AE 15: Optimizing color spaces

Suggested answers

APPLICATION EXERCISE ANSWERS

MODIFIED
March 20, 2025

```
library(tidyverse)
library(colorspace) # for improved color palettes
library(scales) # for improved labels
library(ggthemes) # for scale_color_colorblind()

theme_set(theme_classic(base_size = 12))
```

Import birth data

The Social Security Administration keeps detailed records on births and deaths in the United States. For our analysis, we will use a dataset of the number of births daily in the United States from 1994-2014.[1]

```
births <- read_rds("data/births.Rds")
births
```

```
# A tibble: 7,670 × 7
    year month   date_of_month day_of_week births date_of_month_catego…¹ weekend
   <dbl> <ord>           <dbl> <ord>        <dbl> <fct>                  <lgl>
 1  1994 January             1 Saturday      8096 1                      TRUE
 2  1994 January             2 Sunday        7772 2                      TRUE
 3  1994 January             3 Monday       10142 3                      FALSE
 4  1994 January             4 Tuesday      11248 4                      FALSE
 5  1994 January             5 Wednesday    11053 5                      FALSE
 6  1994 January             6 Thursday     11406 6                      FALSE
 7  1994 January             7 Friday       11251 7                      FALSE
 8  1994 January             8 Saturday      8653 8                      TRUE
 9  1994 January             9 Sunday        7910 9                      TRUE
10  1994 January            10 Monday       10498 10                     FALSE
# ℹ 7,660 more rows
# ℹ abbreviated name: ¹date_of_month_categorical
```

