

Data Visualization. 9 - Case Studies

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Code Horizons

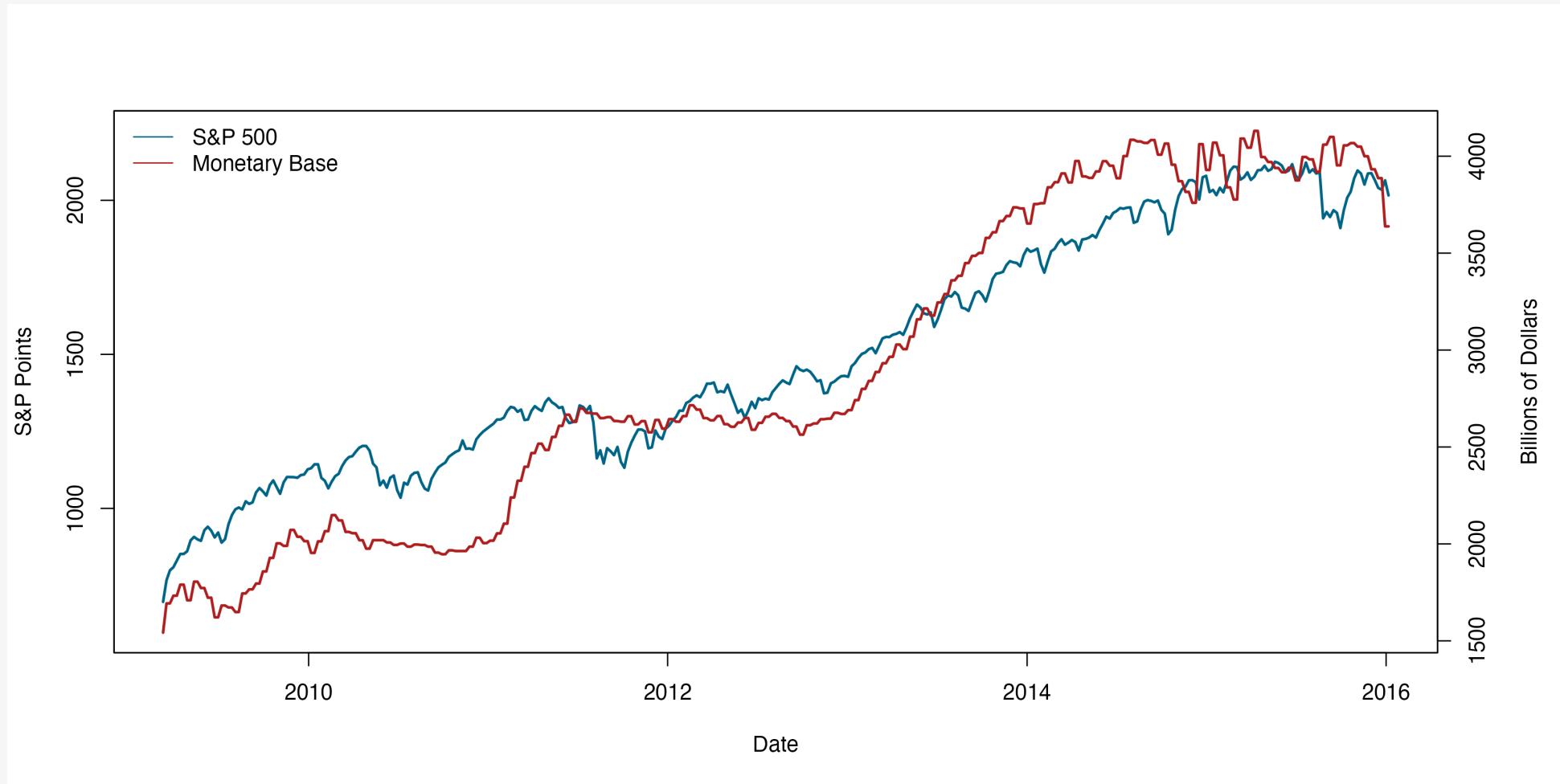
February 2025

Some Case Studies

Load our packages

```
library(here)      # manage file paths
library(tidyverse) # your friend and mine
library(cavax)     # california vaccination exemption data
library(colorspace) # luminance-balanced palettes
library(demog)      # demographic data for a graph
library(ggforce)    # useful enhancements to ggplot
library(ggrepel)    # Text and labels
library(gssr)       # the gss packaged for r
library(patchwork)  # compose multiple plots
library(scales)     # scale adjustments and enhancements
library(socviz)     # data and some useful functions
```

Two y-axes

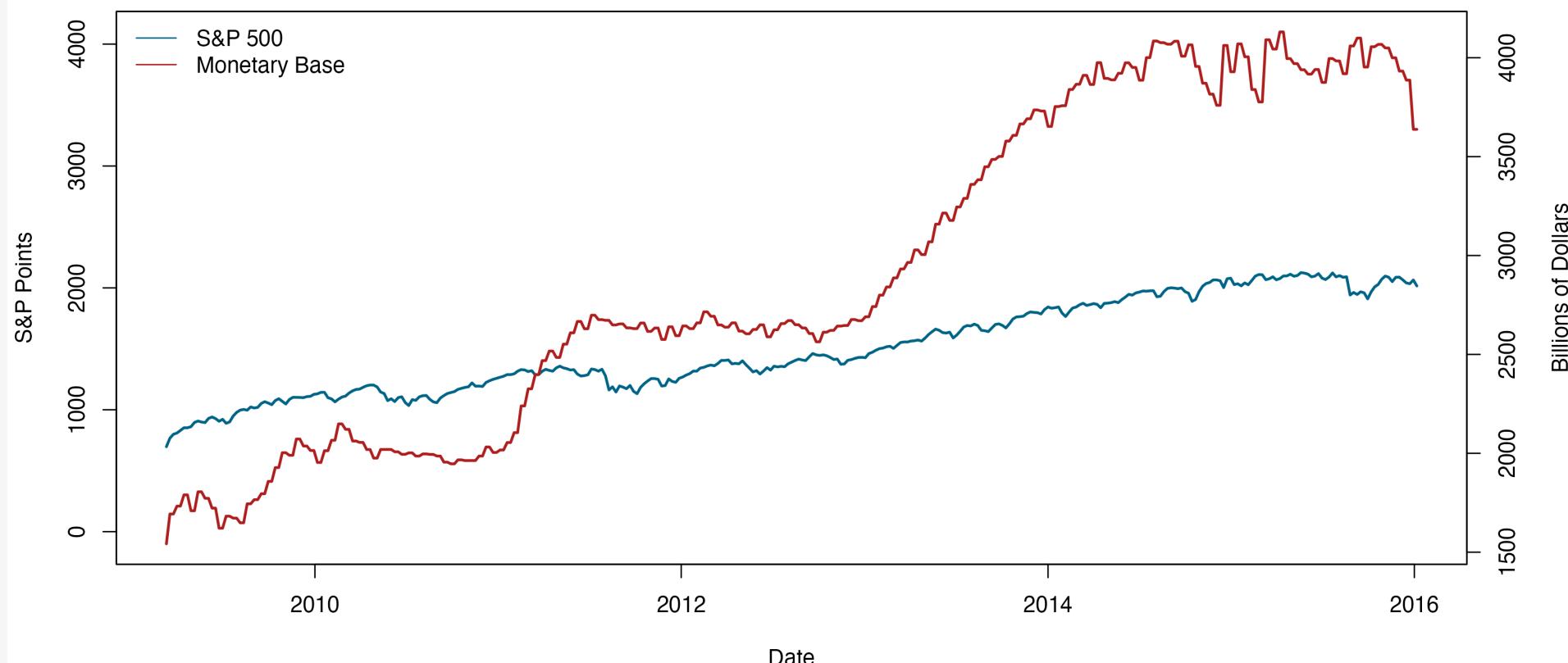


Have we found the secret key to the stock market?



No. No we have not.

Start y1 at Zero; Max both at Max y2



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.
# i 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.
# i 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.  
# i 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.  
# i 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
```

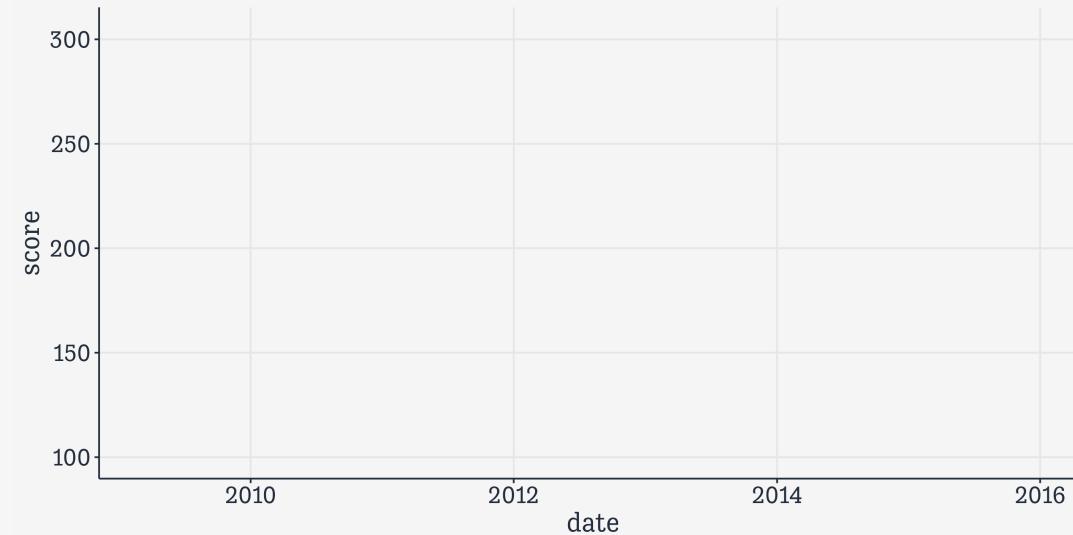
Make two plots

```
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.
# i 704 more rows
```

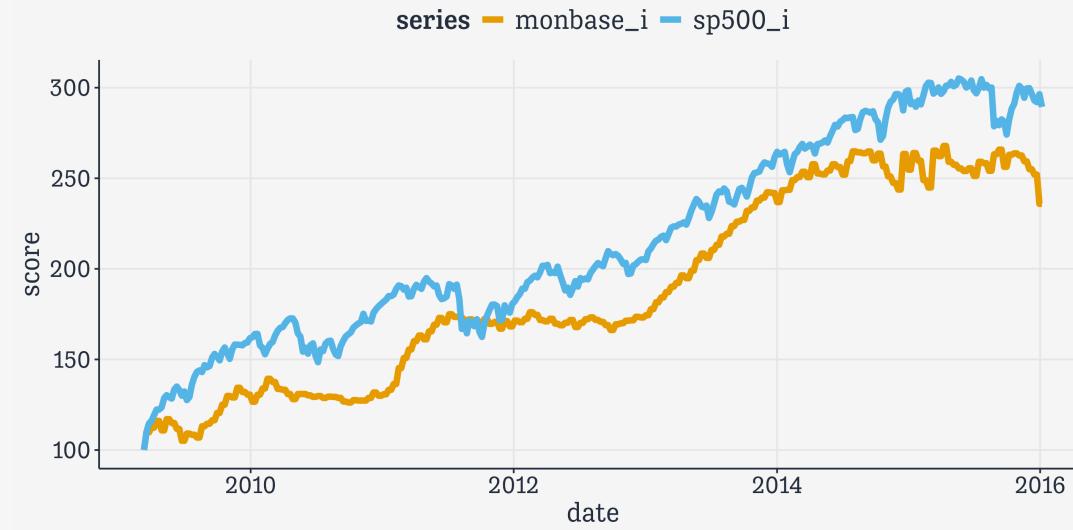
Make two plots

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



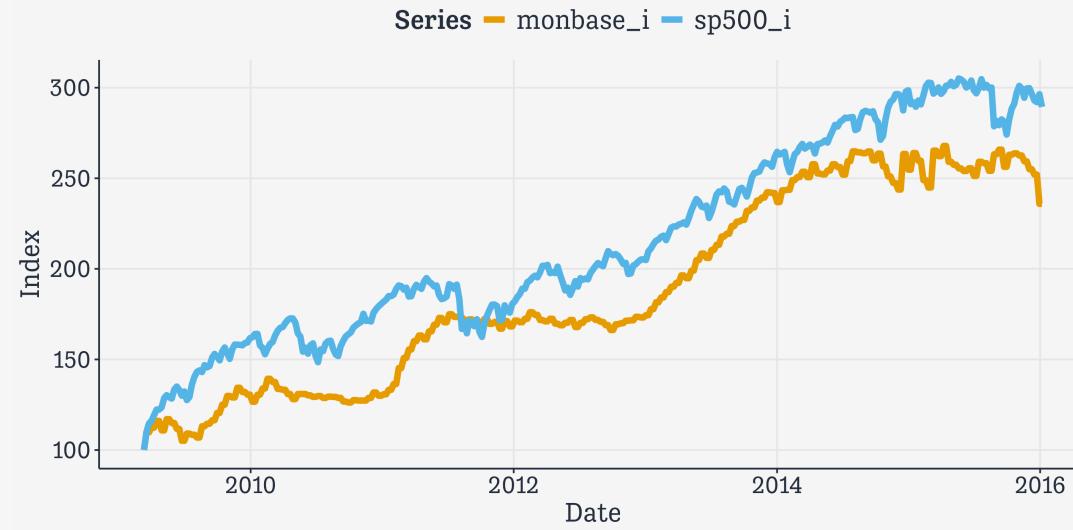
Make two plots

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



Make two plots

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



Make two plots

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

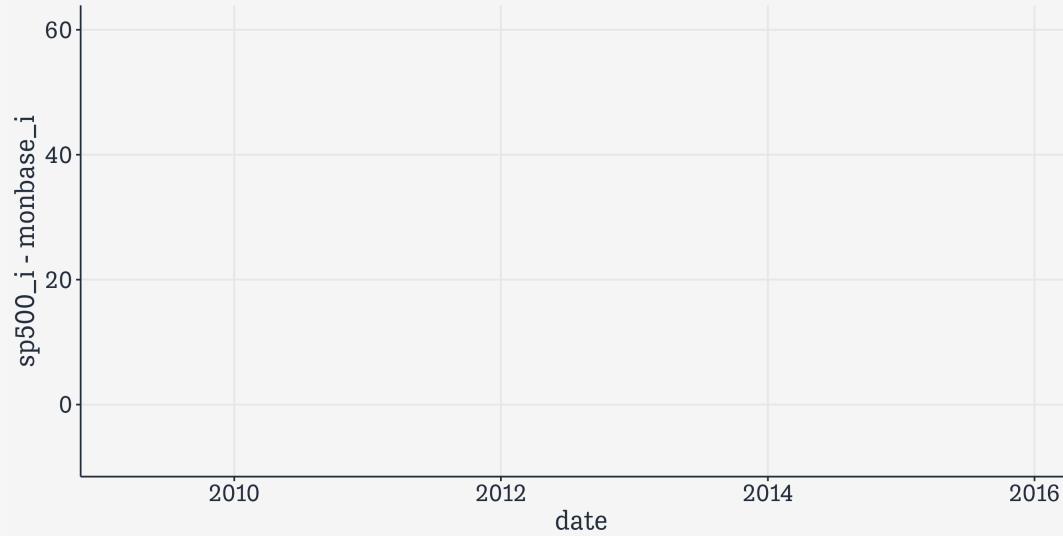
# The original df
fredts
```

```
# 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.
# i 347 more rows
```

Make two plots

```
fredts_m >
  ggplot(mapping =
    aes(x = date,
        y = score,
        color = series)) +
  geom_line(linewidth = 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(linewidth = 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(linewidth = 1.5)
```



Make two plots

```
fredts_m >
  ggplot(mapping =
    aes(x = date,
        y = score,
        color = series)) +
  geom_line(linewidth = 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(linewidth = 1.5) +
  labs(x = "Date", y = "Difference")
```



Make two plots

```
fredts_m >
  ggplot(mapping =
    aes(x = date,
        y = score,
        color = series)) +
  geom_line(linewidth = 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(linewidth = 1.5) +
  labs(x = "Date", y = "Difference") →
  p2
```

Make two plots

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

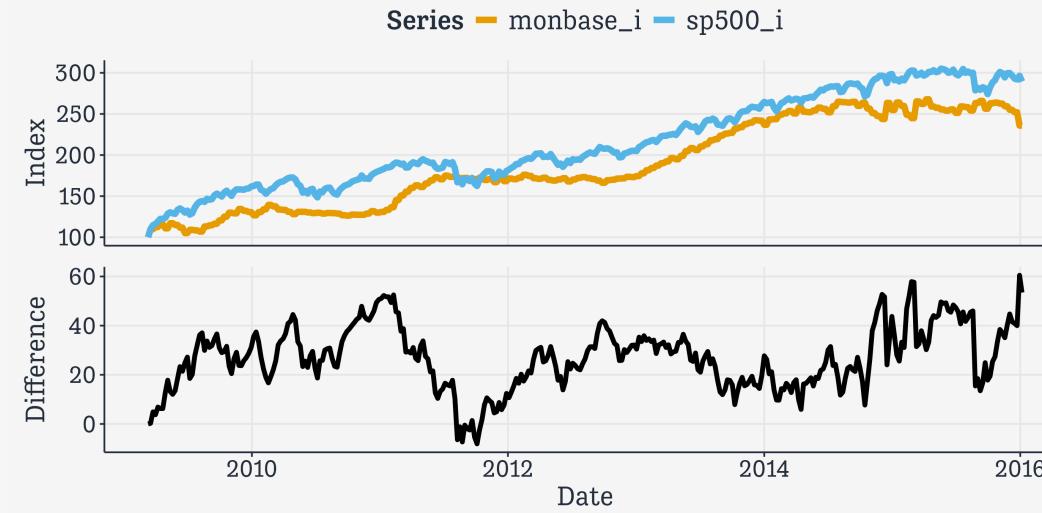
# The original df
fredts >
  ggplot(mapping =
    aes(x = date,
        y = sp500_i - monbase_i)) +
  geom_line(linewidth = 1.5) +
  labs(x = "Date", y = "Difference") →
  p2
```

Combine with patchwork

