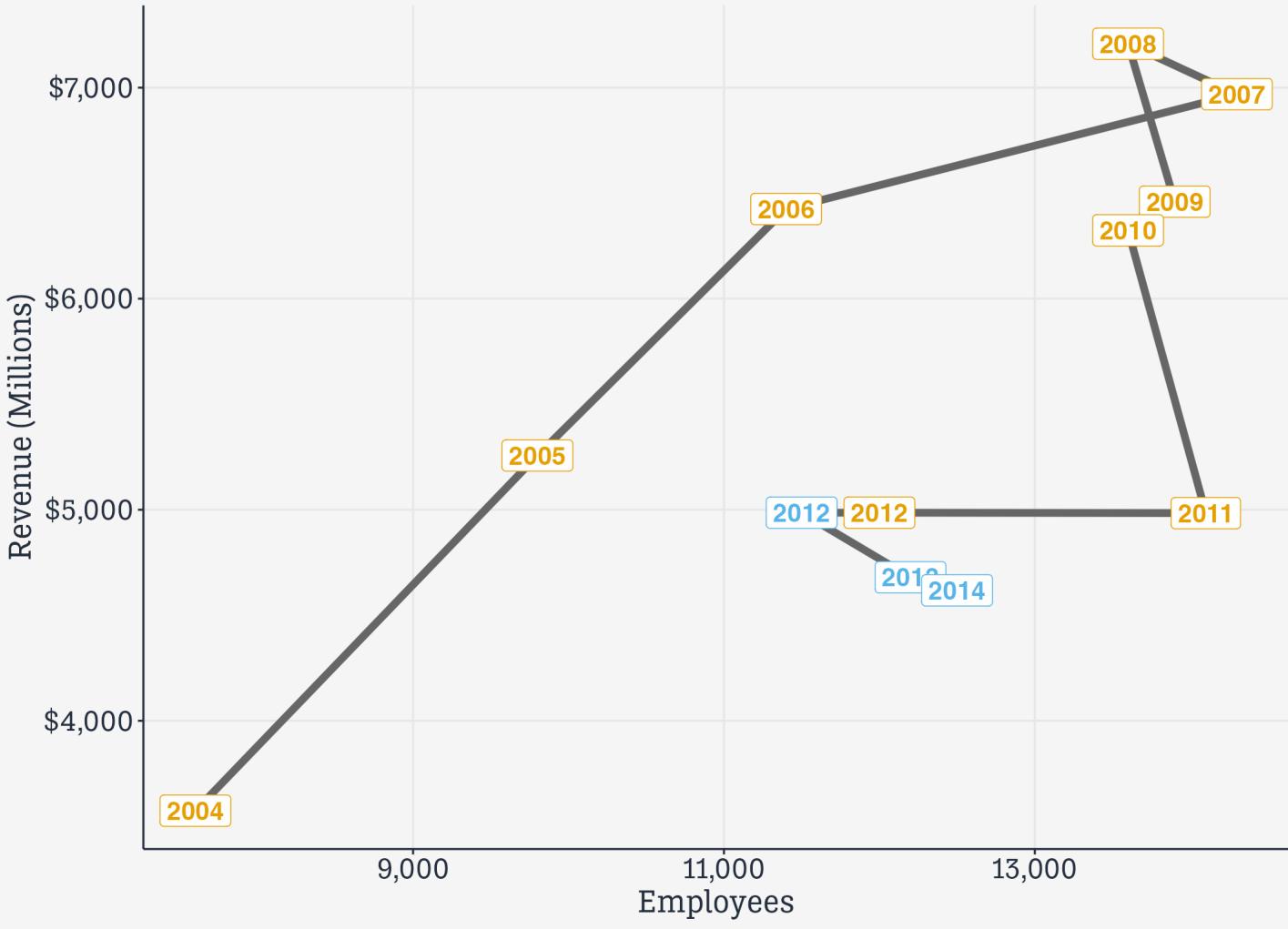
Option 1

```
yahoo |>
  ggplot(mapping =
    aes(x = Employees,
        y = Revenue)) +
  geom_path(color = "gray40",
            size = rel(2)) +
  geom_label(aes(color = Mayer,
                 label = Year),
             size = rel(5),
             fontface = "bold") +
  scale_y_continuous(labels = label_dollar(
  scale_x_continuous(labels = label_comma()
  theme(legend.position = "bottom") +
  labs(color = "Mayer is CEO",
       x = "Employees", y = "Revenue (Milli
       title = "Yahoo Employees vs Revenues
  yahoo1
```

Option 1

```
yahoo |>
  ggplot(mapping =
    aes(x = Employees,
        y = Revenue)) +
  geom_path(color = "gray40",
            size = rel(2)) +
  geom_label(aes(color = Mayer,
                 label = Year),
             size = rel(5),
             fontface = "bold") +
  scale_y_continuous(labels = label_dollar(
  scale_x_continuous(labels = label_comma()
  theme(legend.position = "bottom") +
  labs(color = "Mayer is CEO",
       x = "Employees", y = "Revenue (Milli
       title = "Yahoo Employees vs Revenues
yahoo1
```

Yahoo Employees vs Revenues, 2004-2014



Mayer is CEO No Yes

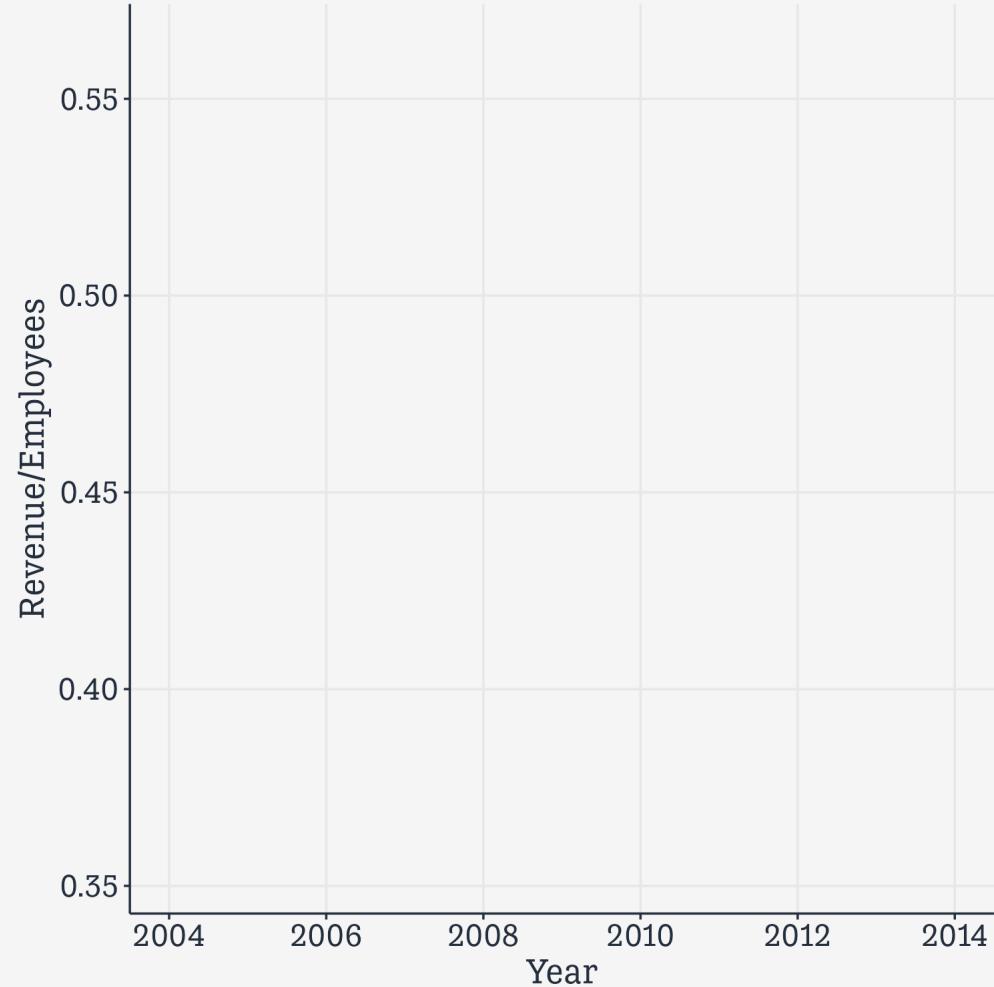
Redrawn with geom_path()

Alternatively ...

```
yahoo
## # A tibble: 12 × 4
##       Year Revenue Employees Mayer
##   <dbl>    <dbl>      <dbl> <chr>
## 1 2004     3574      7600 No
## 2 2005     5257      9800 No
## 3 2006     6425     11400 No
## 4 2007     6969     14300 No
## 5 2008     7208     13600 No
## 6 2009     6460     13900 No
## 7 2010     6324     13600 No
## 8 2011     4984     14100 No
## 9 2012     4986     12000 No
## 10 2012    4986     11500 Yes
## 11 2013    4680     12200 Yes
## 12 2014    4618     12500 Yes
```

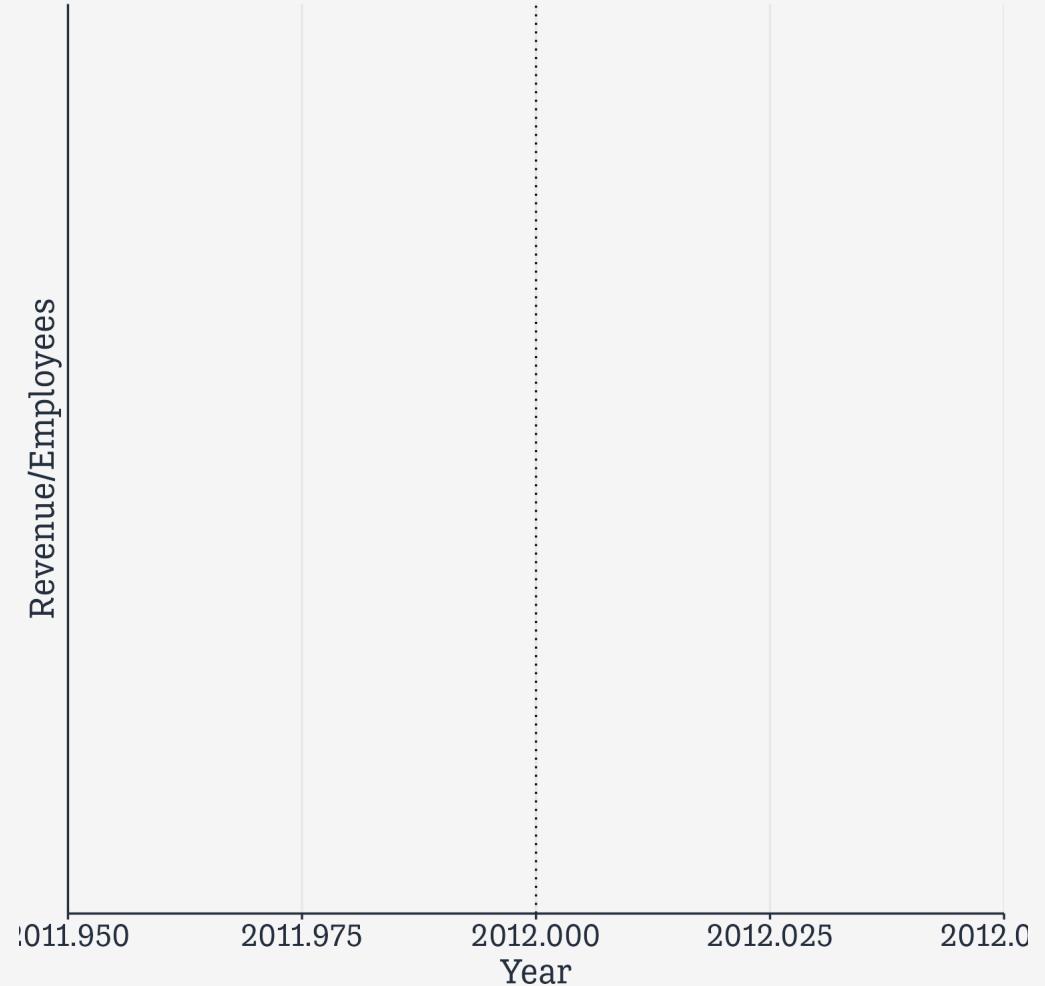
Alternatively ...

```
yahoo |>  
ggplot(mapping =  
       aes(x = Year,  
            y = Revenue/Employees))
```



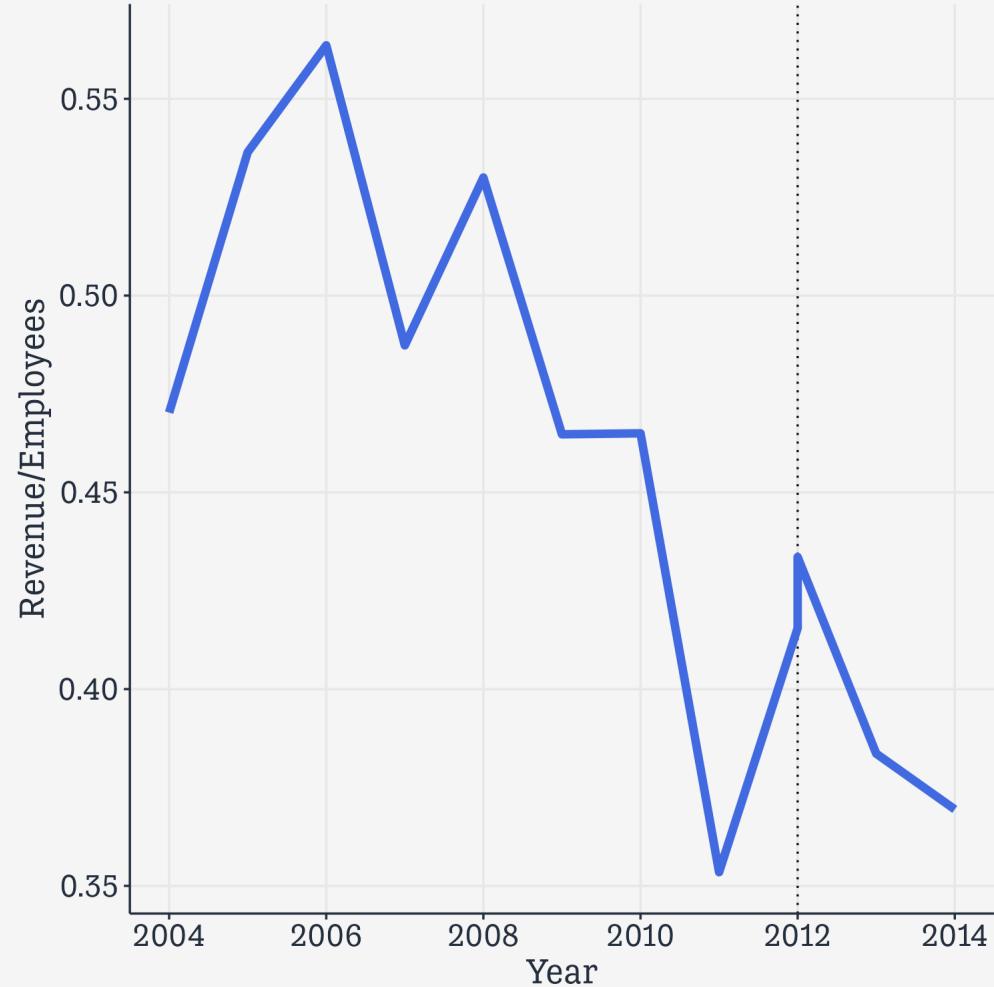
Alternatively ...

```
yahoo |>  
ggplot(mapping =  
       aes(x = Year,  
             y = Revenue/Employees)) +  
geom_vline(xintercept = 2012,  
           size = rel(0.5),  
           linetype = "dotted")
```



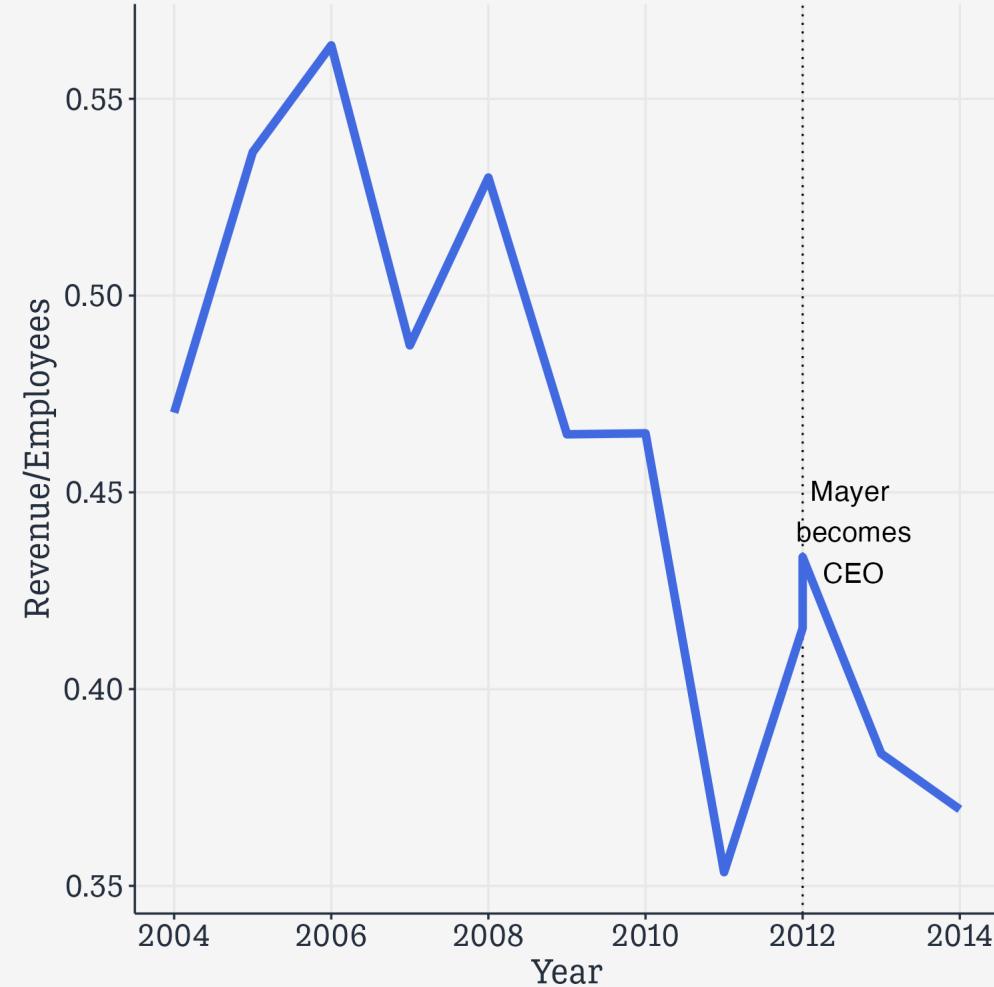
Alternatively ...

```
yahoo |>  
ggplot(mapping =  
       aes(x = Year,  
             y = Revenue/Employees)) +  
geom_vline(xintercept = 2012,  
           size = rel(0.5),  
           linetype = "dotted") +  
geom_line(color = "royalblue", size = rel
```



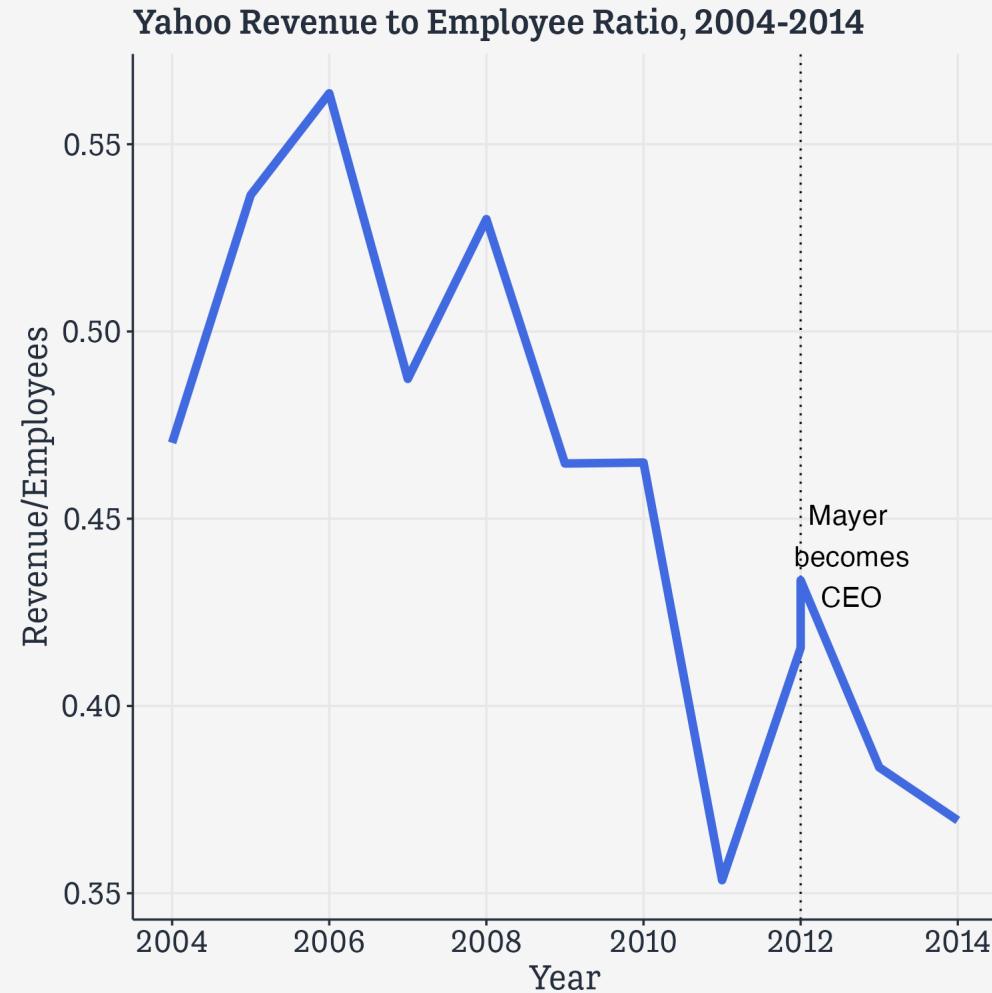
Alternatively ...

```
yahoo |>  
ggplot(mapping =  
       aes(x = Year,  
             y = Revenue/Employees)) +  
geom_vline(xintercept = 2012,  
           size = rel(0.5),  
           linetype = "dotted") +  
geom_line(color = "royalblue", size = rel  
annotate("text", x = 2012.6, y = 0.44,  
       label = "Mayer\n becomes\n CEO",
```



Alternatively ...

