Reproducible Research: Peer Assessment 1

Setting up the environment

```
library(tidyverse)
library(ggplot2)
library(lubridate)
library(tufte)

# Reduce precision (we're working with actual steps, after all) and disable
# scientific notation (for now)
options(digits=1)
# Big penalty to bias against switch to scientific notation
options(scipen=999)

# Default options for code chunks
knitr::opts_chunk$set(cache = TRUE,
                      warning = FALSE,
                      message = FALSE,
                      dpi = 300,
                      echo = TRUE,
                      out.width = '80%',
                      # dev = 'cairo_pdf',
                      fig.align = 'center')

knitr::opts_chunk$set(cache = TRUE, warning = FALSE, message = FALSE, dpi = 300)

#######################################
# Convenience functions
#######################################
# Convert interval code to time
id_to_time <- function(id) {
  id %>%
    as.character() %>%
    str_pad(width = 4,
            side = 'left',
            pad = "0") %>%
    readr::parse_time(format = '%H%M')
}

# Plot theme
my_theme <- function(x) {

    theme(
    strip.text = element_text(size = 12, hjust = 0.5, face = "bold"),
    plot.title = element_text(hjust = 0.5, size = 16),
    plot.subtitle = element_text(hjust = 0.5, face = "italic"),
    axis.title = element_text(size = 12),
    axis.text = element_text(size = 10),
    panel.spacing.x = unit(1, "cm")
  )
}
```

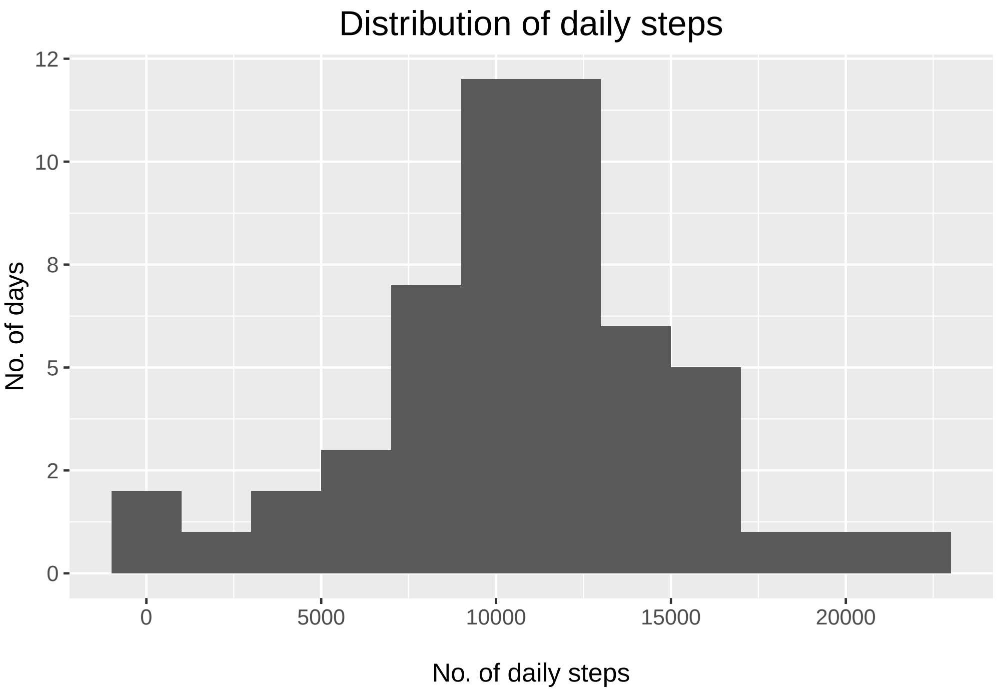
Loading and preprocessing the data

```
odata <- read_csv('data/activity.csv')
```

Histogram of the total number of steps for each day

```
daily <- odata %>%
    group_by(date) %>%
    summarize(total = sum(steps))

# Plot:
daily %>%
  ggplot(aes(x = total)) +
  geom_histogram(binwidth = 2000) +
  labs(x = "\nNo. of daily steps",
       y = "No. of days",
       title = "Distribution of daily steps") +
  my_theme()
```



Mean and median number of steps per day:

```r
# Mean/median values
day_mean <- mean(daily$total, na.rm = TRUE) %>% round()
day_median <- median(daily$total, na.rm = TRUE) %>% round()
```