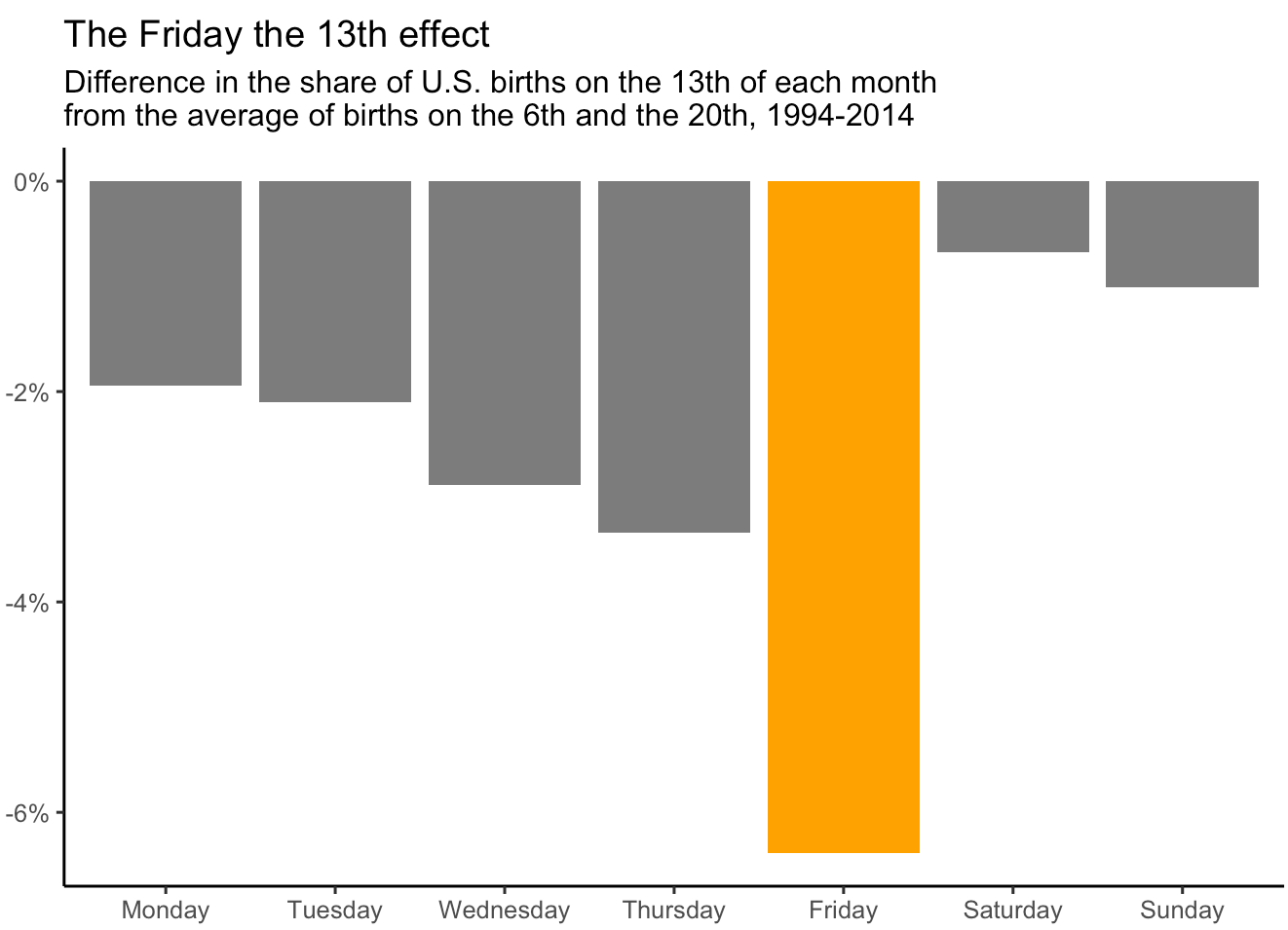
The Friday the 13th effect

Friday the 13th is considered an unlucky day in Western superstition. Let's see if fewer babies are born on the 13th of each month if it falls on a Friday compared to another week day. Specifically, we will compare the average number of births on the 13th of the month to the average number of births on the 6th and 20th of the month.

Your turn: Visualize the results using a bar chart. Emphasize the difference on Fridays compared to other weekdays.[2]

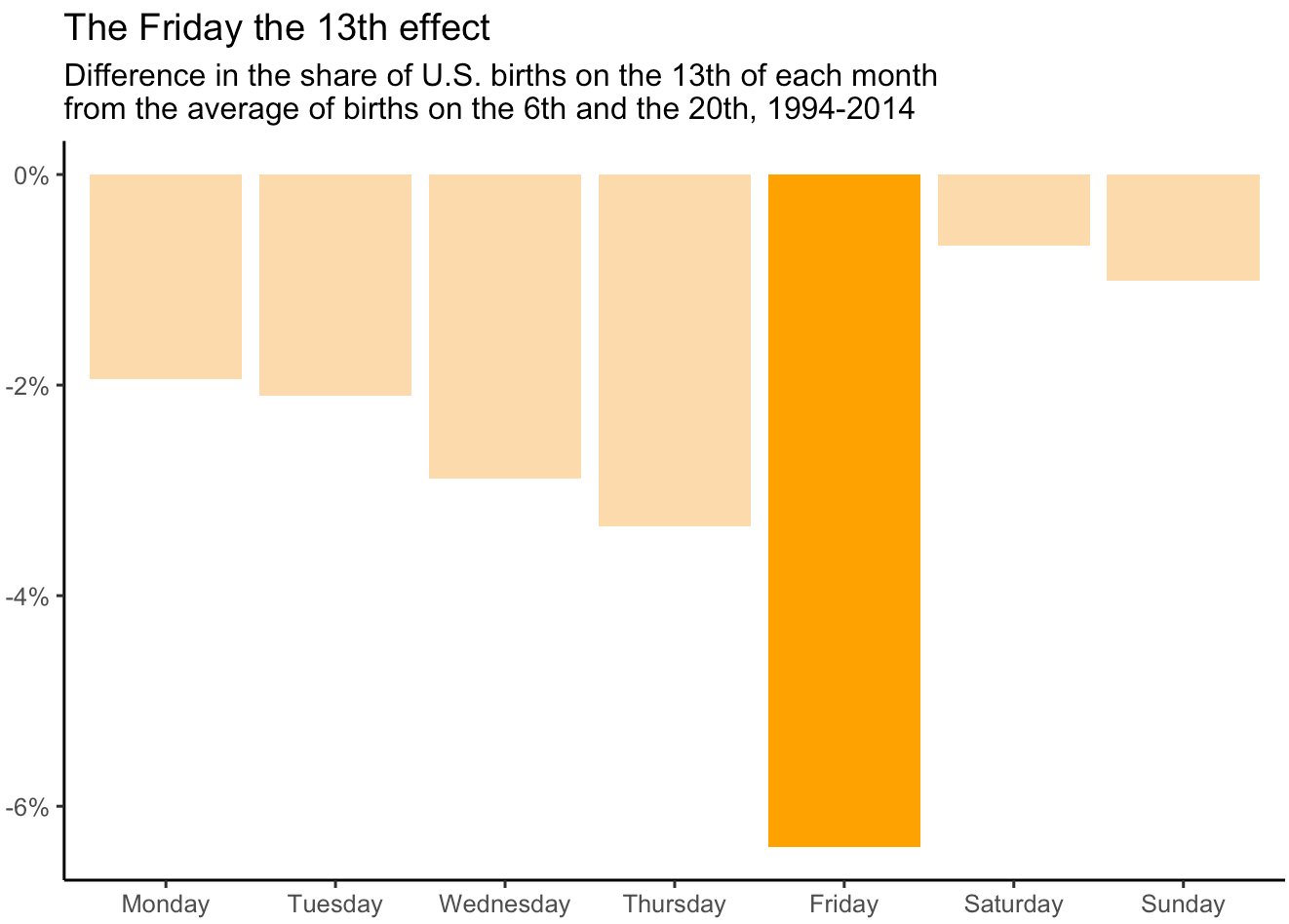
```
friday_13_births <- births |>
  # only look at births on the 6, 13, and 20th
  filter(date_of_month %in% c(6, 13, 20)) |>
  # distinguish 6/20 from 13
  mutate(not_13 = date_of_month == 13) |>
  # calculate average number of births for each week day and whether or not it was the 13th
  summarize(
    avg_births = mean(births),
    .by = c(day_of_week, not_13)
  ) |>
  # calculate the difference in percentage
  pivot_wider(
    names_from = not_13,
    values_from = avg_births
  ) |>
  mutate(pct_diff = (`TRUE` - `FALSE`) / `FALSE`) |>
  arrange(day_of_week)

# highlight one bar in orange
ggplot(
  data = friday_13_births,
  mapping = aes(
    x = day_of_week,
    y = pct_diff,
    fill = day_of_week == "Friday"
  )
) +
  geom_col() +
  scale_y_continuous(labels = label_percent()) +
  scale_fill_manual(values = c("grey50", "orange"), guide = "none") +
  labs(
    x = NULL,
    y = NULL,
    title = "The Friday the 13th effect",
```

```
    subtitle = "Difference in the share of U.S. births on the 13th of each month\nfrom the
        average of births on the 6th and the 20th, 1994-2014"
  )
```




```
# use transparency instead
ggplot(
  data = friday_13_births,
  mapping = aes(
    x = day_of_week,
    y = pct_diff,
    alpha = day_of_week == "Friday"
  )
) +
  geom_col(fill = "orange") +
  scale_y_continuous(labels = label_percent()) +
  scale_alpha_manual(values = c(0.4, 1), guide = "none") +
  labs(
    x = NULL,
    y = NULL,
    title = "The Friday the 13th effect",
```

```
    subtitle = "Difference in the share of U.S. births on the 13th of each month\nfrom the
        average of births on the 6th and the 20th, 1994-2014"
  )
```



