title: “Reproducible_Research_homework2”

author: “Yipu Ding”

output: html_document

date: “2025-03-11”

Loading and preprocessing the data

```
library(readr)
library(dplyr)
library(ggplot2)
library(scales)
Sys.setlocale("LC_TIME","English")
```

```
## [1] "English_United States.1252"
```

```
# Load the dataset
activity <- read_csv("C:/Users/aaact/Downloads/activity.csv")
```

What is mean total number of steps taken per day?

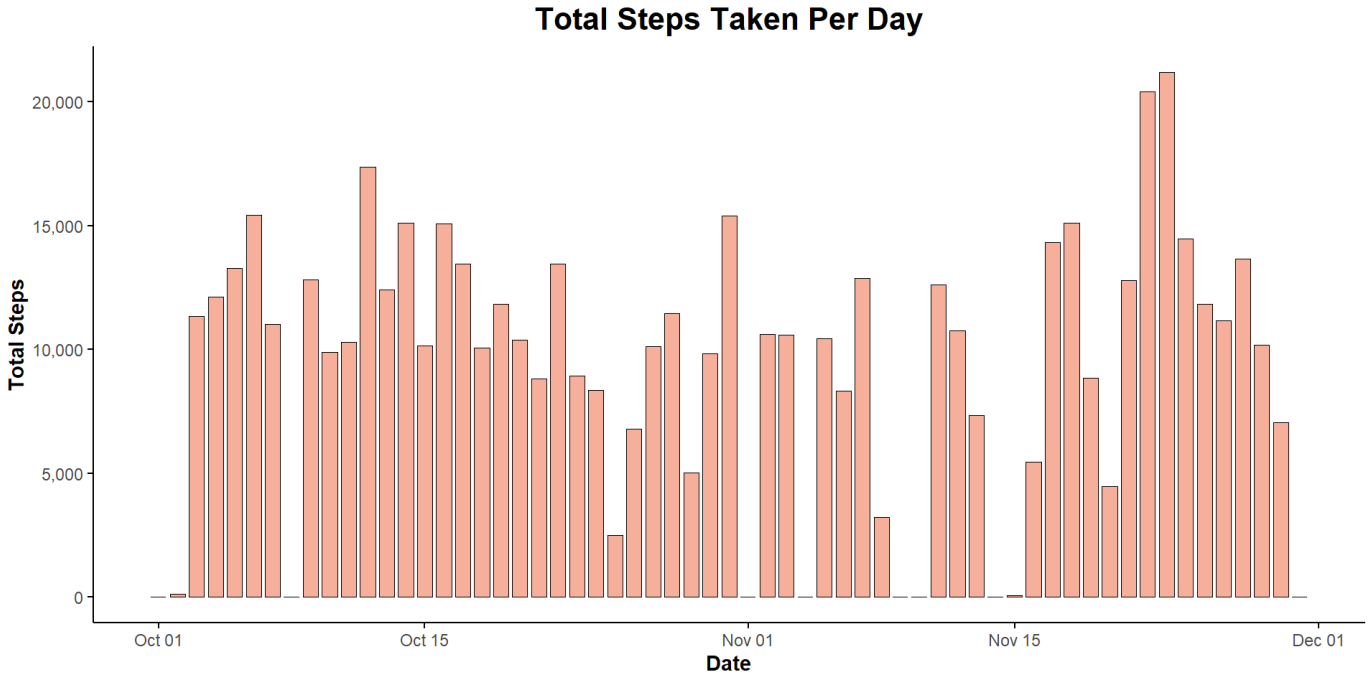
Calculate the total number of steps taken per day

```
# Group by date and calculate total steps per day
total_steps_per_date <- activity %>%
  group_by(date) %>%
  summarize(total_steps = sum(steps, na.rm = TRUE))

print(total_steps_per_date)
```

```
## # A tibble: 61 × 2
##    date       total_steps
##    <date>           <dbl>
##  1 2012-10-01           0
##  2 2012-10-02         126
##  3 2012-10-03       11352
##  4 2012-10-04       12116
##  5 2012-10-05       13294
##  6 2012-10-06       15420
##  7 2012-10-07       11015
##  8 2012-10-08           0
##  9 2012-10-09       12811
## 10 2012-10-10        9900
## # ℹ 51 more rows
```