```
library(patchwork)
```

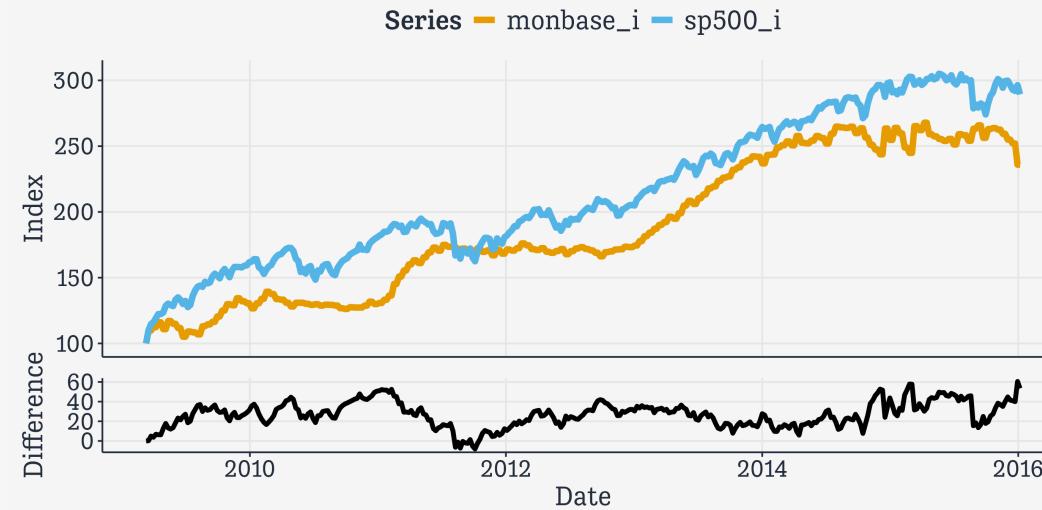
Combine with patchwork

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



Combine with patchwork

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

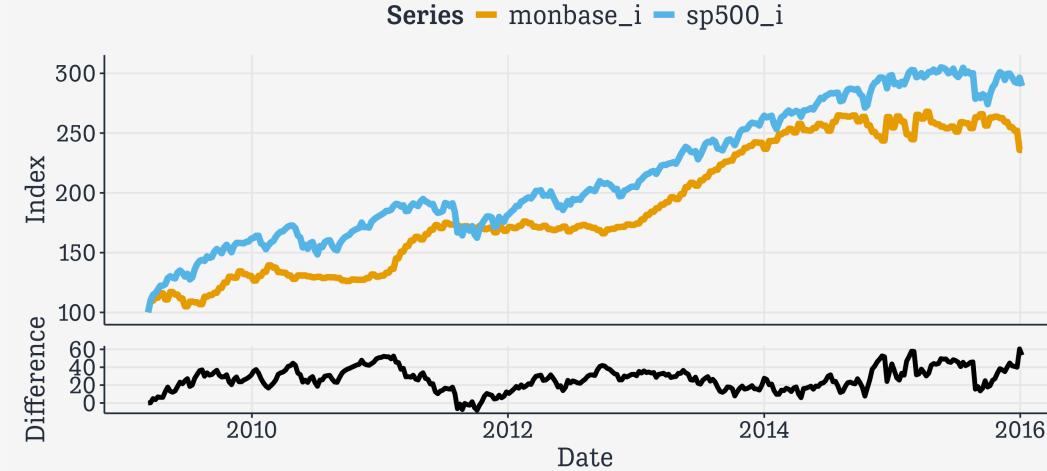


Combine with patchwork

```
library(patchwork)

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

Index and Difference

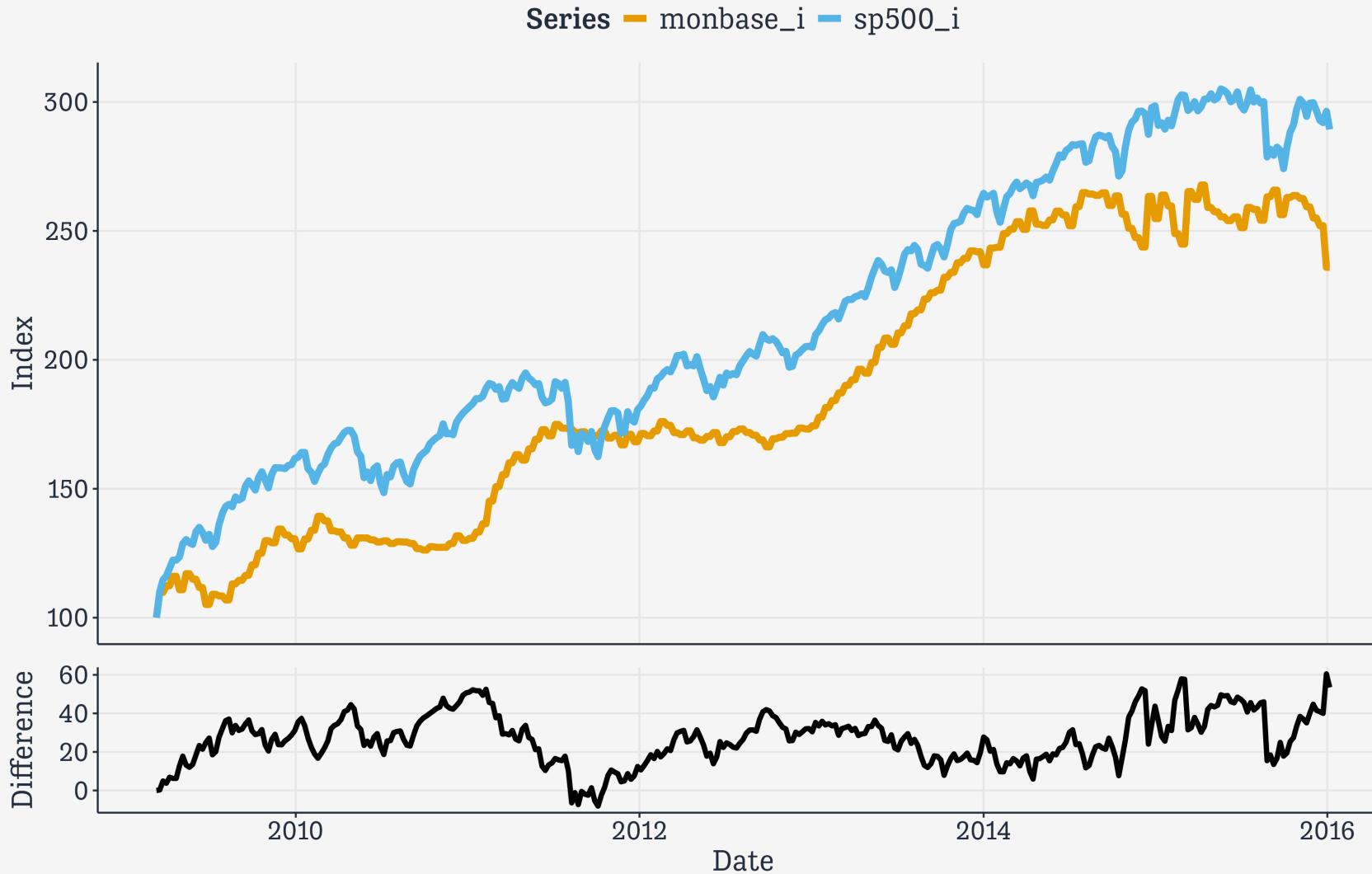


Combine with patchwork

```
library(patchwork)

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

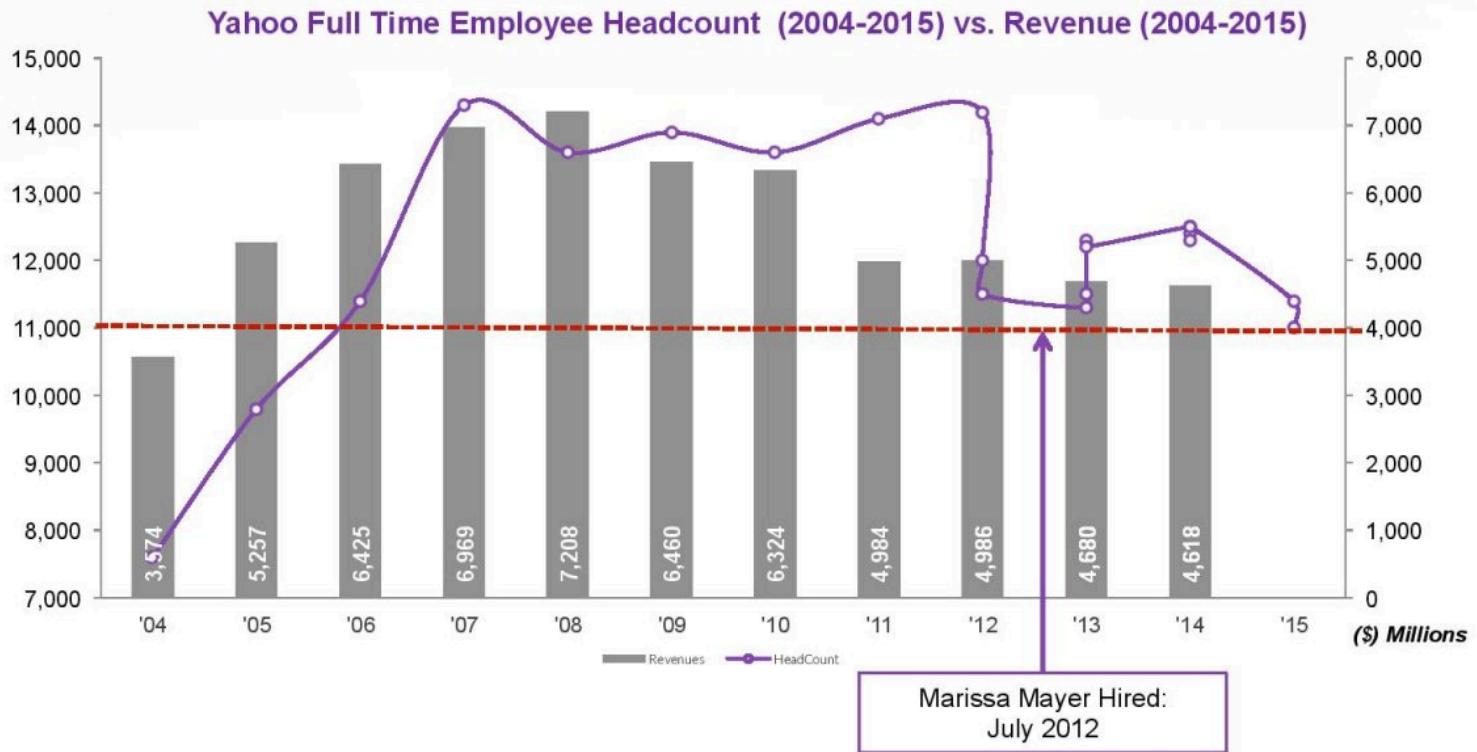
Index and Difference



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
```

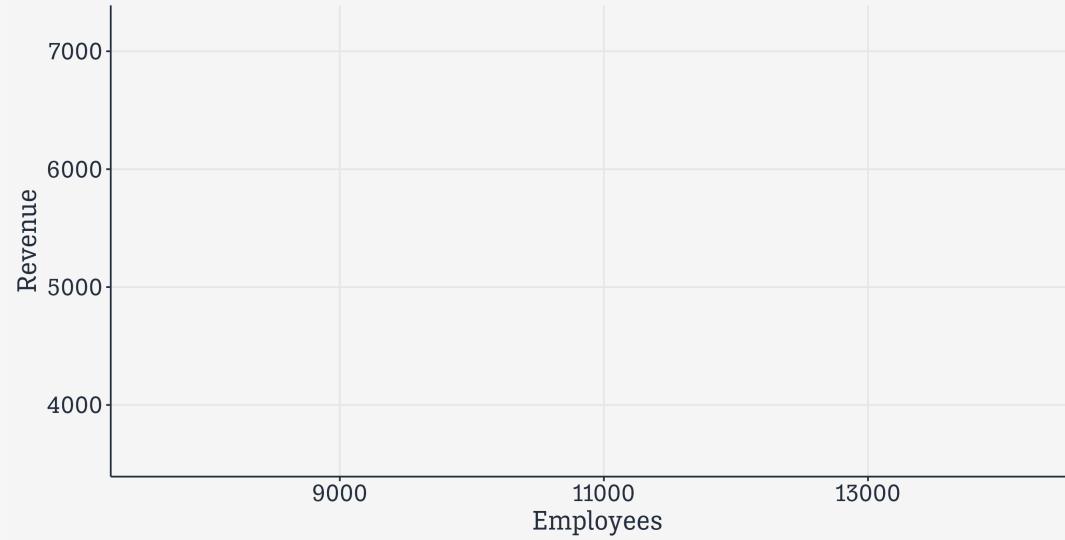
Option 1

```
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
```

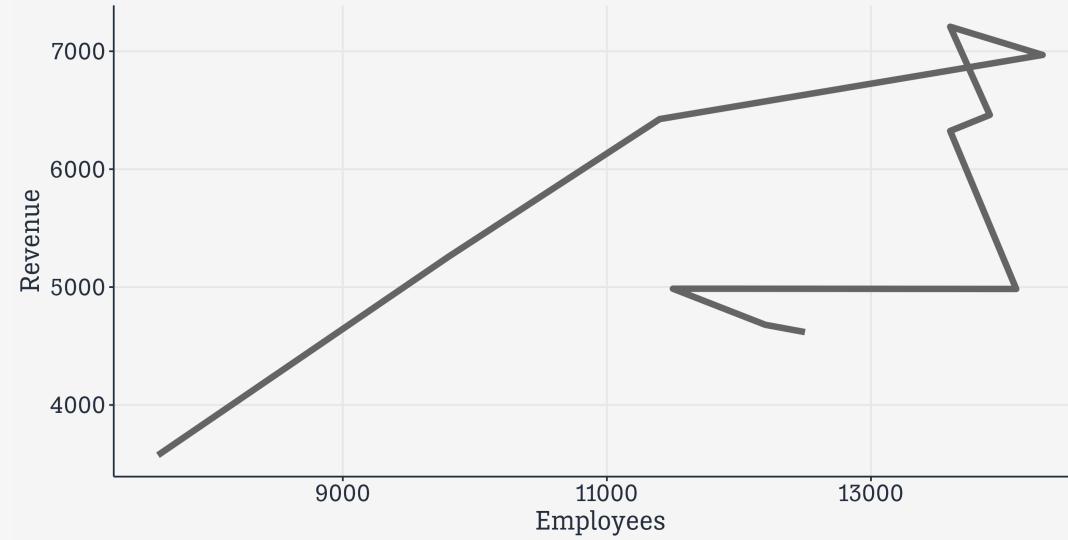
Option 1

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



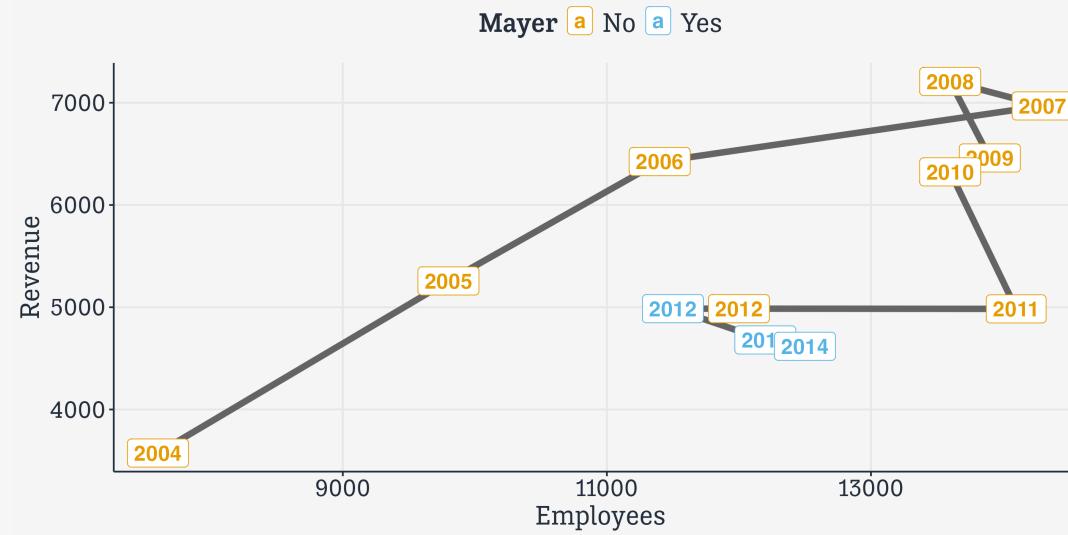
Option 1

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



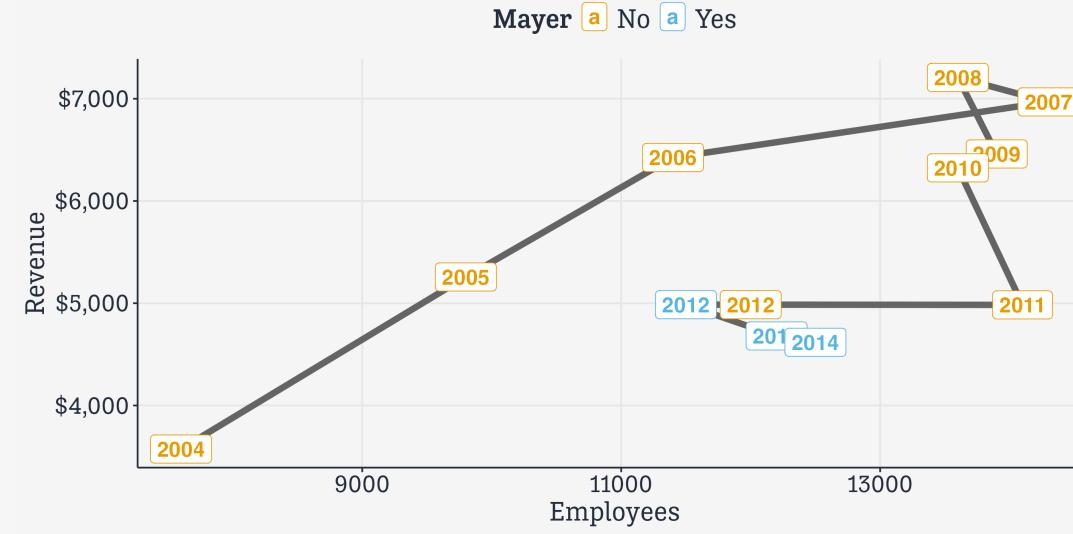
Option 1

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



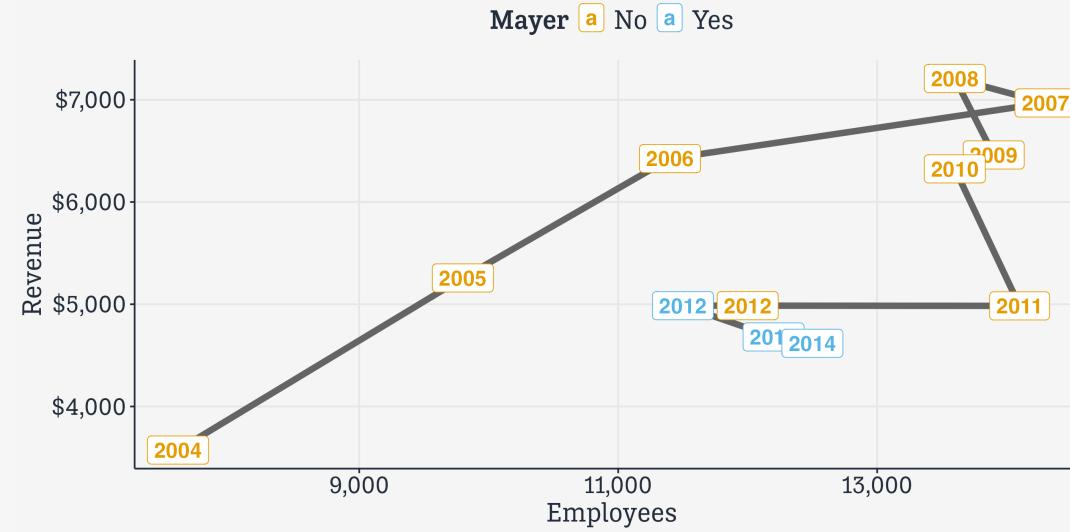
Option 1

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



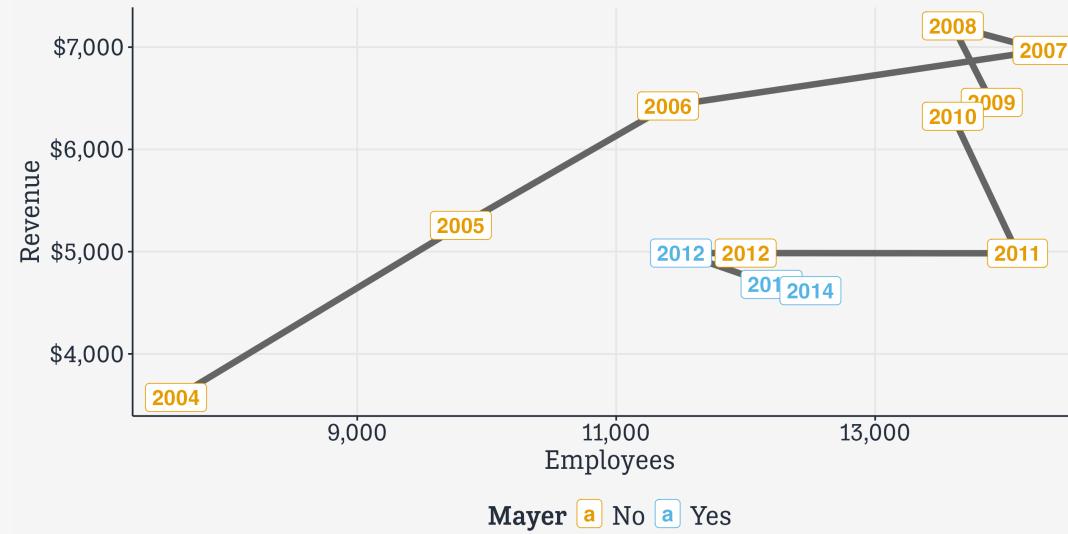
Option 1

```
yahoo %>  
  ggplot(mapping =  
    aes(x = Employees,  
        y = Revenue)) +  
  geom_path(color = "gray40",  
            linewidth = 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())
```