Create a heatmap showing average number of births by day of year

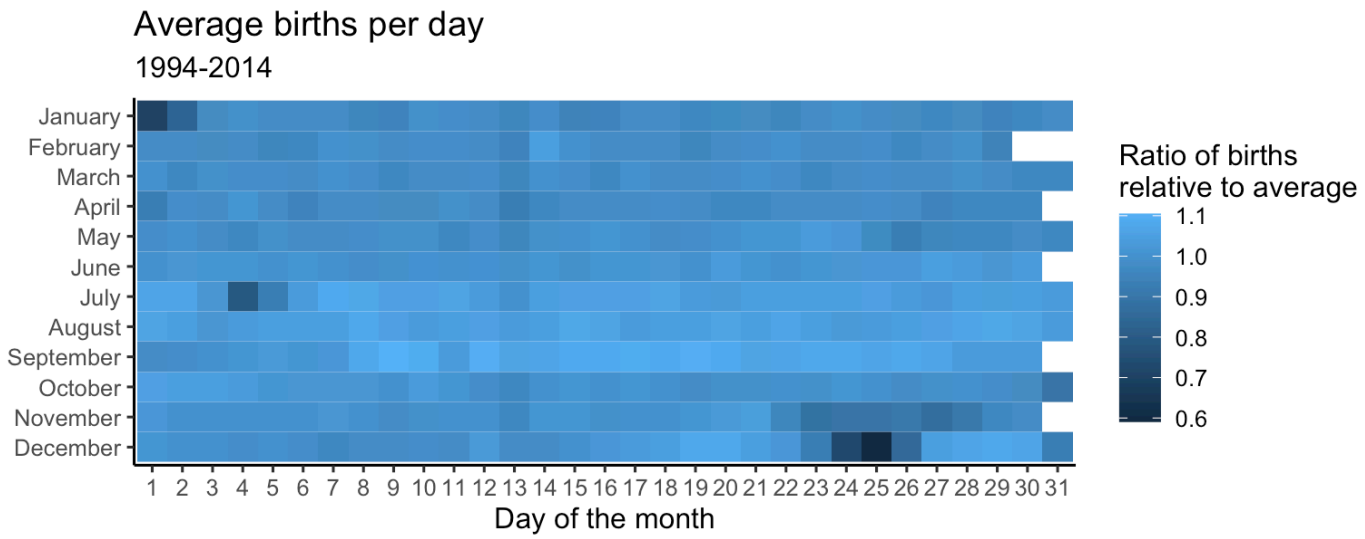
Let's explore the relative popularity of each calendar day for births. We will create a heatmap showing the relative ratio of births for each day of the year compared to the annual average.

```
avg_births_month_day <- births |>
  group_by(month, date_of_month_categorical) |>
  summarize(avg_births = mean(births), .groups = "drop") |>
  mutate(avg_births_ratio = avg_births / mean(births$births))
avg_births_month_day
```

```
# A tibble: 366 × 4
   month   date_of_month_categorical avg_births avg_births_ratio
   <ord>   <fct>                         <dbl>           <dbl>
```

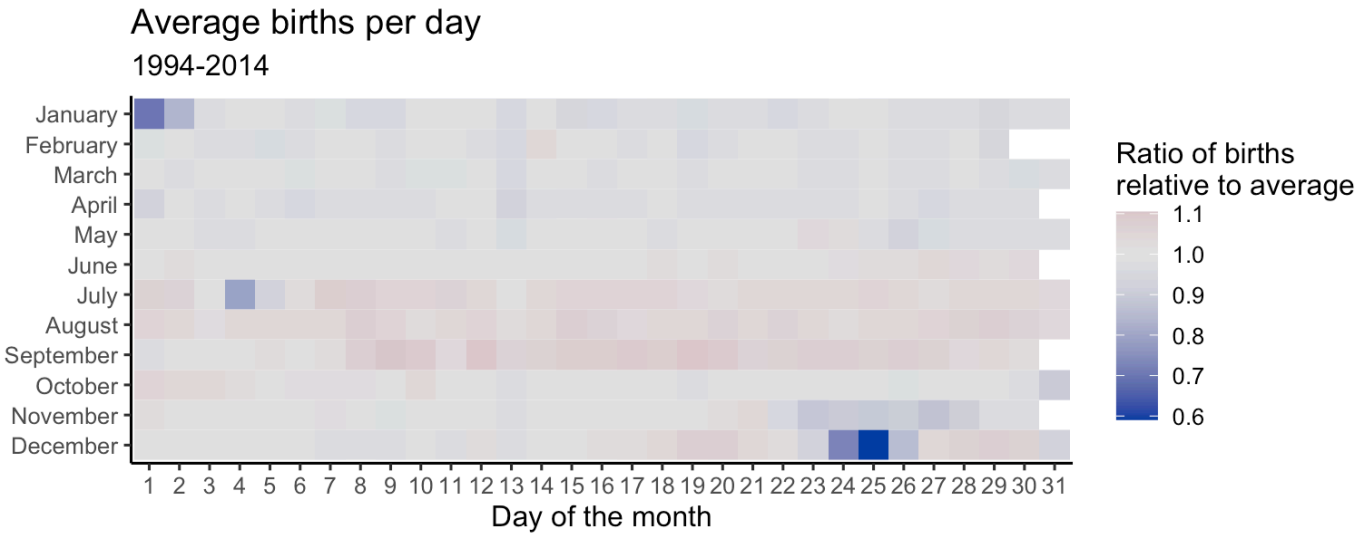
```
 1 January 1                7827.          0.700
 2 January 2                9356.          0.837
 3 January 3               10869.          0.973
 4 January 4               11064.          0.990
 5 January 5               10992.          0.984
 6 January 6               10942.          0.979
 7 January 7               10963.          0.981
 8 January 8               10656.          0.954
 9 January 9               10672.          0.955
10 January 10              11072.          0.991
# ℹ 356 more rows
```

```r
birth_days_plot <- ggplot(
  data = avg_births_month_day,
  # By default, the y-axis will have December at the top, so use fct_rev() to reverse it
  mapping = aes(x = date_of_month_categorical, y = fct_rev(month), fill = avg_births_ratio)
) +
  geom_tile() +
  # Add nice labels
  labs(
    x = "Day of the month", y = NULL,
    title = "Average births per day",
    subtitle = "1994-2014",
    fill = "Ratio of births\nrelative to average"
  ) +
  # Force all the tiles to have equal widths and heights
  coord_equal()
birth_days_plot
```