Make a histogram of the total number of steps taken each day

```
# Create a bar plot (histogram) of total steps per day
ggplot(total_steps_per_date, aes(x = date, y = total_steps)) +
  geom_bar(
    stat = "identity",
    fill = "#F69B85",  # Bar fill color
    color = "black",   # Bar border color (black and thin)
    alpha = 0.8,       # Transparency
    width = 0.8,       # Bar width
    size = 0.3         # Border thickness
  ) +
  labs(
    title = "Total Steps Taken Per Day",
    x = "Date",
    y = "Total Steps"
  ) +
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.title = element_text(face = "bold"),
    axis.line = element_line(color = "black", size = 0.5),
    axis.ticks = element_line(color = "black", size = 0.5),
    panel.grid.major = element_blank(),
    panel.grid.minor = element_blank(),
    panel.background = element_blank()
  ) +
  scale_y_continuous(labels = scales::comma)  # Format y-axis labels with commas
```



Calculate and report the mean and median of the

total number of steps taken per day

```
# Calculate mean and median steps per day
mean_median_steps <- activity %>%
  group_by(date) %>%
  summarize(
    total_steps_mean = mean(steps, na.rm = TRUE),
    total_steps_median = median(steps, na.rm = TRUE)
  )

print(mean_median_steps)
```

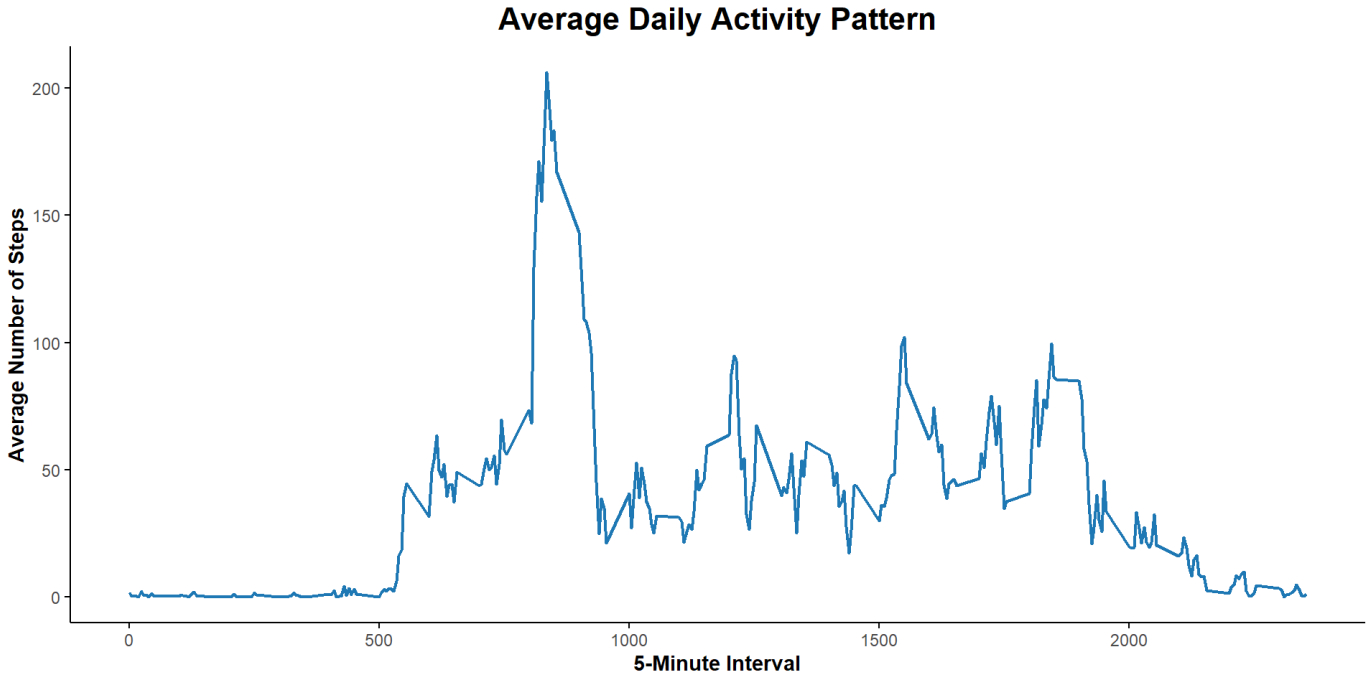
```
## # A tibble: 61 × 3
##    date       total_steps_mean total_steps_median
##    <date>                <dbl>              <dbl>
##  1 2012-10-01          NaN                   NA
##  2 2012-10-02            0.438                0
##  3 2012-10-03           39.4                  0
##  4 2012-10-04           42.1                  0
##  5 2012-10-05           46.2                  0
##  6 2012-10-06           53.5                  0
##  7 2012-10-07           38.2                  0
##  8 2012-10-08          NaN                   NA
##  9 2012-10-09           44.5                  0
## 10 2012-10-10           34.4                  0
## # ℹ 51 more rows
```

