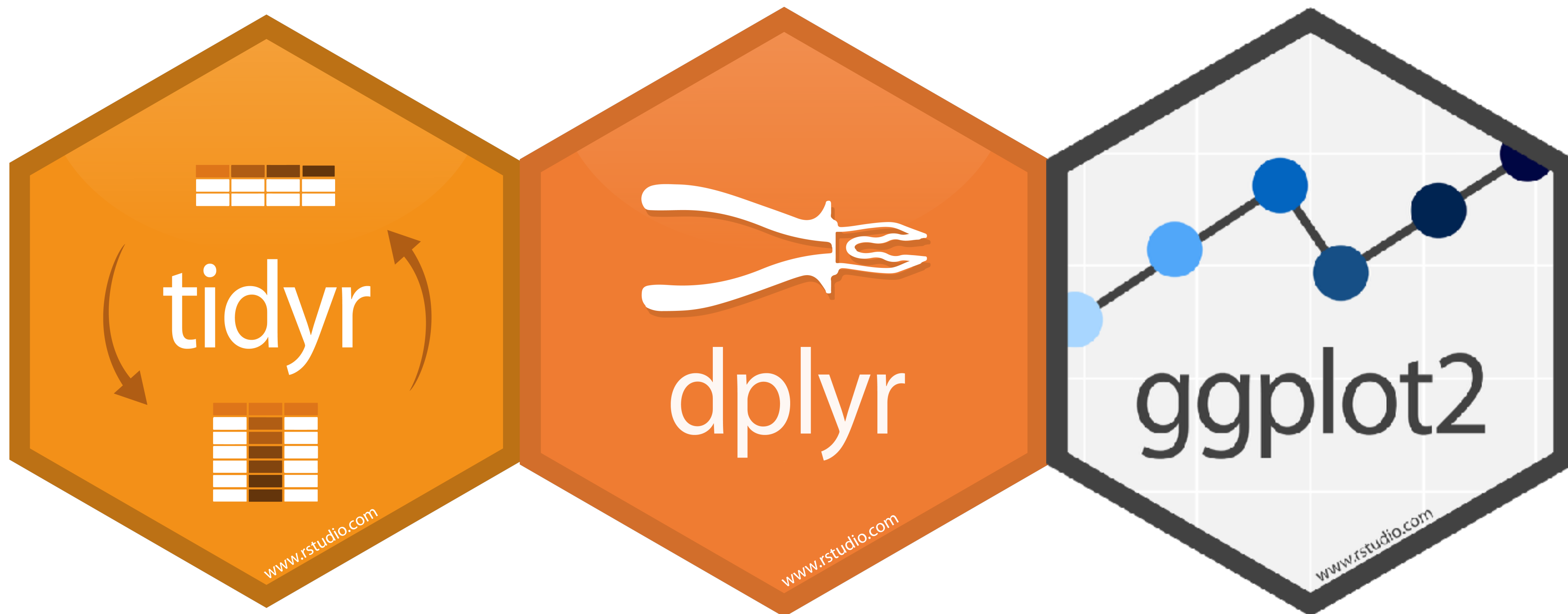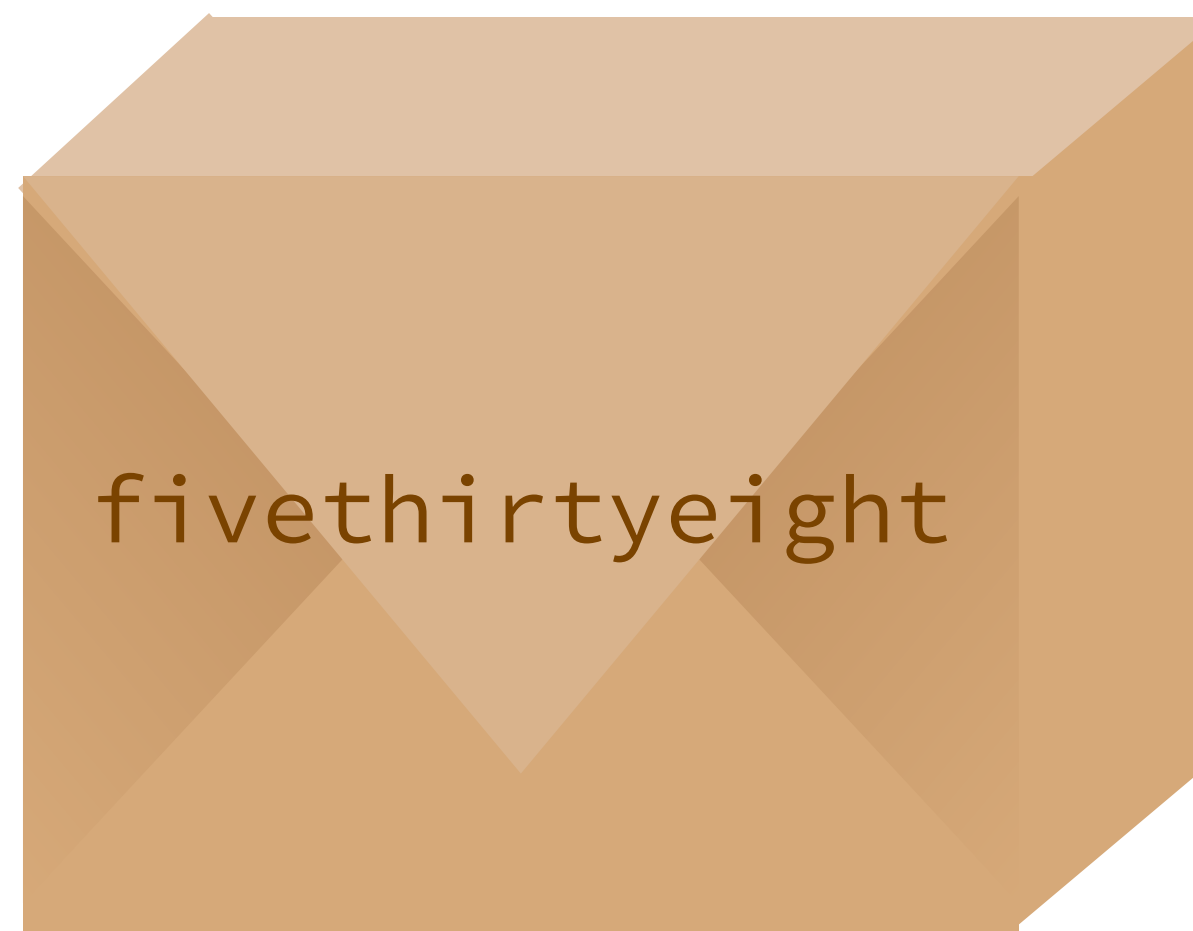