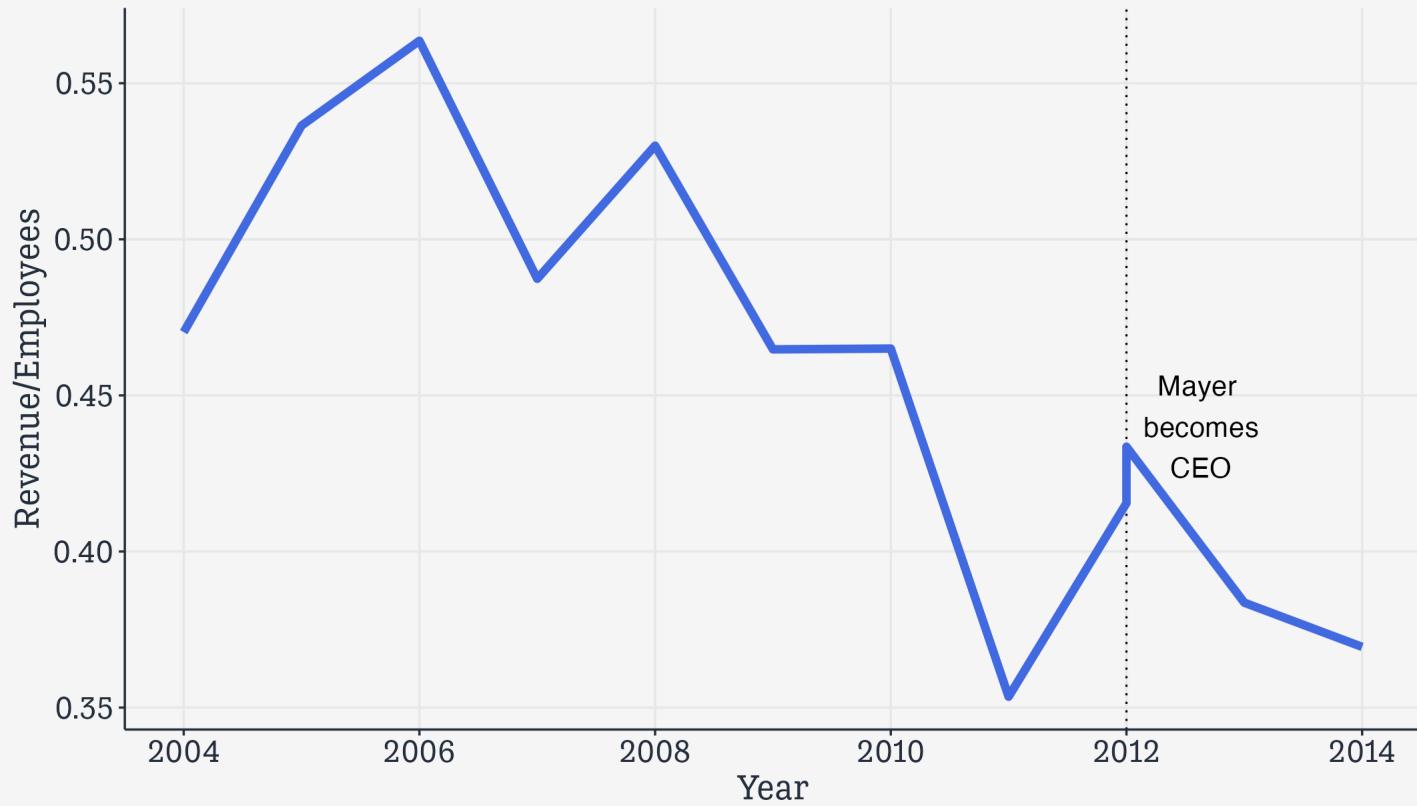
```
yahoo |>  
  ggplot(mapping =  
    aes(x = Year,  
        y = Revenue/Employees)) +  
  geom_vline(xintercept = 2012,  
             size = rel(0.5),  
             linetype = "dotted") +  
  geom_line(color = "royalblue", size = rel  
  annotate("text", x = 2012.6, y = 0.44,  
          label = "Mayer\n becomes\n CEO",  
  labs(title = "Yahoo Revenue to Employee R  
        x = "Year",  
        y = "Revenue/Employees")
```



Alternatively ...

```
yahoo |>
  ggplot(mapping =
    aes(x = Year,
        y = Revenue/Employees)) +
  geom_vline(xintercept = 2012,
             size = rel(0.5),
             linetype = "dotted") +
  geom_line(color = "royalblue", size = rel
  annotate("text", x = 2012.6, y = 0.44,
           label = "Mayer\n becomes\n CEO",
  labs(title = "Yahoo Revenue to Employee R
       x = "Year",
       y = "Revenue/Employees") ->
  yahoo2
```

Yahoo Revenue to Employee Ratio, 2004-2014



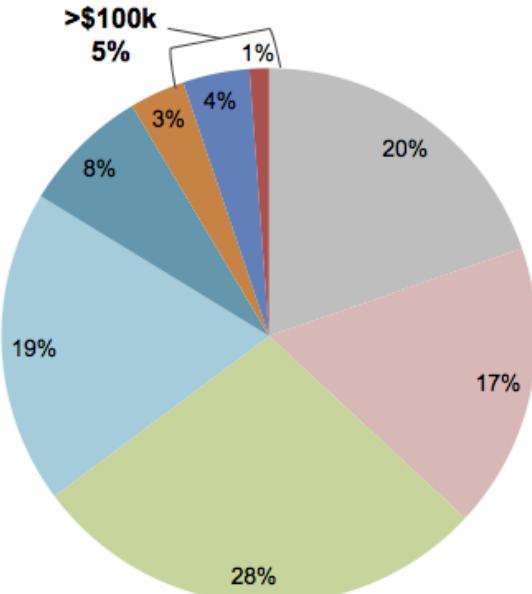
If you're interested in the ratio, just show the ratio.

Say no to pie

Pie charts are easy to mess up

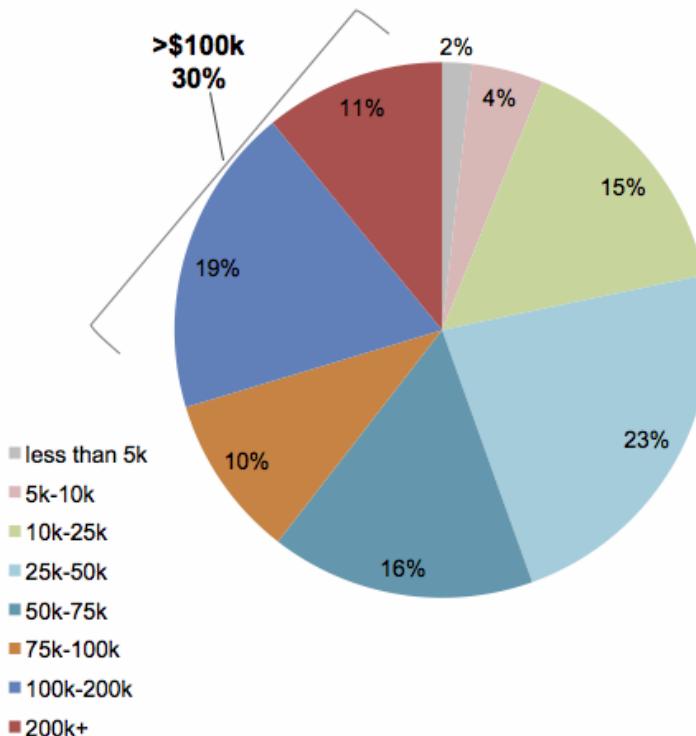
Borrower Distribution by Outstanding Balance

out of 44 million borrowers in 2016



Debt Distribution by Outstanding Balance

out of \$1.3 trillion in 2016



The data

studebt

```
## # A tibble: 16 × 4
##   Debt      type     pct Debtrc
##   <ord>    <fct>   <int> <ord>
## 1 Under $5 Borrowers    20 Under $5
## 2 $5-$10  Borrowers    17 $5-$10
## 3 $10-$25 Borrowers    28 $10-$25
## 4 $25-$50 Borrowers    19 $25-$50
## 5 $50-$75 Borrowers     8 $50-$75
## 6 $75-$100 Borrowers    3 $75-$100
## 7 $100-$200 Borrowers    4 $100-$200
## 8 Over $200 Borrowers    1 Over $200
## 9 Under $5 Balances     2 Under $5
## 10 $5-$10  Balances     4 $5-$10
## 11 $10-$25 Balances    15 $10-$25
## 12 $25-$50 Balances    23 $25-$50
## 13 $50-$75 Balances    16 $50-$75
## 14 $75-$100 Balances    10 $75-$100
## 15 $100-$200 Balances   19 $100-$200
## 16 Over $200 Balances    11 Over $200
```

Debt and Debtrc are both ordered factors.

A little prep work

```
p_ylab <- "Amount Owed, in thousands of Dollars"
p_title <- "Outstanding Student Loans"
p_subtitle <- "44 million borrowers owe a total of $1.3 trillion"
p_caption <- "Source: FRB NY"

studebt <- studebt |>
  mutate(type_label = recode(type, "Borrowers" = "Percent of all Borrowers",
                             "Balances" = "Percent of all Balances"))

studebt

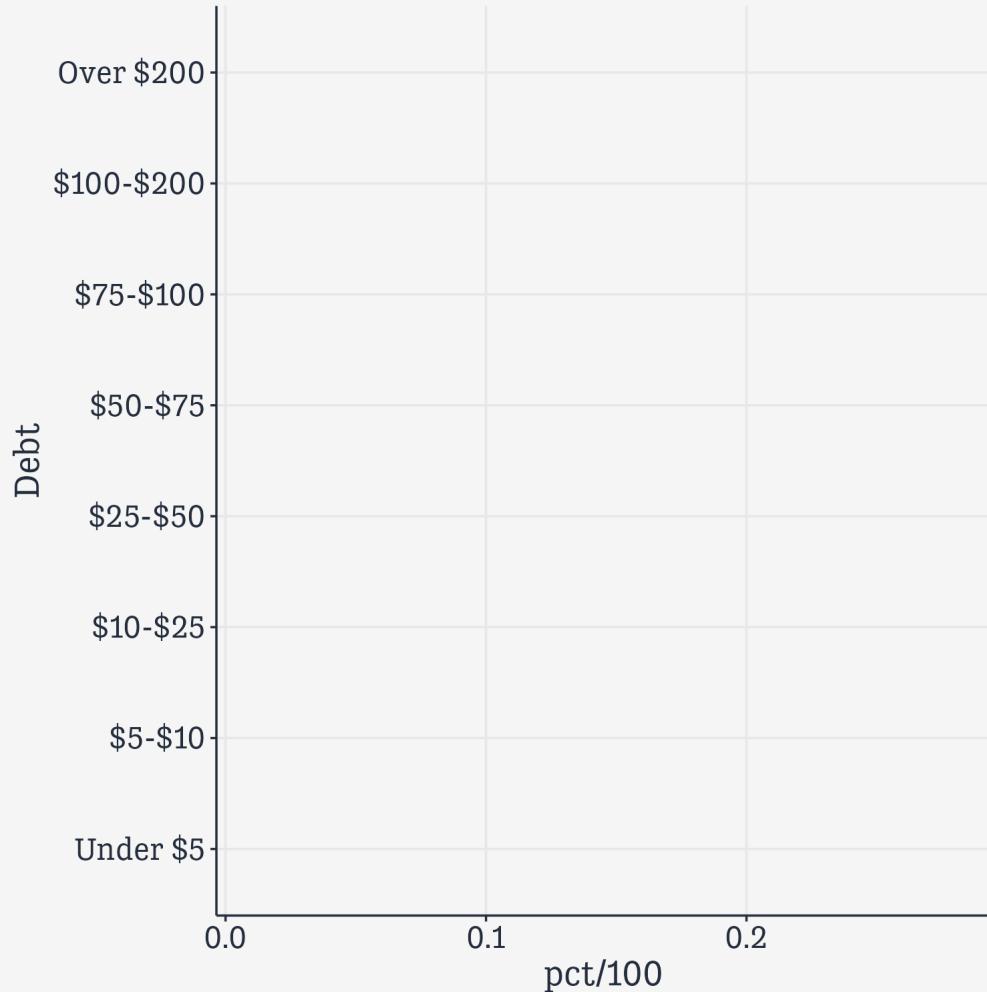
## # A tibble: 16 × 5
##   Debt      type     pct Debtrc type_label
##   <ord>    <fct>    <int> <ord>   <fct>
## 1 Under $5 Borrowers     20 Under $5 Percent of all Borrowers
## 2 $5-$10  Borrowers     17 $5-$10  Percent of all Borrowers
## 3 $10-$25 Borrowers     28 $10-$25 Percent of all Borrowers
## 4 $25-$50 Borrowers     19 $25-$50 Percent of all Borrowers
## 5 $50-$75 Borrowers      8 $50-$75 Percent of all Borrowers
## 6 $75-$100 Borrowers     3 $75-$100 Percent of all Borrowers
## 7 $100-$200 Borrowers     4 $100-$200 Percent of all Borrowers
## 8 Over $200 Borrowers     1 Over $200 Percent of all Borrowers
## 9 Under $5  Balances     2 Under $5  Percent of all Balances
## 10 $5-$10  Balances      4 $5-$10  Percent of all Balances
## 11 $10-$25 Balances      15 $10-$25 Percent of all Balances
## 12 $25-$50 Balances      23 $25-$50 Percent of all Balances
## 13 $50-$75 Balances      16 $50-$75 Percent of all Balances
## 14 $75-$100 Balances     10 $75-$100 Percent of all Balances
## 15 $100-$200 Balances     19 $100-$200 Percent of all Balances
## 16 Over $200 Balances     11 Over $200 Percent of all Balances
```

Debt Plot 1

```
studebt
## # A tibble: 16 × 5
##   Debt      type     pct Debtrc type_label
##   <ord>    <fct>   <int> <ord>  <fct>
## 1 Under $5 Borrowers    20 Under $5 Percent of all Borrowers
## 2 $5-$10  Borrowers    17 $5-$10  Percent of all Borrowers
## 3 $10-$25 Borrowers    28 $10-$25 Percent of all Borrowers
## 4 $25-$50 Borrowers    19 $25-$50 Percent of all Borrowers
## 5 $50-$75 Borrowers     8 $50-$75 Percent of all Borrowers
## 6 $75-$100 Borrowers    3 $75-$100 Percent of all Borrowers
## 7 $100-$200 Borrowers    4 $100-$200 Percent of all Borrowers
## 8 Over $200 Borrowers    1 Over $200 Percent of all Borrowers
## 9 Under $5 Balances     2 Under $5 Percent of all Balances
## 10 $5-$10  Balances     4 $5-$10  Percent of all Balances
## 11 $10-$25 Balances     15 $10-$25 Percent of all Balances
## 12 $25-$50 Balances     23 $25-$50 Percent of all Balances
## 13 $50-$75 Balances     16 $50-$75 Percent of all Balances
## 14 $75-$100 Balances    10 $75-$100 Percent of all Balances
## 15 $100-$200 Balances    19 $100-$200 Percent of all Balances
## 16 Over $200 Balances    11 Over $200 Percent of all Balances
```

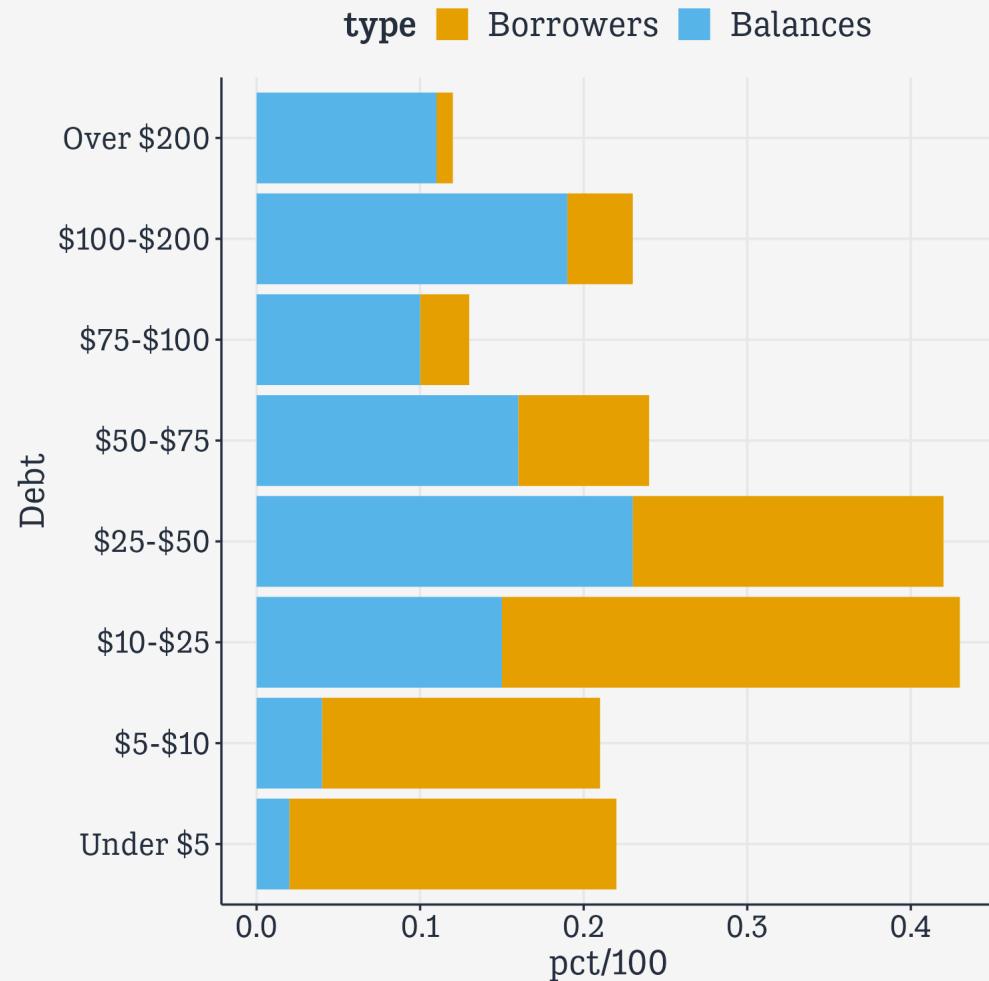
Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type))
```



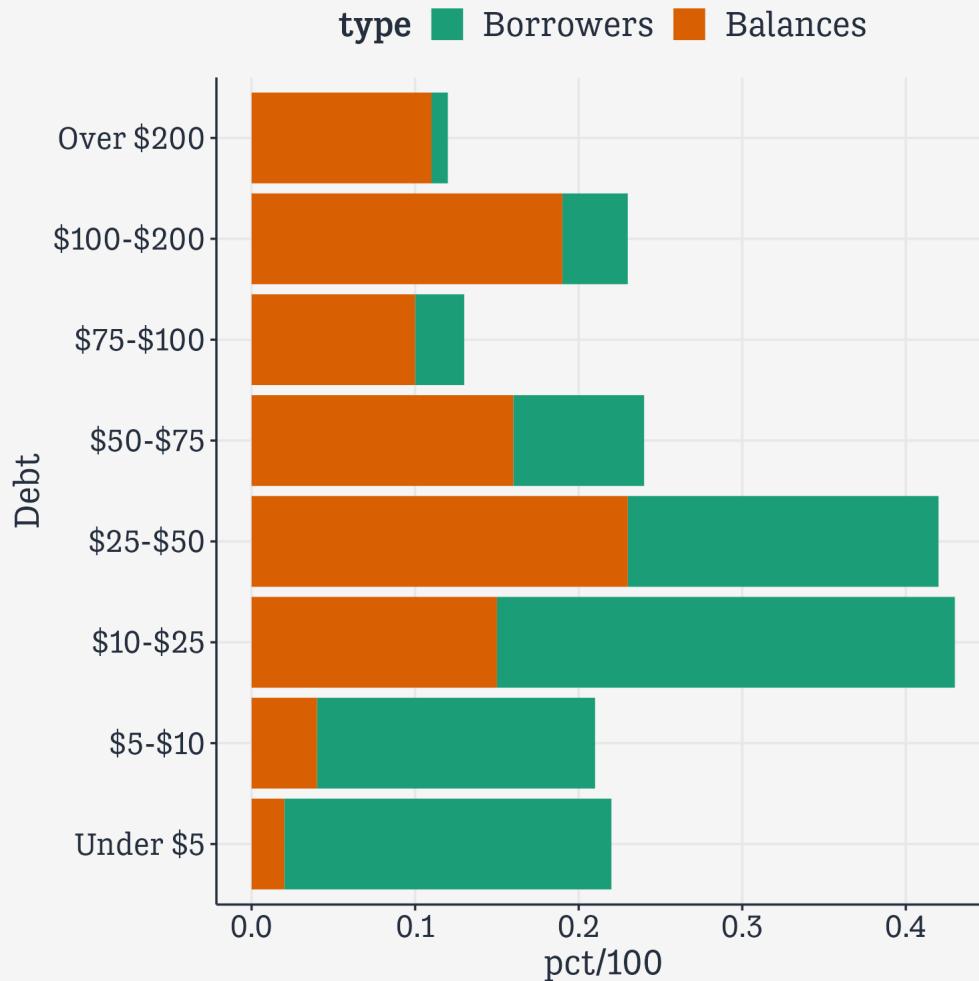
Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col()
```



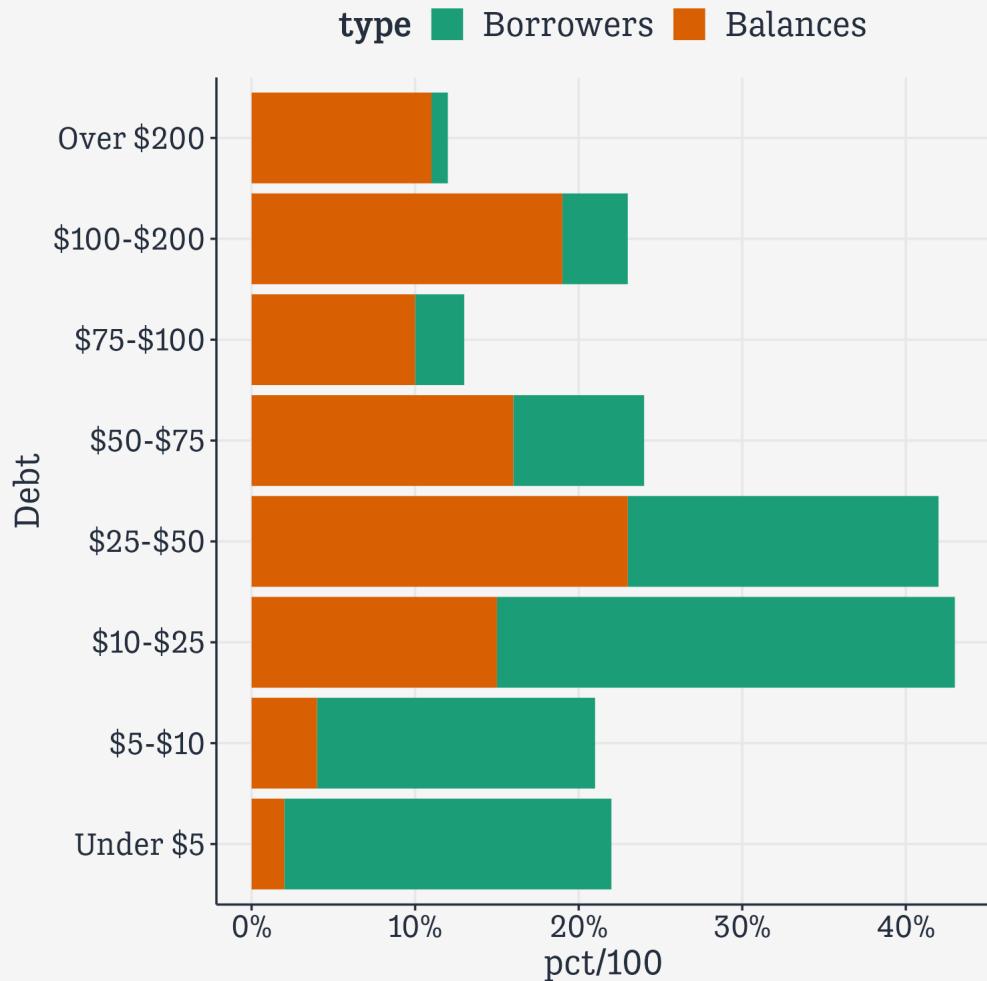
Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col() +  
  scale_fill_brewer(type = "qual",  
                    palette = "Dark2")
```



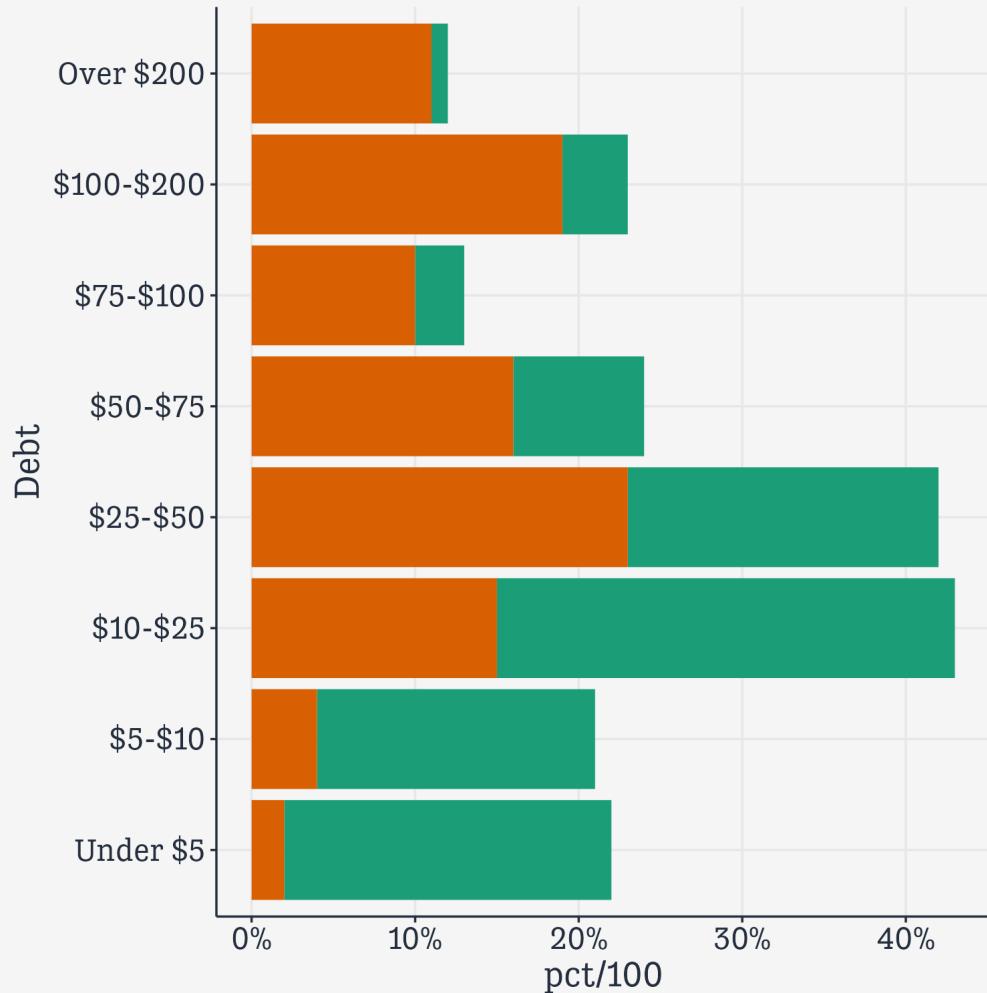
Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col() +  
  scale_fill_brewer(type = "qual",  
                    palette = "Dark2") +  
  scale_x_continuous(labels = label_percent())
```