What is the average daily activity pattern?

Make a time series plot (i.e. type = “l”) of the 5-minute interval (x-axis) and the average number of

steps taken, averaged across all days (y-axis)

```
# Group by interval and calculate average steps
activity_time_series <- activity %>%
  group_by(interval) %>%
  summarize(average_steps = mean(steps, na.rm = TRUE))

# Create a time series plot
ggplot(activity_time_series, aes(x = interval, y = average_steps)) +
  geom_line(color = "#1F78B4", size = 0.8) +
  labs(
    title = "Average Daily Activity Pattern",
    x = "5-Minute Interval",
    y = "Average Number of Steps"
  ) +
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.title = element_text(face = "bold"),
    axis.line = element_line(color = "black", size = 0.5),
    axis.ticks = element_line(color = "black", size = 0.5),
    panel.grid.major = element_blank(),
    panel.grid.minor = element_blank(),
    panel.background = element_blank()
  )
```



Which 5-minute interval, on average across all the days in the dataset, contains the maximum number

# of steps?

```
# Find the interval with the maximum average steps
max_interval <- activity_time_series %>%
  filter(average_steps == max(average_steps, na.rm = TRUE))

print(max_interval)
```

```
## # A tibble: 1 × 2
##   interval average_steps
##      <dbl>         <dbl>
## 1      835          206.
```

The answer is 8:35, with 206 average steps.

Imputing missing values

Calculate and report the total number of missing values in the dataset

```
# Count the number of rows with missing steps
missing_rows <- activity %>% filter(is.na(steps))
nrow(missing_rows)
```

```
## [1] 2304
```

The total number of missing values was 2304.

Devise a strategy for filling in all of the missing values in the dataset. The strategy does not need to be sophisticated.

Create a new dataset that is equal to the original dataset but with the missing data filled in.