Mean steps taken per day: **10766**

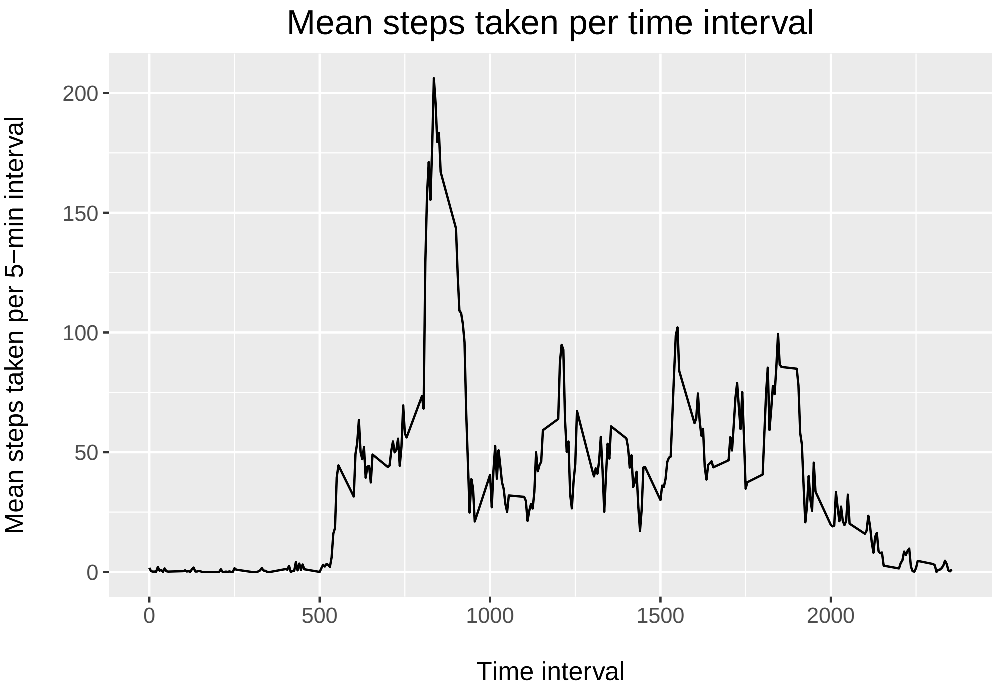
Median steps taken per day: **10765**

What is the average daily activity pattern?

```r
interval_means <- odata %>%
  group_by(interval) %>%
  summarize(mean = mean(steps, na.rm = TRUE)) %>%
  ungroup() %>%
  na.omit()

# Take the row with highest mean (interval with highest mean steps)
interval_max <- interval_means %>%
  slice_max(mean, n=1) %>%
  # Round the values.
  round()

interval_means %>%
  ggplot(aes(x = interval, y = mean)) +
  geom_line() +
  labs(x = "\nTime interval",
       y = "Mean steps taken per 5-min interval\n",
       title = "Mean steps taken per time interval") +
  my_theme()
```



```
# Convert interval code to time
interval_time <- id_to_time(interval_max$interval)
```

The above plot shows the number of steps taken, on average, during each 5-minute interval. During the study period, interval #835 was the one during which the most steps were taken–on average, 206. Interval #835 corresponds to 08:35:00.

Imputing missing values

Missing data points: **2304**.

We will impute missing data with the mean value from the same intervals in remaining days. This is under the assumption that there are typical<- times of the day (e.g., 12 am through 6 am) where an individual is likely to be at rest. We use `data.table` which affords a good combination of execution speed and readability. Column `imputed` in the new dataframe (`impdata`) stores non-missing and imputed values.

Coding environment

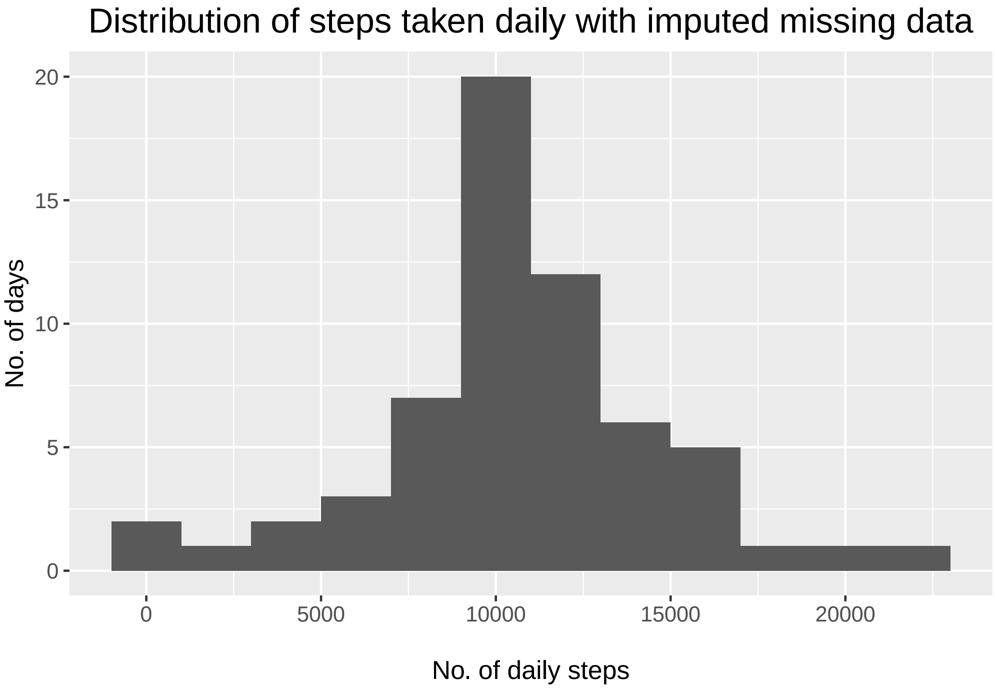
Using `data.table` operations mostly as an exercise, but it should also be the fastest option.

```
# Loading for fast operation when imputing
library(data.table)

# For readability, create a "lambda" function which will go into the
# data.table statement
impute.mean <- function(var) replace(var, is.na(var), mean(var, na.rm = TRUE))
# Create data.table
impdata <-setDT(odata)
```

```
impdata[,
        imputed := impute.mean(steps),
        by = interval]

# On a copy of the data, group by day and sum daily steps
histdata <- impdata[,
                    .(total = sum(imputed)),
                    by = date]
# Plot histo
histdata %>%
  ggplot(aes(x = total)) +
  geom_histogram(binwidth = 2000) +
  labs(x = "\nNo. of daily steps",
       y = "No. of days",
       title = "Distribution of steps taken daily with imputed missing data"
       ) +
  my_theme()
```