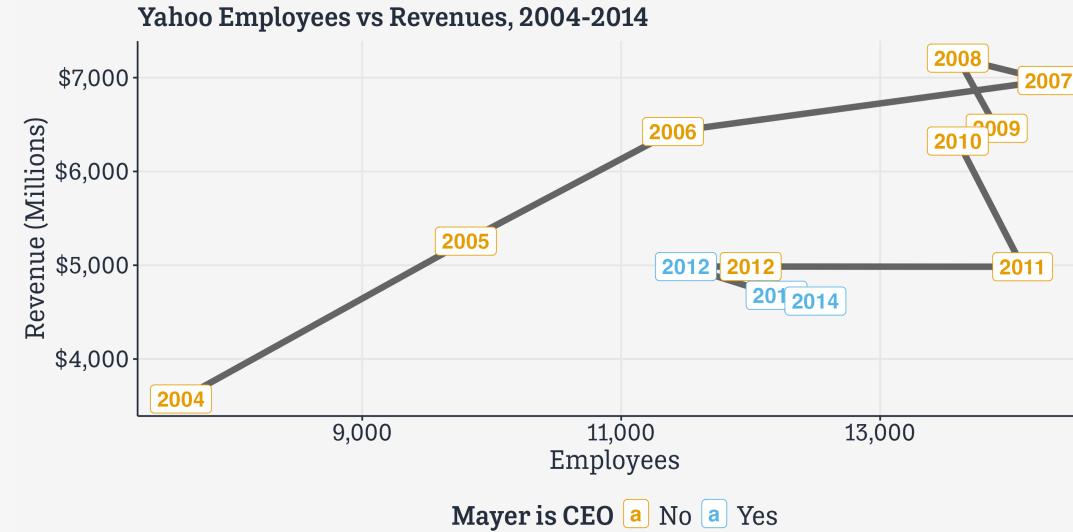
Option 1

```
yahoo %>  
  ggplot(mapping =  
    aes(x = Employees,  
        y = Revenue)) +  
  geom_path(color = "gray40",  
            linewidth = 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",  
            linewidth = 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, 2004-2014")
```



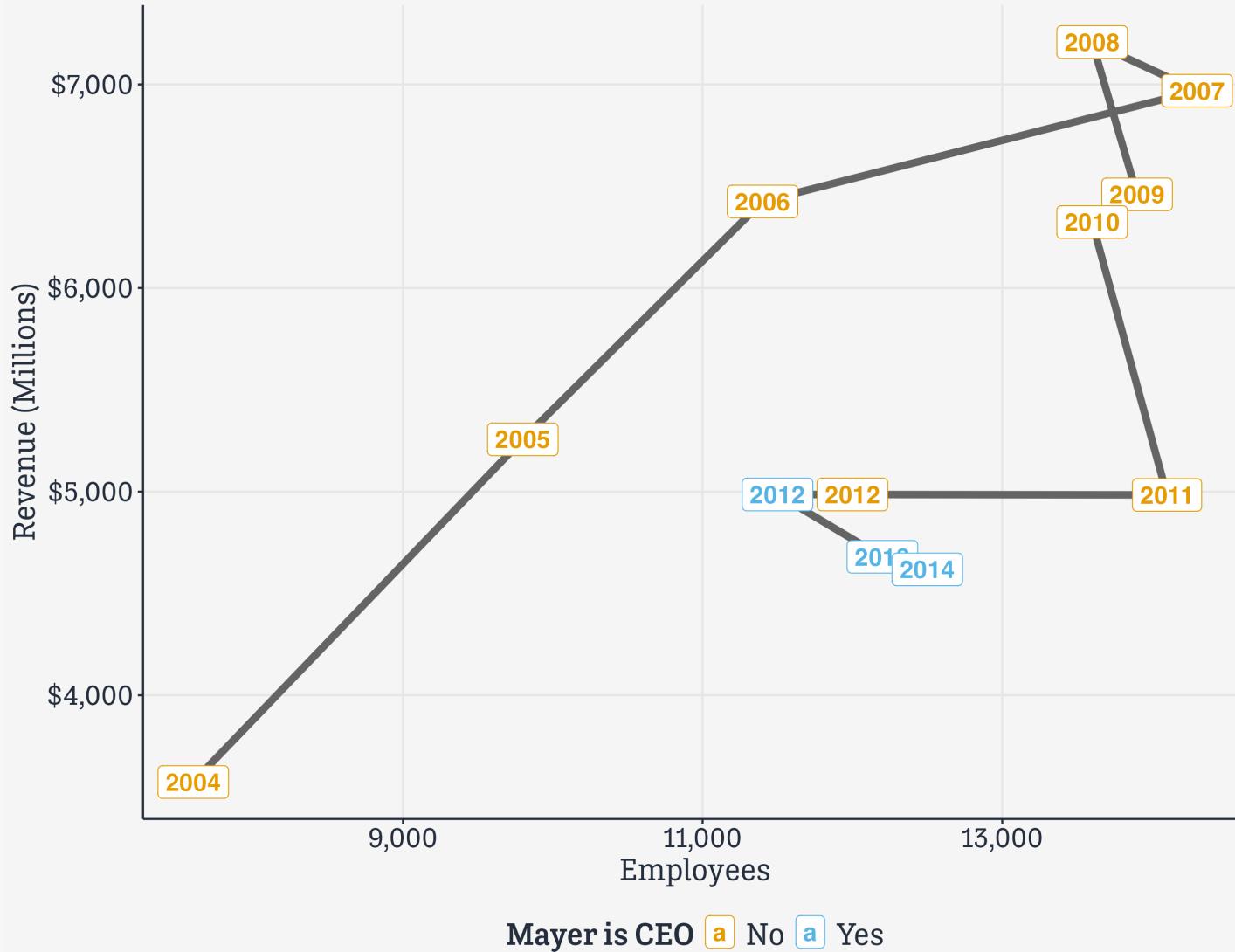
Option 1

```
yahoo ▷  
  ggplot(mapping =  
    aes(x = Employees,  
        y = Revenue)) +  
  geom_path(color = "gray40",  
            linewidth = 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, 2004-2014")  
yahoo1
```

Option 1

```
yahoo ▷  
  ggplot(mapping =  
    aes(x = Employees,  
        y = Revenue)) +  
  geom_path(color = "gray40",  
            linewidth = 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, 2004-2014")  
yahoo1
```

Yahoo Employees vs Revenues, 2004-2014



Redrawn with `geom_path()`

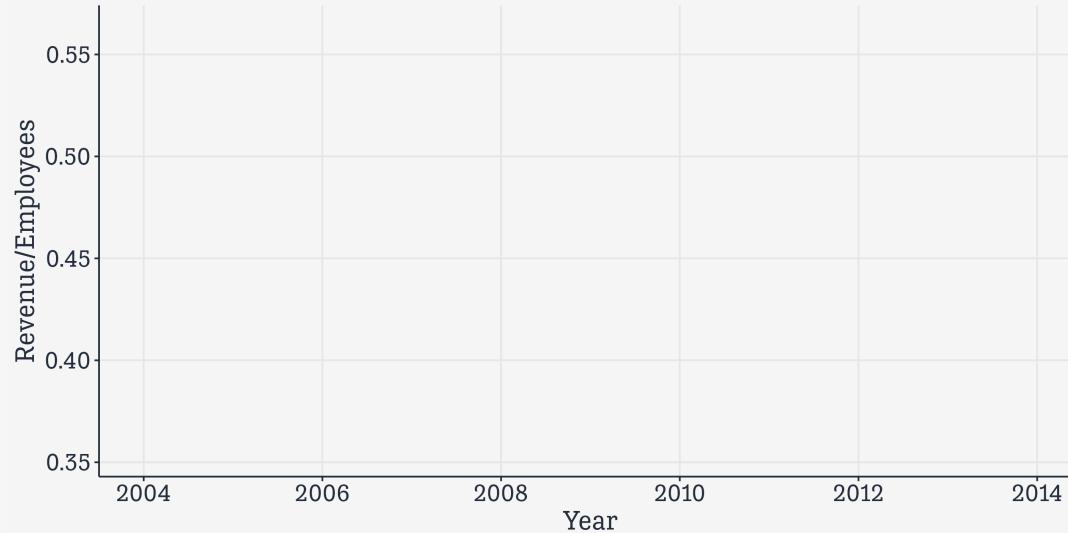
Alternatively ...

```
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
```

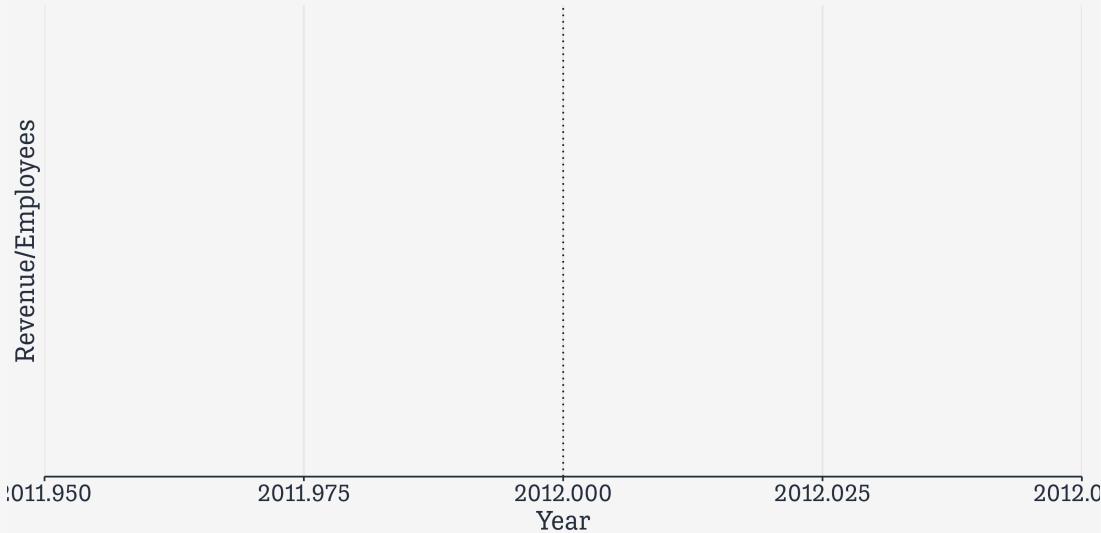
Alternatively ...

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



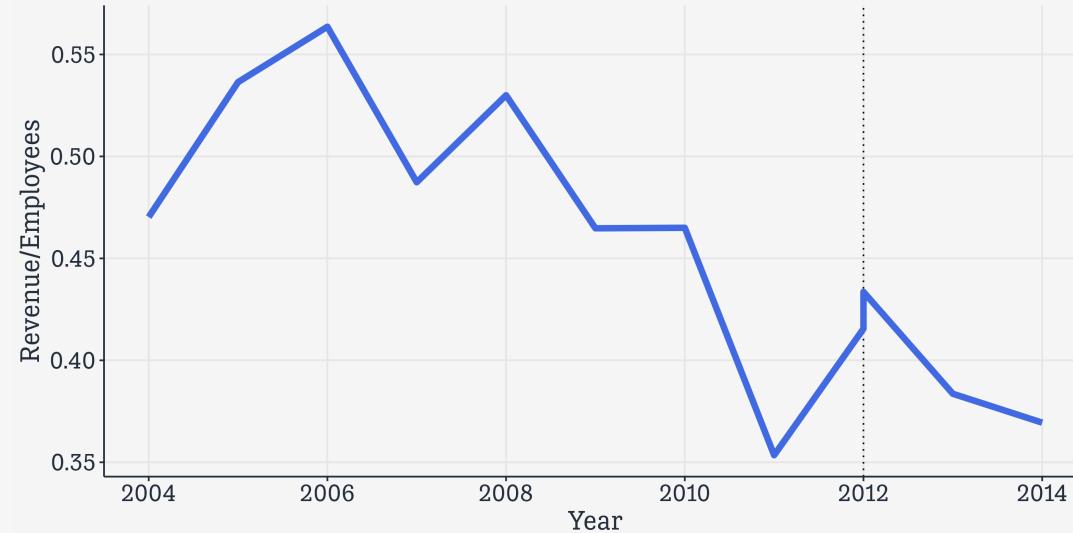
Alternatively ...

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



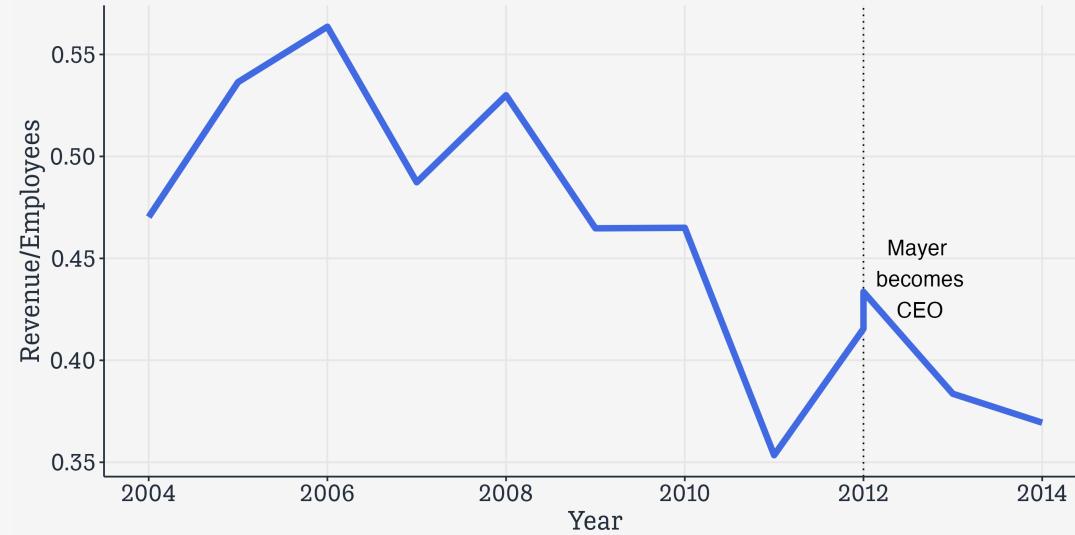
Alternatively ...

```
yahoo %>%
  ggplot(mapping =
    aes(x = Year,
        y = Revenue/Employees)) +
  geom_vline(xintercept = 2012,
             linewidth = rel(0.5),
             linetype = "dotted") +
  geom_line(color = "royalblue", linewidth = rel(2))
```



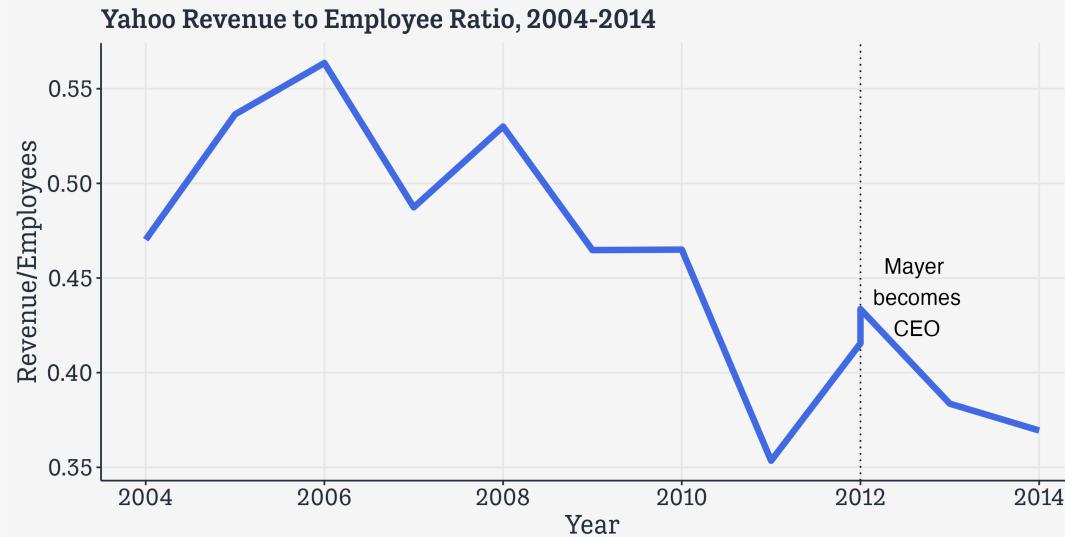
Alternatively ...

```
yahoo %>  
  ggplot(mapping =  
    aes(x = Year,  
        y = Revenue/Employees)) +  
  geom_vline(xintercept = 2012,  
             linewidth = rel(0.5),  
             linetype = "dotted") +  
  geom_line(color = "royalblue", linewidth = rel(2)) +  
  annotate("text", x = 2012.6, y = 0.44,  
          label = "Mayer\n becomes\n CEO", size = rel(5))
```



Alternatively ...