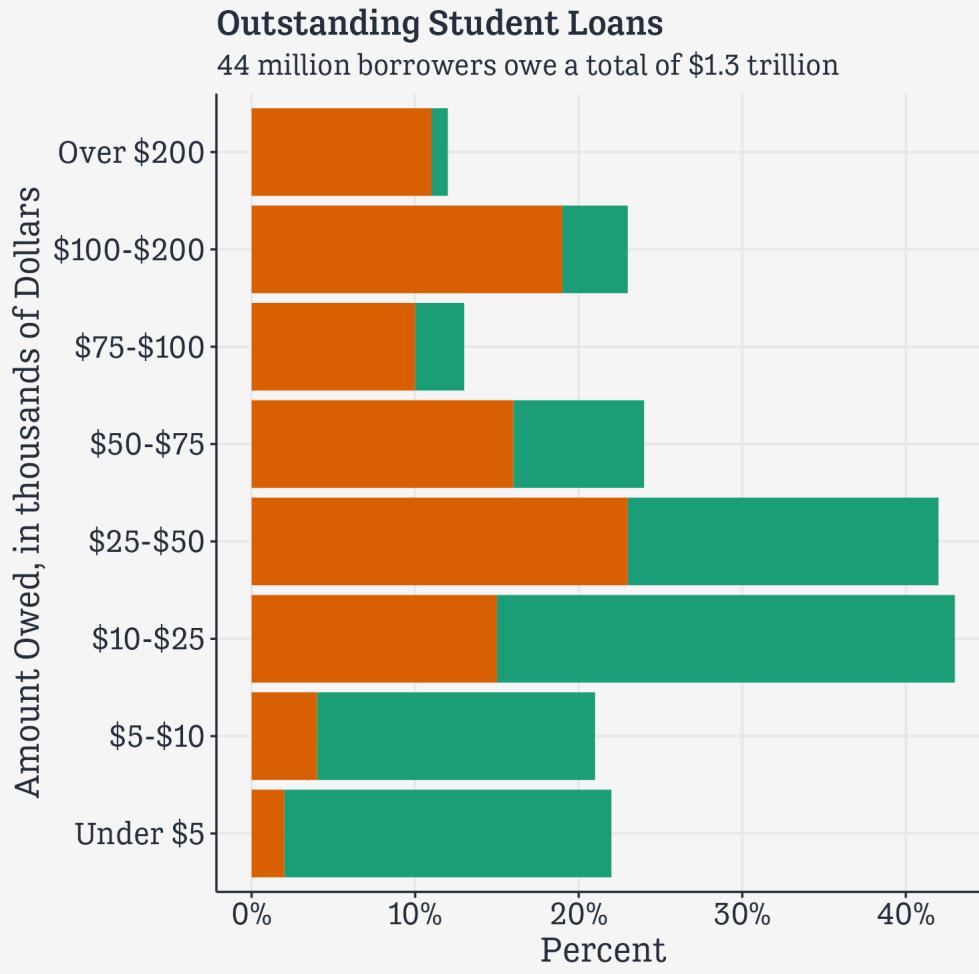
Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col() +  
  scale_fill_brewer(type = "qual",  
                    palette = "Dark2") +  
  scale_x_continuous(labels = label_percent()) +  
  guides(fill = "none")
```



Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col() +  
  scale_fill_brewer(type = "qual",  
                    palette = "Dark2") +  
  scale_x_continuous(labels = label_percent()) +  
  guides(fill = "none") +  
  labs(x = "Percent",  
       y = p_ylab,  
       caption = p_caption,  
       title = p_title,  
       subtitle = p_subtitle)
```

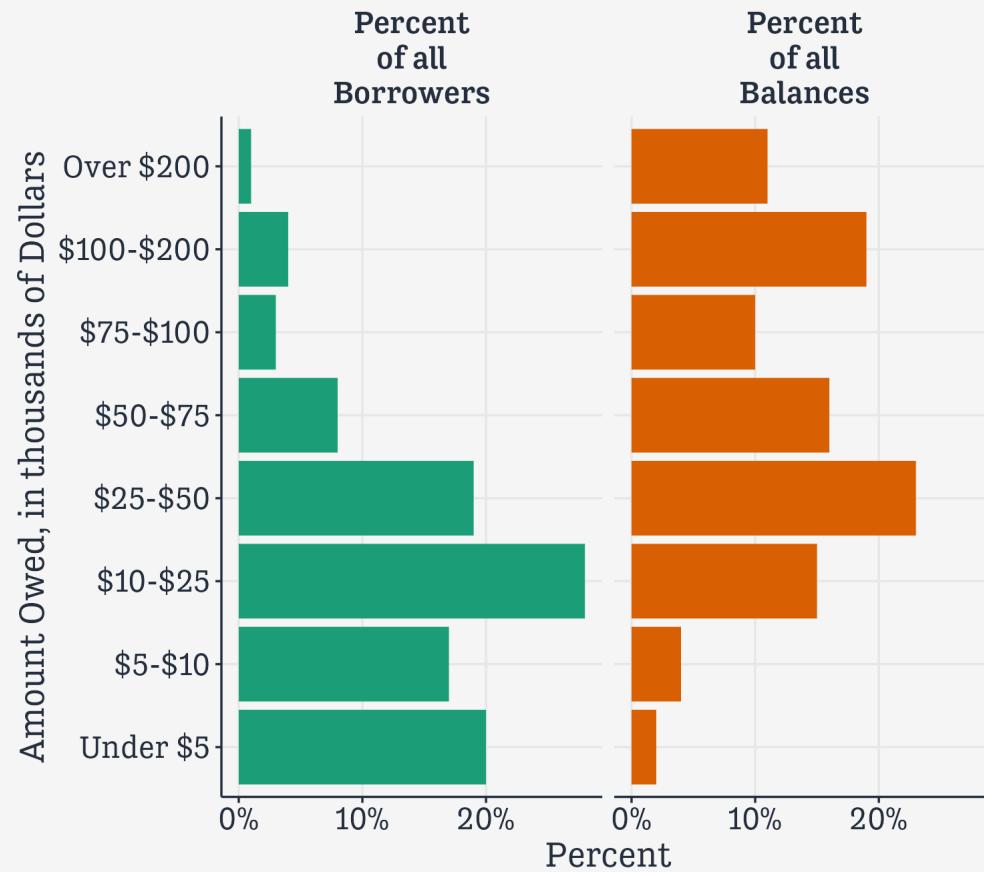


Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col() +  
  scale_fill_brewer(type = "qual",  
                    palette = "Dark2") +  
  scale_x_continuous(labels = label_percent()) +  
  guides(fill = "none") +  
  labs(x = "Percent",  
       y = p_ylab,  
       caption = p_caption,  
       title = p_title,  
       subtitle = p_subtitle) +  
  facet_wrap(~ type_label,  
            labeller =  
              label_wrap_gen(width=10))
```

Outstanding Student Loans

44 million borrowers owe a total of \$1.3 trillion



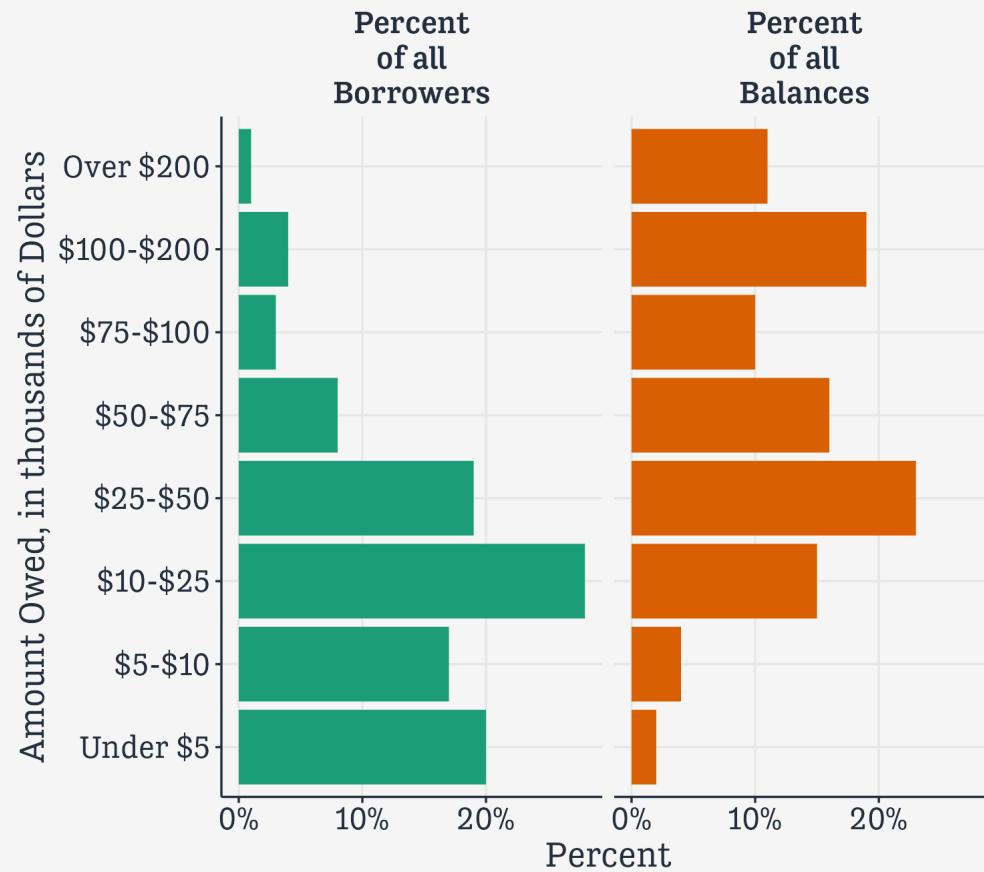
Source: FRB NY

Debt Plot 1

```
studebt |>  
  ggplot(mapping =  
    aes(x = pct/100,  
        y = Debt,  
        fill = type)) +  
  geom_col() +  
  scale_fill_brewer(type = "qual",  
                    palette = "Dark2") +  
  scale_x_continuous(labels = label_percent()) +  
  guides(fill = "none") +  
  labs(x = "Percent",  
       y = p_ylab,  
       caption = p_caption,  
       title = p_title,  
       subtitle = p_subtitle) +  
  facet_wrap(~ type_label,  
             labeller =  
               label_wrap_gen(width=10)) +  
  theme(strip.text.x =  
        element_text(face = "bold"))
```

Outstanding Student Loans

44 million borrowers owe a total of \$1.3 trillion



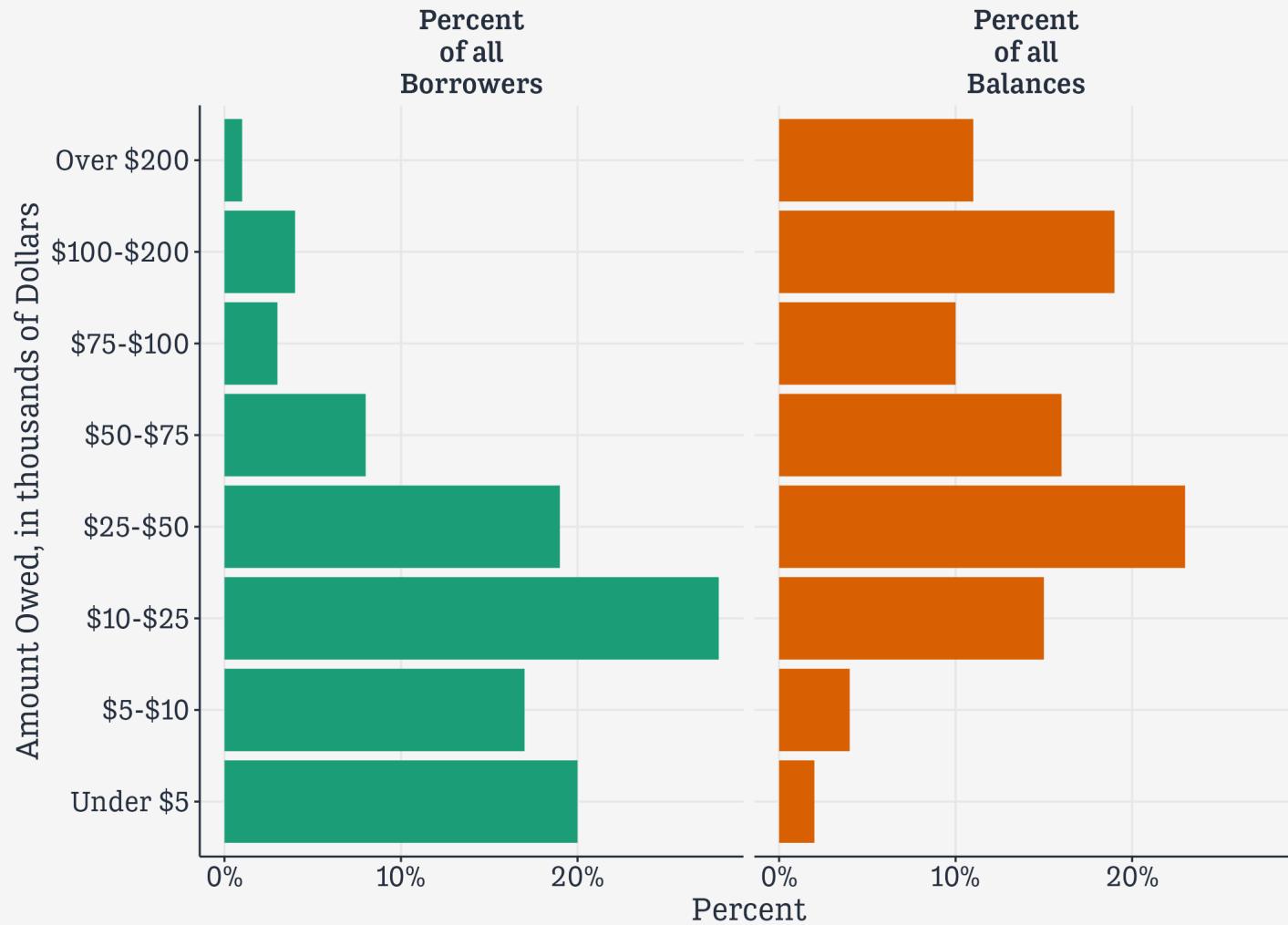
Source: FRB NY

Debt Plot 1

```
studebt |>
  ggplot(mapping =
    aes(x = pct/100,
        y = Debt,
        fill = type)) +
  geom_col() +
  scale_fill_brewer(type = "qual",
                    palette = "Dark2") +
  scale_x_continuous(labels = label_percent()) +
  guides(fill = "none") +
  labs(x = "Percent",
       y = p_ylab,
       caption = p_caption,
       title = p_title,
       subtitle = p_subtitle) +
  facet_wrap(~ type_label,
             labeller =
               label_wrap_gen(width=10)) +
  theme(strip.text.x =
        element_text(face = "bold")) ->
  p1_debt
```

Outstanding Student Loans

44 million borrowers owe a total of \$1.3 trillion



Source: FRB NY

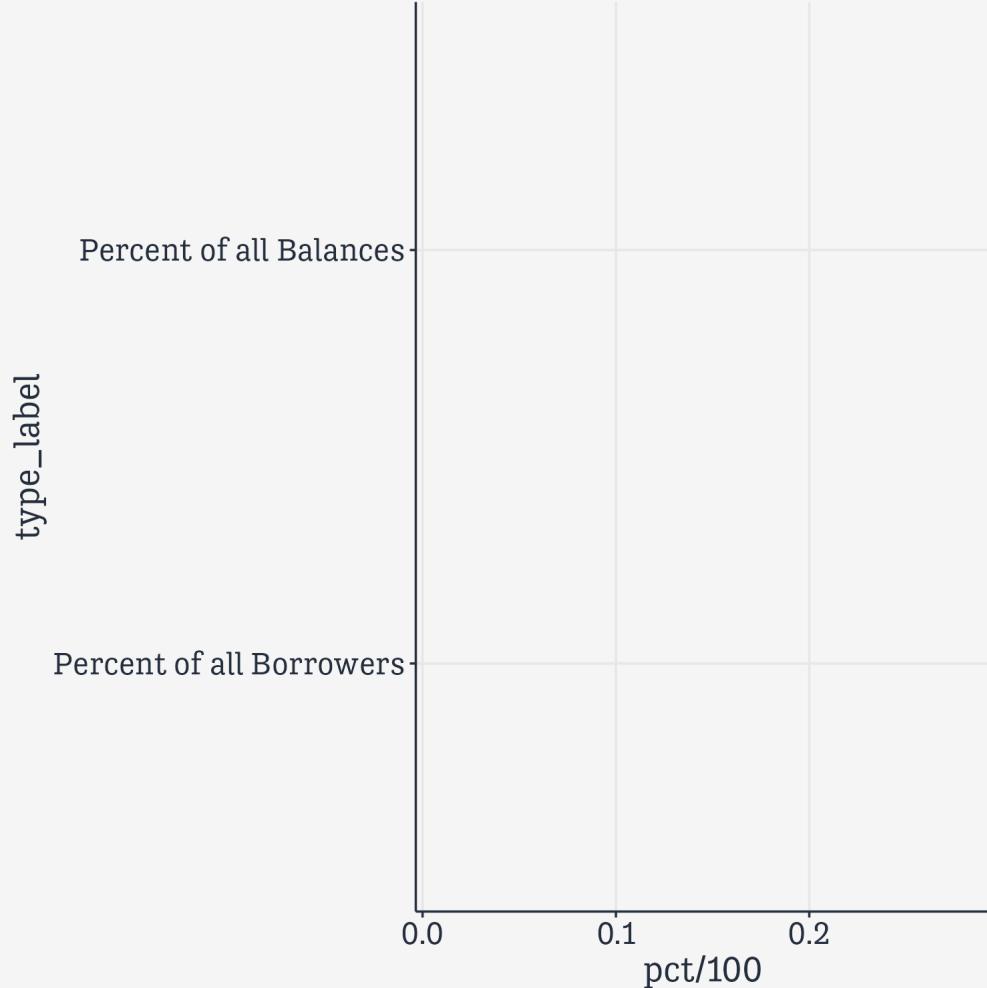
Pies redrawn as facets

Alternatively, as a kind of stacked bar chart

```
studebt
## # A tibble: 16 × 5
##   Debt      type     pct Debtrc type_label
##   <ord>    <fct>   <int> <ord>  <fct>
## 1 Under $5 Borrowers 20 Under $5 Percent of all Borrowers
## 2 $5-$10  Borrowers 17 $5-$10 Percent of all Borrowers
## 3 $10-$25 Borrowers 28 $10-$25 Percent of all Borrowers
## 4 $25-$50 Borrowers 19 $25-$50 Percent of all Borrowers
## 5 $50-$75 Borrowers  8 $50-$75 Percent of all Borrowers
## 6 $75-$100 Borrowers  3 $75-$100 Percent of all Borrowers
## 7 $100-$200 Borrowers  4 $100-$200 Percent of all Borrowers
## 8 Over $200 Borrowers  1 Over $200 Percent of all Borrowers
## 9 Under $5  Balances  2 Under $5 Percent of all Balances
## 10 $5-$10   Balances  4 $5-$10 Percent of all Balances
## 11 $10-$25  Balances 15 $10-$25 Percent of all Balances
## 12 $25-$50  Balances 23 $25-$50 Percent of all Balances
## 13 $50-$75  Balances 16 $50-$75 Percent of all Balances
## 14 $75-$100 Balances 10 $75-$100 Percent of all Balances
## 15 $100-$200 Balances 19 $100-$200 Percent of all Balances
## 16 Over $200 Balances 11 Over $200 Percent of all Balances
```

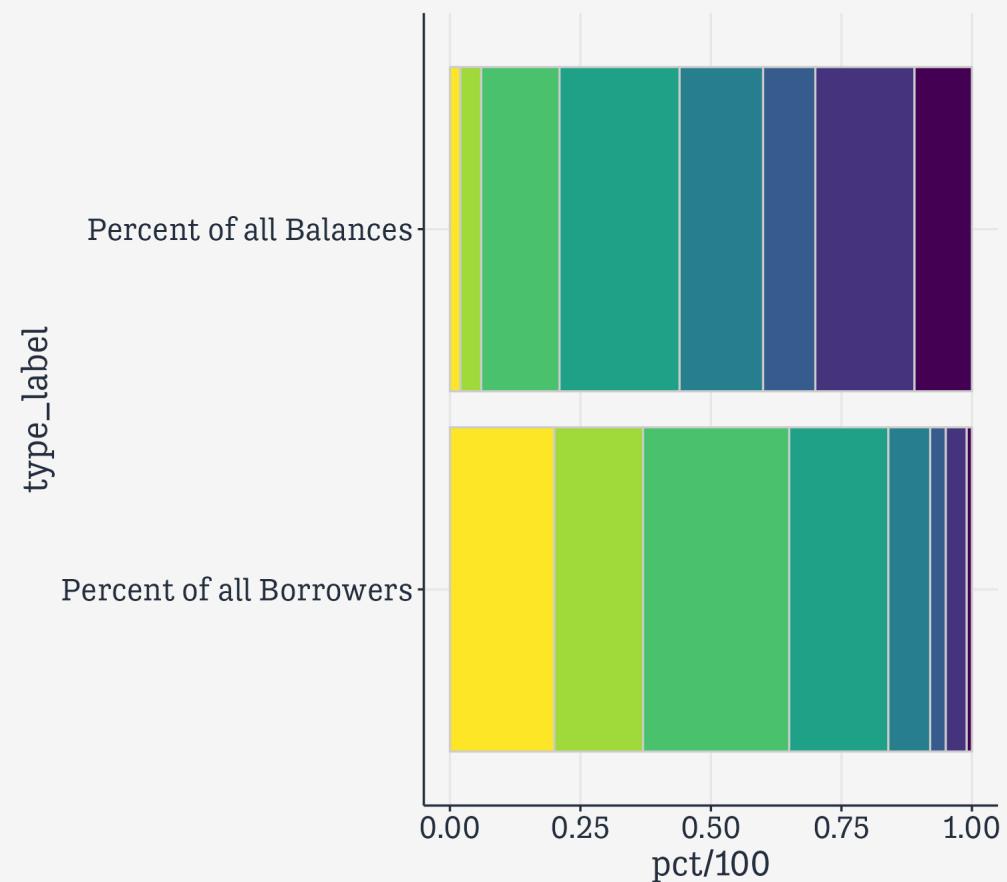
Alternatively, as a kind of stacked bar chart

```
studebt |>  
  ggplot(mapping = aes(x = pct/100,  
                        y = type_label,  
                        fill = Debtrc))
```



Alternatively, as a kind of stacked bar chart

```
studebt |>  
  ggplot(mapping = aes(x = pct/100,  
                        y = type_label,  
                        fill = Debtrc)) +  
  geom_col(color = "gray80")
```

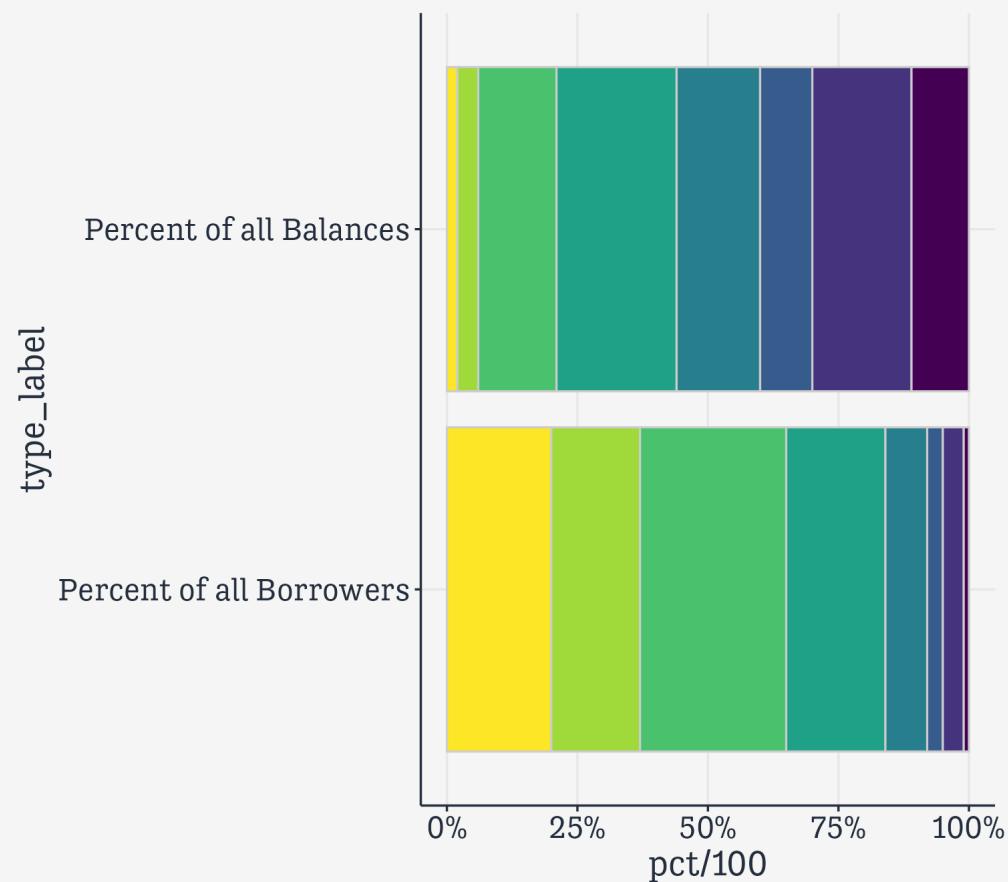


Alternatively, as a kind of stacked bar chart