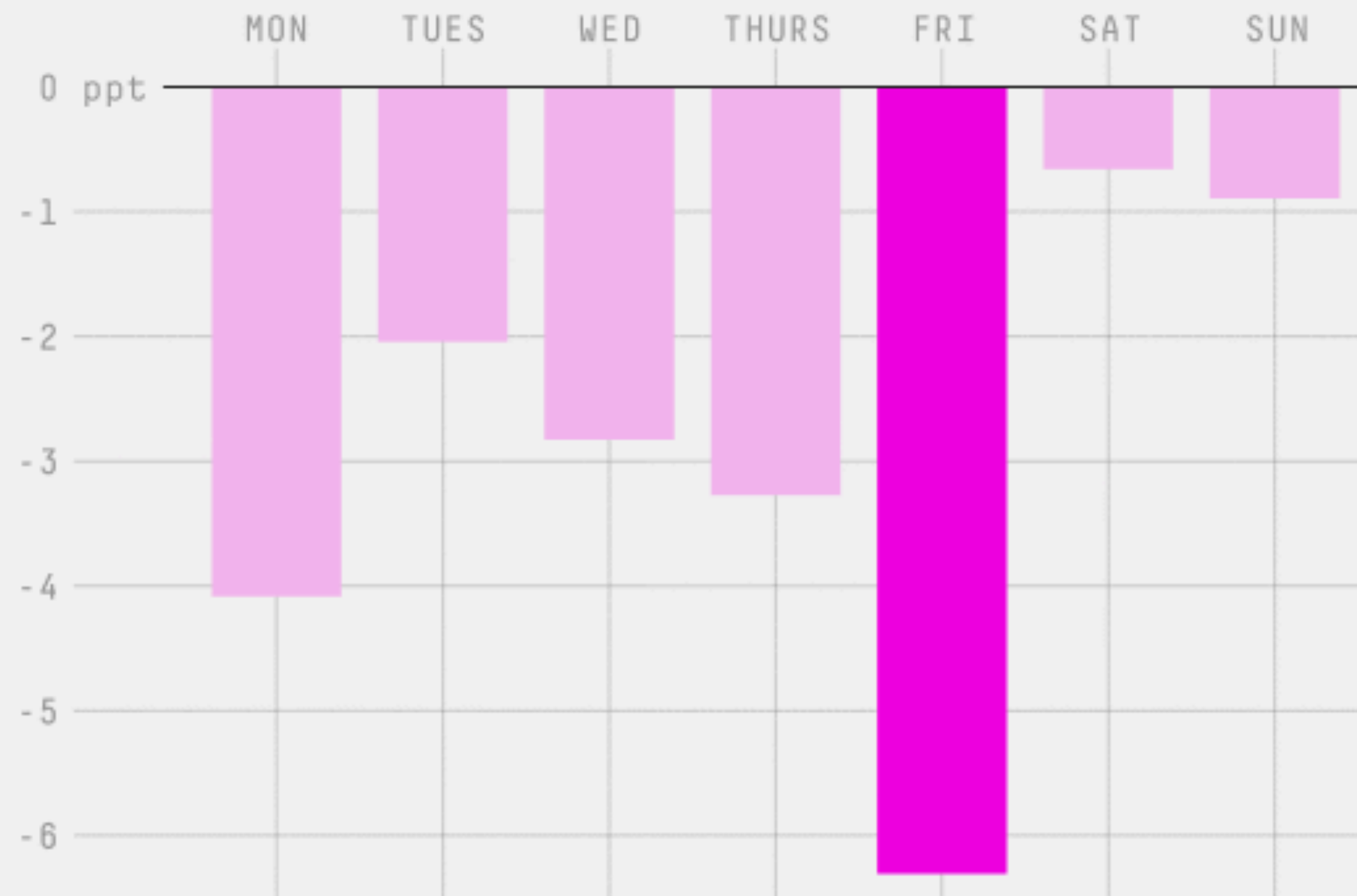# Case Study