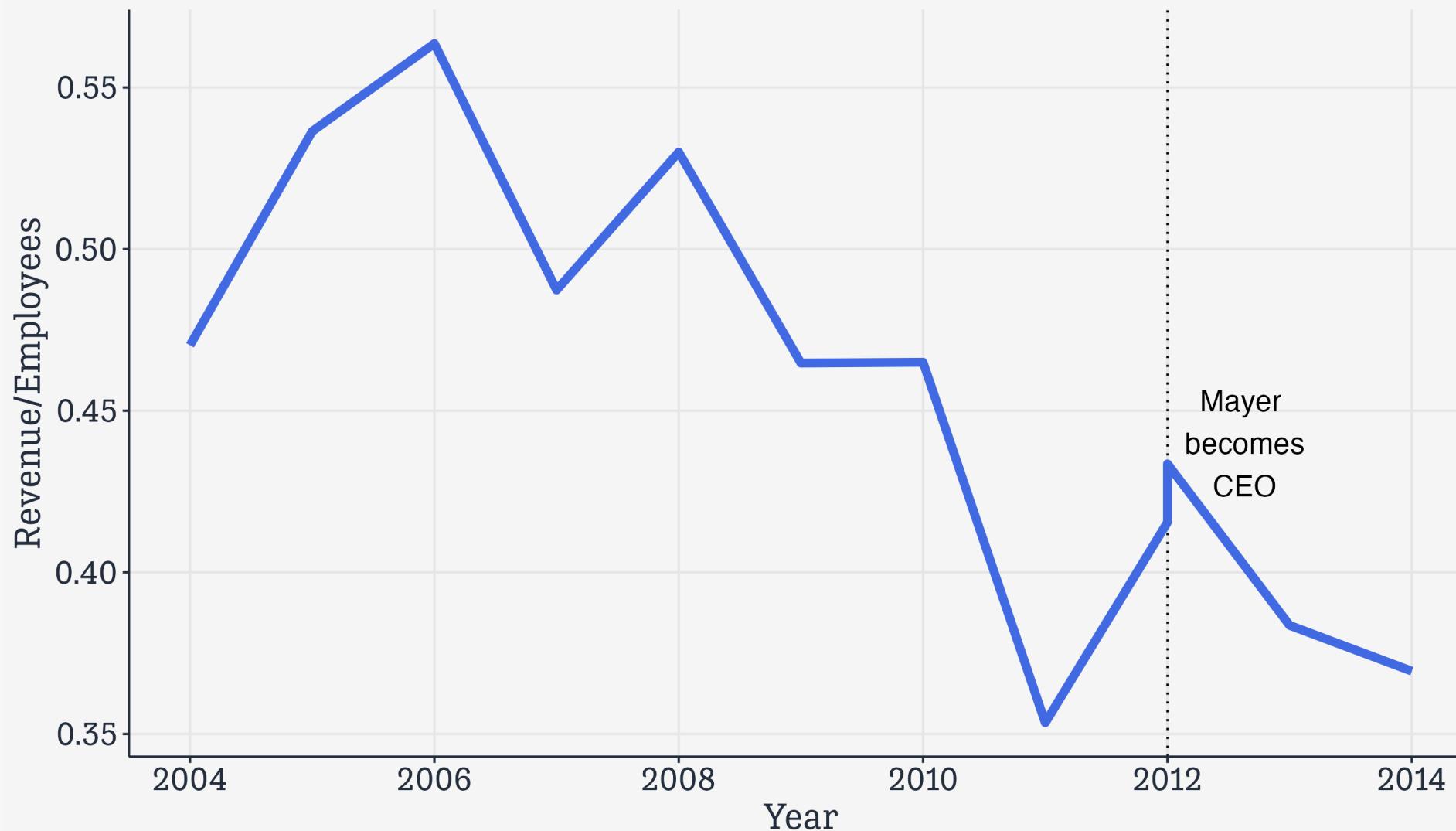
```
yahoo %>%
  ggplot(mapping =
    aes(x = Year,
        y = Revenue/Employees)) +
  geom_vline(xintercept = 2012,
             linewidth = rel(0.5),
             linetype = "dotted") +
  geom_line(color = "royalblue", linewidth = rel(2)) +
  annotate("text", x = 2012.6, y = 0.44,
          label = "Mayer\n becomes\n CEO", size = rel(5))
  labs(title = "Yahoo Revenue to Employee Ratio, 2004-2011",
       x = "Year",
       y = "Revenue/Employees")
```



Alternatively ...

```
yahoo %>  
  ggplot(mapping =  
    aes(x = Year,  
        y = Revenue/Employees)) +  
  geom_vline(xintercept = 2012,  
             linewidth = rel(0.5),  
             linetype = "dotted") +  
  geom_line(color = "royalblue", linewidth = rel(2)) +  
  annotate("text", x = 2012.6, y = 0.44,  
          label = "Mayer\n becomes\n CEO", size = rel(5))  
  labs(title = "Yahoo Revenue to Employee Ratio, 2004-2011",  
       x = "Year",  
       y = "Revenue/Employees") →  
  yahoo2
```

Yahoo Revenue to Employee Ratio, 2004-2014



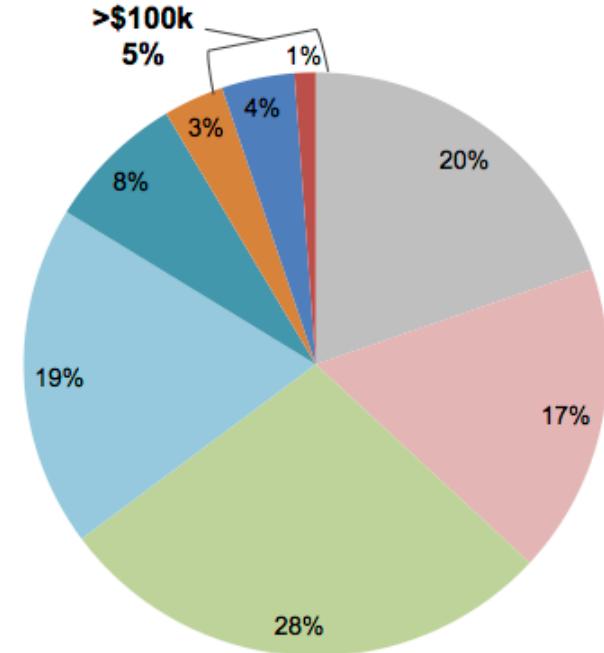
If you're interested in the ratio, just show the ratio.

Say no to pie

Pie charts are easy to mess up

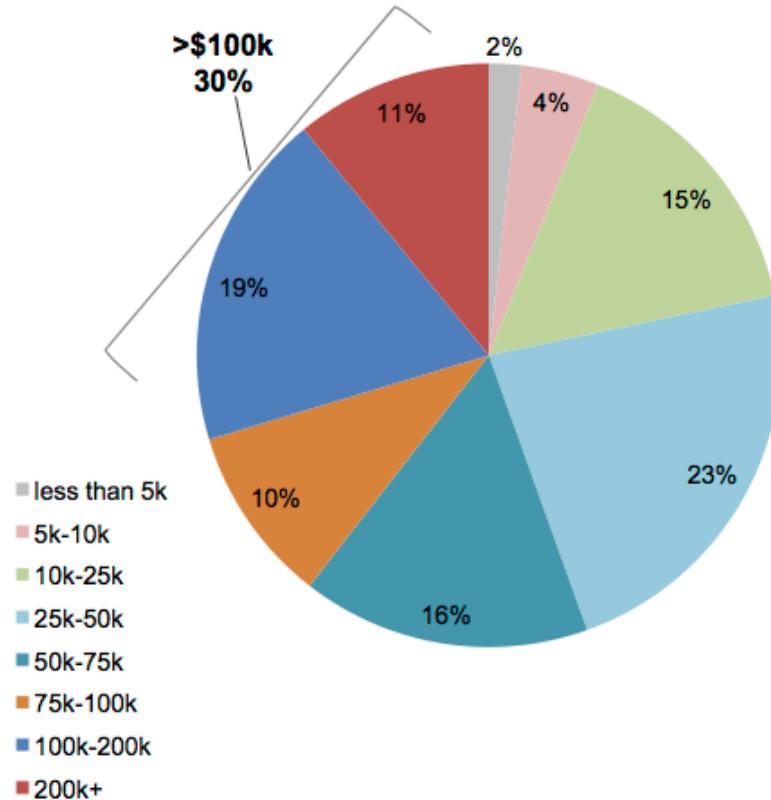
Borrower Distribution by Outstanding Balance

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
```

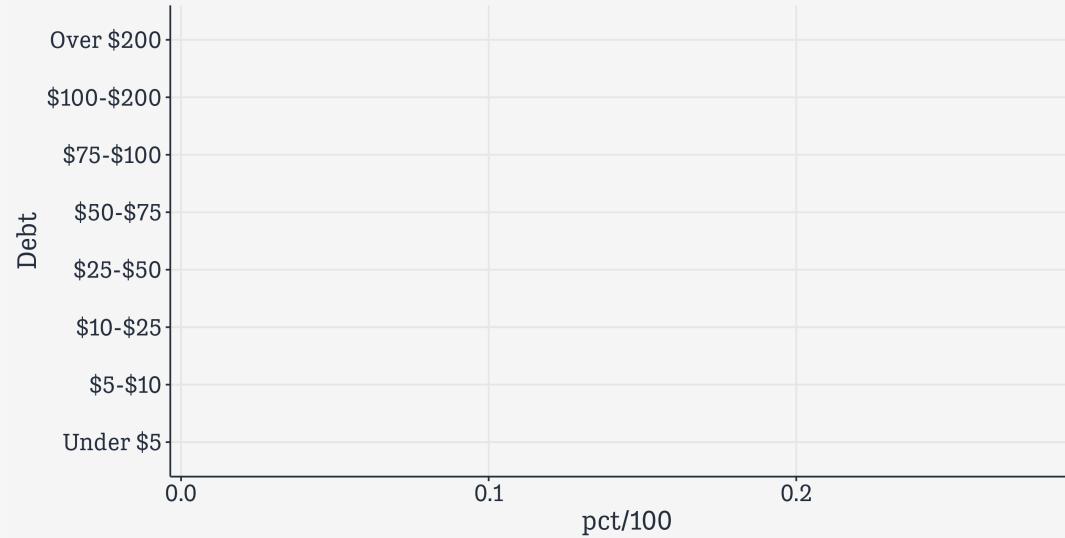
Debt Plot 1

```
studebt
```

| # | 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 |

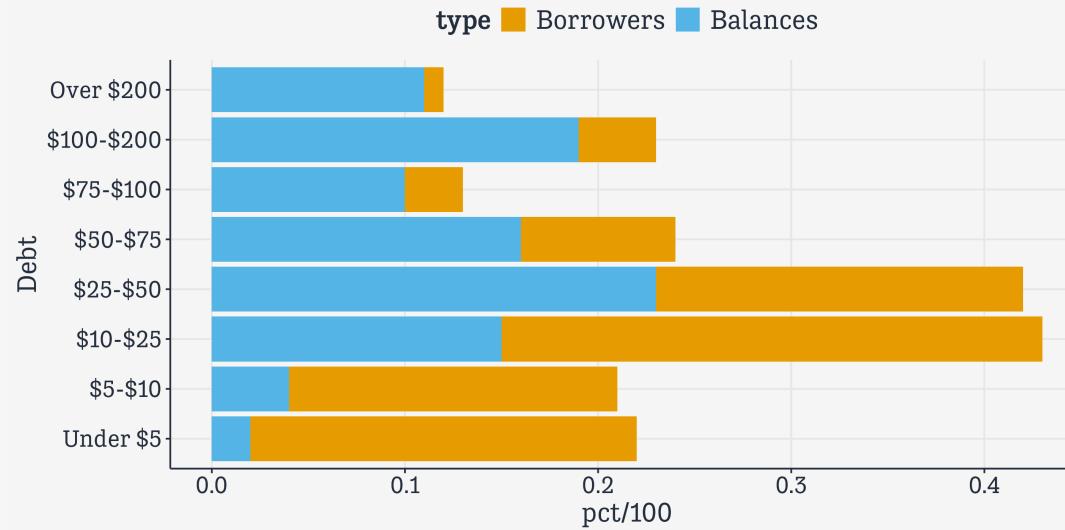
Debt Plot 1

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



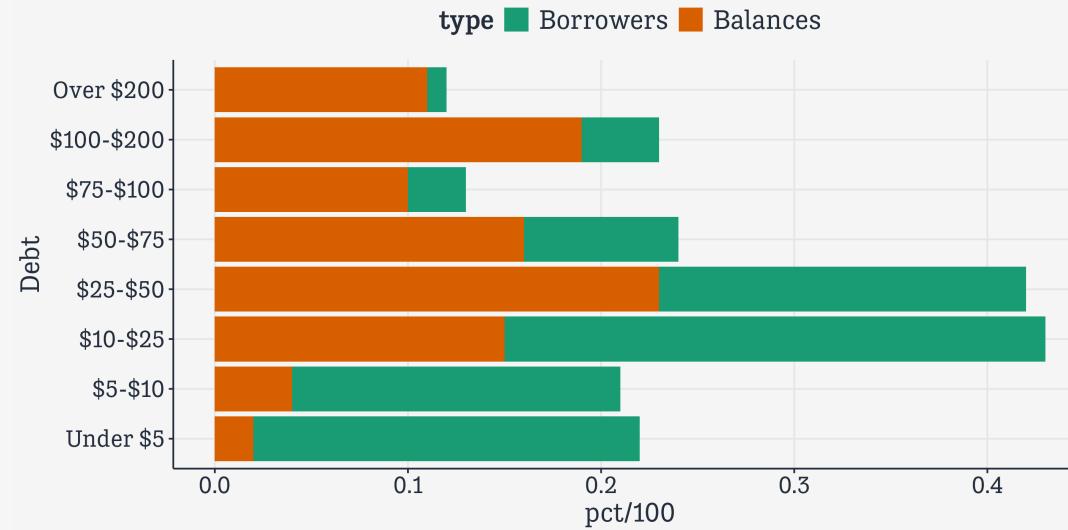
Debt Plot 1

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



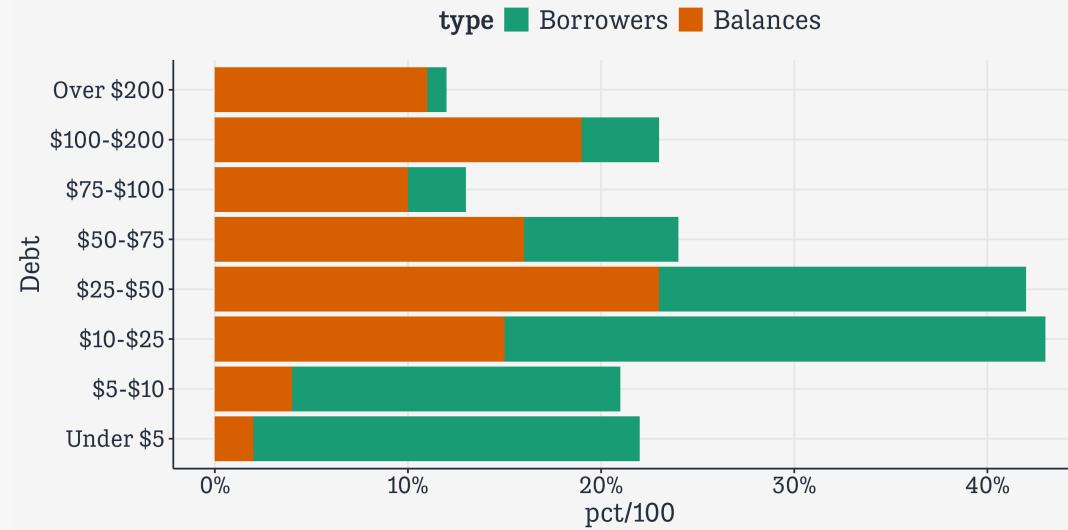
Debt Plot 1

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



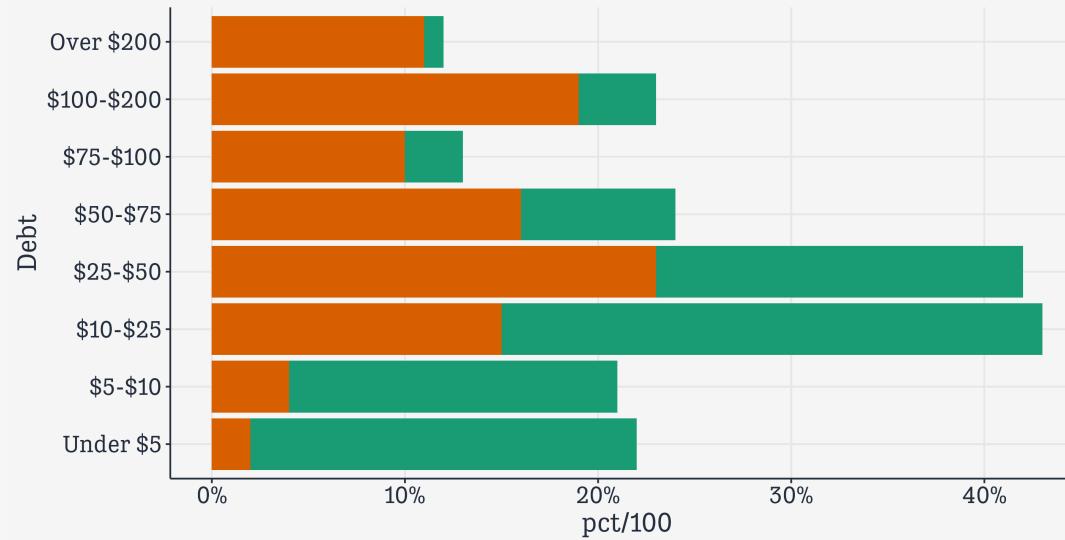
Debt Plot 1

```
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())
```



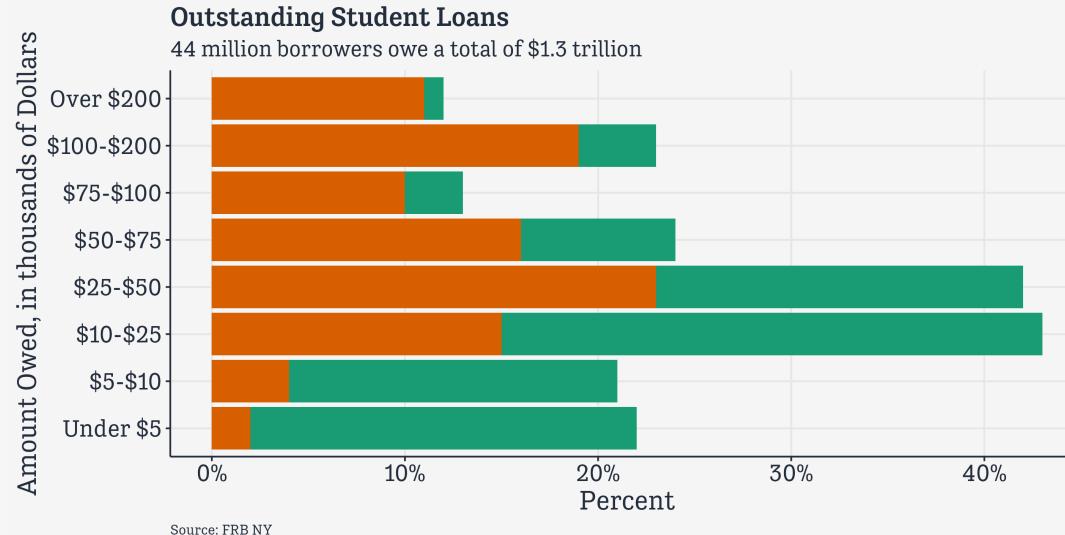
Debt Plot 1