```
studebt |>  
  ggplot(mapping = aes(x = pct/100,  
                        y = type_label,  
                        fill = Debtrc)) +  
  geom_col(color = "gray80") +  
  scale_x_continuous(labels =  
    label_percent())
```

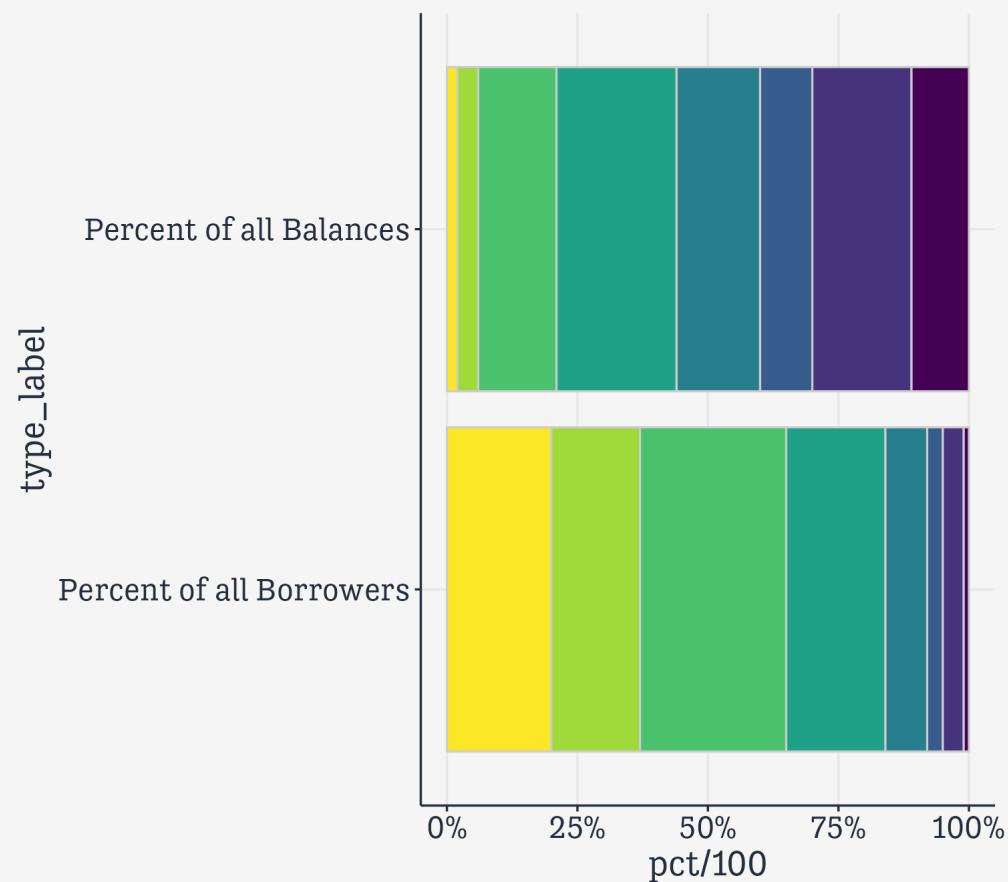
Debtrc

Over \$200	\$75-\$100	\$25-\$50	\$10-\$25	\$0-\$10
\$100-\$200	\$50-\$75	\$25-\$50	\$10-\$25	\$0-\$10



Alternatively, as a kind of stacked bar chart

```
studebt |>  
  ggplot(mapping = aes(x = pct/100,  
                        y = type_label,  
                        fill = Debtrc)) +  
  geom_col(color = "gray80") +  
  scale_x_continuous(labels =  
    label_percent()) +  
  scale_fill_viridis_d()
```



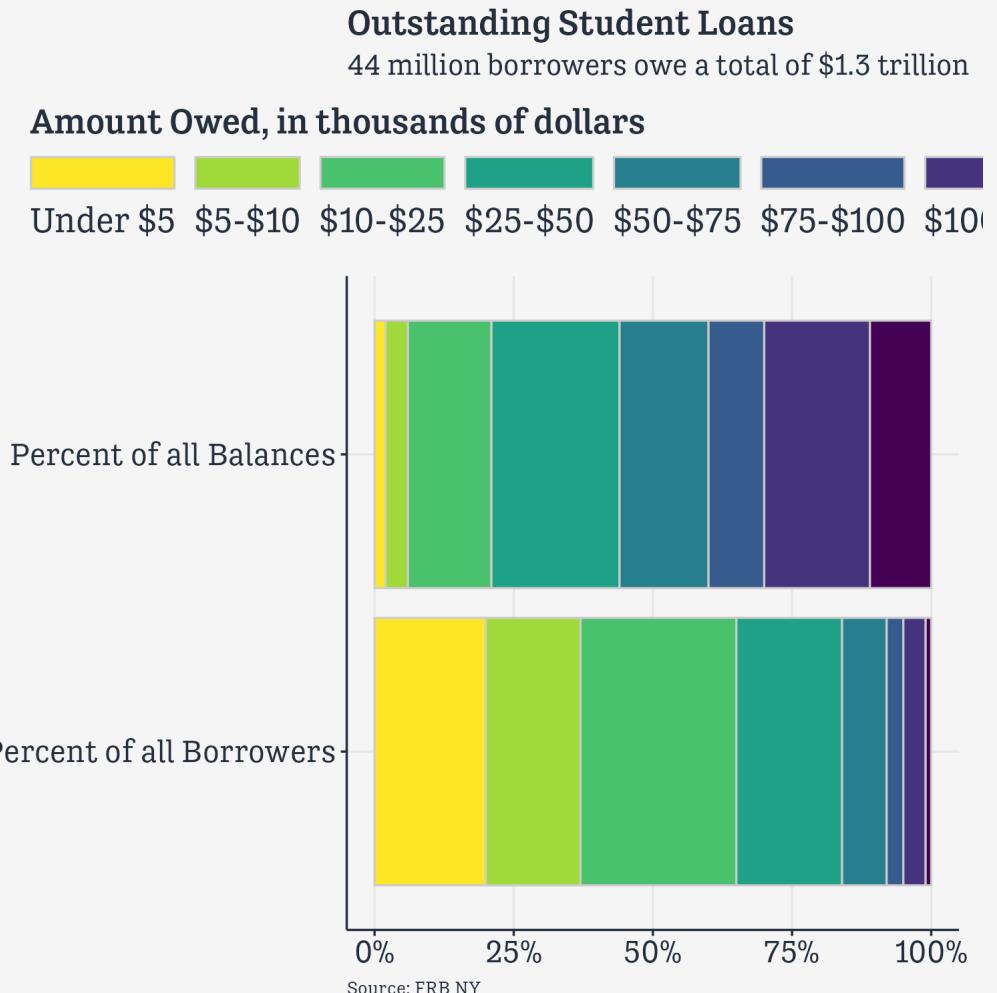
Alternatively, as a kind of stacked bar chart

```
studebt |>  
  ggplot(mapping = aes(x = pct/100,  
                        y = type_label,  
                        fill = Debtrc)) +  
  geom_col(color = "gray80") +  
  scale_x_continuous(labels =  
    label_percent()) +  
  scale_fill_viridis_d() +  
  guides(fill =  
    guide_legend(reverse = TRUE,  
                 title.position = "top",  
                 label.position = "bottom",  
                 keywidth = 3,  
                 nrow = 1))
```



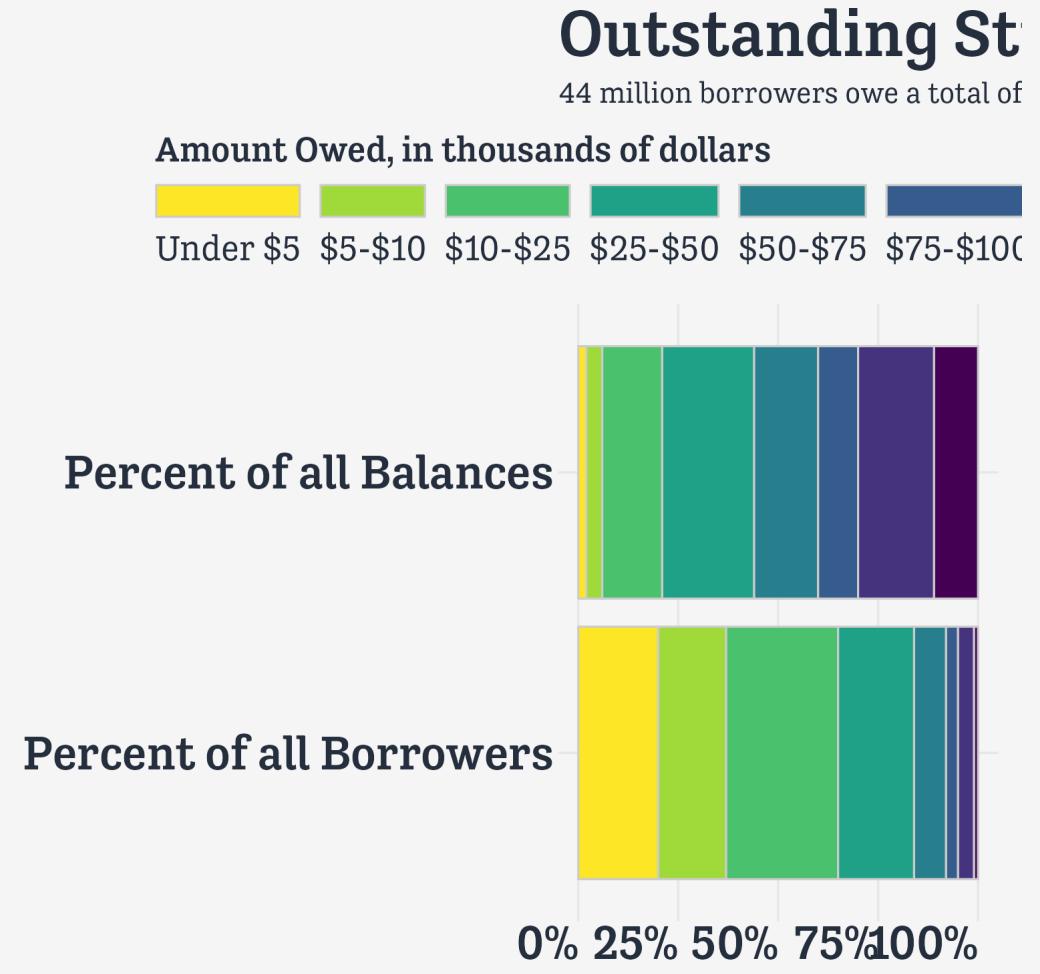
Alternatively, as a kind of stacked bar chart

```
studebt |>
  ggplot(mapping = aes(x = pct/100,
                        y = type_label,
                        fill = Debtrc)) +
  geom_col(color = "gray80") +
  scale_x_continuous(labels =
    label_percent()) +
  scale_fill_viridis_d() +
  guides(fill =
    guide_legend(reverse = TRUE,
                 title.position = "top",
                 label.position = "bottom",
                 keywidth = 3,
                 nrow = 1)) +
  labs(x = NULL, y = NULL,
       fill = "Amount Owed, in thousands of dollars",
       caption = p_caption, title = p_title,
       subtitle = p_subtitle)
```



Alternatively, as a kind of stacked bar chart

```
student |>
  ggplot(mapping = aes(x = pct/100,
                        y = type_label,
                        fill = Debtrc)) +
  geom_col(color = "gray80") +
  scale_x_continuous(labels =
                      label_percent()) +
  scale_fill_viridis_d() +
  guides(fill =
         guide_legend(reverse = TRUE,
                     title.position = "top",
                     label.position = "bottom",
                     keywidth = 3,
                     nrow = 1)) +
  labs(x = NULL, y = NULL,
       fill = "Amount Owed, in thousands of dollars",
       caption = p_caption, title = p_title,
       subtitle = p_subtitle) +
  theme(legend.position = "top",
        plot.title = element_text(size = rel(2.8)),
        axis.text = element_text(face = "bold",
                                 hjust = 1,
                                 size = rel(2)),
        axis.ticks.length = unit(0, "cm"),
        axis.line = element_blank(),
        panel.grid = element_blank())
```



Source: FRB NY

Alternatively, as a kind of stacked bar chart

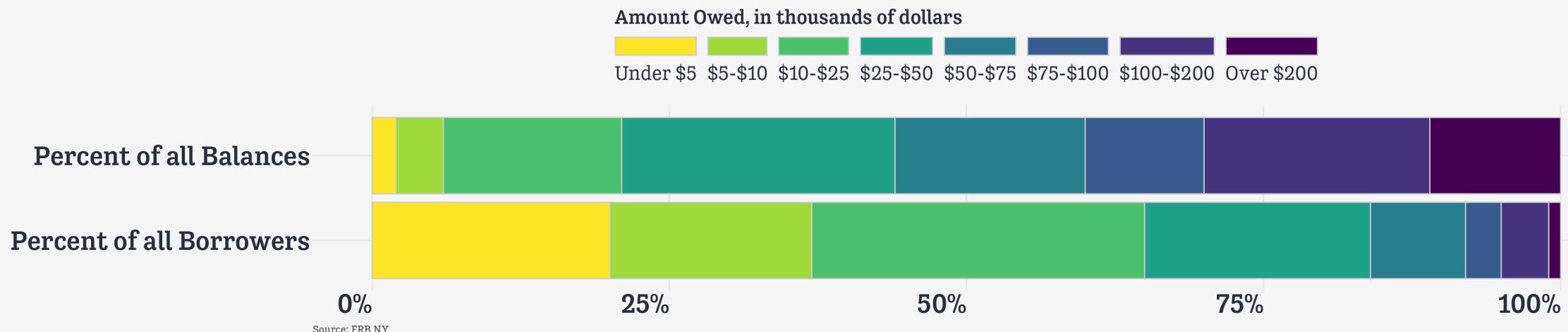
```
studebt |>
  ggplot(mapping = aes(x = pct/100,
                        y = type_label,
                        fill = Debtrc)) +
  geom_col(color = "gray80") +
  scale_x_continuous(labels =
    label_percent()) +
  scale_fill_viridis_d() +
  guides(fill =
    guide_legend(reverse = TRUE,
                 title.position = "top",
                 label.position = "bottom",
                 keywidth = 3,
                 nrow = 1)) +
  labs(x = NULL, y = NULL,
       fill = "Amount Owed, in thousands of dollars",
       caption = p_caption, title = p_title,
       subtitle = p_subtitle) +
  theme(legend.position = "top",
        plot.title = element_text(size = rel(2.8)),
        axis.text = element_text(face = "bold",
                                 hjust = 1,
                                 size = rel(2)),
        axis.ticks.length = unit(0, "cm"),
        axis.line = element_blank(),
        panel.grid = element_blank()) ->
  p_debt2
```

Alternatively, as a kind of stacked bar chart

```
studebt |>
  ggplot(mapping = aes(x = pct/100,
                        y = type_label,
                        fill = Debtrc)) +
  geom_col(color = "gray80") +
  scale_x_continuous(labels =
    label_percent()) +
  scale_fill_viridis_d() +
  guides(fill =
    guide_legend(reverse = TRUE,
                 title.position = "top",
                 label.position = "bottom",
                 keywidth = 3,
                 nrow = 1)) +
  labs(x = NULL, y = NULL,
       fill = "Amount Owed, in thousands of dollars",
       caption = p_caption, title = p_title,
       subtitle = p_subtitle) +
  theme(legend.position = "top",
        plot.title = element_text(size = rel(2.8)),
        axis.text = element_text(face = "bold",
                                 hjust = 1,
                                 size = rel(2)),
        axis.ticks.length = unit(0, "cm"),
        axis.line = element_blank(),
        panel.grid = element_blank()) ->
  p_debt2
```

Outstanding Student Loans

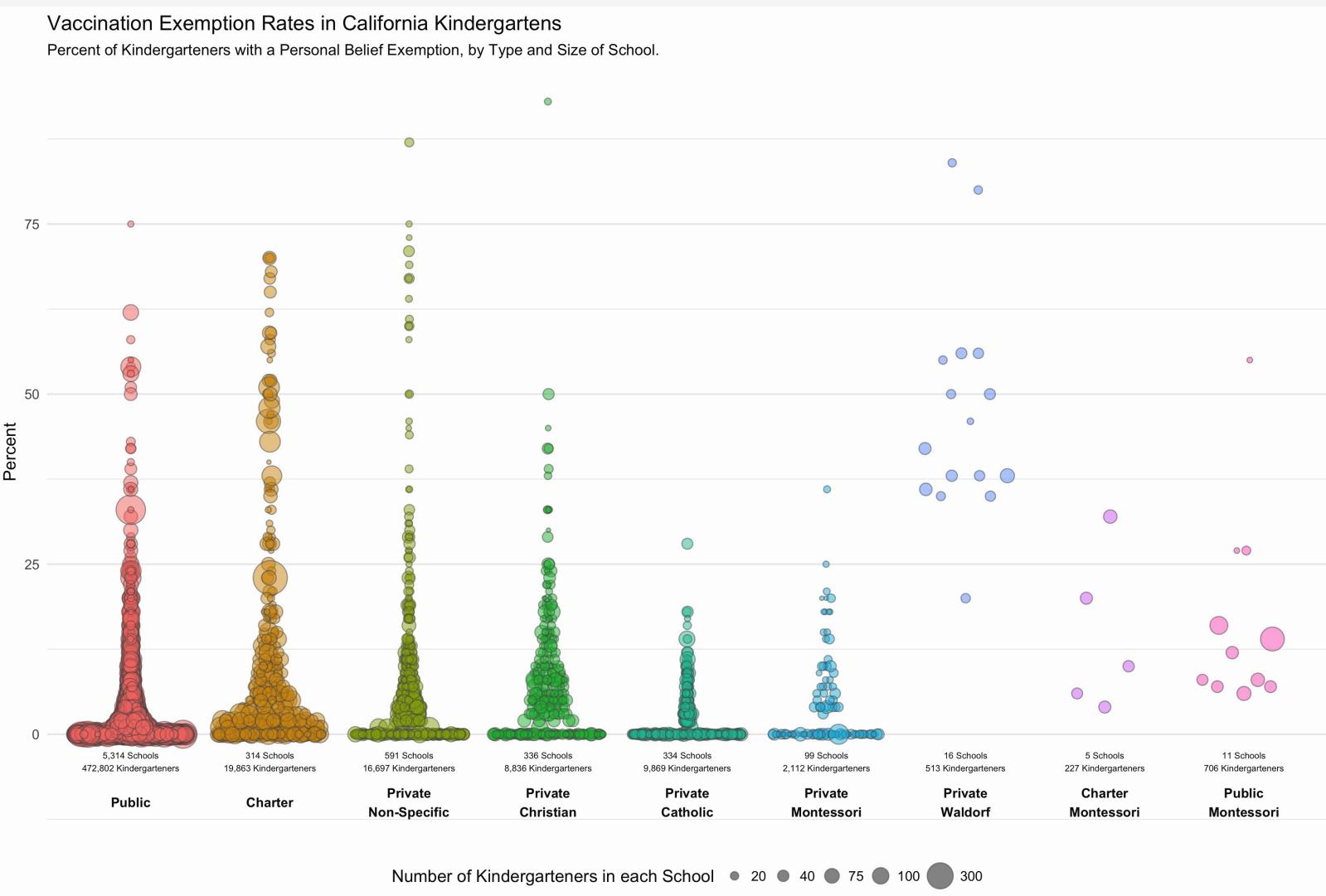
44 million borrowers owe a total of \$1.3 trillion



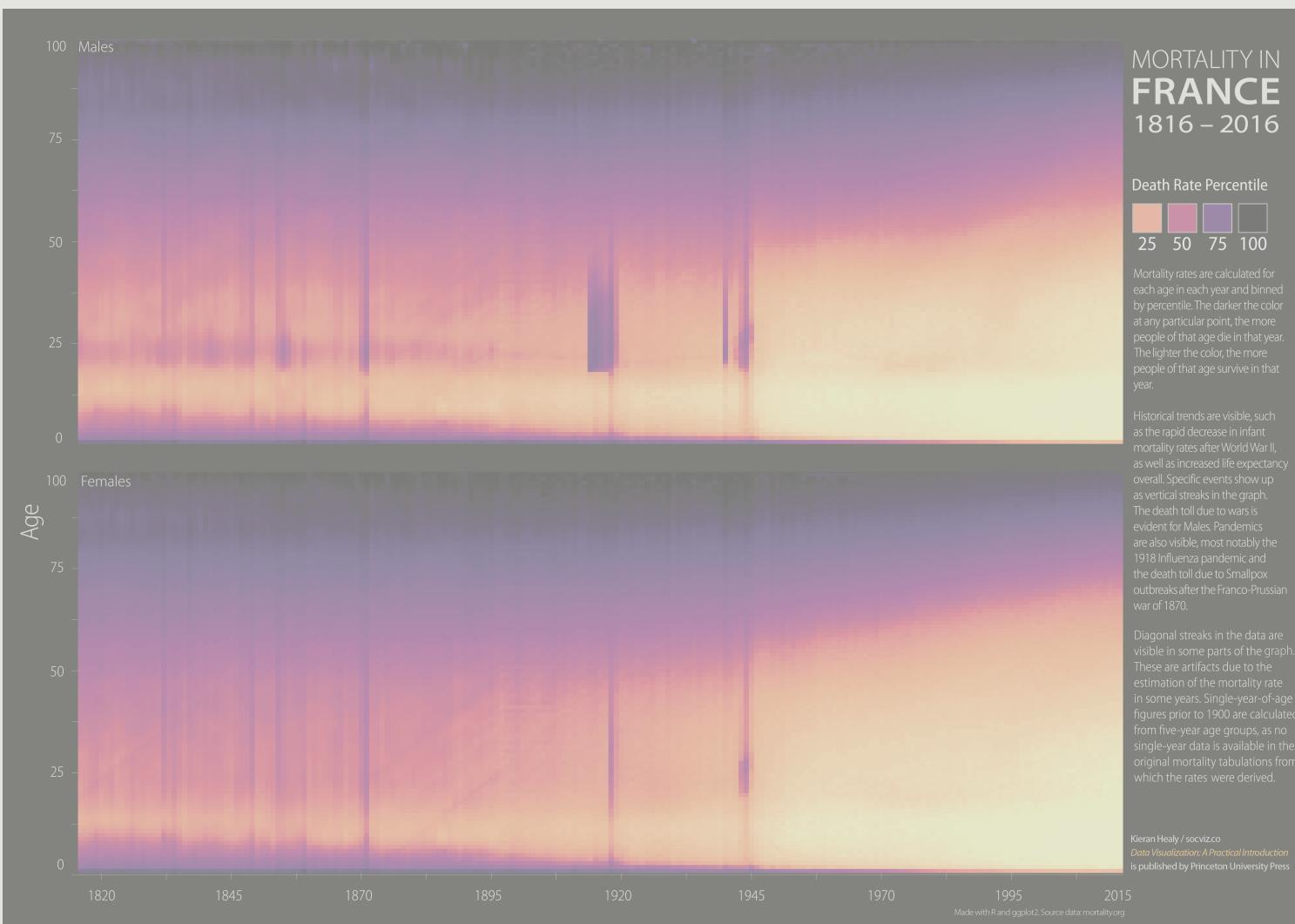
Pies redrawn as sideways-stacked columns

**But I want
a pony**

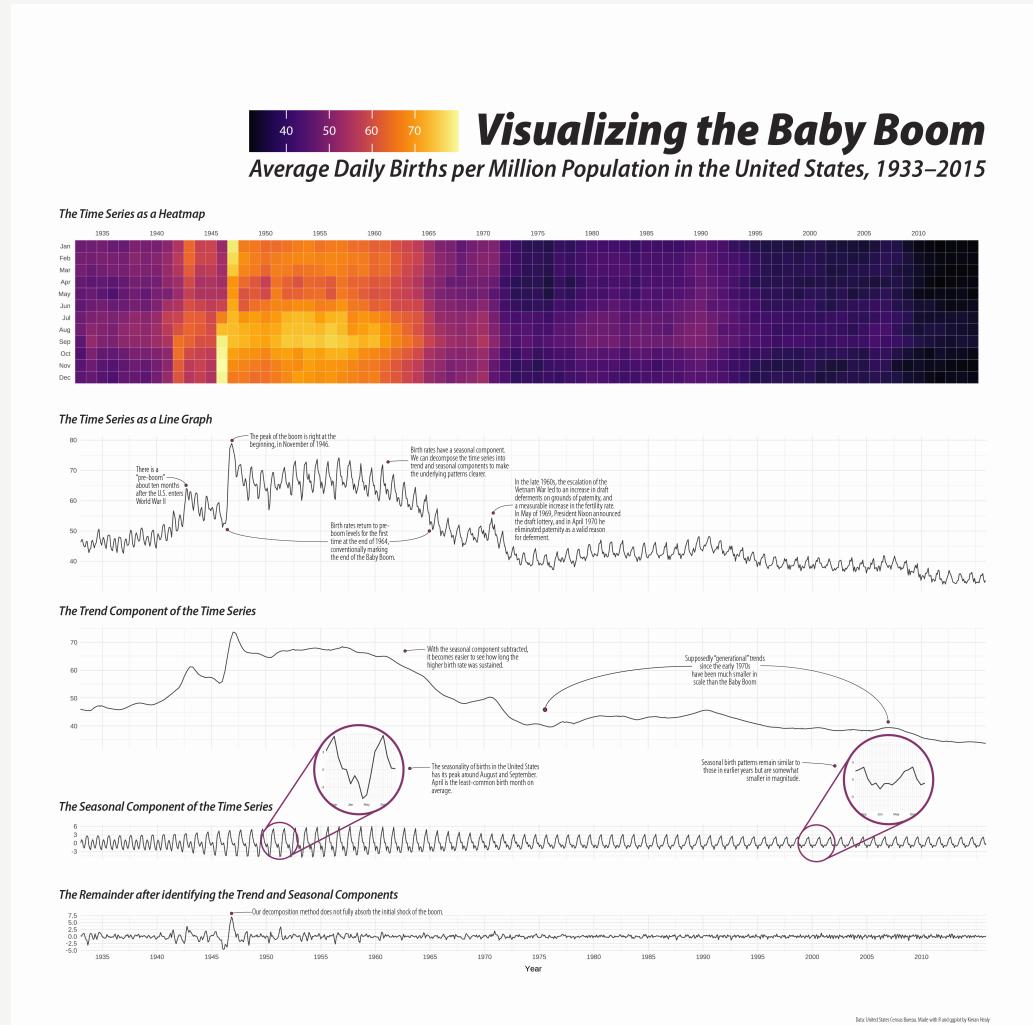
Show ponies



Show ponies



Show ponies



OK boomer

The demog package