fivethirtyeight

Datasets and code from the <u>fivethirtyeight </u>website.
(Not officially published by 'FiveThirtyEight').

```
# install.packages("fivethirtyeight")

library(fivethirtyeight)
```

The Friday the 13th effect

Difference in the share of U.S. births on the 13th of each month from the average of births on the 6th and the 20th, 1994-2014

Excludes holidays

FIVETHIRTYEIGHT   SOURCES: CDC/NCHS, SOCIAL SECURITY ADMINISTRATION

https://fivethirtyeight.com/features/some-people-are-too-superstitious-to-have-a-baby-on-friday-the-13th/

Can we replicate this plot?

Your Turn 1

Take a look at
`US_births_1994_2003`

With your neighbour, brainstorm the steps needed to get the data in a form ready to make the plot.

The Friday the 13th effect

Difference in the share of U.S. births on the 13th of each month from the average of births on the 6th and the 20th, 1994-2014
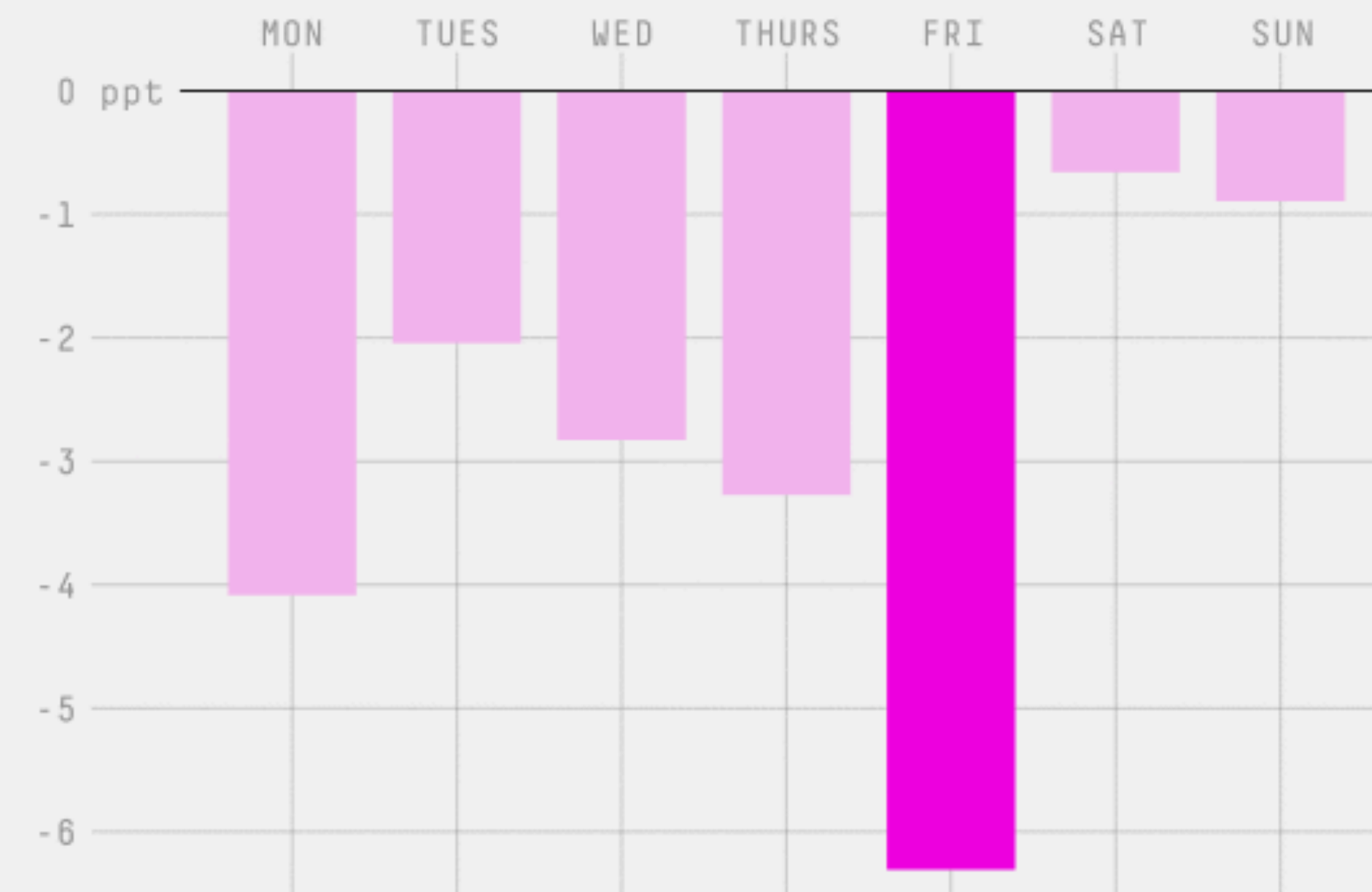
Excludes holidays