```
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")
```



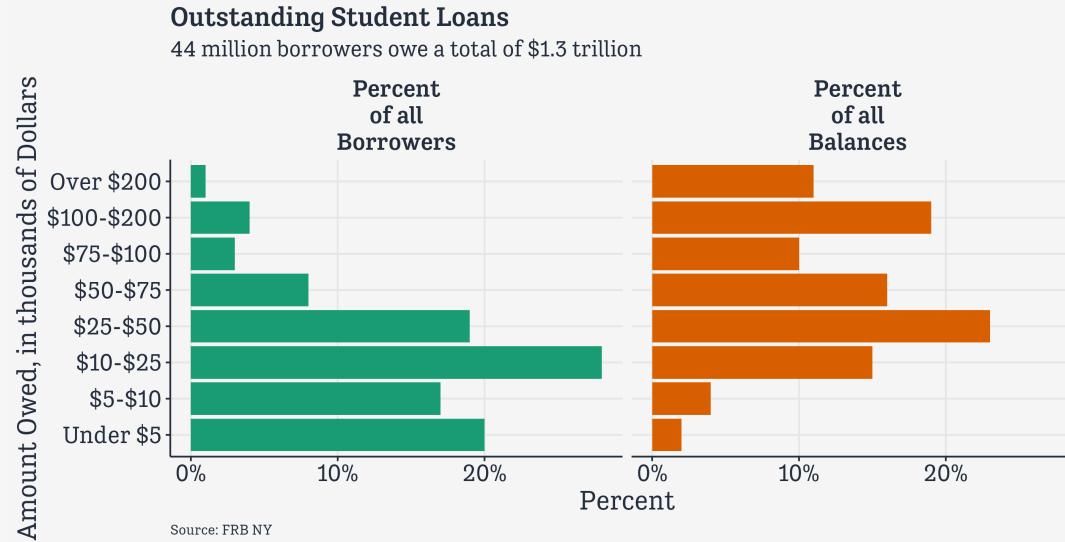
Debt Plot 1

```
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)
```



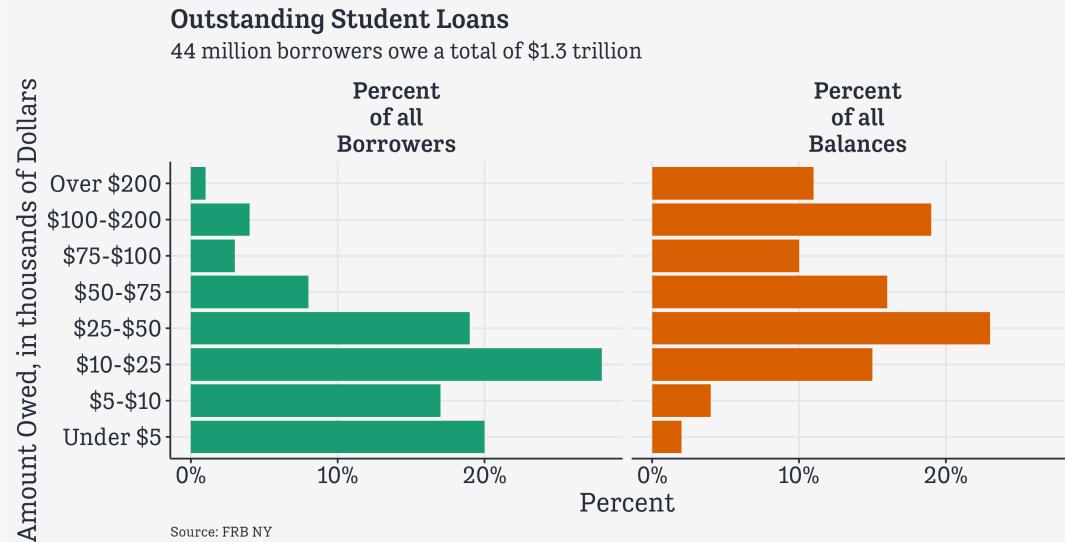
Debt Plot 1

```
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))
```



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"))
```

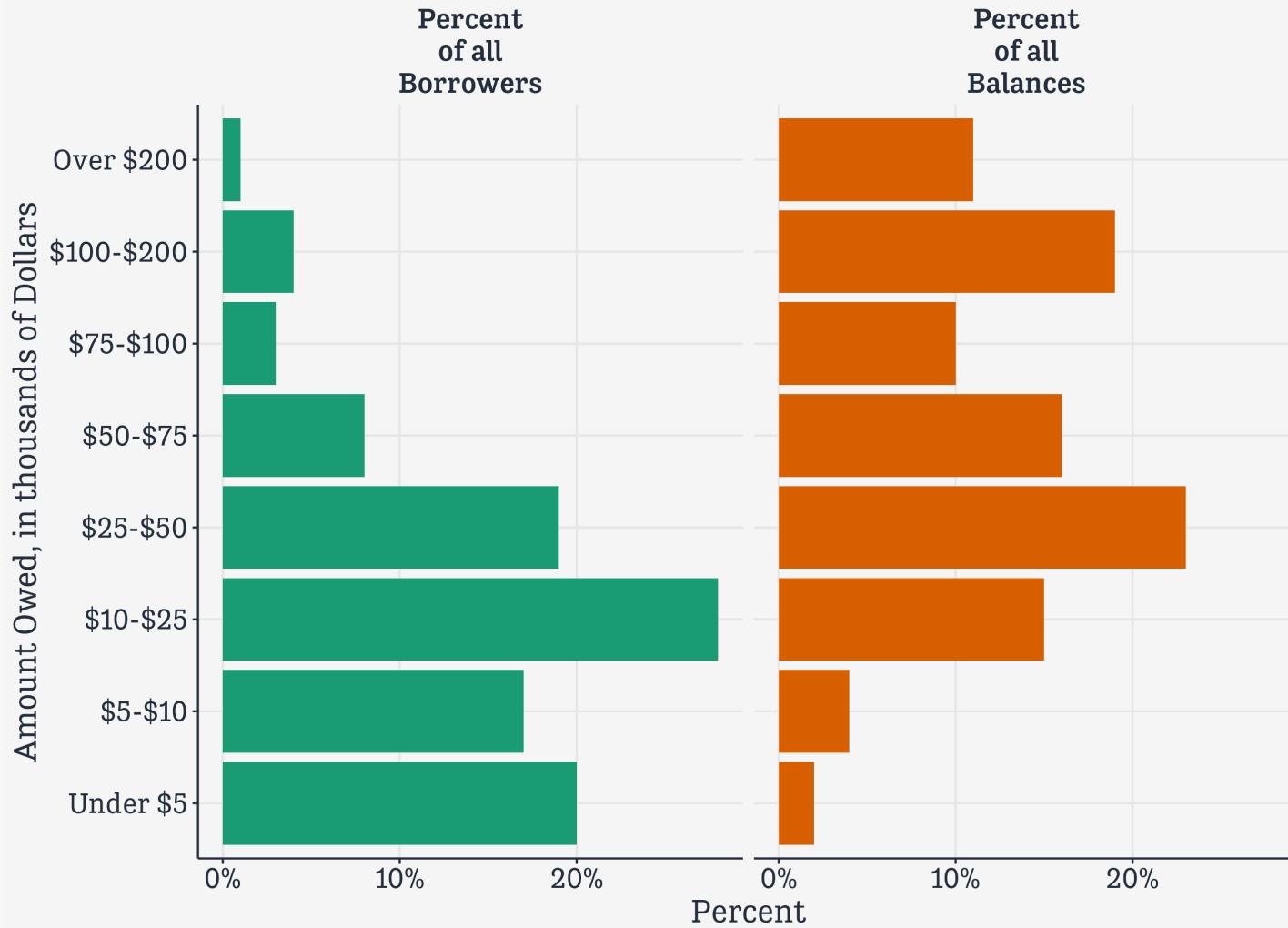


Debt Plot 1

```
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

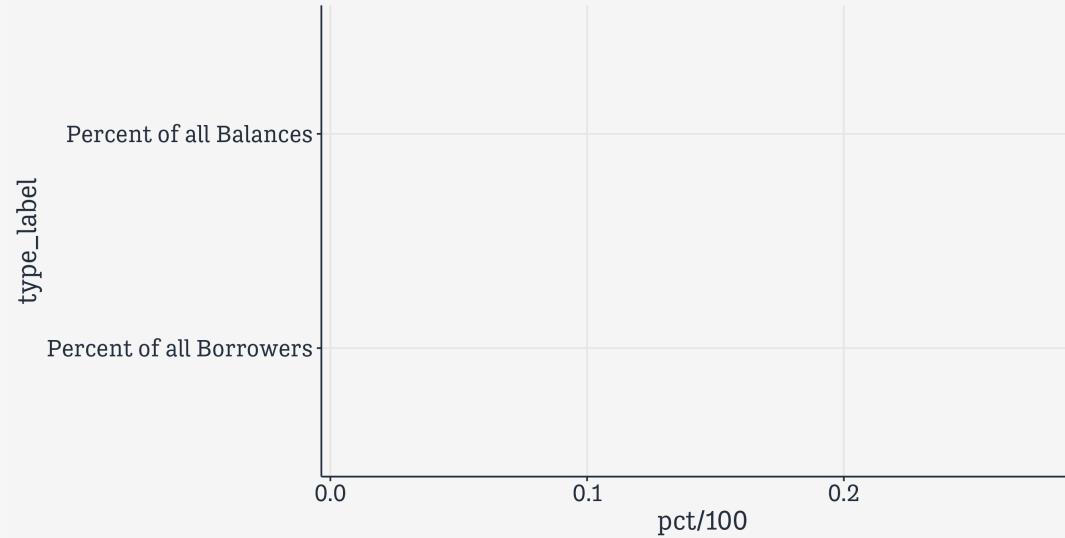
Alternatively, a kind of stacked bar chart

```
studebt
```

| # | Debt | type | pct | Debtrc | type_label |
|----|-------------|-----------|-----|-------------|--------------------------|
| 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 |

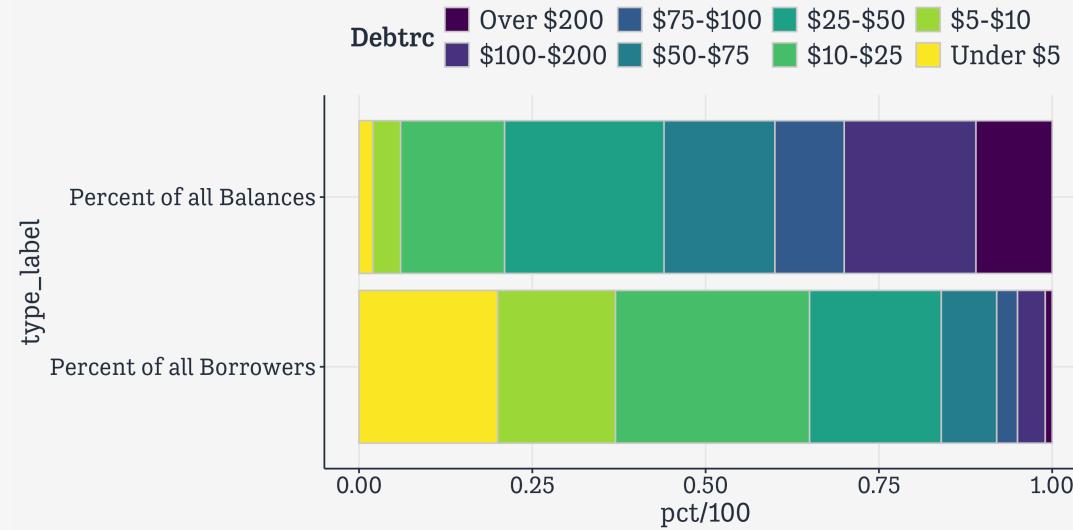
Alternatively, a kind of stacked bar chart

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



Alternatively, a kind of stacked bar chart

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



Alternatively, 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())
```



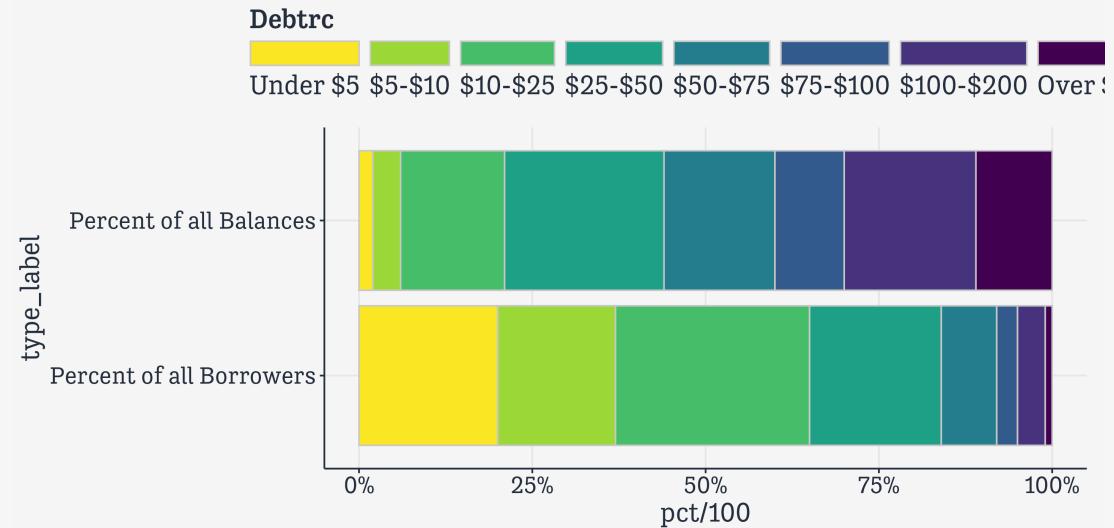
Alternatively, a kind of stacked bar chart

```
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()
```



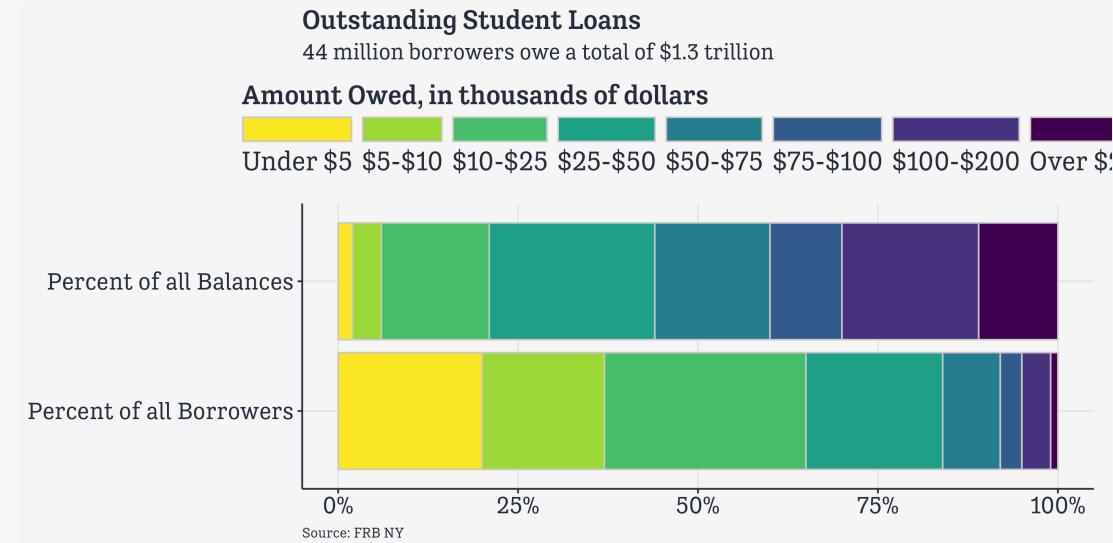
Alternatively, a kind of stacked bar chart

```
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))
```



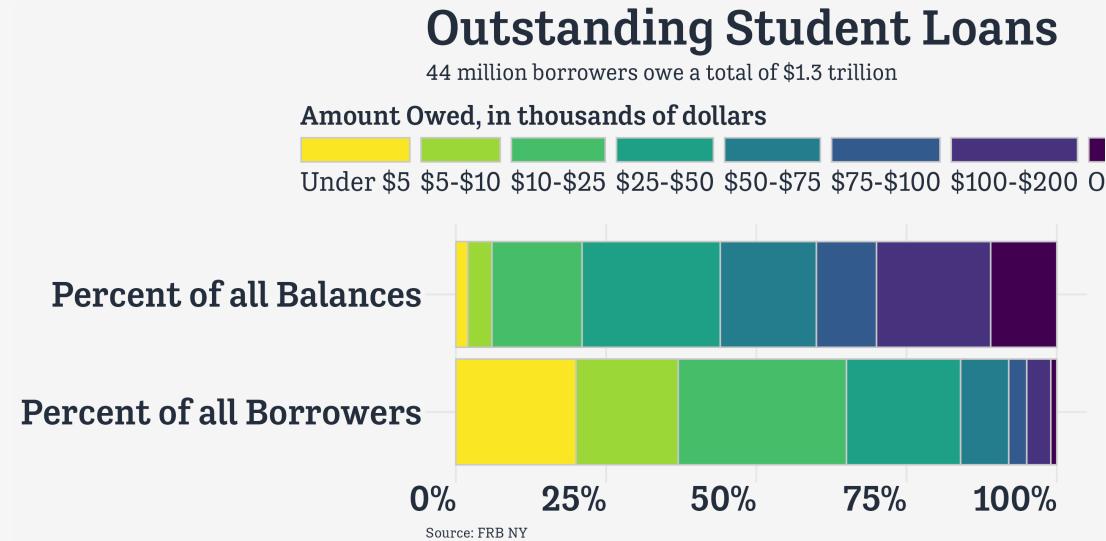
Alternatively, a kind of stacked bar chart

```
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, 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())
```