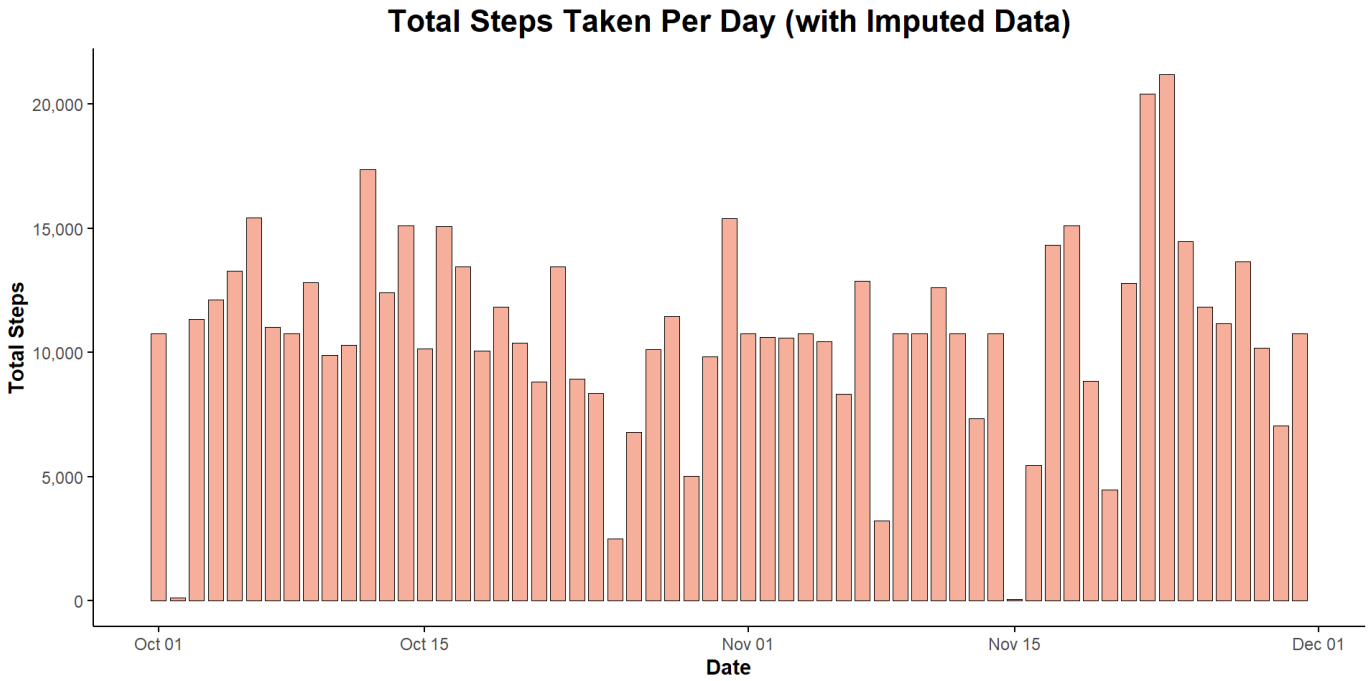
Here, I will fill in the missing values using the mean of the 5-minute interval.

```
# Fill missing values with the mean for that 5-minute interval
activity_filled <- activity %>%
  group_by(interval) %>%
  mutate(steps = ifelse(is.na(steps), mean(steps, na.rm = TRUE), steps))

print(activity_filled)
```

```
## # A tibble: 17,568 × 3
## # Groups:   interval [288]
##     steps date       interval
##     <dbl> <date>        <dbl>
##  1 1.72   2012-10-01        0
##  2 0.340  2012-10-01        5
##  3 0.132  2012-10-01       10
##  4 0.151  2012-10-01       15
##  5 0.0755 2012-10-01       20
##  6 2.09   2012-10-01       25
##  7 0.528  2012-10-01       30
##  8 0.868  2012-10-01       35
##  9 0      2012-10-01       40
## 10 1.47   2012-10-01       45
## # ℹ 17,558 more rows
```