```
# remotes::install_github("kjhealy/demog")
# library(demog)

okboomer

## # A tibble: 1,644 × 12
##   year month n_days births total_pop births_pct births_pct_day date
##   <dbl> <dbl> <dbl>   <dbl>      <dbl>        <dbl> <date>
## 1 1938     1     31  51820  41215000  0.00126    40.6 1938-01-01
## 2 1938     2     28  47421  41215000  0.00115    41.1 1938-02-01
## 3 1938     3     31  54887  41215000  0.00133    43.0 1938-03-01
## 4 1938     4     30  54623  41215000  0.00133    44.2 1938-04-01
## 5 1938     5     31  56853  41215000  0.00138    44.5 1938-05-01
## 6 1938     6     30  53145  41215000  0.00129    43.0 1938-06-01
## 7 1938     7     31  53214  41215000  0.00129    41.6 1938-07-01
## 8 1938     8     31  50444  41215000  0.00122    39.5 1938-08-01
## 9 1938     9     30  50545  41215000  0.00123    40.9 1938-09-01
## 10 1938    10     31  50079  41215000  0.00122   39.2 1938-10-01
## # ... with 1,634 more rows, and 4 more variables: seasonal <dbl>,
## #   trend <dbl>,
## #   remainder <dbl>, country <chr>
```

Boomer Line Graph

```
okboomer
```

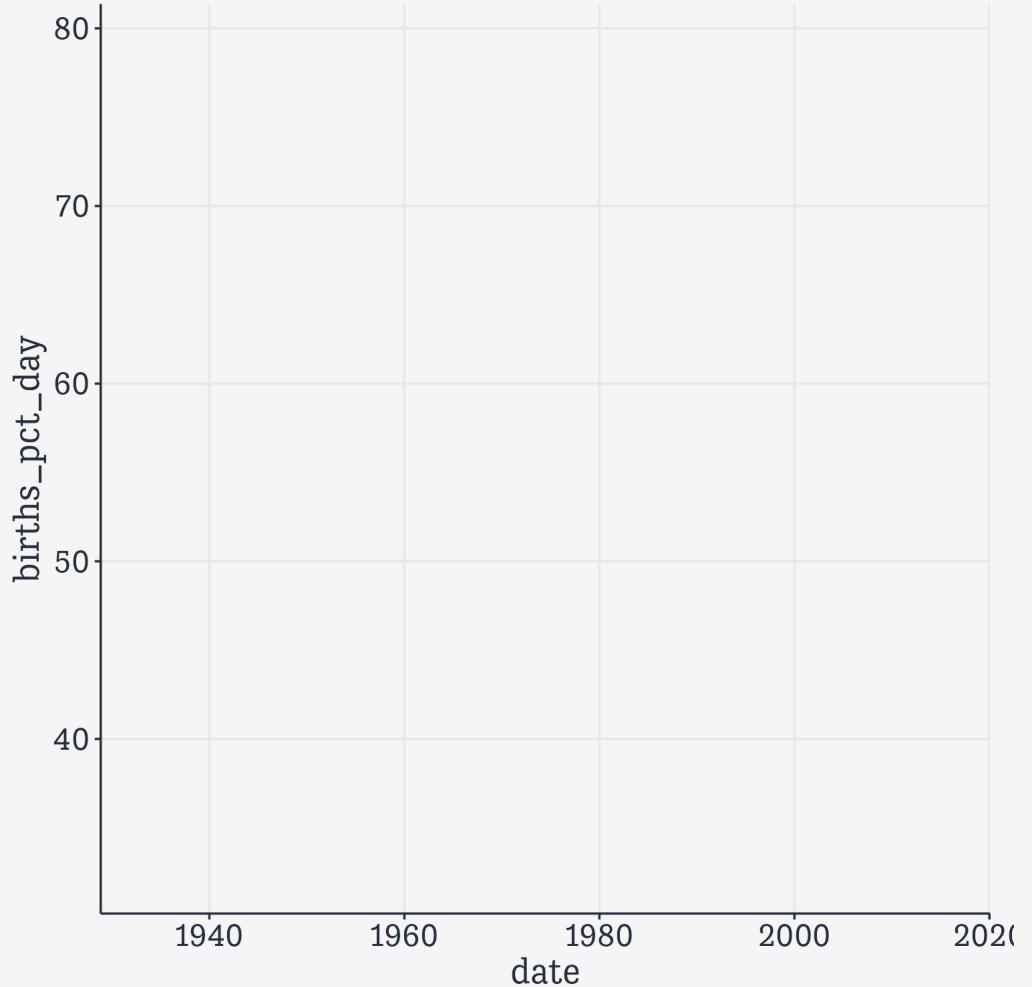
```
## # A tibble: 1,644 × 12
##   year month n_days births total_pop births_pct births_pct_day date
##   <dbl> <dbl>  <dbl>  <dbl>    <dbl>      <dbl>      <dbl> <date>
## 1 1938     1      31  51820  41215000  0.00126   40.6 1938-01-01
## 2 1938     2      28  47421  41215000  0.00115   41.1 1938-02-01
## 3 1938     3      31  54887  41215000  0.00133   43.0 1938-03-01
## 4 1938     4      30  54623  41215000  0.00133   44.2 1938-04-01
## 5 1938     5      31  56853  41215000  0.00138   44.5 1938-05-01
## 6 1938     6      30  53145  41215000  0.00129   43.0 1938-06-01
## 7 1938     7      31  53214  41215000  0.00129   41.6 1938-07-01
## 8 1938     8      31  50444  41215000  0.00122   39.5 1938-08-01
## 9 1938     9      30  50545  41215000  0.00123   40.9 1938-09-01
## 10 1938    10     31  50079  41215000  0.00122  39.2 1938-10-01
## # ... with 1,634 more rows, and 4 more variables: seasonal <dbl>, trend <dbl>,
## #   remainder <dbl>, country <chr>
```

Boomer Line Graph

```
okboomer |>
  filter(country == "United States")  
## # A tibble: 996 × 12  
##   year month n_days births total_pop births_pct births_pct_day date  
##   <dbl> <dbl>  <dbl>  <dbl>    <dbl>      <dbl>          <dbl> <date>  
## 1 1933     1      31 180545 125579000 0.00144        46.4 1933-01-01  
## 2 1933     2      28 165986 125579000 0.00132        47.2 1933-02-01  
## 3 1933     3      31 183762 125579000 0.00146        47.2 1933-03-01  
## 4 1933     4      30 171354 125579000 0.00136        45.5 1933-04-01  
## 5 1933     5      31 174811 125579000 0.00139        44.9 1933-05-01  
## 6 1933     6      30 169255 125579000 0.00135        44.9 1933-06-01  
## 7 1933     7      31 180880 125579000 0.00144        46.5 1933-07-01  
## 8 1933     8      31 181856 125579000 0.00145        46.7 1933-08-01  
## 9 1933     9      30 167637 125579000 0.00133        44.5 1933-09-01  
## 10 1933    10     31 167055 125579000 0.00133       42.9 1933-10-01  
## # ... with 986 more rows, and 4 more variables: seasonal <dbl>, trend <dbl>,  
## #   remainder <dbl>, country <chr>
```

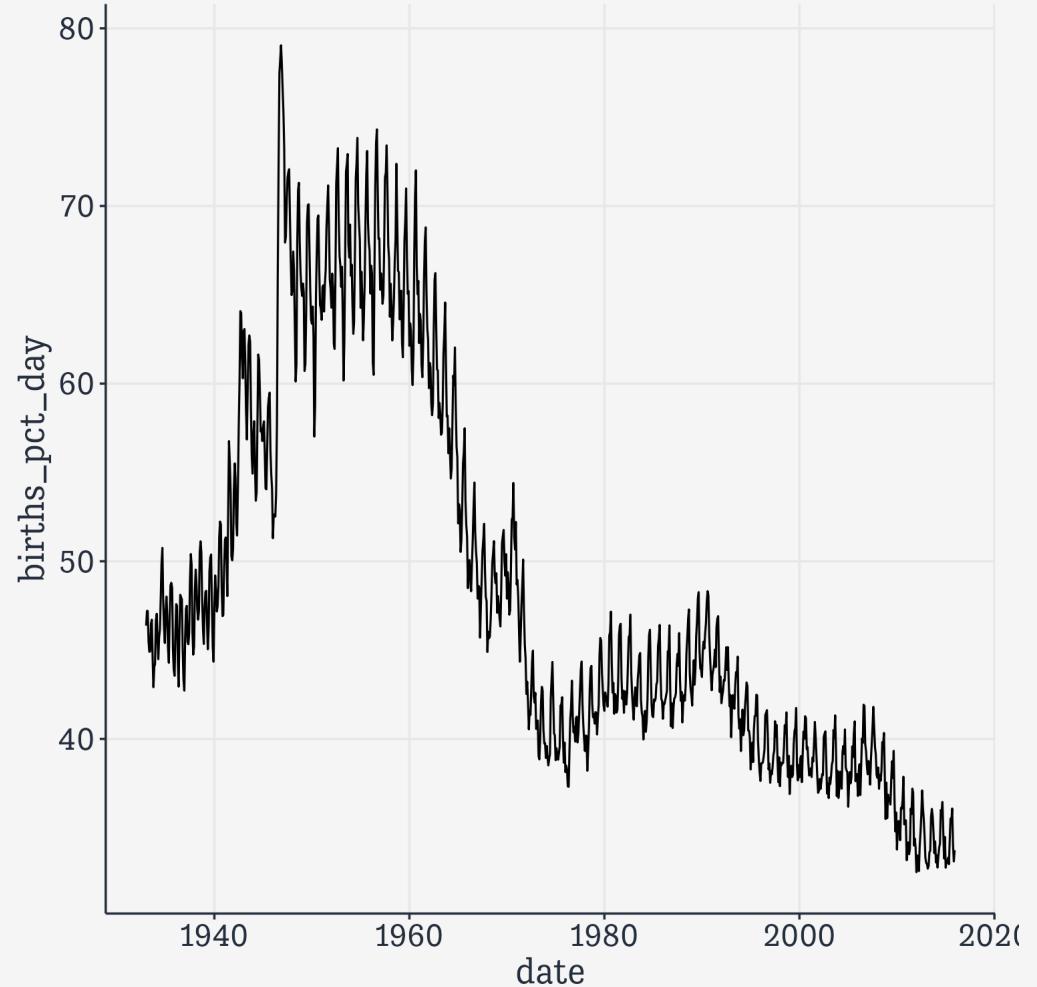
Boomer Line Graph

```
okboomer |>  
  filter(country == "United States") |>  
  ggplot(aes(x = date, y = births_pct_day))
```



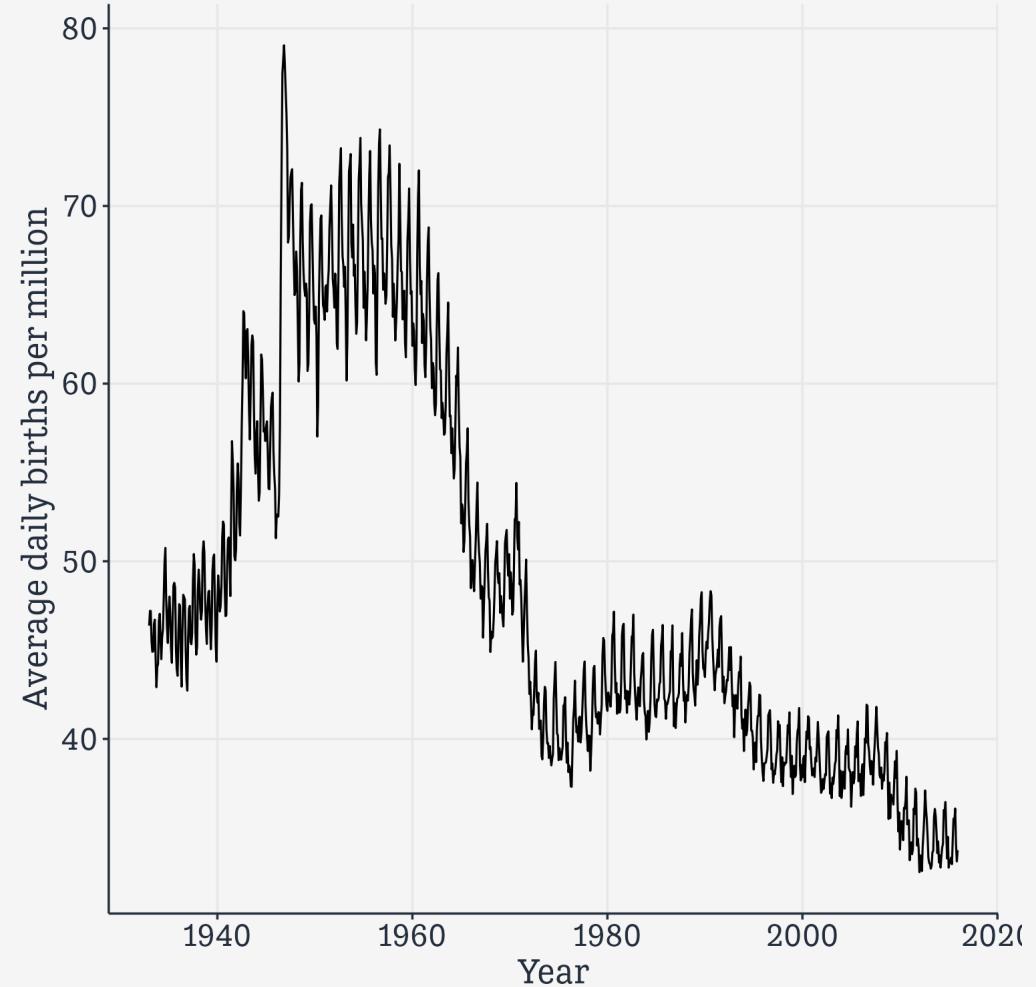
Boomer Line Graph

```
okboomer |>  
  filter(country == "United States") |>  
  ggplot(aes(x = date, y = births_pct_day)) +  
    geom_line(size = 0.5)
```



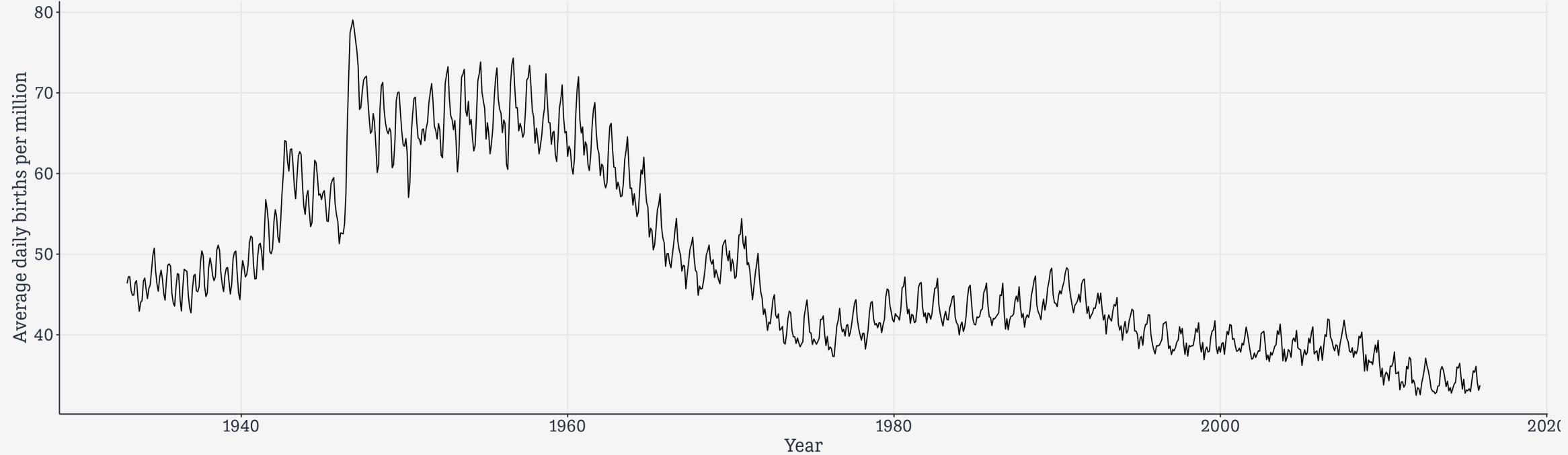
Boomer Line Graph

```
okboomer |>  
  filter(country == "United States") |>  
  ggplot(aes(x = date, y = births_pct_day)) +  
  geom_line(size = 0.5) +  
  labs(x = "Year",  
       y = "Average daily births per million")
```



Boomer Line Graph

```
okboomer |>
  filter(country == "United States") |>
  ggplot(aes(x = date, y = births_pct_day)) +
  geom_line(size = 0.5) +
  labs(x = "Year",
       y = "Average daily births per million") -
  p_lineboom
```

The Baby Boom.

Tiled Heatmap

```
okboomer
## # A tibble: 1,644 × 12
##   year month n_days births total_pop births_pct
##   <dbl> <dbl>   <dbl>   <dbl>    <dbl>      <dbl>
## 1 1938     1       31   51820  41215000  0.00126
## 2 1938     2       28   47421  41215000  0.00115
## 3 1938     3       31   54887  41215000  0.00133
## 4 1938     4       30   54623  41215000  0.00133
## 5 1938     5       31   56853  41215000  0.00138
## 6 1938     6       30   53145  41215000  0.00129
## 7 1938     7       31   53214  41215000  0.00129
## 8 1938     8       31   50444  41215000  0.00122
## 9 1938     9       30   50545  41215000  0.00123
## 10 1938    10      31   50079  41215000  0.00122
## # ... with 1,634 more rows, and 4 more variables: sea
## #   remainder <dbl>, country <chr>
```

Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
           levels = unique(year),
           ordered = TRUE),
  month_fct = factor(month,
                      levels = rev(c(1:12)),
                      labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                    "May", "Jun", "Jul", "Aug",
                                    "Sep", "Oct", "Nov", "Dec")),
                      ordered = TRUE))
```

```
## # A tibble: 1,644 × 14
##   year month n_days births total_pop births_pct ...
##   <dbl> <dbl>   <dbl>   <dbl>     <dbl>      <dbl>    ...
## 1 1938     1     31  51820  41215000 0.00126
## 2 1938     2     28  47421  41215000 0.00115
## 3 1938     3     31  54887  41215000 0.00133
## 4 1938     4     30  54623  41215000 0.00133
## 5 1938     5     31  56853  41215000 0.00138
## 6 1938     6     30  53145  41215000 0.00129
## 7 1938     7     31  53214  41215000 0.00129
## 8 1938     8     31  50444  41215000 0.00122
## 9 1938     9     30  50545  41215000 0.00123
## 10 1938    10     31  50079  41215000 0.00122
## ... with 1,634 more rows, and 6 more variables: sec ...
## #   remainder <dbl>, country <chr>, year_fct <ord>
```

Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
    month_fct = factor(month,
      levels = rev(c(1:12)),
      labels = rev(c("Jan", "Feb", "Mar", "Apr",
        "May", "Jun", "Jul", "Aug",
        "Sep", "Oct", "Nov", "Dec")),
      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything())
```

```
## # A tibble: 1,644 × 14
##   year month year_fct month_fct n_days births to
##   <dbl> <dbl> <ord>    <ord>     <dbl> <dbl>
## 1 1938     1 1938     Jan       31 51820  4
## 2 1938     2 1938     Feb       28 47421  4
## 3 1938     3 1938     Mar       31 54887  4
## 4 1938     4 1938     Apr       30 54623  4
## 5 1938     5 1938     May       31 56853  4
## 6 1938     6 1938     Jun       30 53145  4
## 7 1938     7 1938     Jul       31 53214  4
## 8 1938     8 1938     Aug       31 50444  4
## 9 1938     9 1938     Sep       30 50545  4
## 10 1938    10 1938    Oct       31 50079  4
## ... with 1,634 more rows, and 6 more variables: bi
##   date <date>, seasonal <dbl>, trend <dbl>, rema
```

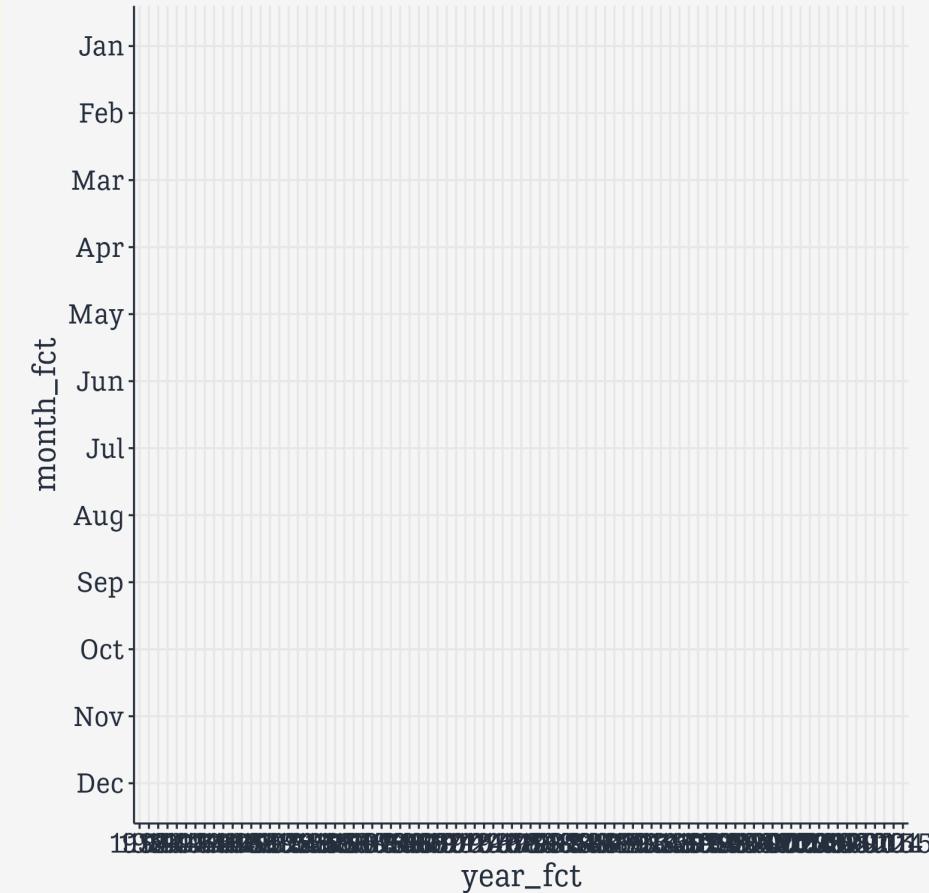
Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
    month_fct = factor(month,
      levels = rev(c(1:12)),
      labels = rev(c("Jan", "Feb", "Mar", "Apr",
        "May", "Jun", "Jul", "Aug",
        "Sep", "Oct", "Nov", "Dec")),
      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
  filter(country == "United States")
```

```
## # A tibble: 996 x 14
##   year month year_fct month_fct n_days births to
##   <dbl> <dbl> <ord>    <ord>     <dbl> <dbl>
## 1 1933  1 1933 Jan       31 180545 125
## 2 1933  2 1933 Feb       28 165986 125
## 3 1933  3 1933 Mar      31 183762 125
## 4 1933  4 1933 Apr      30 171354 125
## 5 1933  5 1933 May      31 174811 125
## 6 1933  6 1933 Jun      30 169255 125
## 7 1933  7 1933 Jul      31 180880 125
## 8 1933  8 1933 Aug      31 181856 125
## 9 1933  9 1933 Sep      30 167637 125
## 10 1933 10 1933 Oct      31 167055 125
## ... with 986 more rows, and 6 more variables: birth
## #   date <date>, seasonal <dbl>, trend <dbl>, rema
```