Alternatively, a kind of stacked bar chart

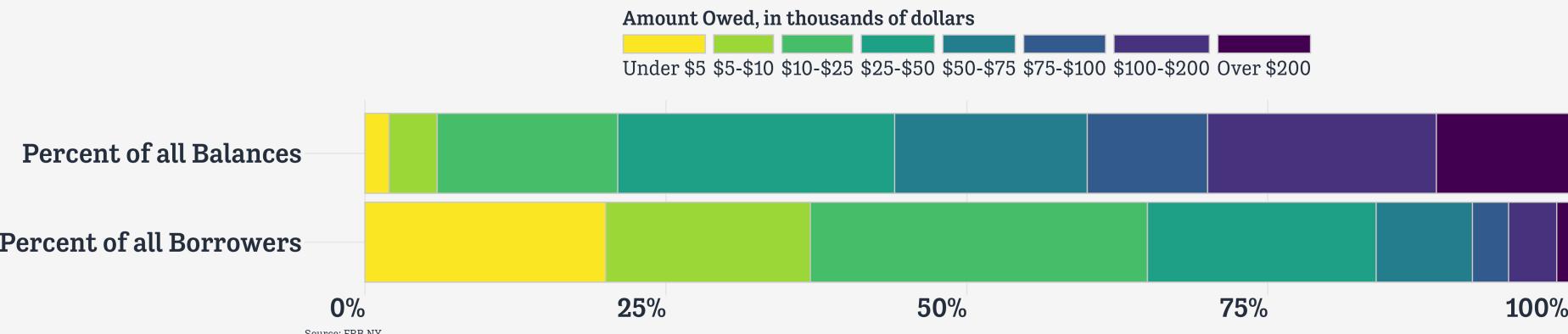
```
studebt >
  ggplot(mapping = aes(x = pct/100,
                        y = type_label,
                        fill = Debtrc)) +
  geom_col(color = "gray80") +
  scale_x_continuous(labels =
    label_percent()) +
  scale_fill_viridis_d() +
  guides(fill =
    guide_legend(reverse = TRUE,
        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

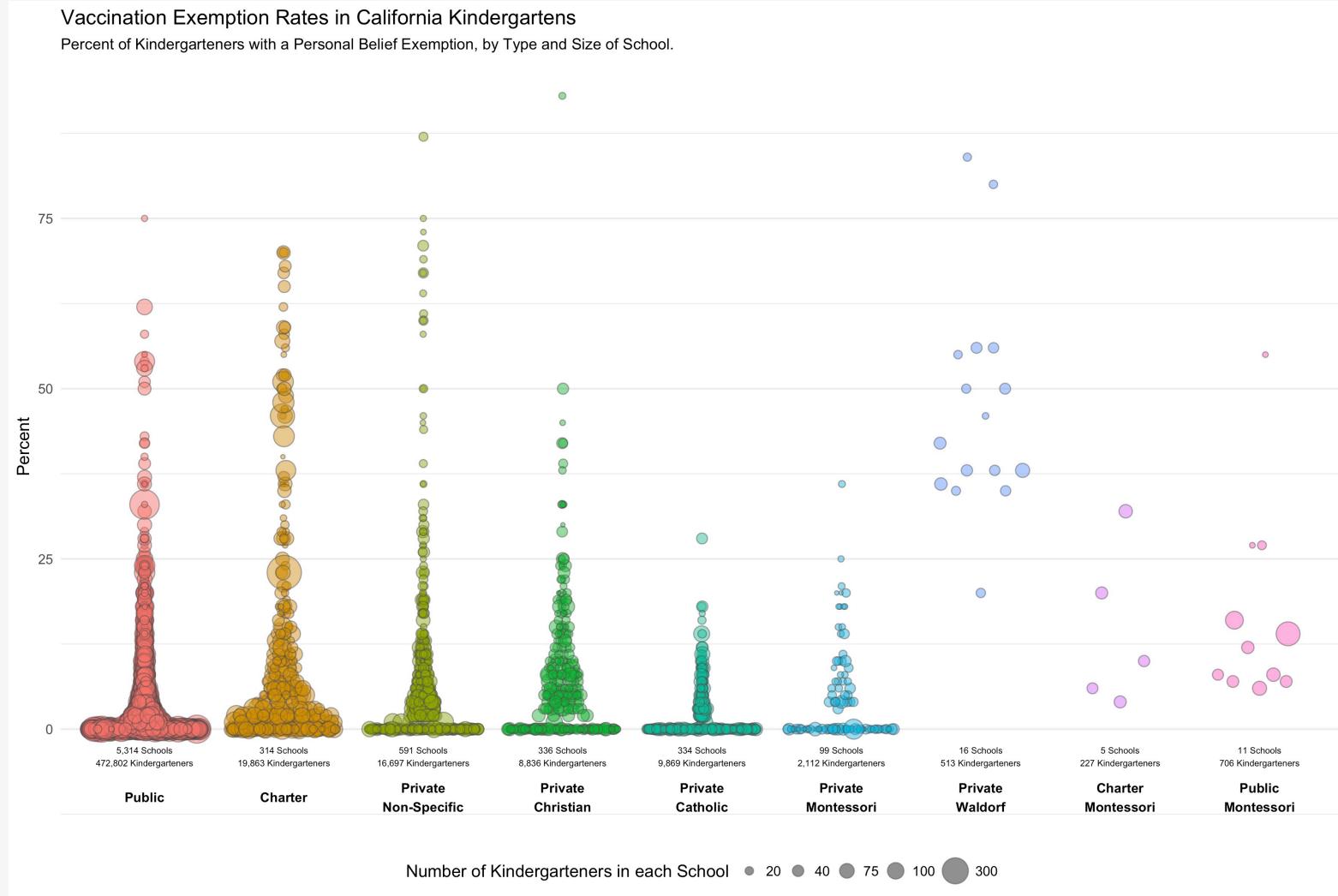


Source: FRB NY

Pies redrawn as sideways-stacked columns

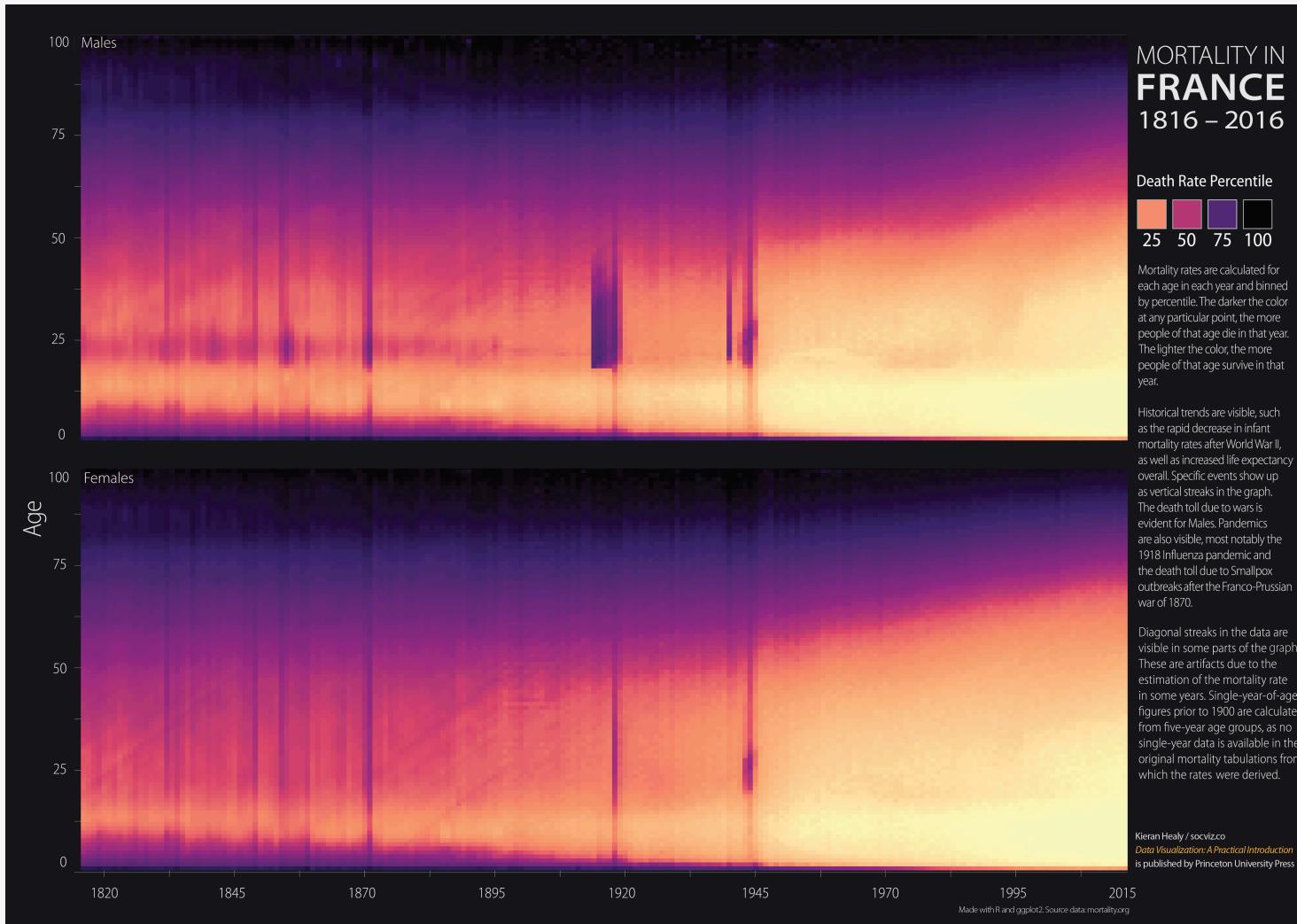
But I want
a pony

Show ponies



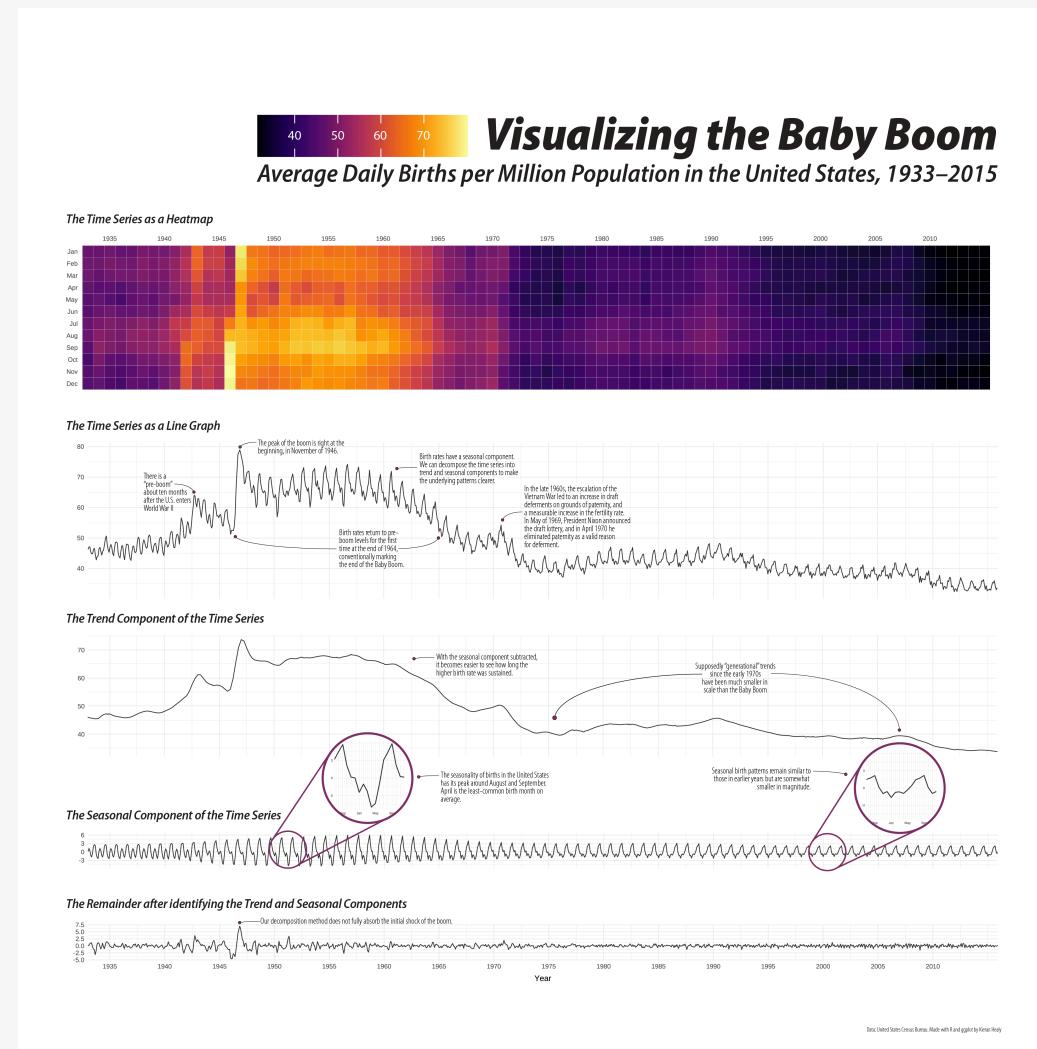
Beeswarm plot

Show ponies



Mortality in France

Show ponies



The Baby Boom

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>       <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
# i 1,634 more rows
# i 4 more variables: seasonal <dbl>, trend <dbl>, remainder <dbl>,
#   country <chr>
```

Boomer Line Graph

okboomer

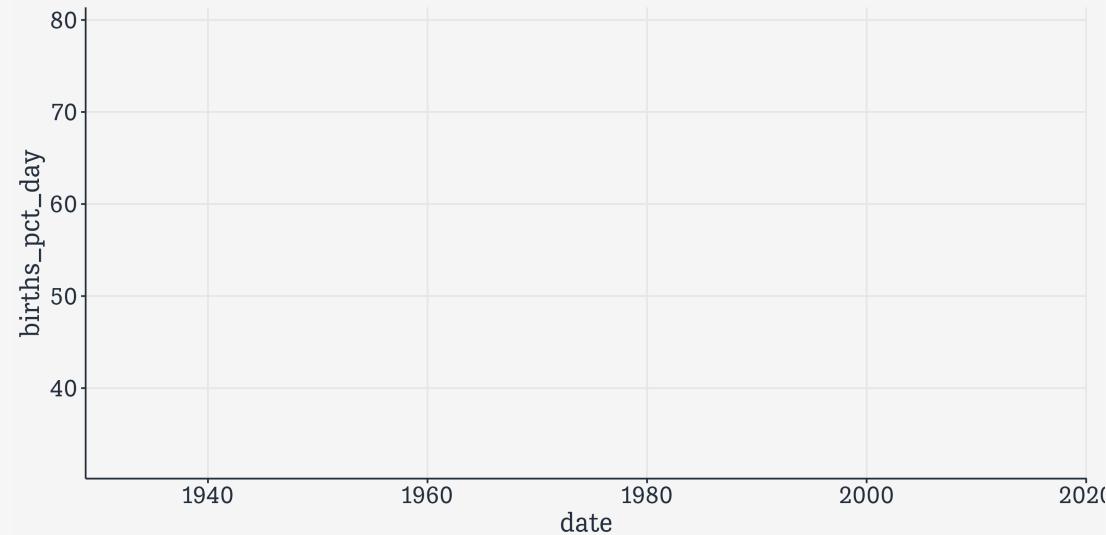
```
# A tibble: 1,644 × 12
  year month n_days births total_pop births_pct births_pct_day date
  <dbl> <dbl> <dbl>   <dbl>    <dbl>      <dbl>       <dbl> <date>
1 1938     1     31  51820  41215000  0.00126    40.6 1938-01-01
2 1938     2     28  47421  41215000  0.00115    41.1 1938-02-01
3 1938     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
# i 1,634 more rows
# i 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  
#> # i 986 more rows  
#> # i 4 more variables: seasonal <dbl>, trend <dbl>, remainder <dbl>,  
#> #   country <chr>
```

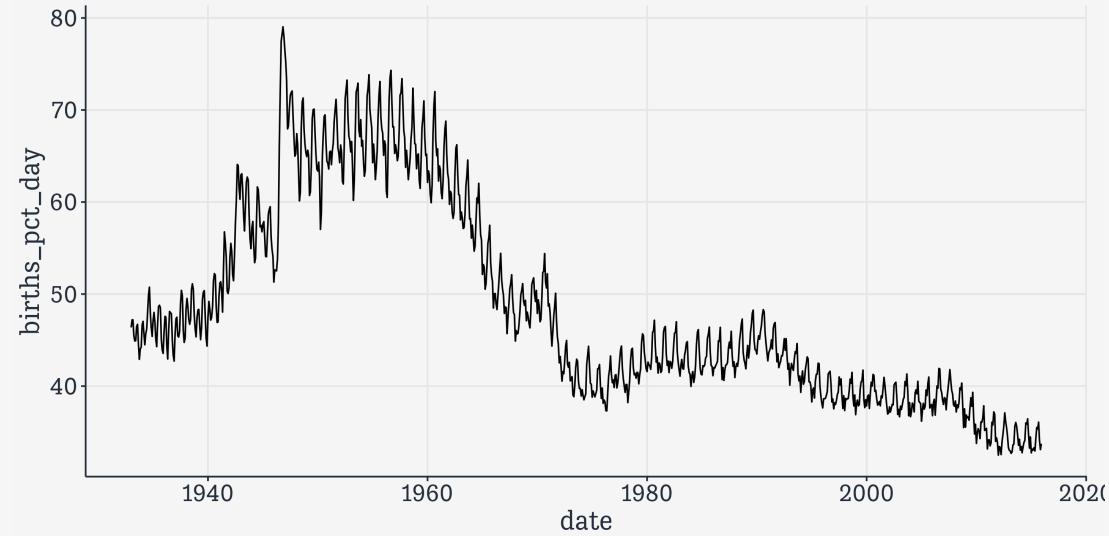
Boomer Line Graph

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



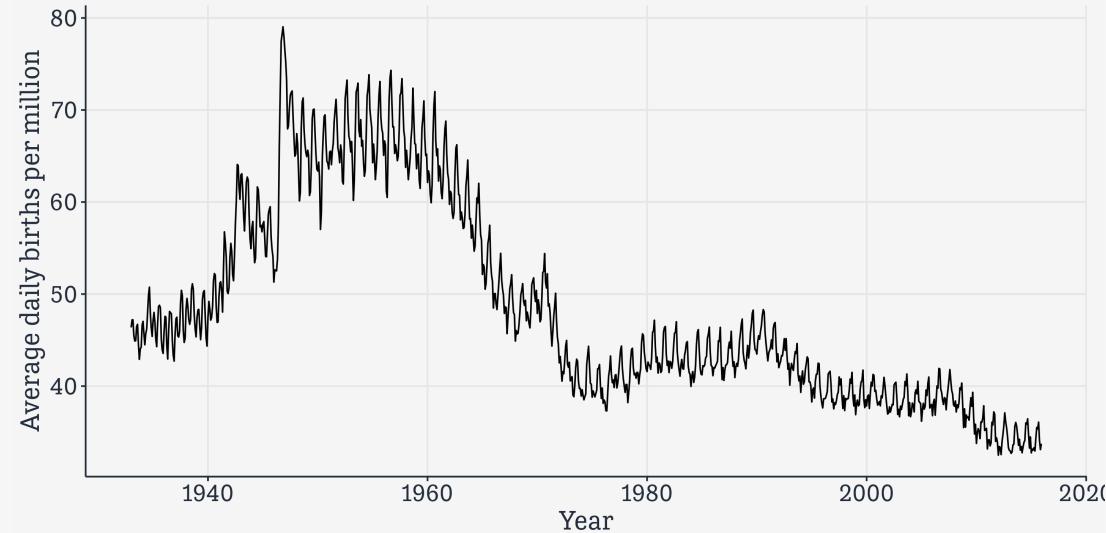
Boomer Line Graph

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



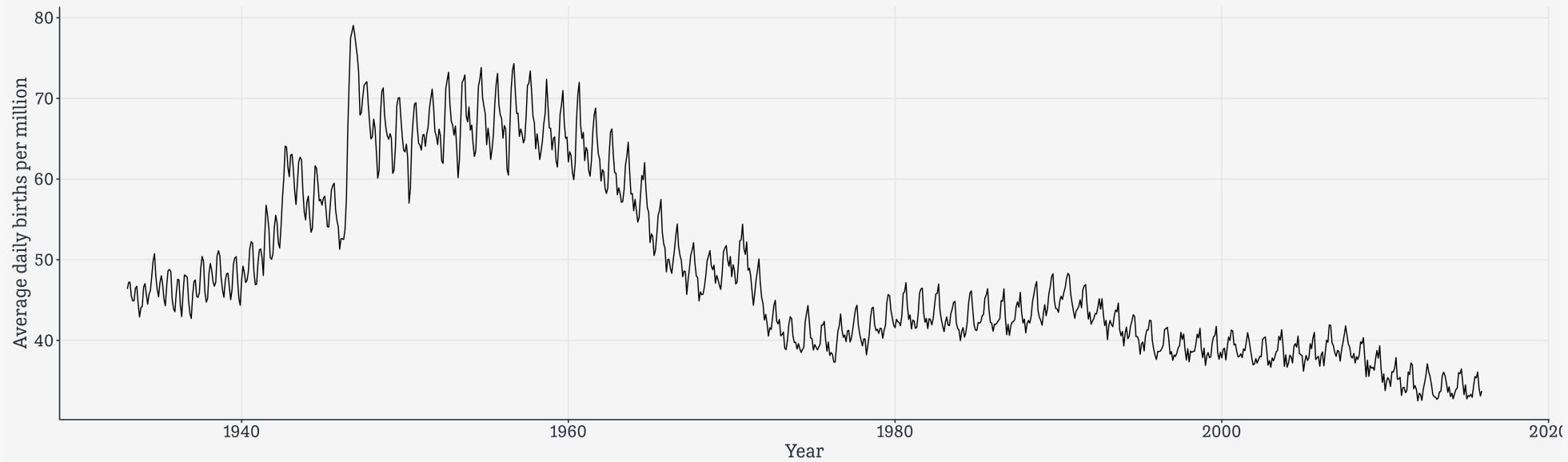
Boomer Line Graph

```
okboomer %>  
  filter(country == "United States") %>  
  ggplot(aes(x = date, y = births_pct_day)) +  
  geom_line(linewidth = 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(linewidth = 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
 39.2 1938-10-01
```