FIVETHIRTYEIGHT   SOURCES: CDC/NCHS, SOCIAL SECURITY ADMINISTRATION

05:00

```
US_births_1994_2003 %>%
  filter(year == 1994) %>%
  ggplot(mapping = aes(x = date, y = births)) +
    geom_line()
```

day_of_week

The Friday the 13th effect

Difference in the share of U.S. births on the 13th of each month from the average of births on the 6th and the 20th, 1994-2014

MON   TUES   WED   THURS   FRI   SAT   SUN

0 ppt

-1

-2

-3

-4

-5

-6

Excludes holidays

FIVETHIRTYEIGHT   SOURCES: CDC/NCHS, SOCIAL SECURITY ADMINISTRATION
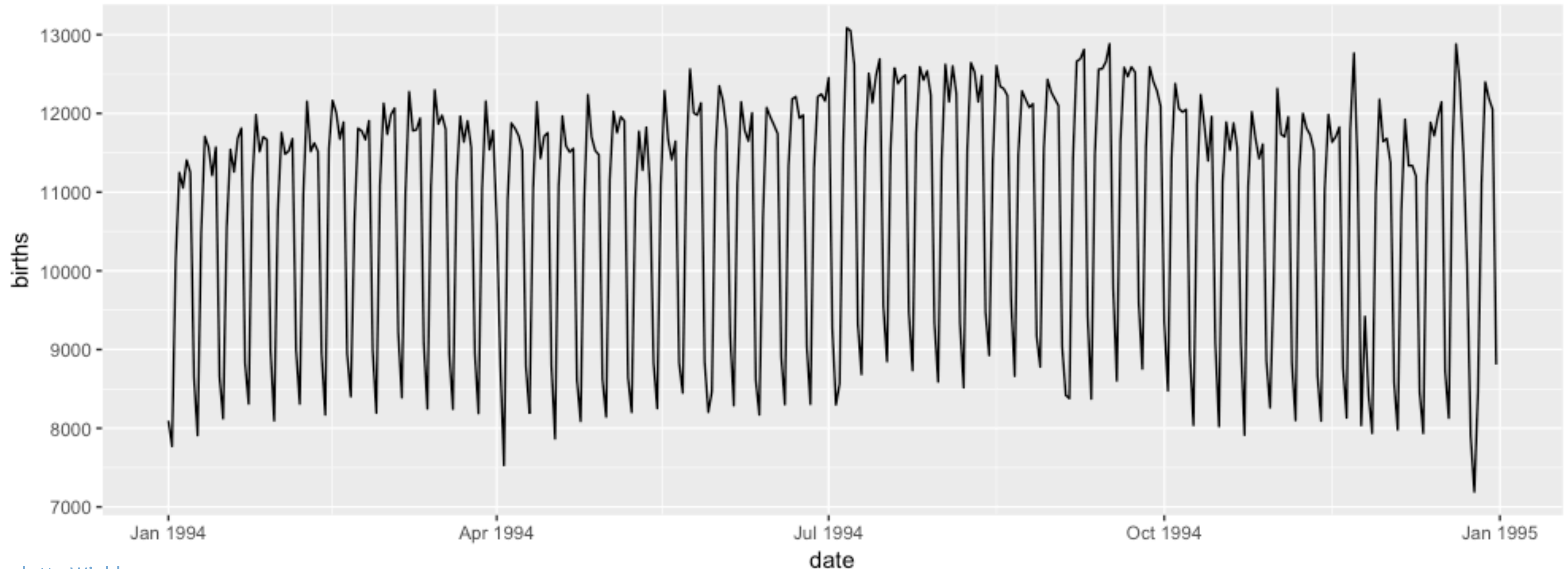
some calculated variable

Data required to make the plot

day_of_week	avg_diff_13*
Mon	-2.69
Tue	-1.38
Wed	-3.27
...	...