Make a histogram of the total number of steps taken each day and Calculate and report the mean and median total number of steps taken per day.

```
# Calculate total steps per day with imputed data
total_steps_per_date_filled <- activity_filled %>%
  group_by(date) %>%
  summarize(total_steps = sum(steps, na.rm = TRUE))

# Create a bar plot (histogram) with imputed data
ggplot(total_steps_per_date_filled, aes(x = date, y = total_steps)) +
  geom_bar(
    stat = "identity",
    fill = "#F69B85",  # Bar fill color
    color = "black",   # Bar border color (black and thin)
    alpha = 0.8,       # Transparency
    width = 0.8,       # Bar width
    size = 0.3         # Border thickness
  ) +
  labs(
    title = "Total Steps Taken Per Day (with Imputed Data)",
    x = "Date",
    y = "Total Steps"
  ) +
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.title = element_text(face = "bold"),
    axis.line = element_line(color = "black", size = 0.5),
    axis.ticks = element_line(color = "black", size = 0.5),
    panel.grid.major = element_blank(),  # Remove major grid lines
    panel.grid.minor = element_blank(),  # Remove minor grid lines
    panel.background = element_blank()   # Remove background
  ) +
  scale_y_continuous(labels = scales::comma)
```




```
# Calculate mean and median with imputed data
mean_median_steps_filled <- activity_filled %>%
  group_by(date) %>%
  summarize(
    total_steps_mean = mean(steps, na.rm = TRUE),
    total_steps_median = median(steps, na.rm = TRUE)
  )

print(mean_median_steps_filled)
```

```
## # A tibble: 61 × 3
##    date       total_steps_mean total_steps_median
##    <date>                <dbl>              <dbl>
##  1 2012-10-01           37.4                34.1
##  2 2012-10-02            0.438               0
##  3 2012-10-03           39.4                 0
##  4 2012-10-04           42.1                 0
##  5 2012-10-05           46.2                 0
##  6 2012-10-06           53.5                 0
##  7 2012-10-07           38.2                 0
##  8 2012-10-08           37.4                34.1
##  9 2012-10-09           44.5                 0
## 10 2012-10-10           34.4                 0
## # ℹ 51 more rows
```

Are there differences in activity patterns between weekdays and weekends?

Create a new factor variable in the dataset with two levels – “weekday” and “weekend” indicating

whether a given date is a weekday or weekend day.

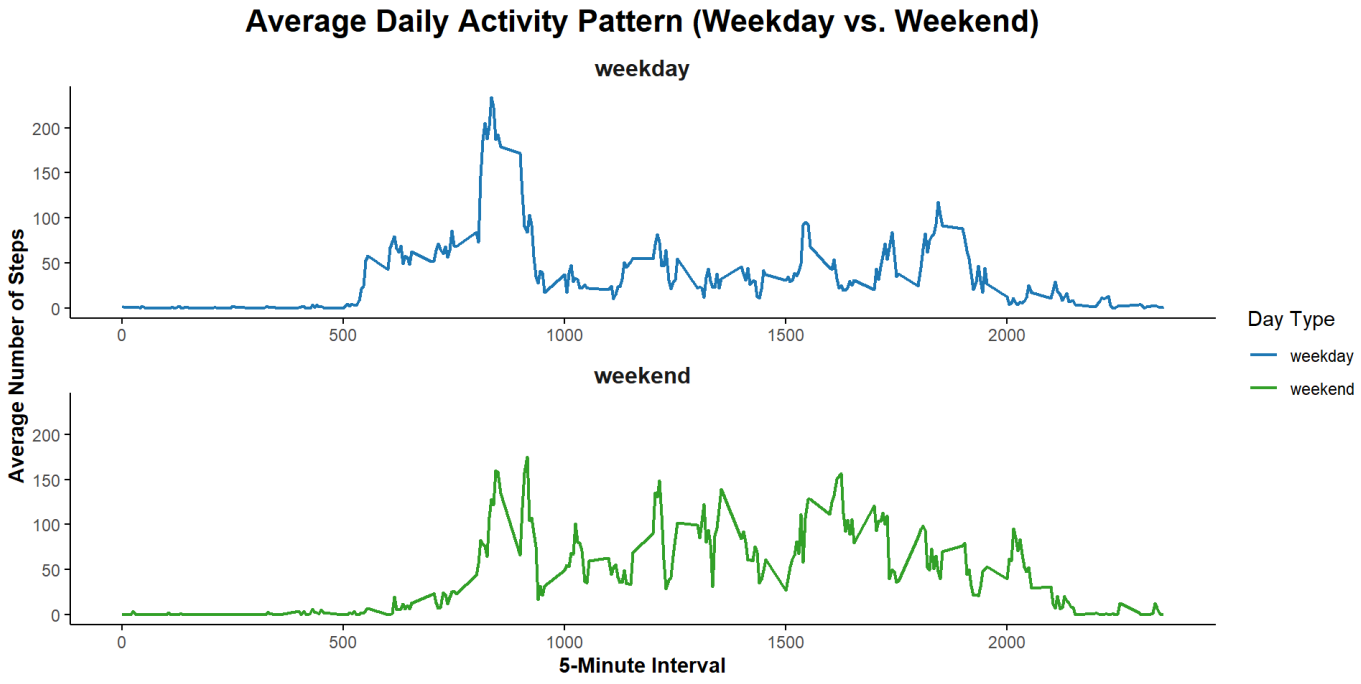
```
# Add a new column to distinguish weekdays and weekends
activity_weekday <- activity %>%
  mutate(weekday = weekdays(date)) %>%
  mutate(weekday_or_end = ifelse(weekday %in% c("Saturday", "Sunday"), "weekend", "weekday"))

print(activity_weekday)
```

```
## # A tibble: 17,568 × 5
##    steps date       interval weekday weekday_or_end
##    <dbl> <date>        <dbl> <chr>   <chr>
##  1    NA 2012-10-01        0 Monday  weekday
##  2    NA 2012-10-01        5 Monday  weekday
##  3    NA 2012-10-01       10 Monday  weekday
##  4    NA 2012-10-01       15 Monday  weekday
##  5    NA 2012-10-01       20 Monday  weekday
##  6    NA 2012-10-01       25 Monday  weekday
##  7    NA 2012-10-01       30 Monday  weekday
##  8    NA 2012-10-01       35 Monday  weekday
##  9    NA 2012-10-01       40 Monday  weekday
## 10    NA 2012-10-01       45 Monday  weekday
## # ℹ 17,558 more rows
```