Tiled Heatmap

```
okboomer ▷  
filter(country == "United States")  
  
# A tibble: 996 × 12  
  year month n_days births total_pop births_pct  
  <dbl> <dbl> <dbl> <dbl>    <dbl>     <dbl>  
  births_pct_day date  
  <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
```

Tiled Heatmap

```
okboomer %>
  filter(country == "United States") %>
  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))
```

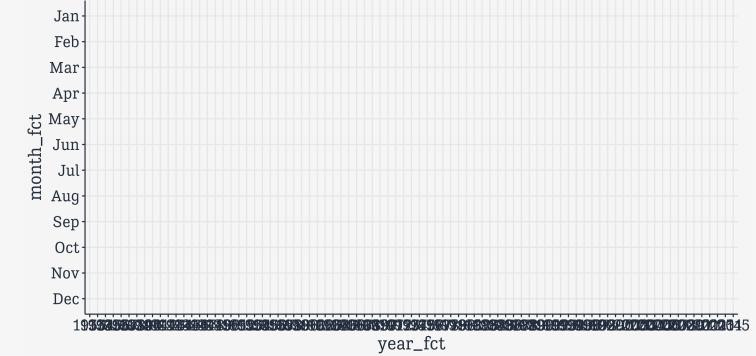
```
# A tibble: 996 x 14
   year month n_days births total_pop births_pct
   <dbl> <dbl> <dbl> <dbl>     <dbl>      <dbl>
1 1933     1     31 180545 125579000 0.00144
2 1933     2     28 165986 125579000 0.00132
3 1933     3     31 183762 125579000 0.00146
4 1933     4     30 171354 125579000 0.00136
5 1933     5     31 174811 125579000 0.00139
6 1933     6     30 169255 125579000 0.00135
7 1933     7     31 180880 125579000 0.00144
8 1933     8     31 181856 125579000 0.00145
9 1933     9     30 167637 125579000 0.00133
10 1933    10     31 167055 125579000 0.00133
42.9 1933    10     31 167055 125579000 0.00133
```

Tiled Heatmap

| # A tibble: 996 × 14 | year | month | year_fct | month_fct | n_days | births | total_pop | births_pct | <dbl> | <dbl> | <ord> | <ord> | <dbl> | <dbl> |
|----------------------|---------|---------|----------|-----------|--------|--------|-----------|------------|---------|---------|-------|-------|-----------|-----------|
| 1 1933 | 1 1933 | 1 1933 | 1 1933 | 1 1933 | 31 | 180545 | 125579000 | 0.00144 | 0.00144 | 0.00144 | Jan | Jan | 31 180545 | 125579000 |
| 2 1933 | 2 1933 | 2 1933 | 2 1933 | 2 1933 | 28 | 165986 | 125579000 | 0.00132 | 0.00132 | 0.00132 | Feb | Feb | 28 165986 | 125579000 |
| 3 1933 | 3 1933 | 3 1933 | 3 1933 | 3 1933 | 31 | 183762 | 125579000 | 0.00146 | 0.00146 | 0.00146 | Mar | Mar | 31 183762 | 125579000 |
| 4 1933 | 4 1933 | 4 1933 | 4 1933 | 4 1933 | 30 | 171354 | 125579000 | 0.00136 | 0.00136 | 0.00136 | Apr | Apr | 30 171354 | 125579000 |
| 5 1933 | 5 1933 | 5 1933 | 5 1933 | 5 1933 | 31 | 174811 | 125579000 | 0.00139 | 0.00139 | 0.00139 | May | May | 31 174811 | 125579000 |
| 6 1933 | 6 1933 | 6 1933 | 6 1933 | 6 1933 | 30 | 169255 | 125579000 | 0.00135 | 0.00135 | 0.00135 | Jun | Jun | 30 169255 | 125579000 |
| 7 1933 | 7 1933 | 7 1933 | 7 1933 | 7 1933 | 31 | 180880 | 125579000 | 0.00144 | 0.00144 | 0.00144 | Jul | Jul | 31 180880 | 125579000 |
| 8 1933 | 8 1933 | 8 1933 | 8 1933 | 8 1933 | 31 | 181856 | 125579000 | 0.00145 | 0.00145 | 0.00145 | Aug | Aug | 31 181856 | 125579000 |
| 9 1933 | 9 1933 | 9 1933 | 9 1933 | 9 1933 | 30 | 167637 | 125579000 | 0.00133 | 0.00133 | 0.00133 | Sep | Sep | 30 167637 | 125579000 |
| 10 1933 | 10 1933 | 10 1933 | 10 1933 | 10 1933 | 31 | 167055 | 125579000 | 0.00133 | 0.00133 | 0.00133 | Oct | Oct | 31 167055 | 125579000 |

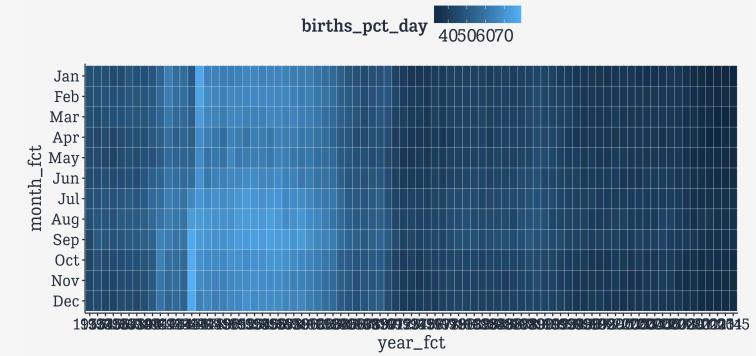
Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  ggplot(aes(x = year_fct, y = month_fct))
```



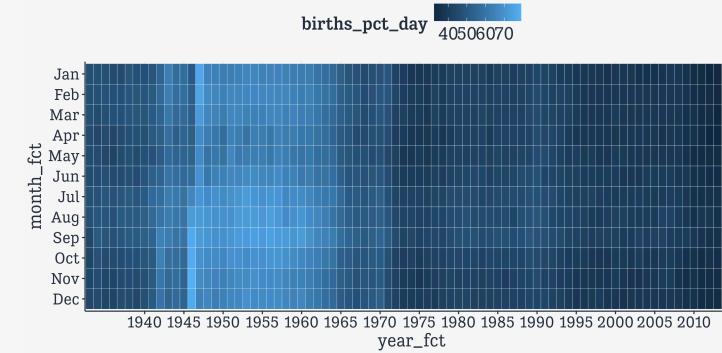
Tiled Heatmap

```
okboomer ▷  
filter(country == "United States") ▷  
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()) ▷  
ggplot(aes(x = year_fct, y = month_fct)) +  
geom_tile(mapping = aes(fill = births_pct_day),  
          color = "white")
```



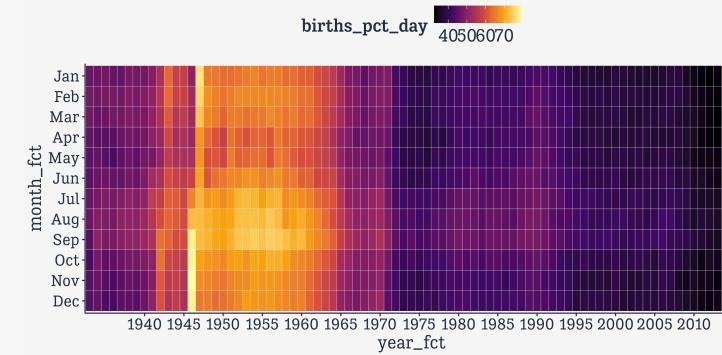
Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  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))
```



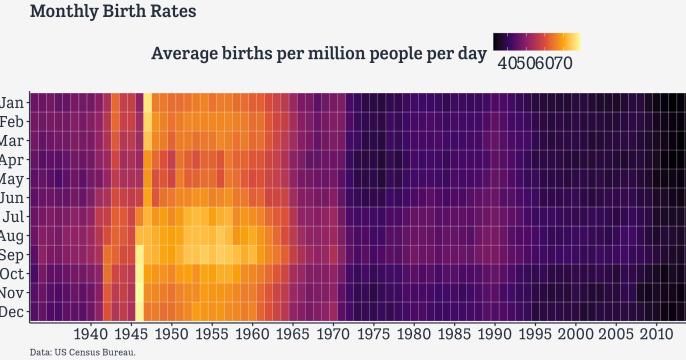
Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  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")
```



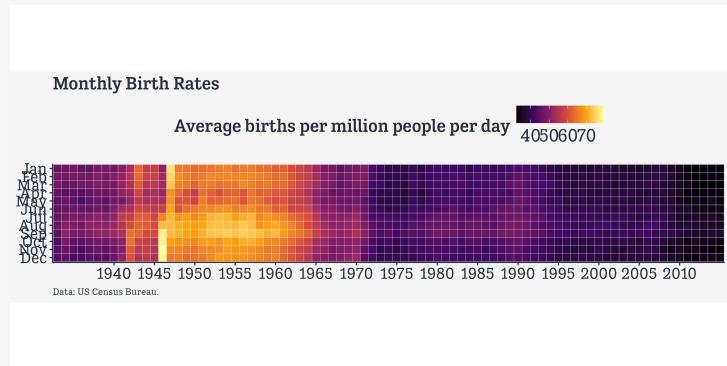
Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  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.")
```



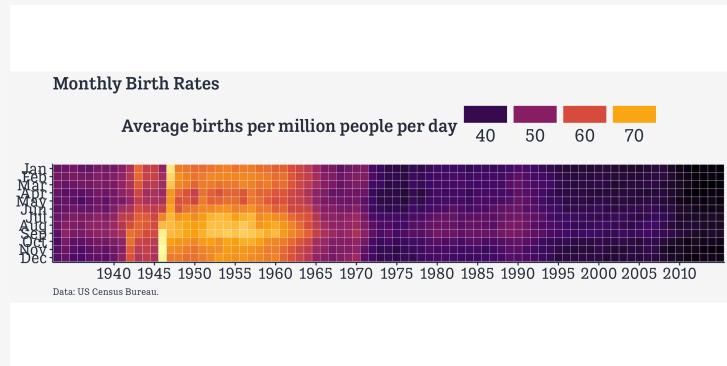
Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  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()
```



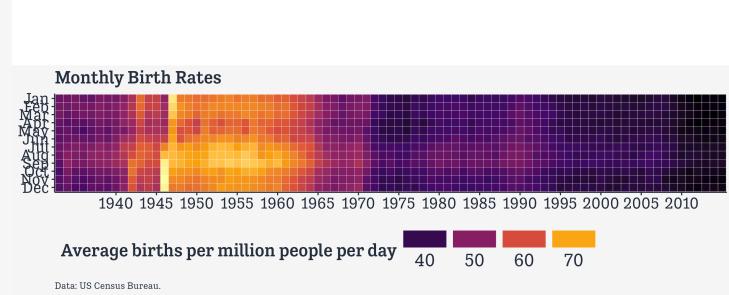
Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  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 >
  filter(country == "United States") >
  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()) >
  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")
```

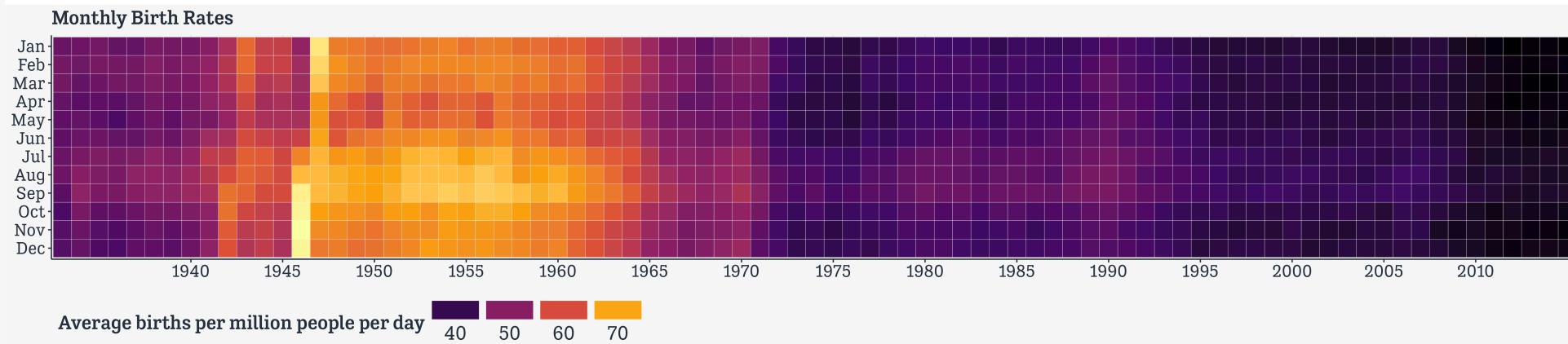


Tiled Heatmap

```
okboomer >
  filter(country == "United States") >
  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()) >
  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 >
  filter(country == "United States") >
  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()) >
  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
# i 7,022 more rows
# i 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 exempt
  <dbl> <chr>  <chr> <chr>  <chr>    <dbl>    <dbl>    <dbl>
med_exempt
  <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
# i 7,022 more rows
# i 3 more variables: rel_exempt <dbl>, mwc <fct>, kind <fct>
```

Aux Info Panel

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

cavax %>
  group_by(mwc)
```

```
# A tibble: 7,032 x 13
# Groups:   mwc [11]
  code county name type district city enrollment pbe_pct exempt
  <dbl> <chr>  <chr> <chr>  <chr>    <chr>    <dbl>    <dbl>    <dbl>
med_exempt
<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
# i 7,022 more rows
# i 3 more variables: rel_exempt <dbl>, mwc <fct>, 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))
```

| | mwc | n_schools | n_students |
|----|------------------------------|-----------|------------|
| 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()
```

| | mwc | n_schools | n_students |
|----|------------------------------|-----------|------------|
| 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() >
  mutate(n_schools_fmt = make_comma(n_schools),
         n_students_fmt = make_comma(n_students),
         info_schools = paste(n_schools_fmt, "Schools Enrolling"),
         info_students = paste(n_students_fmt, "Kindergarteners"))
```

| # A tibble: 11 × 7 | mwc | n_schools | n_students | n_schools_fmt | n_students_fmt |
|---------------------------------|-------|-----------|------------|---------------|----------------|
| info_schools | <fct> | <int> | <dbl> | <chr> | <chr> |
| 1 Public Schools... | 5314 | 472802 | 5,314 | 472,802 | 5,314 |
| 2 Charter Schools... | 314 | 19863 | 314 | 19,863 | 314 |
| 3 Private Non-Schools... | 591 | 16697 | 591 | 16,697 | 591 |
| 4 Private Christian Schools... | 336 | 8836 | 336 | 8,836 | 336 |
| 5 Private Catholic Schools... | 334 | 9869 | 334 | 9,869 | 334 |
| 6 Private Montessori Schools... | 99 | 2112 | 99 | 2,112 | 99 Schools |
| ... | | | | | |
| 7 Private Waldo Schools... | 16 | 513 | 16 | 513 | 16 Schools |
| ... | | | | | |
| 8 Charter Montessori Schools... | 5 | 227 | 5 | 227 | 5 Schools |
| E... | | | | | |
| 9 Public Montessori Schools... | 11 | 706 | 11 | 706 | 11 Schools |
| ... | | | | | |
| 10 Private Christian Schools... | 4 | 78 | 4 | 78 | 4 Schools |
| E... | | | | | |
| 11 Private Jewish Schools... | 8 | 237 | 8 | 237 | 8 Schools |

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 Enrolling"),
         info_students = paste(n_students_fmt, "Kindergarteners"))
aux_info
```

A little kludge

```
## This is not an efficient way to do this  
aux_info
```

| mwc | n_schools | n_students | n_schools_fmt | n_students_fmt |
|---------------------|-----------|------------|---------------|----------------|
| info_schools | <fct> | <int> | <dbl> | <chr> |
| | <chr> | | | |
| 1 Public | 5314 | 472802 | 5,314 | 472,802 |
| 5,314 Schoo... | | | | |
| 2 Charter | 314 | 19863 | 314 | 19,863 |
| Schools... | | | | |
| 3 Private Non-S... | 591 | 16697 | 591 | 16,697 |
| Schools... | | | | |
| 4 Private Chris... | 336 | 8836 | 336 | 8,836 |
| Schools... | | | | |
| 5 Private Catho... | 334 | 9869 | 334 | 9,869 |
| Schools... | | | | |
| 6 Private Monte... | 99 | 2112 | 99 | 2,112 |
| Schools ... | | | | |
| 7 Private Waldo... | 16 | 513 | 16 | 513 |
| Schools ... | | | | |
| 8 Charter Monte... | 5 | 227 | 5 | 227 |
| Schools E... | | | | |
| 9 Public Montes... | 11 | 706 | 11 | 706 |
| Schools ... | | | | |
| 10 Private Chris... | 4 | 78 | 4 | 78 |
| Schools E... | | | | |