* using slightly different data

Start

```
# A tibble: 3,652 x 6

    year month date_of_month date       day_of_week births
   <int> <int>         <int> <date>     <ord>        <int>
1   1994     1             1 1994-01-01 Sat           8096
2   1994     1             2 1994-01-02 Sun           7772
3   1994     1             3 1994-01-03 Mon          10142
4   1994     1             4 1994-01-04 Tues         11248
    ...
```

End

```
# A tibble: 7 x 2
  day_of_week avg_diff_13
  <ord>             <dbl>
1 Sun              -0.303
2 Mon              -2.69
3 Tues             -1.38
4 Wed              -3.27
5 Thurs            -3.01
6 Fri              -6.81
7 Sat              -0.738
```

One such process

Get just the data for the 6th, 13th, and 20th

Calculate variable of interest:

(For each month/year):

Find average births on 6th and 20th

Find *percentage difference* between births on 13th and average births on 6th and 20th

Average *percent difference* by day of the week

Create plot

Your Turn 2

Extract just the 6th, 13th and 20th of each month.

(`select(-date)` removes the date column, because it gets in the way later and is redundant).

`02:00`

```
US_births_1994_2003 %>%
  select(-date) %>%
  filter(date_of_month %in% c(6, 13, 20))
```

year <int>	month <int>	date_of_month <int>	day_of_week <ord>	births <int>
1994	1	6	Thurs	11406
1994	1	13	Thurs	11212
1994	1	20	Thurs	11682
1994	2	6	Sun	8309
1994	2	13	Sun	8171
1994	2	20	Sun	8402
1994	3	6	Sun	8389
1994	3	13	Sun	8248
1994	3	20	Sun	8243
1994	4	6	Wed	11811

1-10 of 360 rows   Previous 1 2 3 4 5 6 … 36 Next

One month
Two options for arranging the data

Option 1
days in rows

year <int>	month <int>	date_of_month <int>	day_of_week <ord>	births <int>
1994	1	6	Thurs	11406
1994	1	13	Thurs	11212
1994	1	20	Thurs	11682

Option 2
days in cols

year <int>	month <int>	day_of_week <ord>	6 <int>	13 <int>	20 <int>
1994	1	Thurs	11406	11212	11682

Which one is tidy?

Your Turn 3

Which arrangement is tidy?

(**Hint:** think about our next step *"Find the percent difference between the 13th and the average of the 6th and 12th".* In which layout will this be easier using our tidy tools?)

02:00

Option 1

year <int>	month <int>	date_of_month <int>	day_of_week <ord>	births <int>
1994	1	6	Thurs	11406
1994	1	13	Thurs	11212
1994	1	20	Thurs	11682

Next step, we'd have to write a custom function to summarize these three rows, relying on order, or subsetting to reference dates.
NOT TIDY.

Option 2

year <int>	month <int>	day_of_week <ord>	6 <int>	13 <int>	20 <int>
1994	1	Thurs	11406	11212	11682

Next step, we can use mutate directly referring to columns for days.
TIDY!

Your Turn 4

Tidy the filtered data to have the days in columns.

E.g.

	year <int>	month <int>	day_of_week <ord>	6 <int>	13 <int>	20 <int>
1	1994	1	Thurs	11406	11212	11682
2	1994	2	Sun	8309	8171	8402
3	1994	3	Sun	8389	8248	8243
4	1994	4	Wed	11811	11428	11585
5	1994	5	Fri	11904	11085	11645
6	1994	6	Mon	11130	10692	11337
7	1994	7	Wed	13086	12134	12378
8	1994	8	Sat	9336	9474	9646
9	1994	9	Tues	11448	12560	12584
10	1994	10	Thurs	12017	11398	11876