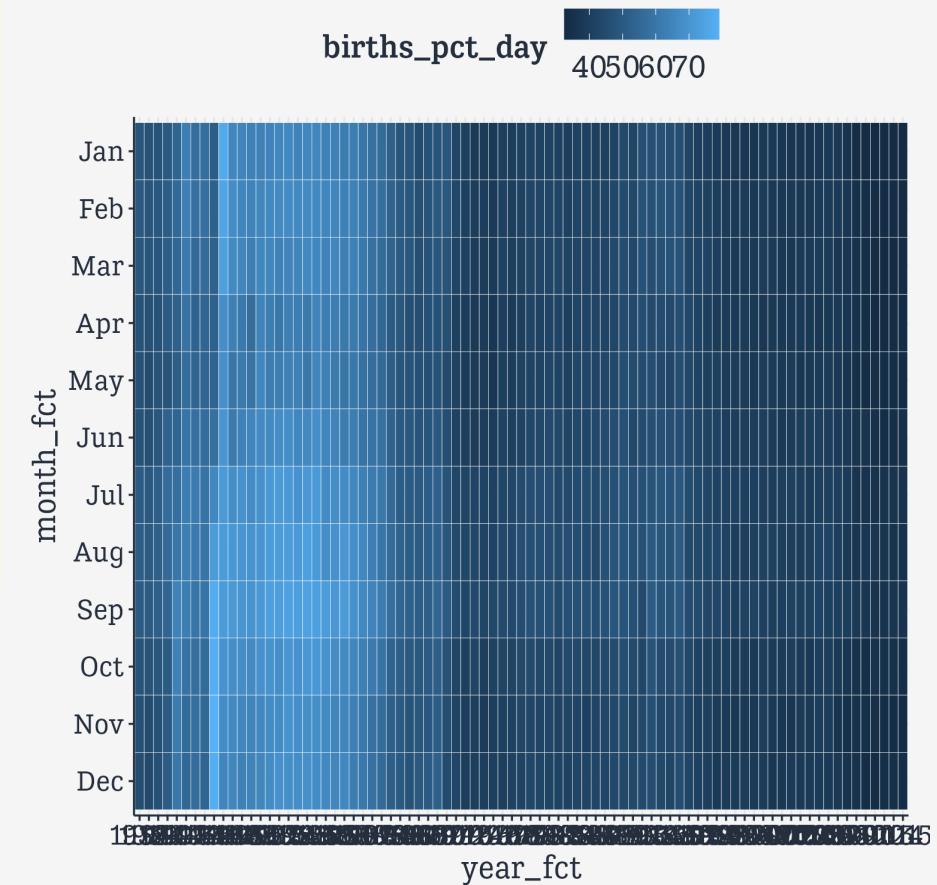
Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
           levels = unique(year),
           ordered = TRUE),
  month_fct = factor(month,
                      levels = rev(c(1:12)),
                      labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                    "May", "Jun", "Jul", "Aug",
                                    "Sep", "Oct", "Nov", "Dec")),
                      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct))
```



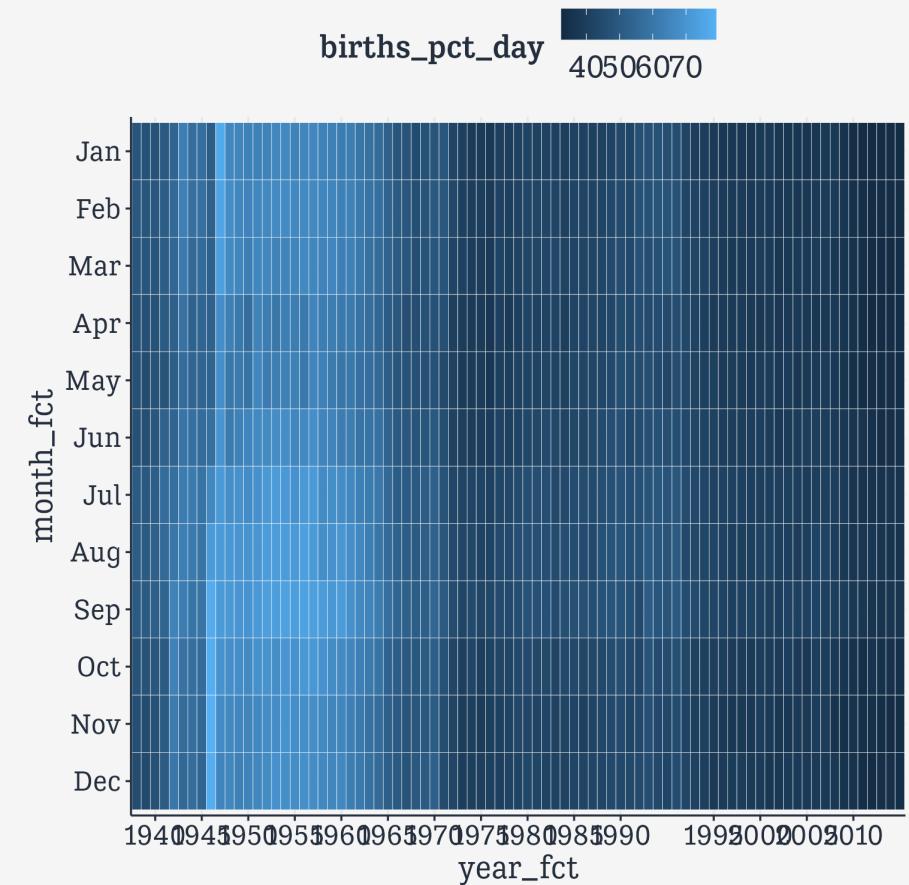
Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
           levels = unique(year),
           ordered = TRUE),
  month_fct = factor(month,
                      levels = rev(c(1:12)),
                      labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                    "May", "Jun", "Jul", "Aug",
                                    "Sep", "Oct", "Nov", "Dec")),
                      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
            color = "white")
```



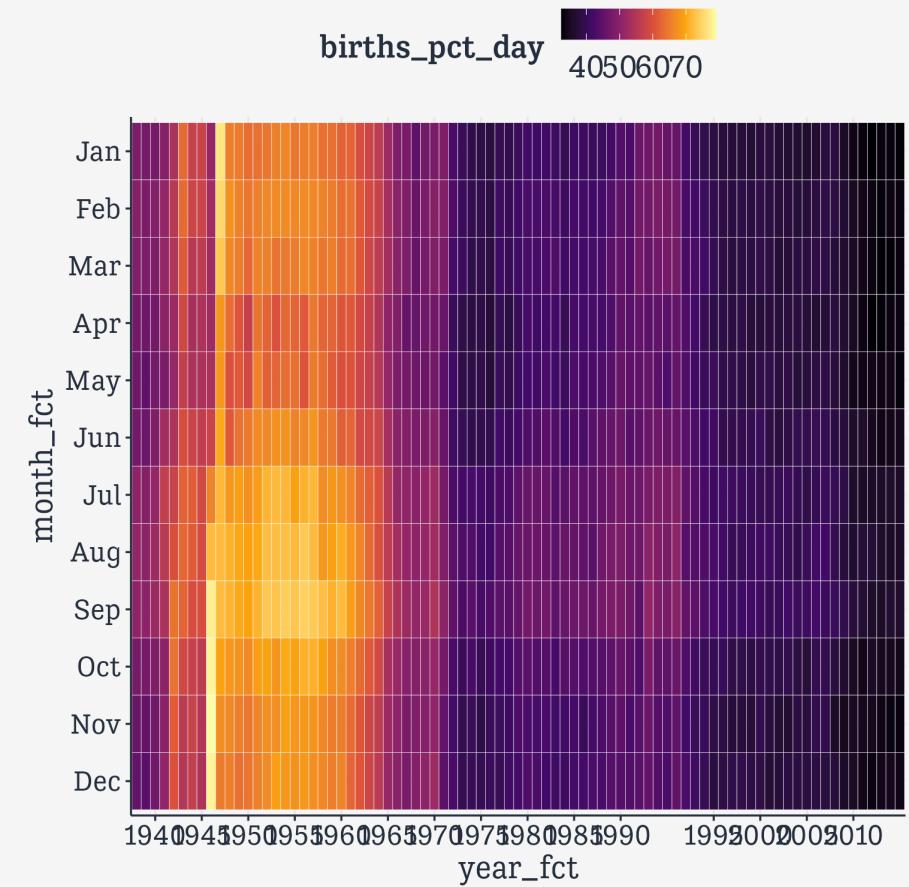
Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
           levels = unique(year),
           ordered = TRUE),
  month_fct = factor(month,
                      levels = rev(c(1:12)),
                      labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                    "May", "Jun", "Jul", "Aug",
                                    "Sep", "Oct", "Nov", "Dec")),
                      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
            color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5))
```



Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
           levels = unique(year),
           ordered = TRUE),
  month_fct = factor(month,
                      levels = rev(c(1:12)),
                      labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                    "May", "Jun", "Jul", "Aug",
                                    "Sep", "Oct", "Nov", "Dec")),
                      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
            color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B")
```

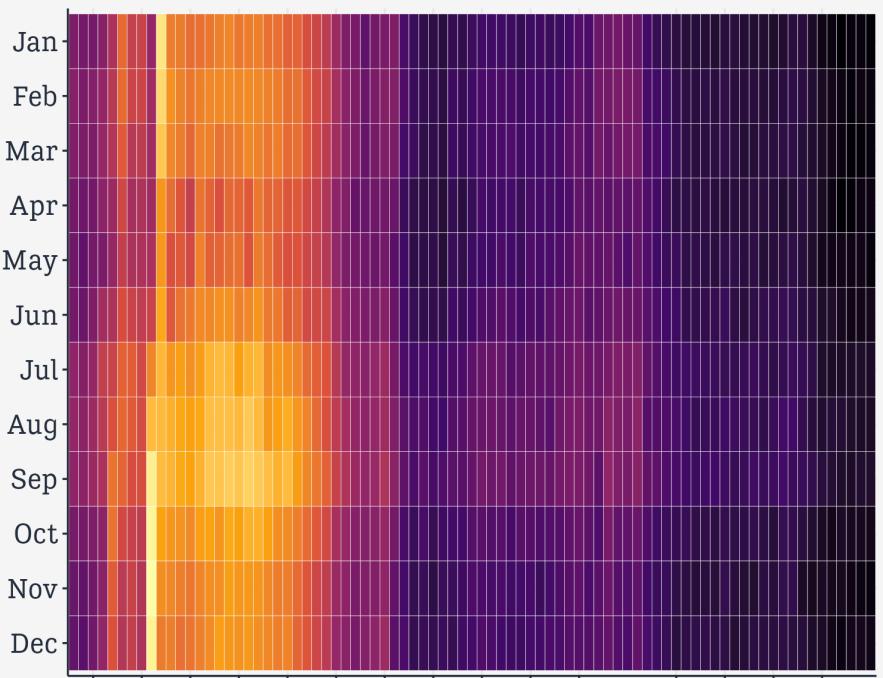


Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
  month_fct = factor(month,
    levels = rev(c(1:12)),
    labels = rev(c("Jan", "Feb", "Mar", "Apr",
      "May", "Jun", "Jul", "Aug",
      "Sep", "Oct", "Nov", "Dec")),
    ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
    color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B") +
  labs(x = NULL, y = NULL,
    title = "Monthly Birth Rates",
    fill = "Average births per million people per day",
    caption = "Data: US Census Bureau.")
```

Monthly Birth Rates

Average births per million people per day



Data: US Census Bureau.

Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
  month_fct = factor(month,
    levels = rev(c(1:12)),
    labels = rev(c("Jan", "Feb", "Mar", "Apr",
      "May", "Jun", "Jul", "Aug",
      "Sep", "Oct", "Nov", "Dec")),
    ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
    color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B") +
  labs(x = NULL, y = NULL,
    title = "Monthly Birth Rates",
    fill = "Average births per million people per day",
    caption = "Data: US Census Bureau.") +
  coord_fixed()
```

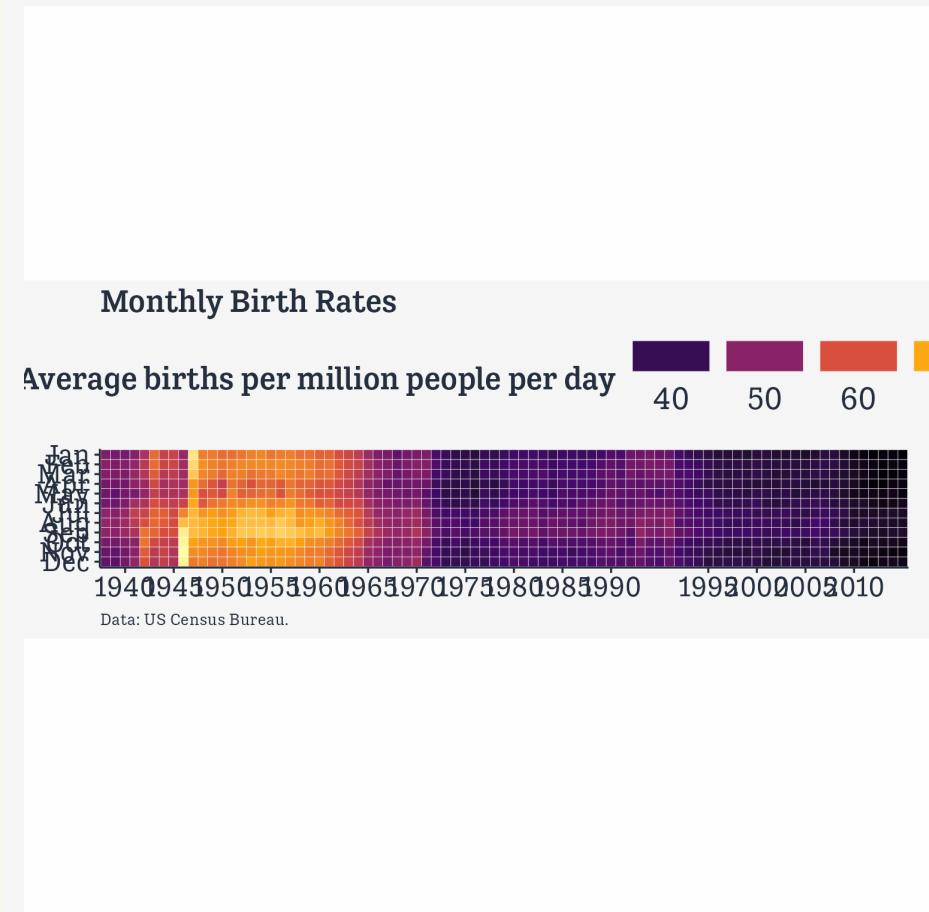
Monthly Birth Rates

Average births per million people per day



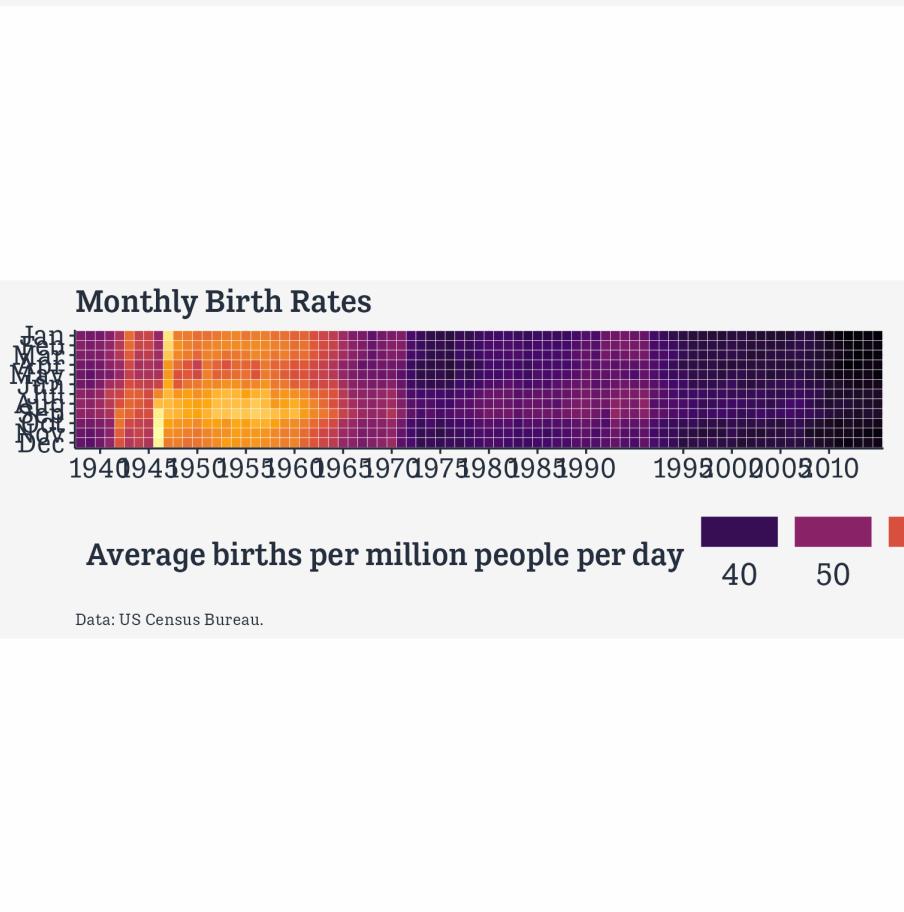
Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
  month_fct = factor(month,
    levels = rev(c(1:12)),
    labels = rev(c("Jan", "Feb", "Mar", "Apr",
      "May", "Jun", "Jul", "Aug",
      "Sep", "Oct", "Nov", "Dec")),
    ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
    color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B") +
  labs(x = NULL, y = NULL,
    title = "Monthly Birth Rates",
    fill = "Average births per million people per day",
    caption = "Data: US Census Bureau.") +
  coord_fixed() +
  guides(fill = guide_legend(keywidth = 3,
    label.position = "bottom"))
```



Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
  month_fct = factor(month,
    levels = rev(c(1:12)),
    labels = rev(c("Jan", "Feb", "Mar", "Apr",
      "May", "Jun", "Jul", "Aug",
      "Sep", "Oct", "Nov", "Dec")),
    ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
    color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B") +
  labs(x = NULL, y = NULL,
    title = "Monthly Birth Rates",
    fill = "Average births per million people per day",
    caption = "Data: US Census Bureau.") +
  coord_fixed() +
  guides(fill = guide_legend(keywidth = 3,
    label.position = "bottom")) +
  theme(legend.position = "bottom",
    legend.justification = "left")
```

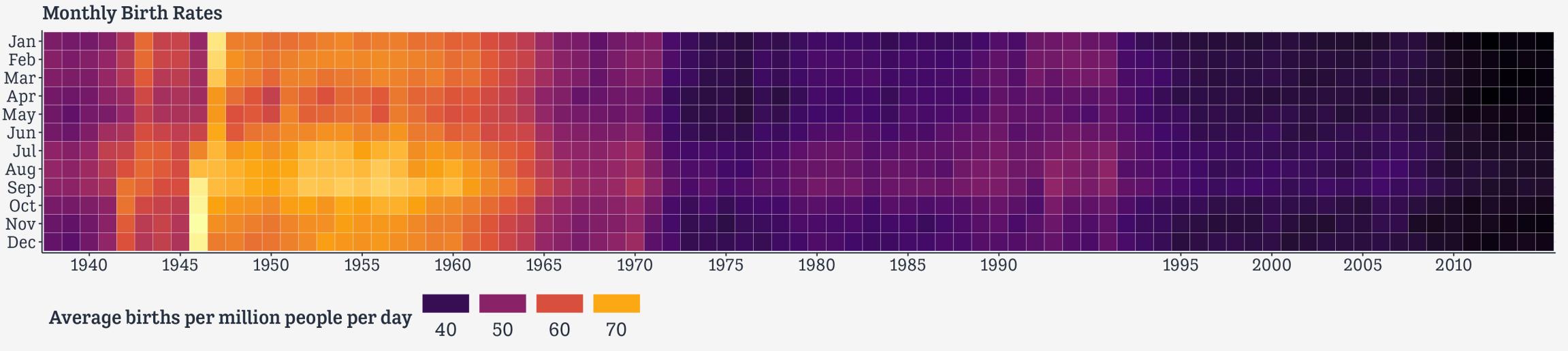


Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
           levels = unique(year),
           ordered = TRUE),
  month_fct = factor(month,
                      levels = rev(c(1:12)),
                      labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                    "May", "Jun", "Jul", "Aug",
                                    "Sep", "Oct", "Nov", "Dec")),
                      ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
            color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B") +
  labs(x = NULL, y = NULL,
       title = "Monthly Birth Rates",
       fill = "Average births per million people per day",
       caption = "Data: US Census Bureau.") +
  coord_fixed() +
  guides(fill = guide_legend(keywidth = 3,
                             label.position = "bottom")) +
  theme(legend.position = "bottom",
        legend.justification = "left") ->
p_tileboom
```

Tiled Heatmap

```
okboomer |>
  mutate(year_fct =
    factor(year,
      levels = unique(year),
      ordered = TRUE),
  month_fct = factor(month,
    levels = rev(c(1:12)),
    labels = rev(c("Jan", "Feb", "Mar", "Apr",
      "May", "Jun", "Jul", "Aug",
      "Sep", "Oct", "Nov", "Dec")),
    ordered = TRUE)) |>
  select(year, month, year_fct, month_fct, everything()) |>
filter(country == "United States") |>
  ggplot(aes(x = year_fct, y = month_fct)) +
  geom_tile(mapping = aes(fill = births_pct_day),
    color = "white") +
  scale_x_discrete(breaks = seq(1940, 2010, 5)) +
  scale_fill_viridis_c(option = "B") +
  labs(x = NULL, y = NULL,
    title = "Monthly Birth Rates",
    fill = "Average births per million people per day",
    caption = "Data: US Census Bureau.") +
  coord_fixed() +
  guides(fill = guide_legend(keywidth = 3,
    label.position = "bottom")) +
  theme(legend.position = "bottom",
    legend.justification = "left") ->
p_tileboom
```



The Baby Boom as a tiled temporal heatmap

Beeswarms and bespoke labels

The cavax package

```
# remotes::install_github("kjhealy/cavax")
library(cavax)

cavax

## # A tibble: 7,032 × 13
##   code county name  type district city enrollment pbe_pct exempt med_exempt
##   <dbl> <chr>  <chr> <chr>   <chr>    <dbl>    <dbl>    <dbl>    <dbl>
## 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...     109      13  12.8       0
## 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...     115       1  0.87  0.87
## 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...      40        0  0         0
## 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...      52       10  9.62       0
## 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...     128       2  1.56       0
## 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...      70        1  1.43       0
## 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...     100       3  3         0
## 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...      70        1  1.43       0
## 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      95        1  1.05  1.05
## 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      50        2  2         0
## # ... with 7,022 more rows, and 3 more variables: rel_exempt <dbl>, mwc <fct>,
## #   kind <fct>
```

Here we will do some custom manual labeling.

Aux Info Panel