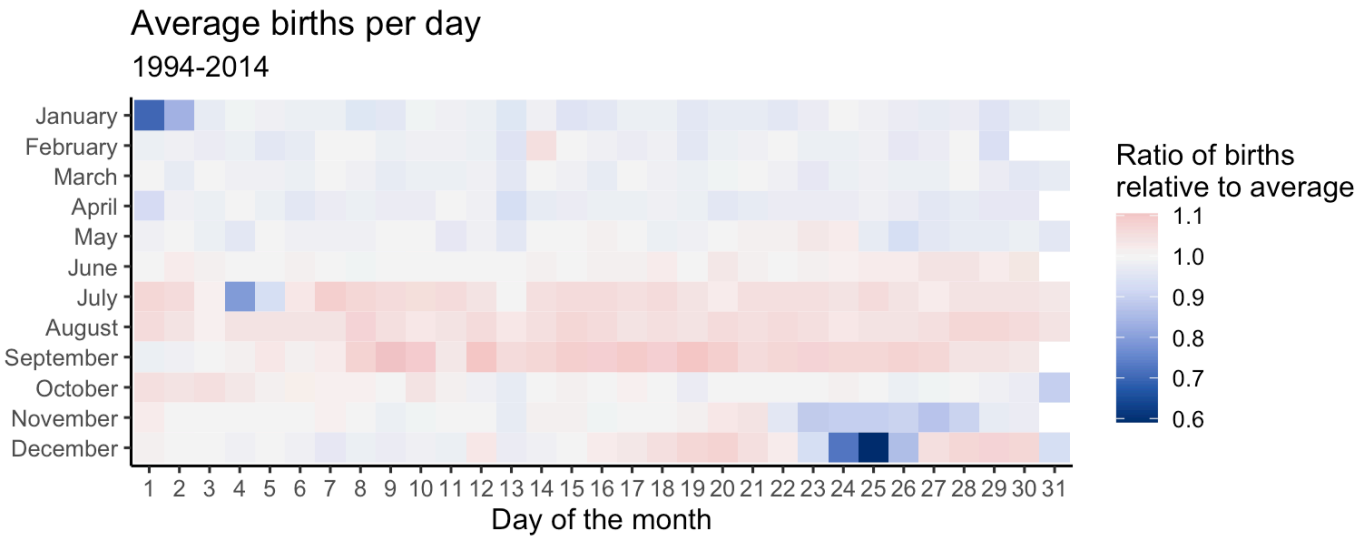


Your turn: Modify the plot to use an appropriate color palette. What days have an unusually high or low number of births?