1-10 of 120 rows   Previous 1 2 3 4 5 6 … 12 Next

03:00

```
US_births_1994_2003 %>%
  select(-date) %>%
  filter(date_of_month %in% c(6, 13, 20)) %>%
  spread(date_of_month, births)
```

	year <int>	month <int>	day_of_week <ord>	6 <int>	13 <int>	20 <int>
1	1994	1	Thurs	11406	11212	11682
2	1994	2	Sun	8309	8171	8402
3	1994	3	Sun	8389	8248	8243
4	1994	4	Wed	11811	11428	11585
5	1994	5	Fri	11904	11085	11645
6	1994	6	Mon	11130	10692	11337
7	1994	7	Wed	13086	12134	12378
8	1994	8	Sat	9336	9474	9646
9	1994	9	Tues	11448	12560	12584
10	1994	10	Thurs	12017	11398	11876

1-10 of 120 rows   Previous 1 2 3 4 5 6 … 12 Next

Your Turn 5

Now use `mutate()` to add columns for:

- The average of the births on the 6th and 20th

- The percentage difference between the number of births on the 13th and the average of the 6th and 20th

(Hint: You need to use backticks ` around the days, e.g. `` `6` ``, `` `13` `` and `` `20` `` to specify the column names)

`03:00`

```
US_births_1994_2003 %>%
  select(-date) %>%
  filter(date_of_month %in% c(6, 13, 20)) %>%
  spread(date_of_month, births) %>%
  mutate(
    avg_6_20 = (`6` + `20`)/2,
    diff_13 = (`13` - avg_6_20) / avg_6_20 * 100
  )
```

| year | month | day_of_week | 6 | 13 | 20 | avg_6_20 | diff_13 |
<int>	<int>	<ord>	<int>	<int>	<int>	<dbl>	<dbl>
1994	1	Thurs	11406	11212	11682	11544.0	-2.87595288
1994	2	Sun	8309	8171	8402	8355.5	-2.20812638
1994	3	Sun	8389	8248	8243	8316.0	-0.81770082
1994	4	Wed	11811	11428	11585	11698.0	-2.30808685
1994	5	Fri	11904	11085	11645	11774.5	-5.85587498
1994	6	Mon	11130	10692	11337	11233.5	-4.82040326
1994	7	Wed	13086	12134	12378	12732.0	-4.69682689
1994	8	Sat	9336	9474	9646	9491.0	-0.17911706
1994	9	Tues	11448	12560	12584	12016.0	4.52729694
1994	10	Thurs	12017	11398	11876	11946.5	-4.59130289