```
library(ggbeeswarm)
```

Aux Info Panel

```
library(ggbeeswarm)
make_comma <- scales::label_comma()
```

Aux Info Panel

```
library(ggbeeswarm)
make_comma <- scales::label_comma()

cavax
```

```
## # A tibble: 7,032 × 13
##   code county name type district city enrollment pbe_pct
##   <dbl> <chr>  <chr> <chr> <chr>   <chr>     <dbl>    <dbl>
## 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...    109     13
## 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...    115      1
## 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...     40      0
## 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...     52     10
## 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...    128      2
## 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...     70      1
## 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...    100      3
## 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...     70      1
## 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...     95      1
## 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...     50      2
## # ... with 7,022 more rows, and 3 more variables: rel_exempt <dbl>
## #   kind <fct>
```

Aux Info Panel

```
library(ggbeeswarm)
make_comma <- scales::label_comma()

cavax |>
  group_by(mwc)
```

```
## # A tibble: 7,032 × 13
## # Groups:   mwc [11]
##       code county name  type district city enrollment pbe_pct
##       <dbl> <chr>  <chr> <chr>  <chr>   <chr>     <dbl>    <dbl>
## 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...     109     13
## 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...     115      1
## 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...      40      0
## 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...      52     10
## 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...     128      2
## 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...      70      1
## 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...     100      3
## 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...      70      1
## 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      95      1
## 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      50      2
## # ... with 7,022 more rows, and 3 more variables: rel_exempt <dbl>
## #   kind <fct>
```

Aux Info Panel

```
library(ggbeeswarm)
make_comma <- scales::label_comma()

cavax |>
  group_by(mwc) |>
  summarize(n_schools=n(),
            n_students = sum(enrollment, na.rm=TRUE))
```

```
## # A tibble: 11 × 3
##   mwc
##   <fct>
##   1 Public
##   2 Charter
##   3 Private Non-Specific
##   4 Private Christian
##   5 Private Catholic
##   6 Private Montessori
##   7 Private Waldorf
##   8 Charter Montessori
##   9 Public Montessori
##  10 Private Christian Montessori
##  11 Private Jewish/Islamic
```

	n_schools	n_students
	<int>	<dbl>
1 Public	5314	472802
2 Charter	314	19863
3 Private Non-Specific	591	16697
4 Private Christian	336	8836
5 Private Catholic	334	9869
6 Private Montessori	99	2112
7 Private Waldorf	16	513
8 Charter Montessori	5	227
9 Public Montessori	11	706
10 Private Christian Montessori	4	78
11 Private Jewish/Islamic	8	237

Aux Info Panel

```

library(ggbeeswarm)
make_comma <- scales::label_comma()

cavax |>
  group_by(mwc) |>
  summarize(n_schools=n(),
            n_students = sum(enrollment, na.rm=TRUE)) |>
  drop_na()

```

Aux Info Panel

```
library(ggbeeswarm)
make_comma <- scales::label_comma()

cavax |>
  group_by(mwc) |>
  summarize(n_schools=n(),
            n_students = sum(enrollment, na.rm=TRUE)) |>
  drop_na() |>
  mutate(n_schools_fmt = make_comma(n_schools),
        n_students_fmt = make_comma(n_students),
        info_schools = paste(n_schools_fmt, "Schools Enrollin",
        info_students = paste(n_students_fmt, "Kindergartener"))

## # A tibble: 11 × 7
##       mwc          n_schools n_students n_schools_fmt n_students
##   <fct>      <int>     <dbl> <chr>           <chr>
## 1 Public       5314    472802 5,314    472,802
## 2 Charter      314     19863 314     19,863
## 3 Private Non-S... 591    16697 591     16,697
## 4 Private Chris... 336     8836 336     8,836
## 5 Private Catho... 334    9869 334     9,869
## 6 Private Monte... 99     2112 99      2,112
## 7 Private Waldo... 16     513  16      513
## 8 Charter Monte... 5      227  5       227
## 9 Public Montes... 11     706  11      706
## 10 Private Chris... 4      78   4       78
## 11 Private Jewis... 8      237  8       237
## # ... with 1 more variable: info_students <chr>
```

Aux Info Panel

```
library(ggbeeswarm)
make_comma <- scales::label_comma()

cavax |>
  group_by(mwc) |>
  summarize(n_schools=n(),
            n_students = sum(enrollment, na.rm=TRUE)) |>
  drop_na() |>
  mutate(n_schools_fmt = make_comma(n_schools),
         n_students_fmt = make_comma(n_students),
         info_schools = paste(n_schools_fmt, "Schools Enrollin",
                               "in", sep = "\n"),
         info_students = paste(n_students_fmt, "Kindergartener",
                               "and", sep = "\n"))
aux_info
```

A little kludge

```
## This is not an efficient way to do this
aux_info
## # A tibble: 11 × 7
##   mwc      n_schools n_students n_schools_fmt n_students
##   <fct>       <int>        <dbl> <chr>        <chr>
## 1 Public        5314     472802 5,314        472,802
## 2 Charter       314      19863 314        19,863
## 3 Private Non-S...    591      16697 591        16,697
## 4 Private Chris...    336      8836 336        8,836
## 5 Private Catho...    334      9869 334        9,869
## 6 Private Monte...     99      2112 99        2,112
## 7 Private Waldo...     16      513 16        513
## 8 Charter Monte...      5      227 5        227
## 9 Public Montes...     11      706 11        706
## 10 Private Chris...      4      78 4        78
## 11 Private Jewis...      8      237 8        237
## # ... with 1 more variable: info_students <chr>
```

A little kludge

```

## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students)

```

A little kludge

```

## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character))

```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc)

## # A tibble: 11 × 3
## # Groups:   mwc [11]
##       mwc
##   <chr>
## 1 Public
## 2 Charter
## 3 Private Non-Specific
## 4 Private Christian
## 5 Private Catholic
## 6 Private Montessori
## 7 Private Waldorf
## 8 Charter Montessori
## 9 Public Montessori
## 10 Private Christian Montessori
## 11 Private Jewish/Islamic
```

info_schools	info_st
<chr>	<chr>
5,314 Schools Enrolling	472,802
314 Schools Enrolling	19,863
591 Schools Enrolling	16,697
336 Schools Enrolling	8,836 K
334 Schools Enrolling	9,869 K
99 Schools Enrolling	2,112 K
16 Schools Enrolling	513 Kin
5 Schools Enrolling	227 Kin
11 Schools Enrolling	706 Kin
4 Schools Enrolling	78 Kind
8 Schools Enrolling	237 Kin

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys()                                ## # A tibble: 11 × 1
                                                ##   mwc
                                                ##   <chr>
                                                ## 1 Charter
                                                ## 2 Charter Montessori
                                                ## 3 Private Catholic
                                                ## 4 Private Christian
                                                ## 5 Private Christian Montessori
                                                ## 6 Private Jewish/Islamic
                                                ## 7 Private Montessori
                                                ## 8 Private Non-Specific
                                                ## 9 Private Waldorf
                                               ## 10 Public
                                              ## 11 Public Montessori
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull()
```

```
## [1] "Charter"           "Charter Montessori"
## [3] "Private Catholic" "Private Christian"
## [5] "Private Christian Montessori" "Private Jewish/Islamic"
## [7] "Private Montessori"      "Private Non-Specific"
## [9] "Private Waldorf"        "Public"
## [11] "Public Montessori"
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character()

## [1] "Charter"                 "Charter Montessori"
## [3] "Private Catholic"        "Private Christian"
## [5] "Private Christian Montessori" "Private Jewish/Islamic"
## [7] "Private Montessori"        "Private Non-Specific"
## [9] "Private Waldorf"          "Public"
## [11] "Public Montessori"
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info
```

```
## # A tibble: 11 × 7
##   mwc             n_schools n_students n_schools_fmt n_students
##   <fct>           <int>      <dbl> <chr>        <chr>
## 1 Public            5314    472802 5,314       472,802
## 2 Charter           314     19863 314        19,863
## 3 Private Non-S...    591     16697 591        16,697
## 4 Private Chris...   336     8836 336        8,836
## 5 Private Catho...   334     9869 334        9,869
## 6 Private Monte...   99      2112 99         2,112
## 7 Private Waldo...   16      513  16         513
## 8 Charter Monte...   5       227  5          227
## 9 Public Montes...   11      706  11         706
## 10 Private Chris...  4       78   4          78
## 11 Private Jewis...  8       237  8          237
## # ... with 1 more variable: info_students <chr>
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students)
```

```
## # A tibble: 11 × 3
##   mwc                <fct>
##   1 Public             <chr>
##   2 Charter            <chr>
##   3 Private Non-Specific <chr>
##   4 Private Christian   <chr>
##   5 Private Catholic    <chr>
##   6 Private Montessori <chr>
##   7 Private Waldorf     <chr>
##   8 Charter Montessori <chr>
##   9 Public Montessori   <chr>
##  10 Private Christian Montessori <chr>
##  11 Private Jewish/Islamic <chr>
```

info_schools	info_st
<chr>	<chr>
5,314 Schools Enrolling	472,802
314 Schools Enrolling	19,863
591 Schools Enrolling	16,697
336 Schools Enrolling	8,836 K
334 Schools Enrolling	9,869 K
99 Schools Enrolling	2,112 K
16 Schools Enrolling	513 Kin
5 Schools Enrolling	227 Kin
11 Schools Enrolling	706 Kin
4 Schools Enrolling	78 Kind
8 Schools Enrolling	237 Kin

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character))
```

```
## # A tibble: 11 × 3
##   mwc          info_schools    info_st
##   <chr>        <chr>        <chr>
## 1 Public       5,314 Schools Enrolling 472,802
## 2 Charter      314 Schools Enrolling 19,863
## 3 Private Non-Specific 591 Schools Enrolling 16,697
## 4 Private Christian 336 Schools Enrolling 8,836 K
## 5 Private Catholic 334 Schools Enrolling 9,869 K
## 6 Private Montessori 99 Schools Enrolling 2,112 K
## 7 Private Waldorf 16 Schools Enrolling 513 Kir
## 8 Charter Montessori 5 Schools Enrolling 227 Kir
## 9 Public Montessori 11 Schools Enrolling 706 Kir
## 10 Private Christian Montessori 4 Schools Enrolling 78 Kind
## 11 Private Jewish/Islamic 8 Schools Enrolling 237 Kir
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_split(mwc)

## <list_of<
##   tbl_df<
##     mwc           : character
##     info_schools : character
##     info_students: character
##   >
## >[1]>
## [[1]]
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Charter 314 Schools Enrolling 19,863 Kindergarteners
##
## [[2]]
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Charter Montessori 5 Schools Enrolling 227 Kindergarteners
##
## [[3]]
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Private Catholic 334 Schools Enrolling 9,869 Kindergarteners
##
## [[4]]
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Private Christian 336 Schools Enrolling 8,836 Kindergarteners
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_split(mwc) |>
  set_names(keys) # There's a better way ...

## <list_of<
##   tbl_df<
##     mwc           : character
##     info_schools : character
##     info_students: character
##   >
## >[1]>
## $Charter
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Charter  314 Schools Enrolling 19,863 Kindergarteners
##
## $`Charter Montessori`
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Charter Montessori 5 Schools Enrolling 227 Kindergarteners
##
## $`Private Catholic`
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Private Catholic 334 Schools Enrolling 9,869 Kindergarteners
##
## $`Private Christian`
## # A tibble: 1 × 3
##   mwc      info_schools      info_students
##   <chr>    <chr>            <chr>
## 1 Private Christian 336 Schools Enrolling 8,836 Kindergarteners
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_split(mwc) |>
  set_names(keys) |> # There's a better way ...
  map_chr(.f = paste, sep = "", collapse = "\n")  

##                                     "Charter\n314 Schools Enrolling\n19,863 Kinderga
##                                         Charter Mo
##                                     "Charter Montessori\n5 Schools Enrolling\n227 Kinderga
##                                         Private
##                                     "Private Catholic\n334 Schools Enrolling\n9,869 Kinderga
##                                         Private C
##                                     "Private Christian\n336 Schools Enrolling\n8,836 Kinderga
##                                         Private Christian Mo
##                                     "Private Christian Montessori\n4 Schools Enrolling\n78 Kinderga
##                                         Private Jewish
##                                     "Private Jewish/Islamic\n8 Schools Enrolling\n237 Kinderga
##                                         Private Mo
##                                     "Private Montessori\n99 Schools Enrolling\n2,112 Kinderga
##                                         Private Non-
##                                     "Private Non-Specific\n591 Schools Enrolling\n16,697 Kinderga
##                                         Private
##                                     "Private Waldorf\n16 Schools Enrolling\n513 Kinderga
##                                         Public Mo
##                                     "Public\n5,314 Schools Enrolling\n472,802 Kinderga
##                                         Public Mo
##                                     "Public Montessori\n11 Schools Enrolling\n706 Kinderga
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_split(mwc) |>
  set_names(keys) |> # There's a better way ...
  map_chr(.f = paste, sep = "", collapse = "\n") ->
  special_x_labs
```

A little kludge

```
## This is not an efficient way to do this
aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_by(mwc) |>
  group_keys() |>
  pull() |>
  as.character() ->
  keys

aux_info |>
  select(mwc, info_schools, info_students) |>
  mutate(across(everything(), as.character)) |>
  group_split(mwc) |>
  set_names(keys) |> # There's a better way ...
  map_chr(.f = paste, sep = "", collapse = "\n") ->
  special_x_labs
```


At last, the Beeplot

```
cavax
## # A tibble: 7,032 × 13
##   code county name type district city enrollment pbe_pct
##   <dbl> <chr>  <chr> <chr>  <chr>   <chr>     <dbl>    <dbl>
## 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...     109     13
## 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...     115      1
## 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...      40      0
## 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...      52     10
## 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...     128      2
## 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...      70      1
## 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...     100      3
## 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...      70      1
## 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      95      1
## 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      50      2
## # ... with 7,022 more rows, and 3 more variables: rel_exempt <dbl>
## #   kind <fct>
```

At last, the Beeplot

```
cavax |>
  filter(mwc %nin% c("Private Christian Montessori",
  "Charter Montessori",
  "Private Jewish/Islamic"))
```

```
## # A tibble: 7,015 × 13
##   code county name type district city enrollment pbe_pct
##   <dbl> <chr>  <chr> <chr>  <chr>  <chr>    <dbl>   <dbl>
## 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...    109     13
## 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...    115     1
## 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...     40      0
## 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...     52     10
## 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...    128     2
## 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...     70      1
## 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...    100     3
## 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...     70      1
## 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...     95      1
## 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...     50      2
## # ... with 7,005 more rows, and 3 more variables: rel_exempt <dbl>
## #   kind <fct>
```

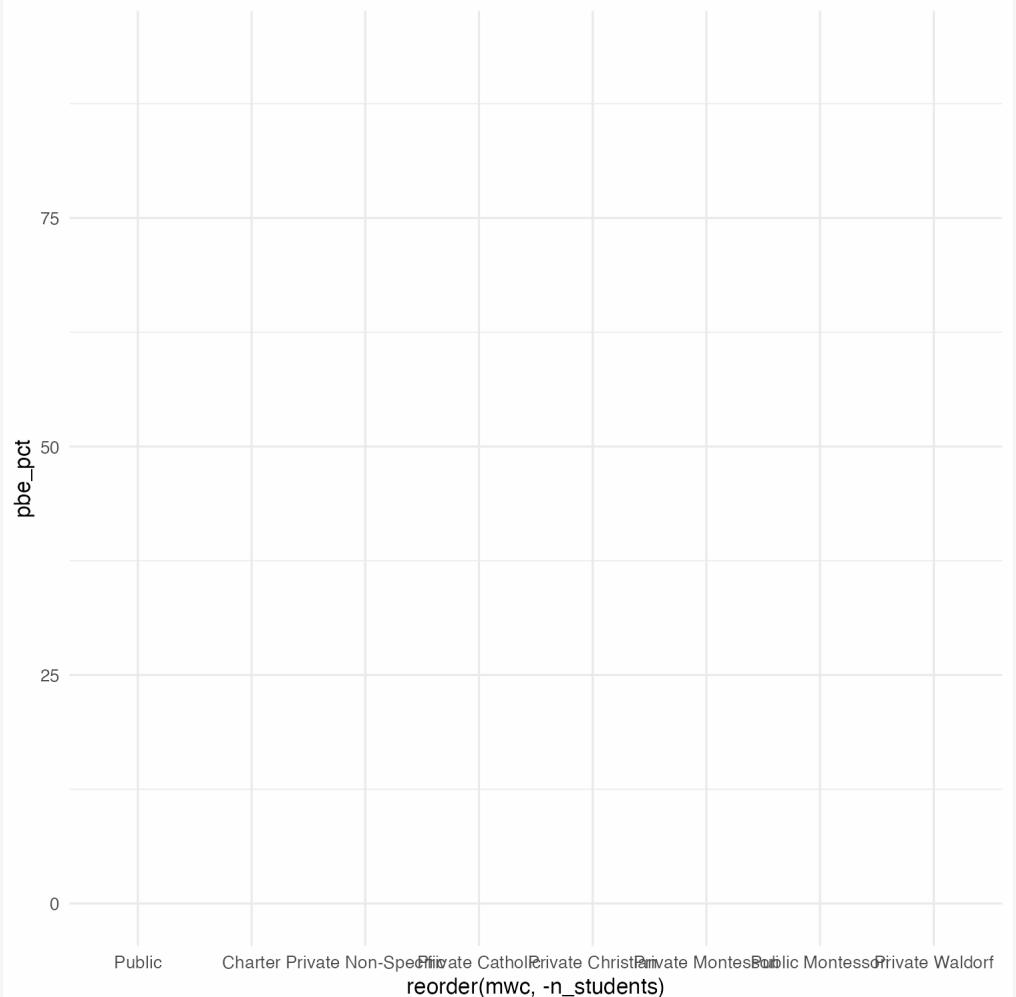
At last, the Beeplot

```
cavax |>
  filter(mwc %nin% c("Private Christian Montessori",
                     "Charter Montessori",
                     "Private Jewish/Islamic")) |>
  left_join(aux_info, by = "mwc")
```

```
## # A tibble: 7,015 × 19
##       code county name type district city enrollment pbe_pct
##       <dbl> <chr>  <chr> <chr> <chr>   <chr>      <dbl>    <dbl>
## 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...     109     13
## 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...     115     1
## 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...      40      0
## 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...      52     10
## 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...     128      2
## 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...      70      1
## 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...     100      3
## 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...      70      1
## 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      95      1
## 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...      50      2
## # ... with 7,005 more rows, and 9 more variables: rel_exempt <dbl>
## #   kind <fct>, n_schools <int>, n_students <dbl>, n_schools_fm
## #   n_students_fmt <chr>, info_schools <chr>, info_students <ch
```

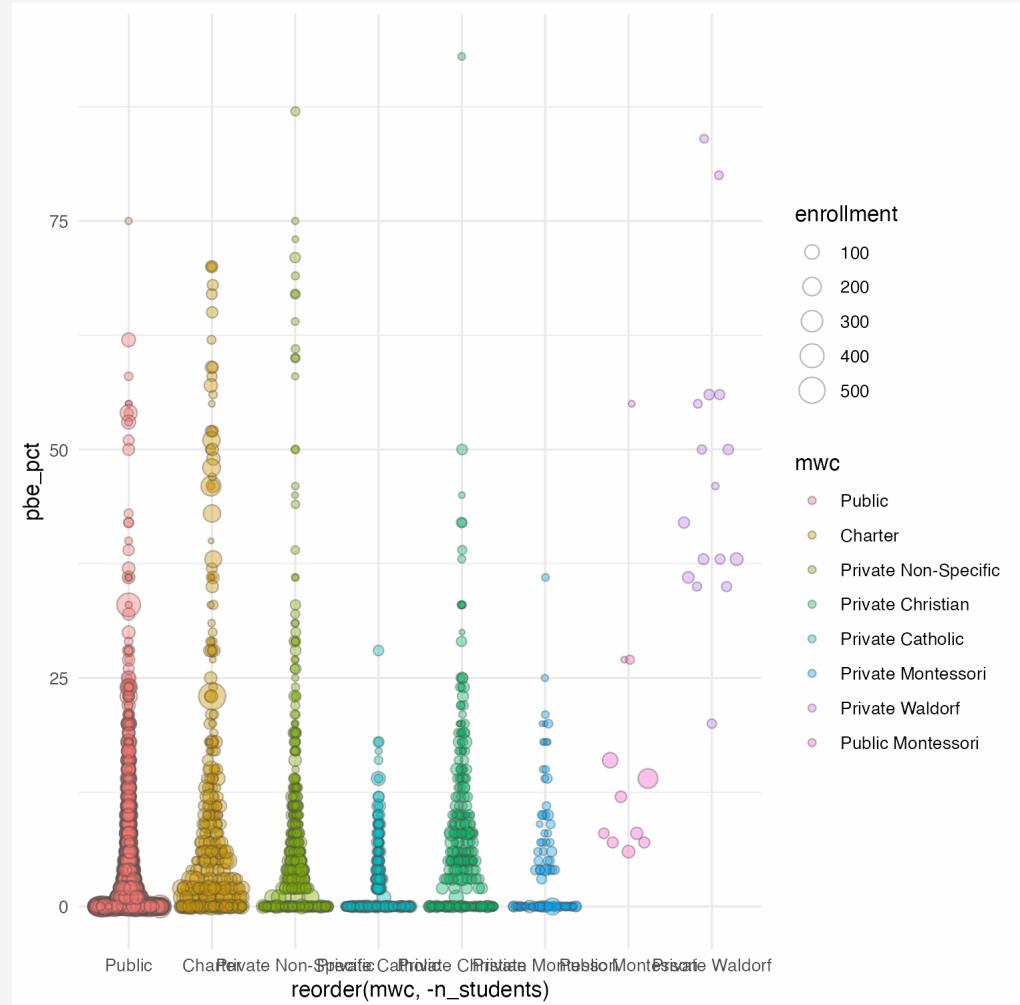
At last, the Beeplot

```
cavax |>  
  filter(mwc %nin% c("Private Christian Montessori",  
                    "Charter Montessori",  
                    "Private Jewish/Islamic")) |>  
  left_join(aux_info, by = "mwc") |>  
  ggplot(mapping =  
    aes(y = pbe_pct,  
        x = reorder(mwc, -n_students),  
        size = enrollment,  
        fill = mwc))
```



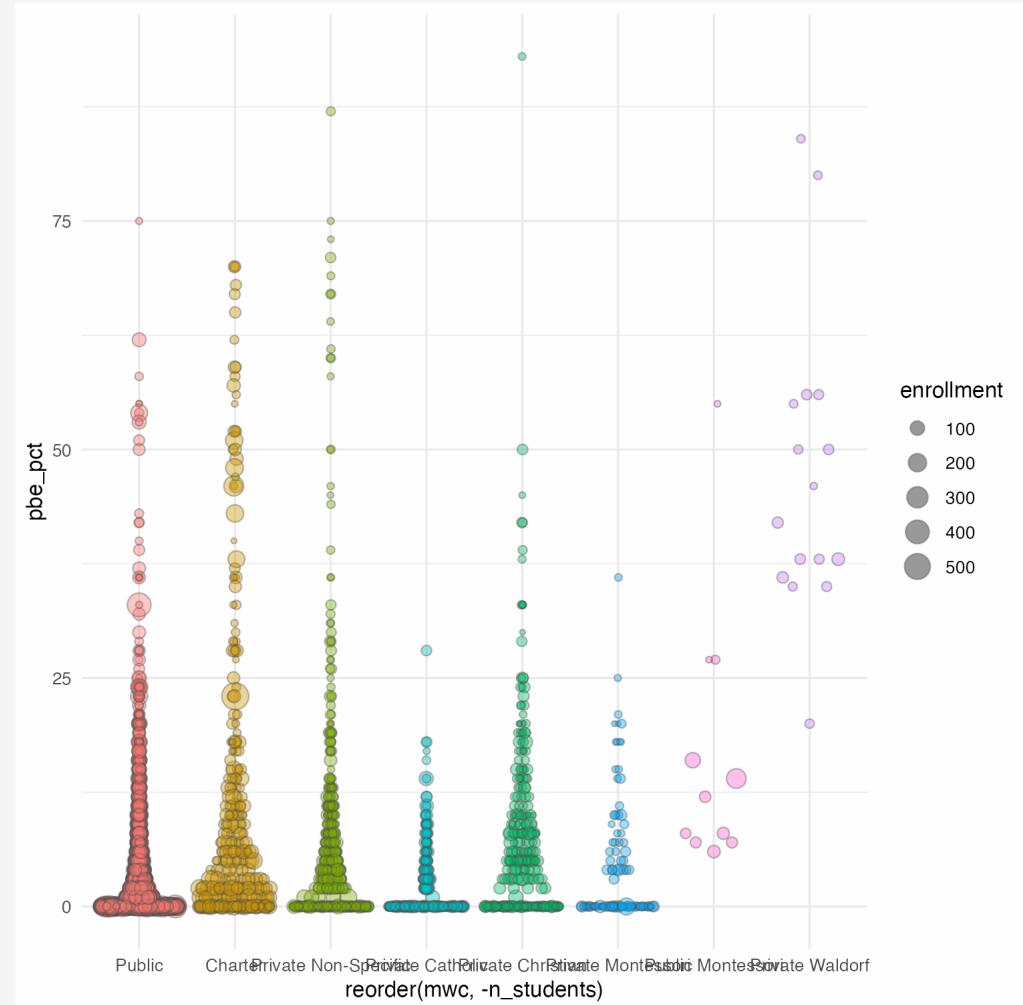
At last, the Beeplot

```
cavax |>  
filter(mwc %nin% c("Private Christian Montessori",  
                  "Charter Montessori",  
                  "Private Jewish/Islamic")) |>  
left_join(aux_info, by = "mwc") |>  
ggplot(mapping =  
       aes(y = pbe_pct,  
            x = reorder(mwc, -n_students),  
            size = enrollment,  
            fill = mwc)) +  
  geom_quasirandom(shape=21,  
                    alpha = 0.4,color="gray30",  
                    method = "quasirandom",  
                    varwidth = FALSE,  
                    bandwidth = 0.9)
```