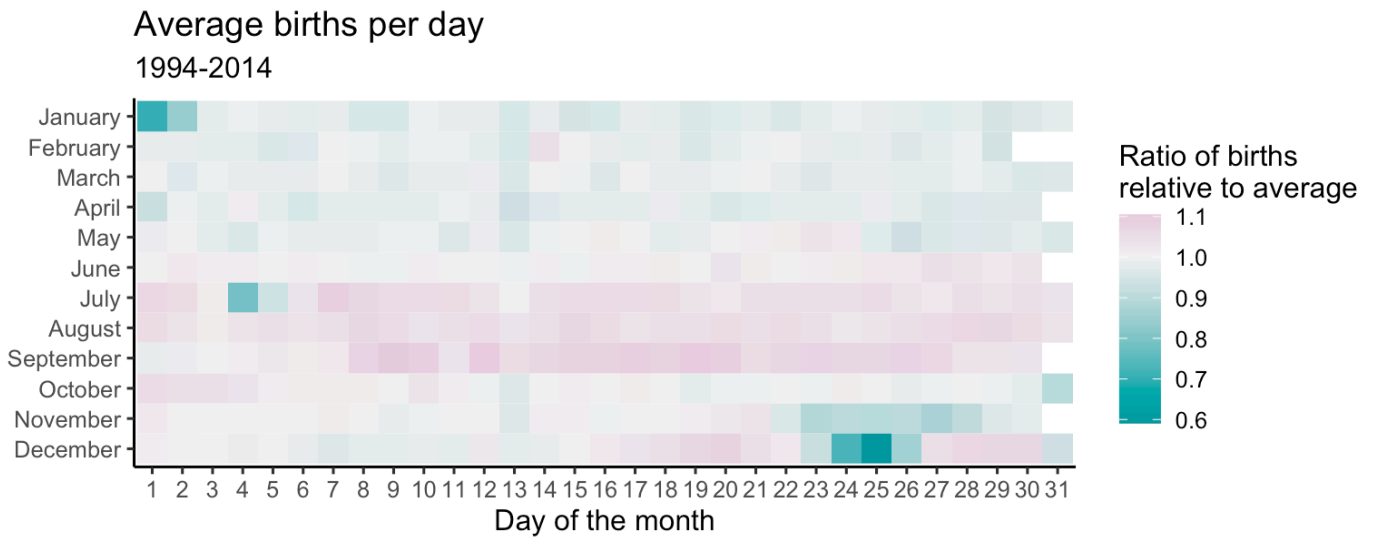
```
birth_days_plot + scale_fill_continuous_diverging(mid = 1)
```



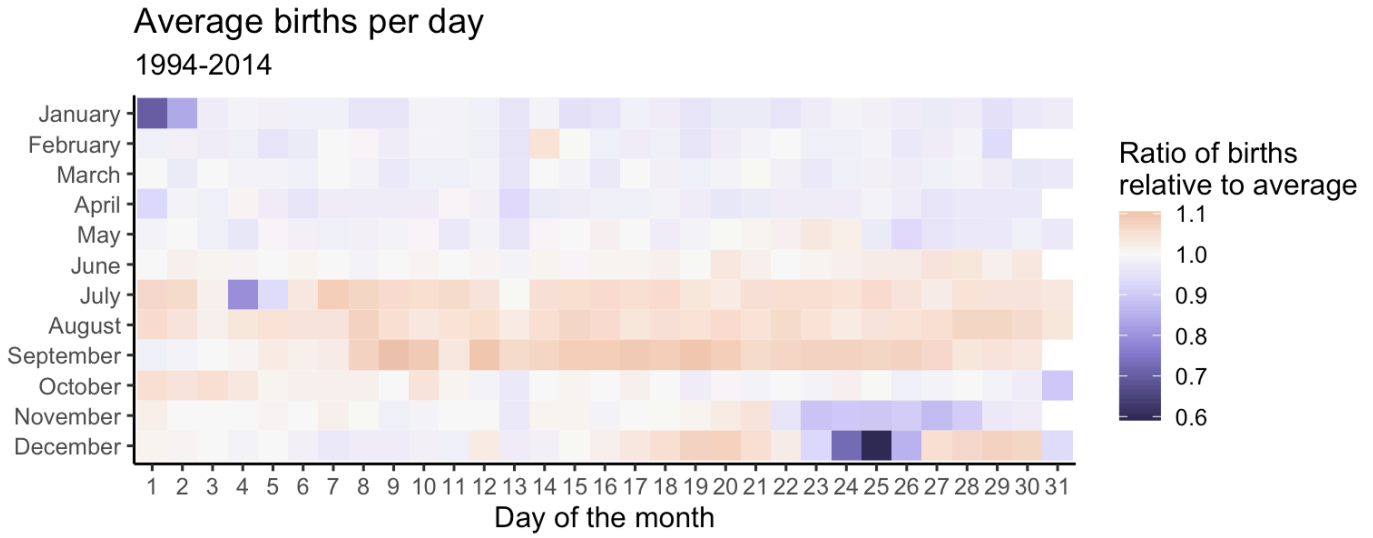

```
birth_days_plot + scale_fill_continuous_diverging(palette = "Blue-Red 3", mid = 1)
```




```
birth_days_plot + scale_fill_continuous_diverging(palette = "Tropic", mid = 1)
```




```
birth_days_plot + scale_fill_continuous_diverging(palette = "Purple-Brown", mid = 1)
```



Add response here.

Session information

Footnotes

1. Collected by FiveThirtyEight. ↩
2. Essentially a replication of Carl Bialik's original chart. ↩