Are there differences in activity patterns between weekdays and weekends?

To answer this question, we will use imputed data and convert the dates to a “day-of-the-week” integer (*i.e.*, Monday = 1, Tuesday = 2, *etc*…). We’ll then plot the mean steps taken per 5-minute interval during weekdays and weekends.

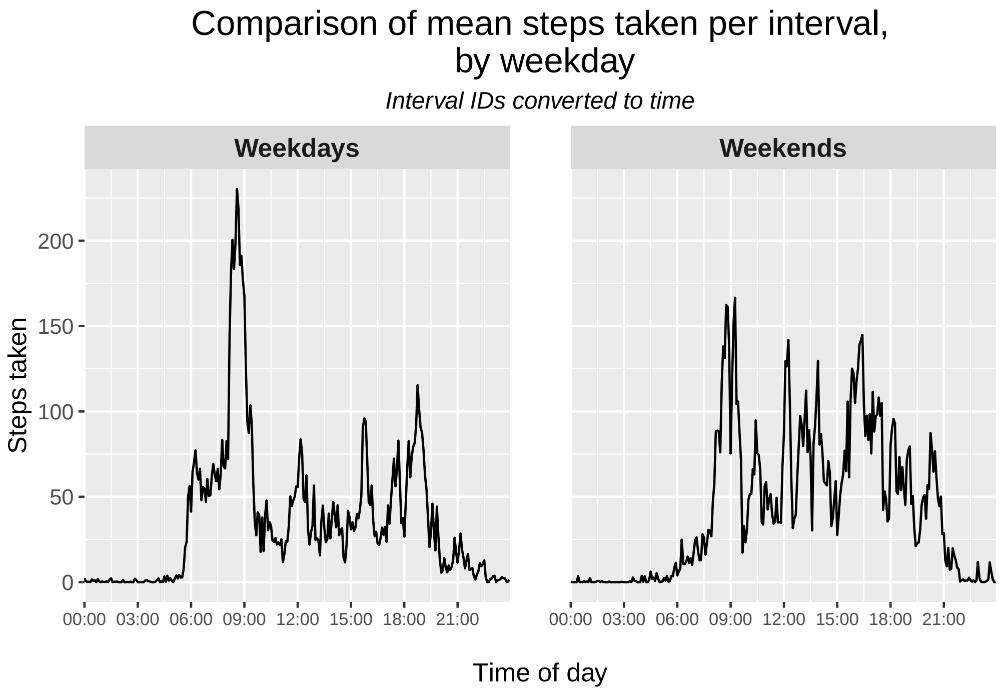
```
# Get day-of-the-week and mark each row as "Weekdays" or "Weekends" (factor)
weekdata <- setDT(copy(impdata))
weekdata[, `:=`(day = as.integer(strftime(date, '%u')))]
weekdata[, `:=`(type = ifelse(day > 5, "Weekends", "Weekdays"))]
```

```r
weekdata[, type := as.factor(type)]

# Time formatting function
time_label <- function(x) {strftime(x, '%H:%M')}

# Compute mean values for each 5 min-interval
weekdata[, `:=`(mean_steps = mean(imputed, na.rm = TRUE),
                time = id_to_time(interval)),
     by = .(interval, type)]
# Select columns we're interested in
cols = c('date', 'time', 'mean_steps')
# Aggregate for plotting
weekdata[, .SD[1L], by = .(interval, type), .SDcols = cols] %>%

ggplot(aes(x = time, y = mean_steps)) +
  geom_line() +
  facet_wrap(vars(type), labeller = label_value) +
  labs(x = "\nTime of day",
       y = "Steps taken",
       title = "Comparison of mean steps taken per interval,\n by weekday",
       subtitle = "Interval IDs converted to time") +
  scale_x_time(labels = time_label,
               breaks = scales::breaks_width('3 hours'),
               expand = expansion()) +
  my_theme() +
  theme(axis.text.x = element_text(size = 8))
```


Comparison of mean steps taken per interval,
by weekday
Interval IDs converted to time
Weekdays
Weekends
Steps taken
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Time of day