1-10 of 120 rows   Previous 1 2 3 4 5 6 … 12 Next

```
births_diff_13 <- US_births_1994_2003 %>%
   select(-date) %>%
   filter(date_of_month %in% c(6, 13, 20)) %>%
   spread(date_of_month, births) %>%
   mutate(
      avg_6_20 = (`6` + `20`)/2,
      diff_13 = (`13` - avg_6_20) / avg_6_20 * 100
   )
```
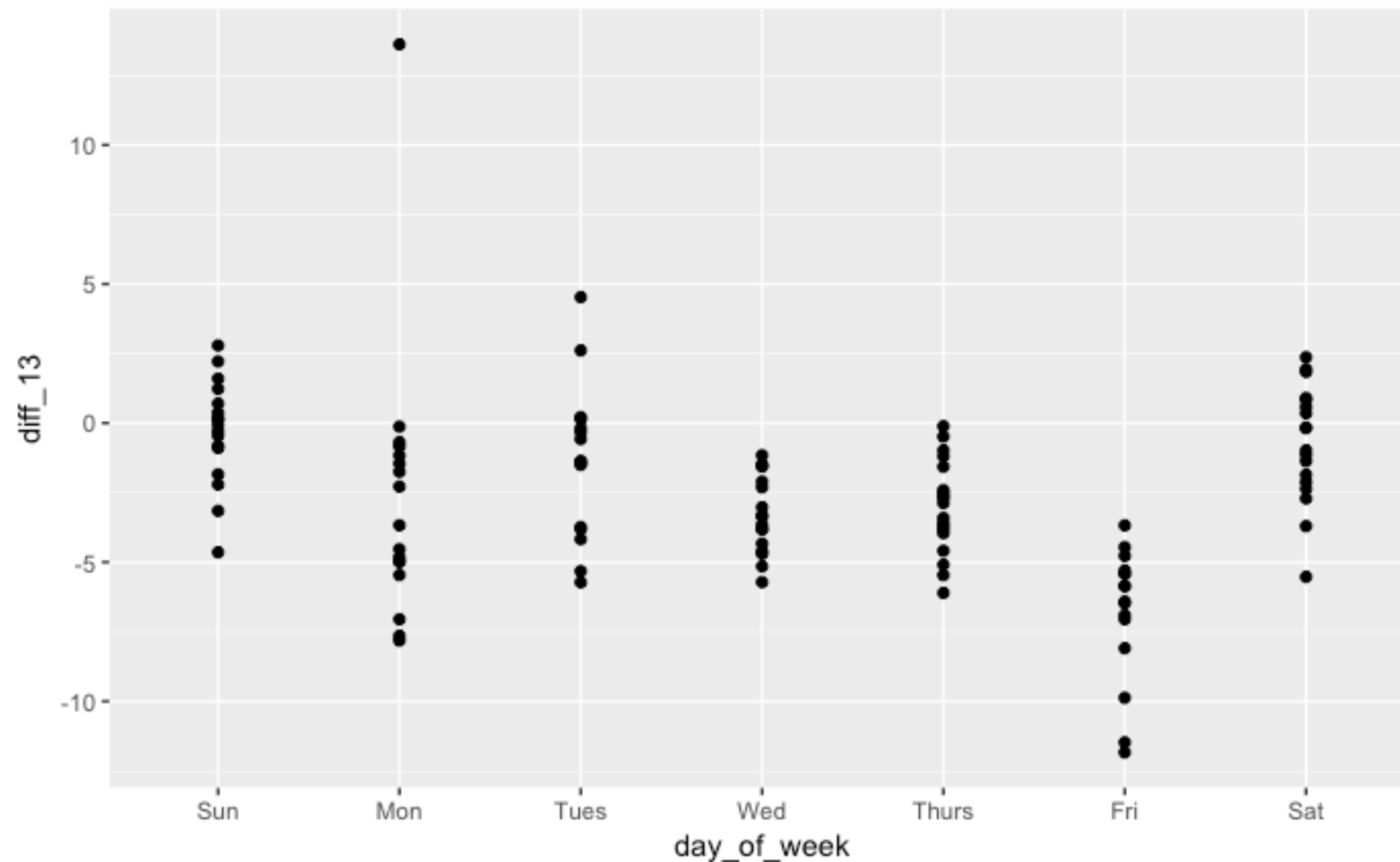
year <int>	month <int>	day_of_week <ord>	6 <int>	13 <int>	20 <int>	avg_6_20 <dbl>	diff_13 <dbl>
1994	1	Thurs	11406	11212	11682	11544.0	-2.87595288
1994	2	Sun	8309	8171	8402	8355.5	-2.20812638
1994	3	Sun	8389	8248	8243	8316.0	-0.81770082
1994	4	Wed	11811	11428	11585	11698.0	-2.30808685
1994	5	Fri	11904	11085	11645	11774.5	-5.85587498
1994	6	Mon	11130	10692	11337	11233.5	-4.82040326
1994	7	Wed	13086	12134	12378	12732.0	-4.69682689
1994	8	Sat	9336	9474	9646	9491.0	-0.17911706
1994	9	Tues	11448	12560	12584	12016.0	4.52729694
1994	10	Thurs	12017	11398	11876	11946.5	-4.59130289

1-10 of 120 rows   Previous   1   2   3   4   5   6   …   12   Next

```
births_diff_13 %>%
  ggplot(mapping = aes(day_of_week, diff_13)) +
    geom_point()
```

```
births_diff_13 %>%
    filter(day_of_week == "Mon", diff_13 > 10)
```

year <int>	month <int>	day_of_week <ord>	6 <int>	13 <int>	20 <int>	avg_6_20 <dbl>	diff_13 <dbl>
1999	9	Mon	8249	11481	11961	10105	13.61702

1 row

Your Turn 6

Summarize each day of the week to have mean of `diff_13`.

Then, recreate the fivethirtyeight plot.
(**Hint:** use `geom_col()` not `geom_bar()`)

(**Extra challenge:** use a different summary, and/or another way of visualizing the data)

`05:00`

```
US_births_1994_2003 %>%
  select(-date) %>%
  filter(date_of_month %in% c(6, 13, 20)) %>%
  spread(date_of_month, births) %>%
  mutate(
    avg_6_20 = (`6` + `20`)/2,
    diff_13 = (`13` - avg_6_20) / avg_6_20 * 100
  ) %>%
  group_by(day_of_week) %>%
  summarise(avg_diff_13 = mean(diff_13))
```

| day_of_week <ord>	avg_diff_13 <dbl>
Sun	-0.3026934
Mon	-2.6856859
Tues	-1.3776517
Wed	-3.2735133
Thurs	-3.0117652
Fri	-6.8057874
Sat	-0.7376400

```
births_13_sum <- US_births_1994_2003 %>%
  select(-date) %>%
  filter(date_of_month %in% c(6, 13, 20)) %>%
  spread(date_of_month, births) %>%
  mutate(
    avg_6_20 = (`6` + `20`)/2,
    diff_13 = (`13` - avg_6_20) / avg_6_20 * 100
  ) %>%
  group_by(day_of_week) %>%
  summarise(avg_diff_13 = mean(diff_13))
```