Make a panel plot containing a time series plot of the 5-minute interval (x-axis) and the average number of steps taken, averaged across all

weekday days or weekend days (y-axis).

```
# Calculate average steps per interval for weekdays and weekends
activity_time_series_weekday <- activity_weekday %>%
  group_by(interval, weekday_or_end) %>%
  summarize(average_steps = mean(steps, na.rm = TRUE))

# Create a panel plot with separate lines for weekdays and weekends
ggplot(activity_time_series_weekday, aes(x = interval, y = average_steps, color = weekday_or_en
d)) +
  geom_line(size = 0.8) +
  facet_wrap(~weekday_or_end, ncol = 1, scales = "free_x") +  # Ensure each panel has its own x
-axis
  labs(
    title = "Average Daily Activity Pattern (Weekday vs. Weekend)",
    x = "5-Minute Interval",
    y = "Average Number of Steps",
    color = "Day Type"
  ) +
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
    axis.title = element_text(face = "bold"),
    axis.line = element_line(color = "black", size = 0.5),
    axis.ticks = element_line(color = "black", size = 0.5),
    panel.grid.major = element_blank(),  # Remove major grid lines
    panel.grid.minor = element_blank(),  # Remove minor grid lines
    panel.background = element_blank(),  # Remove background
    strip.text = element_text(face = "bold", size = 12)  # Style facet labels
  ) +
  scale_color_manual(values = c("weekday" = "#1F78B4", "weekend" = "#33A02C"))  # Custom line c
olors
```



There are differences in activity patterns between weekdays and weekends. Here are some observations:

1. Activity Intensity: On weekdays, activity intensity may be higher during specific times, such as early morning and late afternoon, likely due to commuting and work-related activities. On weekends, activity might be more evenly distributed, with potential peaks during mid-morning or early afternoon.
2. Activity Distribution: Weekend activities appear to be more spread out without distinct peaks, reflecting a more relaxed schedule and varied leisure activities.
3. Peak Times: Weekdays may show activity peaks in the morning and evening, while weekends could have peaks during mid-morning or early afternoon.
4. Activity Volume: Overall, activity levels on weekends might be higher during certain periods compared to weekdays, possibly because people have more free time for exercise or outdoor activities.