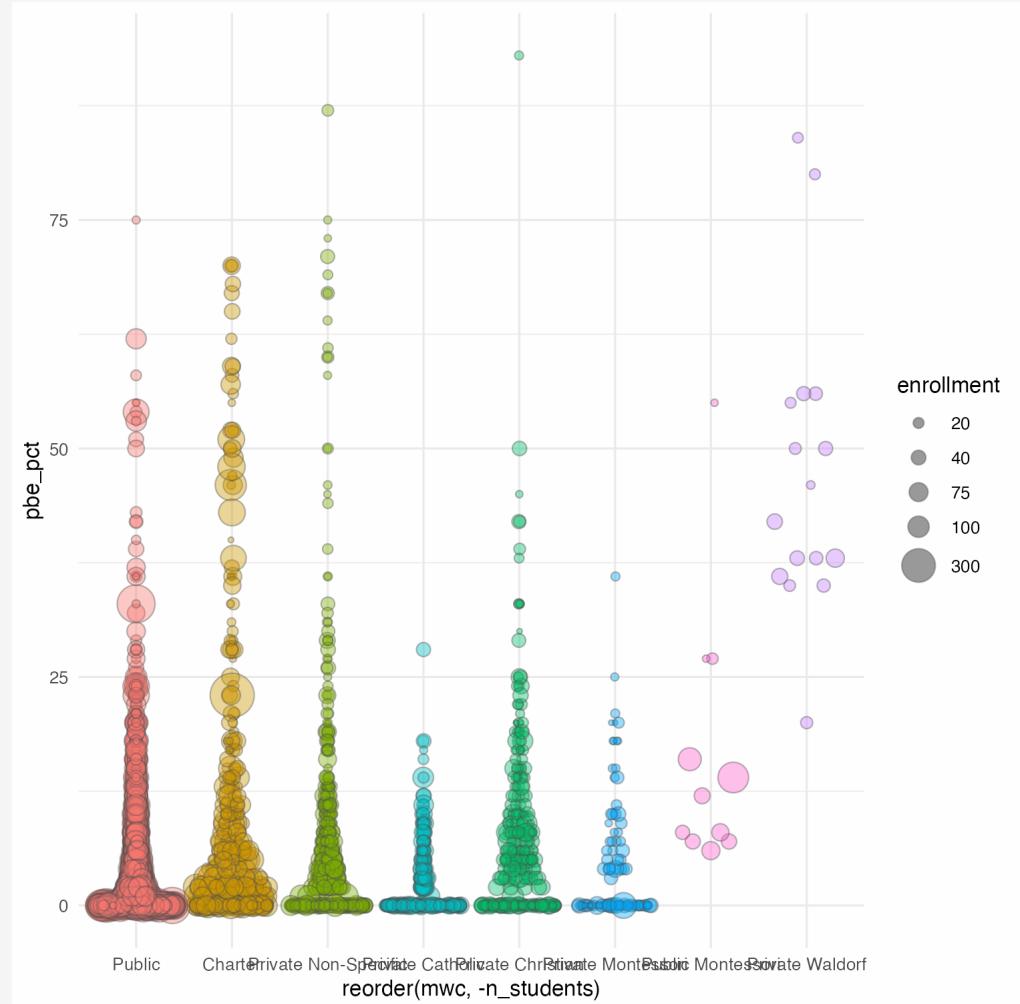
At last, the Beeplot

```
cavax |>  
  filter(mwc %nin% c("Private Christian Montessori",  
                    "Charter Montessori",  
                    "Private Jewish/Islamic")) |>  
  left_join(aux_info, by = "mwc") |>  
  ggplot(mapping =  
    aes(y = pbe_pct,  
        x = reorder(mwc, -n_students),  
        size = enrollment,  
        fill = mwc)) +  
  geom_quasirandom(shape=21,  
    alpha = 0.4,color="gray30",  
    method = "quasirandom",  
    varwidth = FALSE,  
    bandwidth = 0.9) +  
  guides(color = "none",  
    shape= "none",  
    fill= "none",  
    size = guide_legend(override.aes =  
      list(fill = "black")))
```



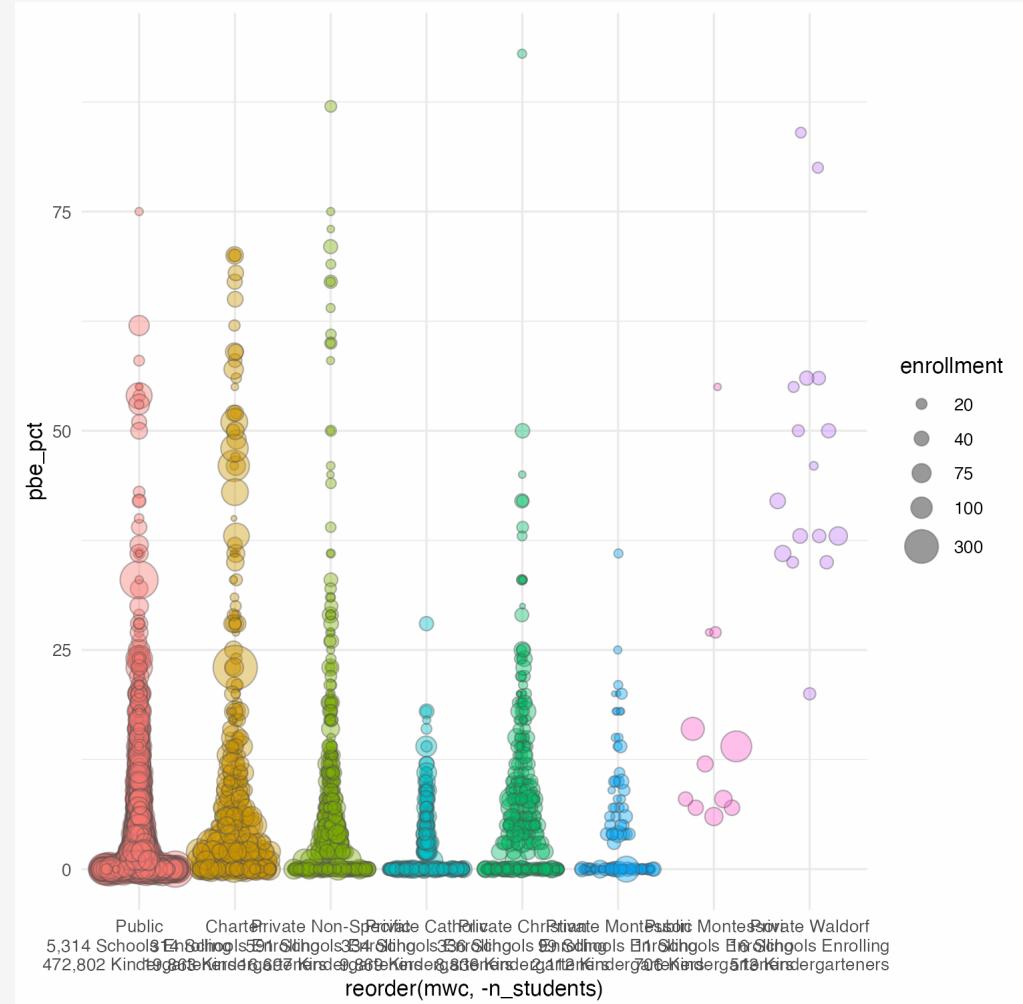
At last, the Beeplot

```
cavax |>  
  filter(mwc %nin% c("Private Christian Montessori",  
                    "Charter Montessori",  
                    "Private Jewish/Islamic")) |>  
  left_join(aux_info, by = "mwc") |>  
  ggplot(mapping =  
    aes(y = pbe_pct,  
        x = reorder(mwc, -n_students),  
        size = enrollment,  
        fill = mwc)) +  
  geom_quasirandom(shape=21,  
    alpha = 0.4,color="gray30",  
    method = "quasirandom",  
    varwidth = FALSE,  
    bandwidth = 0.9) +  
  guides(color = "none",  
    shape= "none",  
    fill= "none",  
    size = guide_legend(override.aes =  
      list(fill = "black"))) +  
  scale_size(breaks=c(20, 40, 75, 100, 300),  
             range=c(1,10))
```



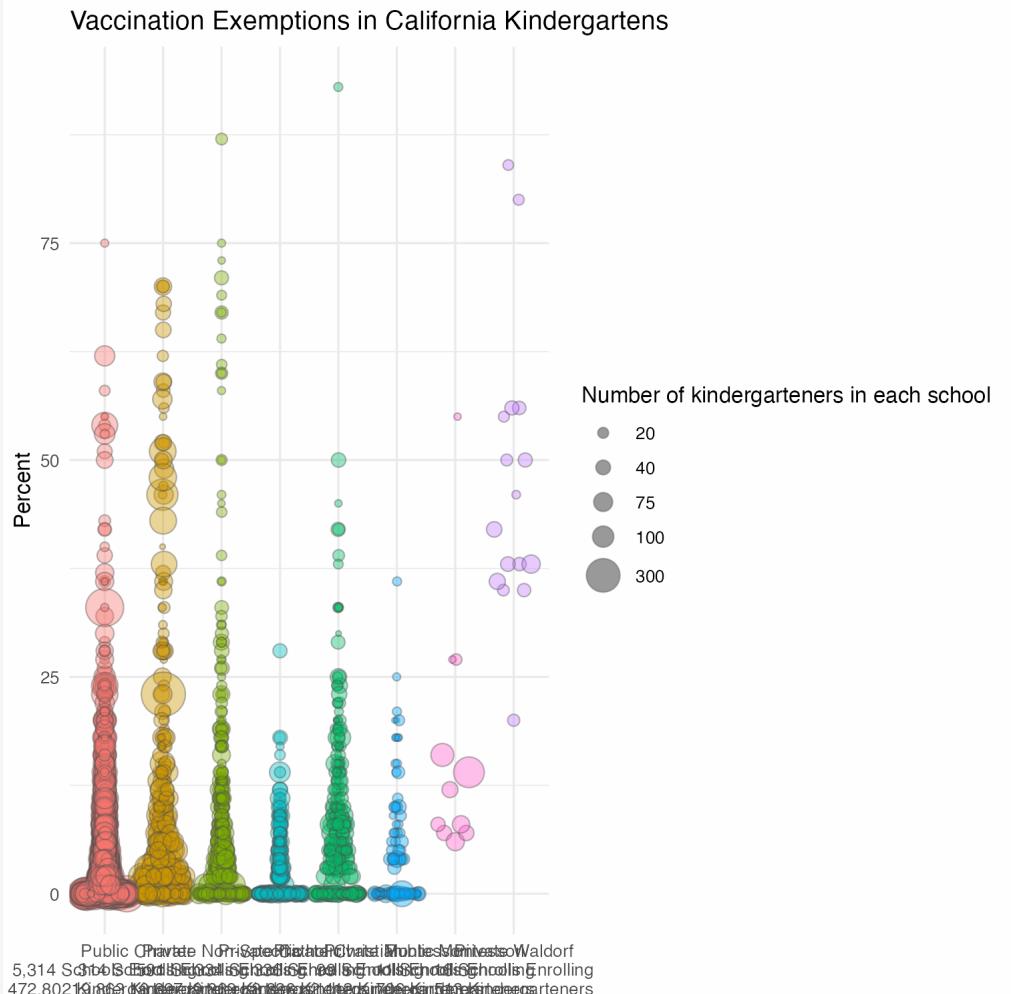
At last, the Beeplot

```
cavax |>  
  filter(mwc %nin% c("Private Christian Montessori",  
    "Charter Montessori",  
    "Private Jewish/Islamic")) |>  
  left_join(aux_info, by = "mwc") |>  
  ggplot(mapping =  
    aes(y = pbe_pct,  
        x = reorder(mwc, -n_students),  
        size = enrollment,  
        fill = mwc)) +  
  geom_quasirandom(shape=21,  
    alpha = 0.4,color="gray30",  
    method = "quasirandom",  
    varwidth = FALSE,  
    bandwidth = 0.9) +  
  guides(color = "none",  
    shape= "none",  
    fill= "none",  
    size = guide_legend(override.aes =  
      list(fill = "black"))) +  
  scale_size(breaks=c(20, 40, 75, 100, 300),  
    range=c(1,10)) +  
  scale_x_discrete(labels = special_x_labs)
```



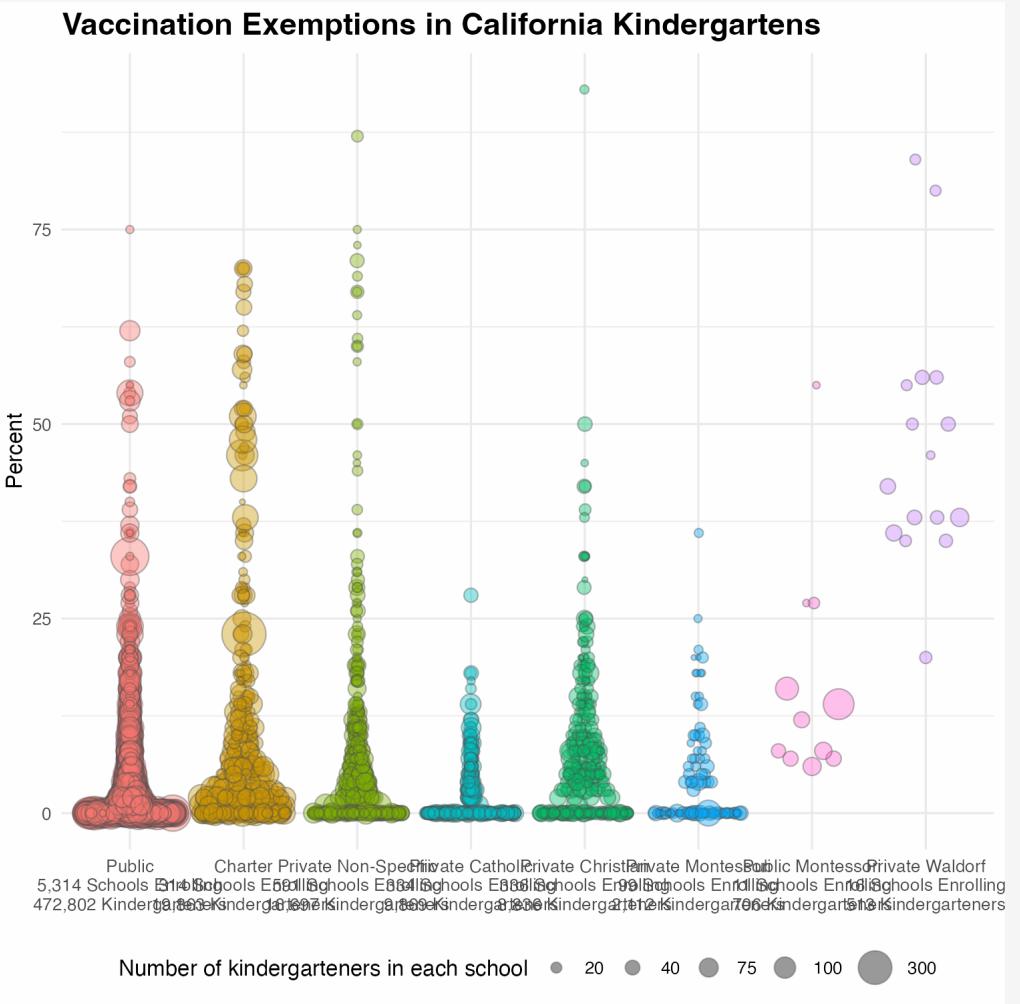
At last, the Beeplot

```
cavax |>  
  filter(mwc %nin% c("Private Christian Montessori",  
    "Charter Montessori",  
    "Private Jewish/Islamic")) |>  
  left_join(aux_info, by = "mwc") |>  
  ggplot(mapping =  
    aes(y = pbe_pct,  
        x = reorder(mwc, -n_students),  
        size = enrollment,  
        fill = mwc)) +  
  geom_quasirandom(shape=21,  
    alpha = 0.4,color="gray30",  
    method = "quasirandom",  
    varwidth = FALSE,  
    bandwidth = 0.9) +  
  guides(color = "none",  
    shape= "none",  
    fill= "none",  
    size = guide_legend(override.aes =  
      list(fill = "black"))) +  
  scale_size(breaks=c(20, 40, 75, 100, 300),  
    range=c(1,10)) +  
  scale_x_discrete(labels = special_x_labs) +  
  labs(size = "Number of kindergarteners in each school",  
    x = NULL, y = "Percent",  
    title = "Vaccination Exemptions in California Kinde
```



At last, the Beeplot

```
cavax |>  
  filter(mwc %nin% c("Private Christian Montessori",  
    "Charter Montessori",  
    "Private Jewish/Islamic")) |>  
  left_join(aux_info, by = "mwc") |>  
  ggplot(mapping =  
    aes(y = pbe_pct,  
        x = reorder(mwc, -n_students),  
        size = enrollment,  
        fill = mwc)) +  
  geom_quasirandom(shape=21,  
    alpha = 0.4,color="gray30",  
    method = "quasirandom",  
    varwidth = FALSE,  
    bandwidth = 0.9) +  
  guides(color = "none",  
    shape= "none",  
    fill= "none",  
    size = guide_legend(override.aes =  
      list(fill = "black")))+  
  scale_size(breaks=c(20, 40, 75, 100, 300),  
    range=c(1,10))+  
  scale_x_discrete(labels = special_x_labs) +  
  labs(size = "Number of kindergarteners in each school",  
    x = NULL, y = "Percent",  
    title = "Vaccination Exemptions in California Kindergarten",  
    theme(legend.position = "bottom",  
      plot.title = element_text(size = rel(1.4),  
      face = "bold")))
```



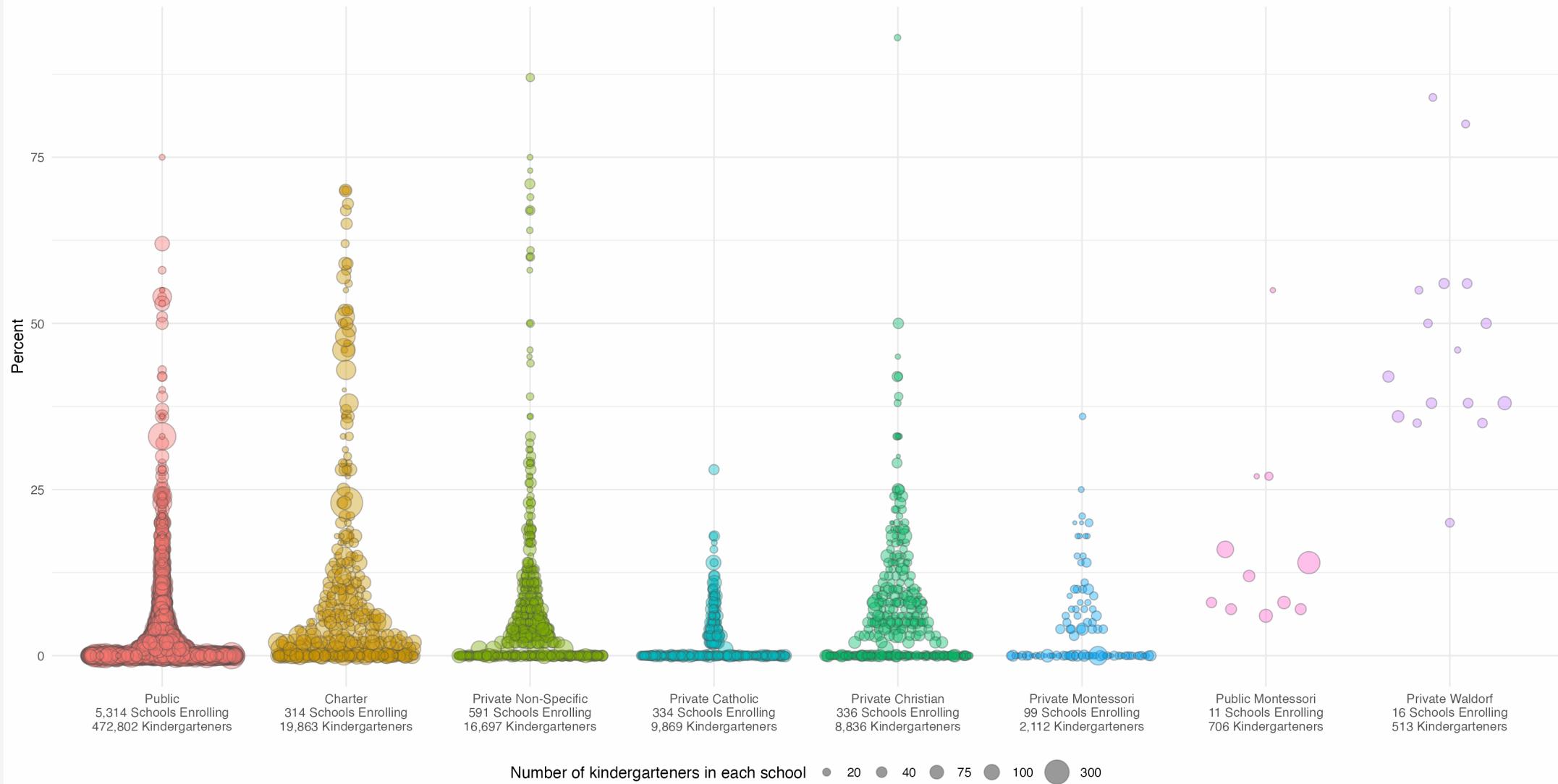
At last, the Beeplot

```
cavax |>
  filter(mwc %nin% c("Private Christian Montessori",
                     "Charter Montessori",
                     "Private Jewish/Islamic")) |>
  left_join(aux_info, by = "mwc") |>
  ggplot(mapping =
    aes(y = pbe_pct,
        x = reorder(mwc, -n_students),
        size = enrollment,
        fill = mwc)) +
  geom_quasirandom(shape=21,
    alpha = 0.4,color="gray30",
    method = "quasirandom",
    varwidth = FALSE,
    bandwidth = 0.9) +
  guides(color = "none",
    shape= "none",
    fill= "none",
    size = guide_legend(override.aes =
      list(fill = "black"))) +
  scale_size(breaks=c(20, 40, 75, 100, 300),
    range=c(1,10)) +
  scale_x_discrete(labels = special_x_labs) +
  labs(size = "Number of kindergarteners in each school",
    x = NULL, y = "Percent",
    title = "Vaccination Exemptions in California Kinde
  theme(legend.position = "bottom",
    plot.title = element_text(size = rel(1.4),
      face = "bold")) ->
  n_bee_main
```

At last, the Beeplot

```
cavax |>
  filter(mwc %nin% c("Private Christian Montessori",
                     "Charter Montessori",
                     "Private Jewish/Islamic")) |>
  left_join(aux_info, by = "mwc") |>
  ggplot(mapping =
    aes(y = pbe_pct,
        x = reorder(mwc, -n_students),
        size = enrollment,
        fill = mwc)) +
  geom_quasirandom(shape=21,
    alpha = 0.4,color="gray30",
    method = "quasirandom",
    varwidth = FALSE,
    bandwidth = 0.9) +
  guides(color = "none",
    shape= "none",
    fill= "none",
    size = guide_legend(override.aes =
      list(fill = "black")))) +
  scale_size(breaks=c(20, 40, 75, 100, 300),
             range=c(1,10)) +
  scale_x_discrete(labels = special_x_labs) +
  labs(size = "Number of kindergarteners in each school",
       x = NULL, y = "Percent",
       title = "Vaccination Exemptions in California Kinde
theme(legend.position = "bottom",
      plot.title = element_text(size = rel(1.4),
                                 face = "bold")) ->
  n_bee_main
```

Vaccination Exemptions in California Kindergartens



Vaccination Exemptions in California Kindergartens