A little kludge

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

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

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

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

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
```

| mwc | n_schools | n_students | n_schools_fmt | n_students_fmt |
|---------------------|-----------|------------|---------------|----------------|
| info_schools | <fct> | <int> | <dbl> | <chr> |
| | <chr> | | | |
| 1 Public | 5314 | 472802 | 5,314 | 472,802 |
| 5,314 Schoo... | | | | |
| 2 Charter | 314 | 19863 | 314 | 19,863 |
| Schools... | | | | 314 |
| 3 Private Non-S... | 591 | 16697 | 591 | 16,697 |
| Schools... | | | | 591 |
| 4 Private Chris... | 336 | 8836 | 336 | 8,836 |
| Schools... | | | | 336 |
| 5 Private Catho... | 334 | 9869 | 334 | 9,869 |
| Schools... | | | | 334 |
| 6 Private Monte... | 99 | 2112 | 99 | 2,112 |
| Schools ... | | | | 99 |
| 7 Private Waldo... | 16 | 513 | 16 | 513 |
| Schools ... | | | | 16 |
| 8 Charter Monte... | 5 | 227 | 5 | 227 |
| Schools E... | | | | 5 |
| 9 Public Montes... | 11 | 706 | 11 | 706 |
| Schools ... | | | | 11 |
| 10 Private Chris... | 4 | 78 | 4 | 78 |
| Schools E... | | | | 4 |

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 | info_schools | info_students |
|-----------------|------------------------------|---------------|-------------------|
| mwc | <fct> | <chr> | <chr> |
| 1 | Public | 5,314 Schools | Enrolling 472,802 |
| Kindergarteners | | | |
| 2 | Charter | 314 Schools | Enrolling 19,863 |
| Kindergarteners | | | |
| 3 | Private Non-Specific | 591 Schools | Enrolling 16,697 |
| Kindergarteners | | | |
| 4 | Private Christian | 336 Schools | Enrolling 8,836 |
| Kindergarteners | | | |
| 5 | Private Catholic | 334 Schools | Enrolling 9,869 |
| Kindergarteners | | | |
| 6 | Private Montessori | 99 Schools | Enrolling 2,112 |
| Kindergarteners | | | |
| 7 | Private Waldorf | 16 Schools | Enrolling 513 |
| Kindergarteners | | | |
| 8 | Charter Montessori | 5 Schools | Enrolling 227 |
| Kindergarteners | | | |
| 9 | Public Montessori | 11 Schools | Enrolling 706 |
| Kindergarteners | | | |
| 10 | Private Christian Montessori | 4 Schools | Enrolling 78 |
| Kindergarteners | | | |
| 11 | Private Jewish/Islamic | 8 Schools | Enrolling 237 |
| 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))
```

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

```
<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
```

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
```

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
"Charter\n314 Schools Enrolling\n19,863 Kindergarteners"
Charter Montessori
"Charter Montessori\n5 Schools Enrolling\n227 Kindergarteners"
Private Catholic
"Private Catholic\n334 Schools Enrolling\n9,869 Kindergarteners"
Private Christian
"Private Christian\n336 Schools Enrolling\n8,836 Kindergarteners"
Private Christian Montessori
"Private Christian Montessori\n4 Schools Enrolling\n78 Kindergarteners"
Private Jewish/Islamic
"Private Jewish/Islamic\n8 Schools Enrolling\n237 Kindergarteners"
Private Montessori
"Private Montessori\n99 Schools Enrolling\n2,112 Kindergarteners"
Private Non-Specific
"Private Non-Specific\n591 Schools Enrolling\n16,697 Kindergarteners"
Private Waldorf
"Private Waldorf\n16 Schools Enrolling\n513 Kindergarteners"
Public
"Public\n5,314 Schools Enrolling\n472,802 Kindergarteners"
Public Montessori
"Public Montessori\n11 Schools Enrolling\n706 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") ->
  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 x 13
   code county name type district city enrollment pbe_pct exempt
   <dbl> <chr>  <chr> <chr>  <chr>    <chr>      <dbl>    <dbl>    <dbl>
1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA...
0          109     13     12.8
2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL...
0.87        115      1     0.87
3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL...
0          40       0     0
4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL...
0          52       10    9.62
5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM...
0          128      2     1.56
6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM...
0          70       1     1.43
7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM...
0          100      3     3
8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM...
0          70       1     1.43
9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...
1.05        95       1     1.05
10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM...
0          50       2     2
```

At last, the Beeplot

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

```
# A tibble: 7,015 x 13
  code county name type district city enrollment pbe_pct exempt
  <dbl> <chr>  <chr> <chr>   <chr>    <chr>     <dbl>    <dbl>    <dbl>
#> 1 1.10e5 ALAME... FAME... PUBL... ALAMEDA... NEWA... 109      13  12.8
#> 2 6.00e6 ALAME... COX ... PUBL... ALAMEDA... OAKL... 115      1   0.87
#> 3 6.00e6 ALAME... LAZE... PUBL... ALAMEDA... OAKL... 40       0   0
#> 4 1.24e5 ALAME... YU M... PUBL... ALAMEDA... OAKL... 52       10  9.62
#> 5 6.10e6 ALAME... AMEL... PUBL... ALAMEDA... ALAM... 128      2   1.56
#> 6 6.11e6 ALAME... BAY ... PUBL... ALAMEDA... ALAM... 70       1   1.43
#> 7 6.09e6 ALAME... DONA... PUBL... ALAMEDA... ALAM... 100      3   3
#> 8 6.09e6 ALAME... EDIS... PUBL... ALAMEDA... ALAM... 70       1   1.43
#> 9 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM... 95       1   1.05
#> 10 6.09e6 ALAME... FRAN... PUBL... ALAMEDA... ALAM... 50       2   2
```

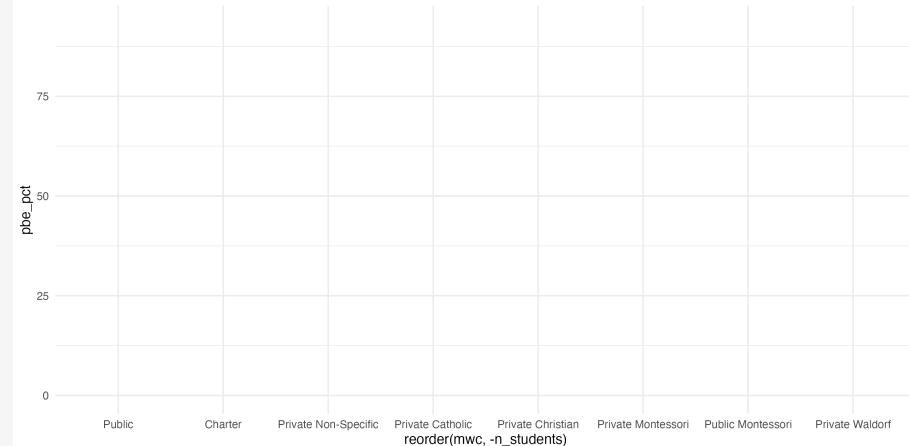
At last, the Beeplot

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

```
# A tibble: 7,015 x 19  
  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
```

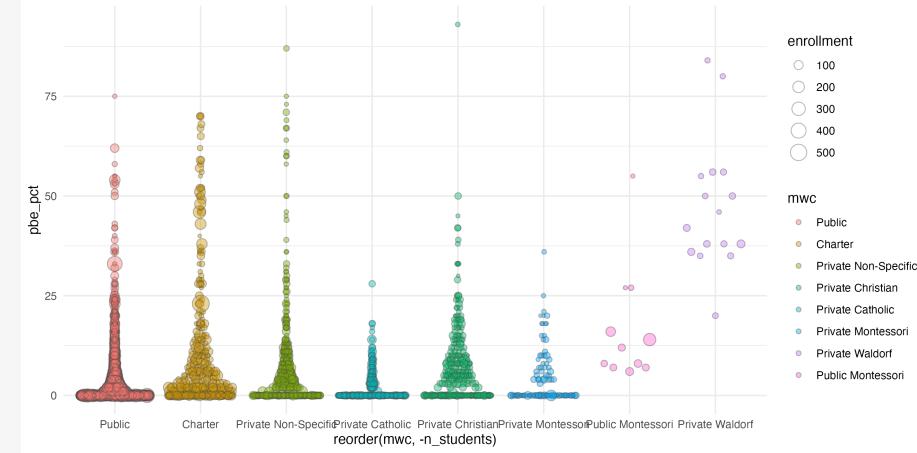
At last, the Beeplot

```
cavax %>  
  filter(mwc %in% 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))
```



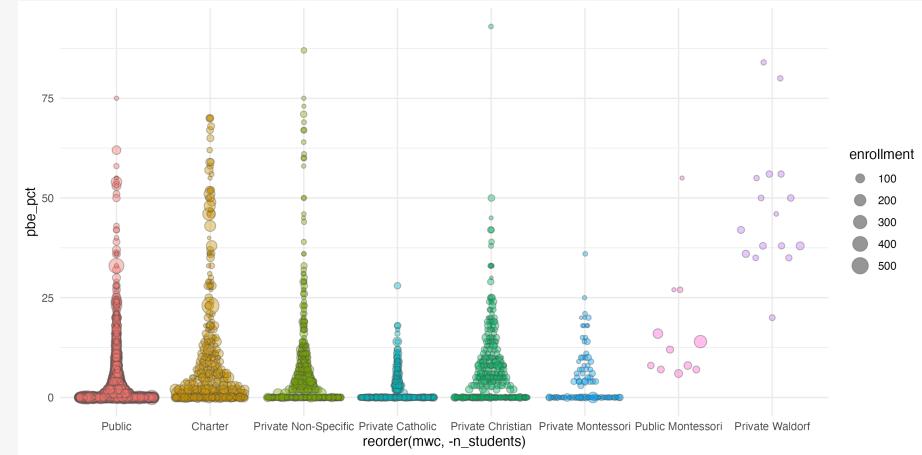
At last, the Beeplot

```
cavax %>%
  filter(mwc %in% 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)
```



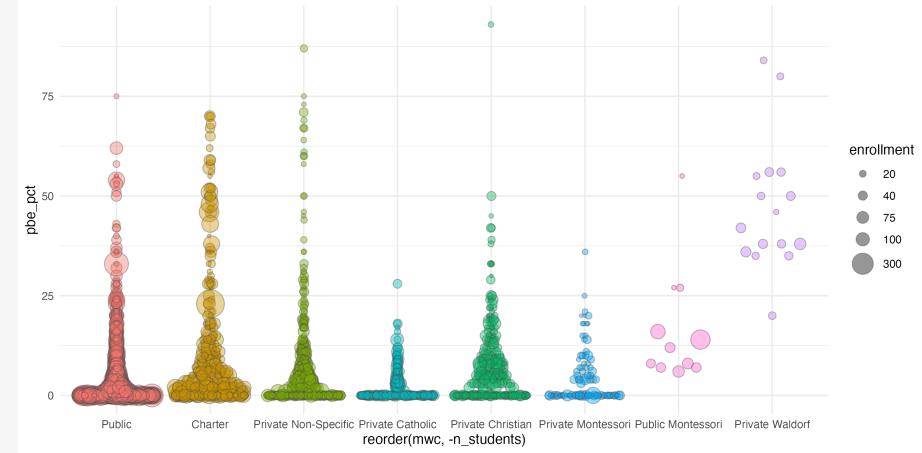
At last, the Beeplot

```
cavax %>  
  filter(mwc %in% 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")))
```



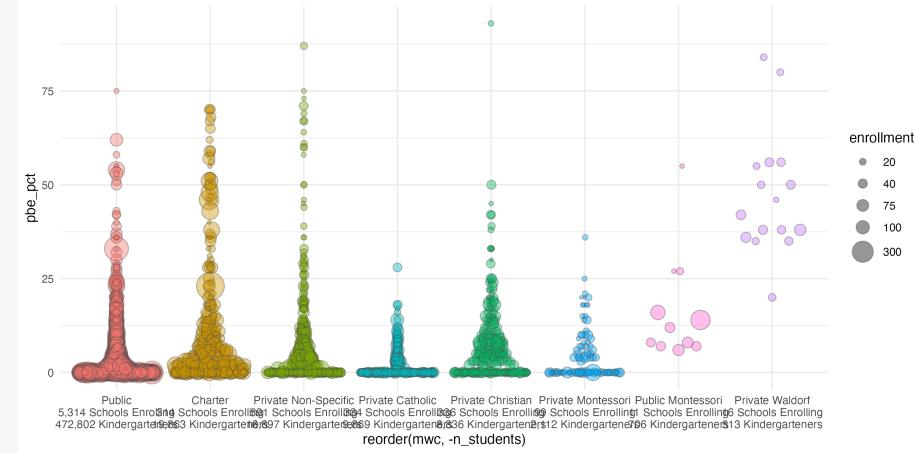
At last, the Beeplot

```
cavax %>  
  filter(mwc %in% 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))
```



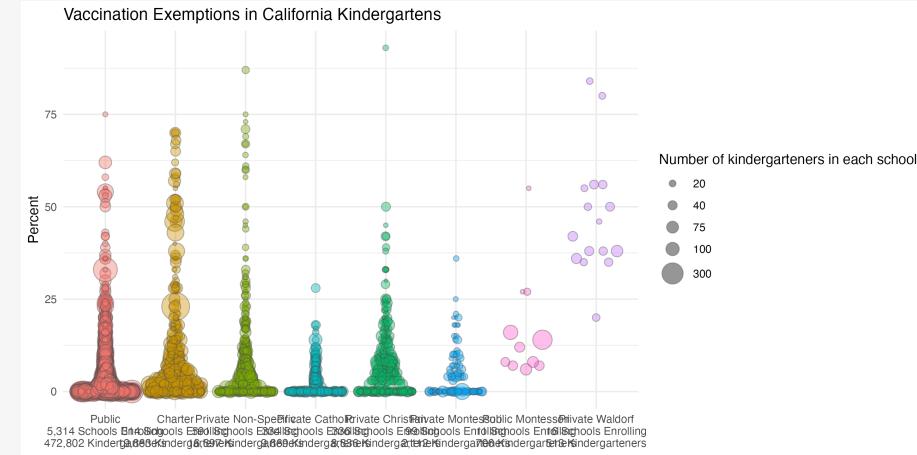
At last, the Beeplot

```
cavax %>%
  filter(mwc %in% 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)
```



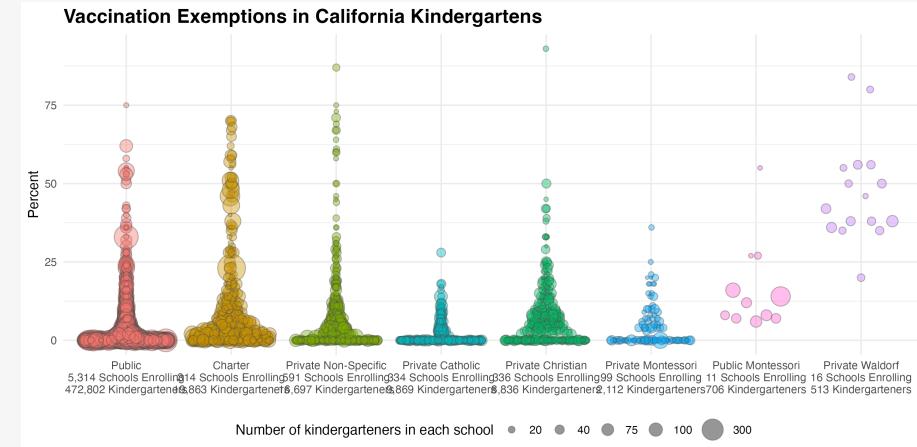
At last, the Beeplot

```
cavax %>%
  filter(mwc %in% 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 Kindergartens")
```



At last, the Beeplot

```
cavax %>%
  filter(mwc %in% 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 Kindergartens")
  theme(legend.position = "bottom",
        plot.title = element_text(size = rel(1.4),
                                  face = "bold"))
```



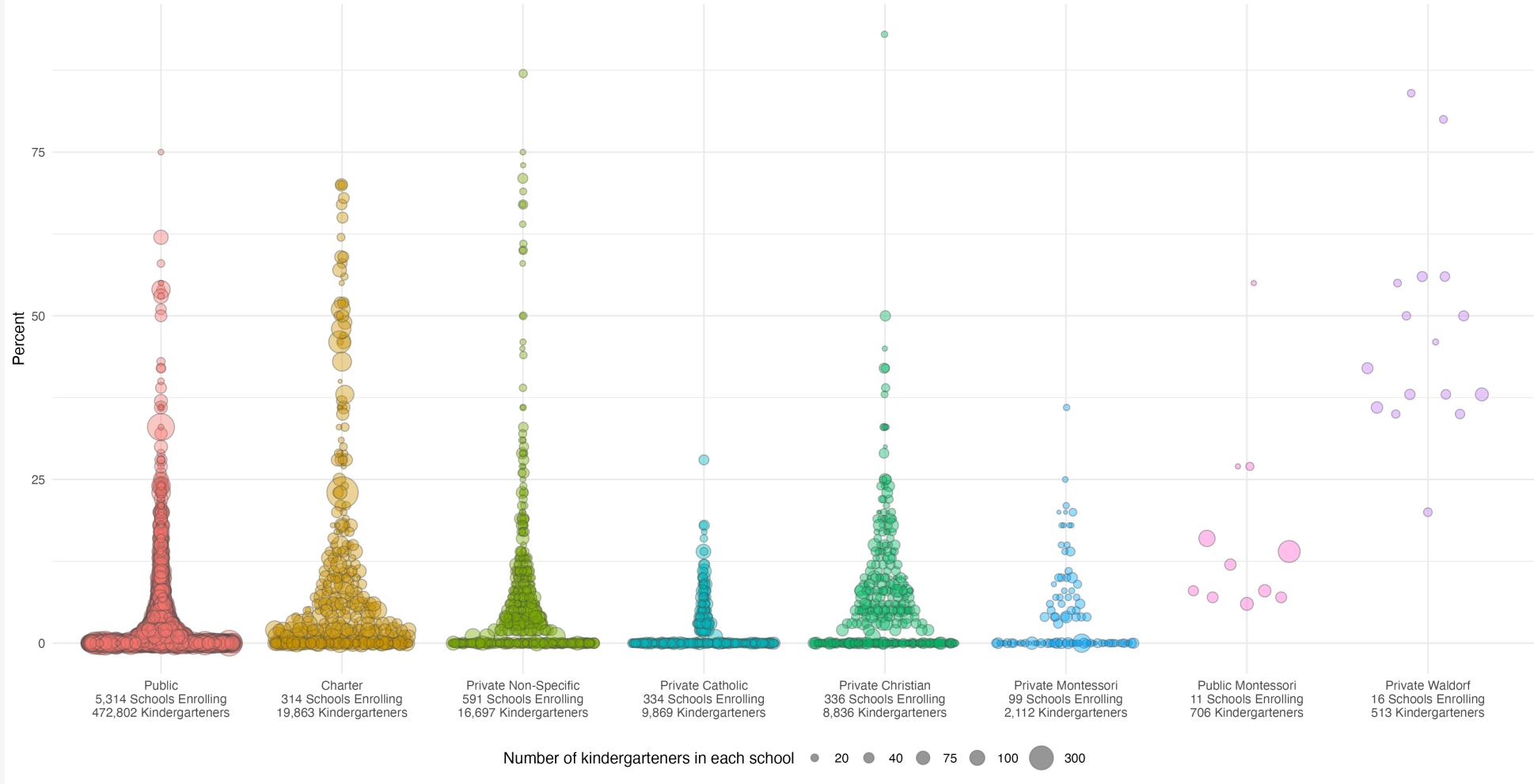
At last, the Beeplot

```
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 Kindergartens")
  theme(legend.position = "bottom",
    plot.title = element_text(size = rel(1.4),
      face = "bold")) -->
p_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 Kindergartens")
  theme(legend.position = "bottom",
    plot.title = element_text(size = rel(1.4),
      face = "bold")) -->
p_bee_main
```

Vaccination Exemptions in California Kindergartens



Vaccination Exemptions in California Kindergartens