day_of_week <ord>	avg_diff_13 <dbl>
Sun	-0.3026934
Mon	-2.6856859
Tues	-1.3776517
Wed	-3.2735133
Thurs	-3.0117652
Fri	-6.8057874
Sat	-0.7376400

```
births_13_sum  %>%
  ggplot(aes(x = day_of_week, y = avg_diff_13)) +
    geom_col()
```
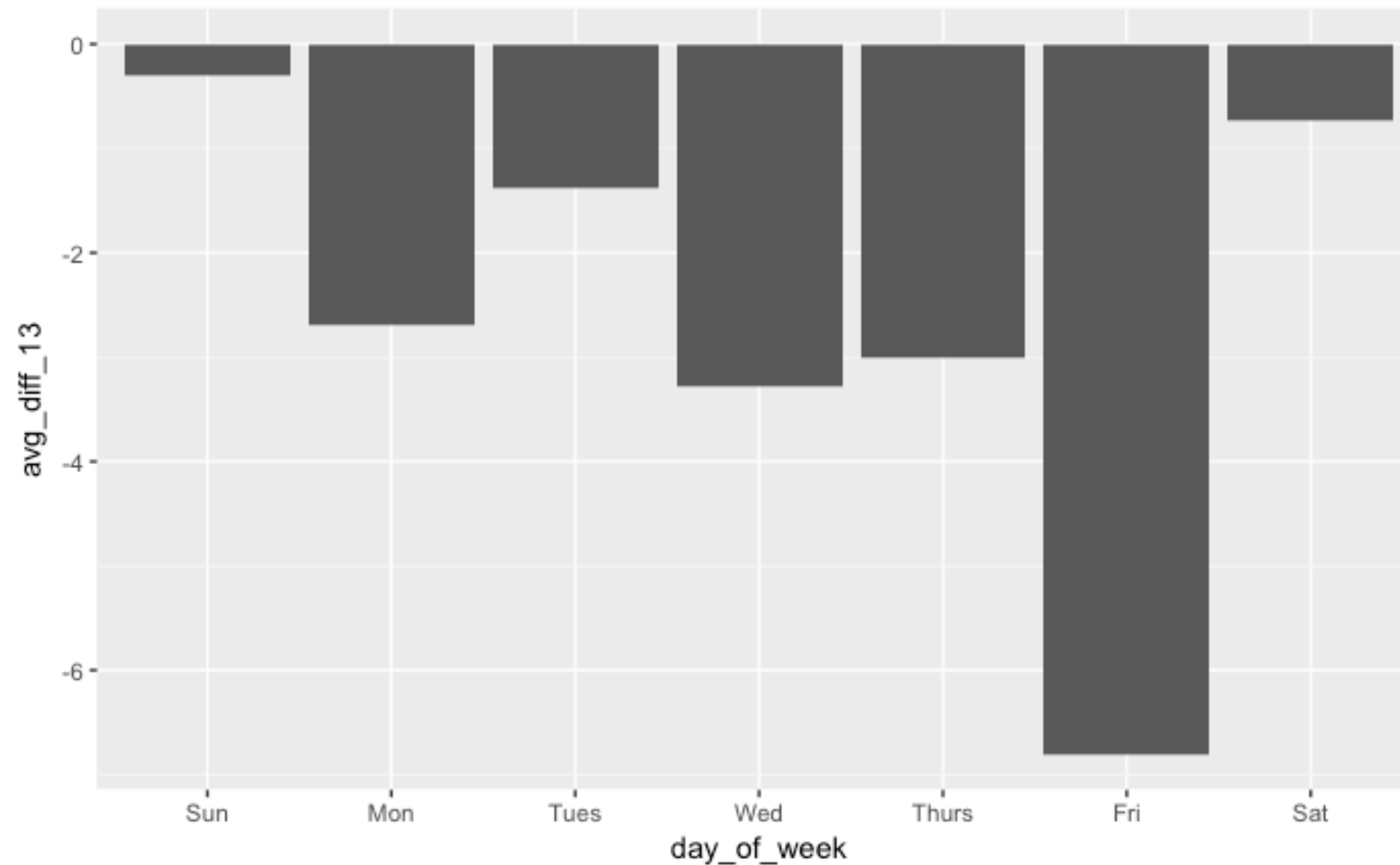
Extra Challenges

If you wanted to use the `US_births_2000_2014` data instead, what would you need to change in the pipeline? How about using both `US_births_1994_2003` **and** `US_births_2000_2014`?

Can you also use the 27th?

Try not removing the `date` column. At what point in the pipeline does it cause problems? Why?

Can you come up with an alternative way to investigate the Friday the 13th effect? Try it out!

Case Study