Google Data Analytics Capstone Project

Summary

Bellabeat is a high-tech company that manufactures health-focused smart products. Collecting data on activity, sleep, stress, and reproductive health has allowed Bellabeat to empower women with knowledge about their own health and habits.

Their main products include:

- The Bellabeat App (Fitness App)
- Leaf (Fitness Tracker)
- Time (Wellness Watch)
- Spring (Smart Water Bottle)
- Bellabeat Membership Plan

Stakeholders:

- Urška Sršen -> Bellabeat cofounder and CCO
- Sando Mur -> Bellabeat cofounder
- Bellabeat Marketing Analytics team

The stakeholders would like to examine the data in order to identify trends and patterns in the usage of Smart Fitness devices that will identify potential opportunities for growth of Bellabeat in the industry.

Ask

Business Task

Find trends and patterns in smart device usage and then relate these trends to one of the Bellabeat products to help improve the marketing strategy and the overall business growth of Bellabeat.

Questions that will guide our Analysis:

1. What are some trends in smart device usage?
2. How could these trends apply to Bellabeat customers?
3. How could these trends help influence Bellabeat marketing strategy?

Prepare

Dataset used

The data source used for our case study is Fitbit Fitness Tracker Data. This dataset is stored in Kaggle and was made available through Mobius. It is an Open-Source dataset. This data set contains personal fitness tracker from thirty Fitbit users.

Dataset Organization

There are a total of 18 .CSV files. Each subject has a unique ID and the data is recorded with a date and time stamp. Each row in the data is a new observation this results in the data being in long format.

Dataset Integrity

The data only has thirty participants which is the minimum sample size for a decent analysis. There is sampling bias since it does not include any gender information. This could mean that the data might include data for men, which is not useful for Bellabeat. The data also only covers 1 month of activity which is a noticeably short period for the analysis.

Process

I will be using RStudio for my analysis because of the size of the data and reproducibility that R offers. R is also useful when visualizing data for stakeholders.

Packages Used for Analysis:

- Tidyverse
- Janitor
- Lubridate
- Skimr
- ggplot2
- dlpry
- readr

1. Installing packages needed

```
# Installing Packages

install.packages('tidyverse')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
install.packages('janitor')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
install.packages('lubridate')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
install.packages('skimr')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
install.packages('ggplot2')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
install.packages('dlpry')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
## Warning: package 'dlpry' is not available for this version of R
##
## A version of this package for your version of R might be available elsewhere,
## see the ideas at
## https://cran.r-project.org/doc/manuals/r-patched/R-admin.html#Installing-packages
```

```
install.packages('readr')
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

2. Loading packages installed

```
# Load Packages

library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.4.0      v purrr   0.3.5
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.3      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(janitor)
```

```
##
## Attaching package: 'janitor'
##
## The following objects are masked from 'package:stats':
##
##     chisq.test, fisher.test
```

```
library(lubridate)
```

```
## Loading required package: timechange
##
## Attaching package: 'lubridate'
##
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(skimr)
library(ggplot2)
library(dplyr)
library(readr)
```

3. Importing datasets needed for analysis

```
# Import the Datasets

```

```r
daily_activity <- read_csv('dailyActivity_merged.csv')
```

```
## Rows: 940 Columns: 15
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (1): ActivityDate
## dbl (14): Id, TotalSteps, TotalDistance, TrackerDistance, LoggedActivitiesDi...
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
daily_sleep <- read_csv('sleepDay_merged.csv')
```

```
## Rows: 413 Columns: 5
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (1): SleepDay
## dbl (4): Id, TotalSleepRecords, TotalMinutesAsleep, TotalTimeInBed
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
daily_steps <- read_csv('dailySteps_merged.csv')
```

```
## Rows: 940 Columns: 3
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (1): ActivityDay
## dbl (2): Id, StepTotal
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
daily_intensities <- read_csv('dailyIntensities_merged.csv')
```

```
## Rows: 940 Columns: 10
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (1): ActivityDay
## dbl (9): Id, SedentaryMinutes, LightlyActiveMinutes, FairlyActiveMinutes, Ve...
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
hourly_steps <- read_csv('hourlySteps_merged.csv')
```

```
## Rows: 22099 Columns: 3
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (1): ActivityHour
## dbl (2): Id, StepTotal
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

4. Preview raw data

```
# daily_activity

head(daily_activity)
```

```
## # A tibble: 6 x 15
##       Id Activ~1 Total~2 Total~3 Track~4 Logge~5 VeryA~6 Moder~7 Light~8 Seden~9
##    <dbl> <chr>     <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 1.50e9 4/12/2~   13162    8.5     8.5        0    1.88   0.550    6.06       0
## 2 1.50e9 4/13/2~   10735    6.97    6.97       0    1.57   0.690    4.71       0
## 3 1.50e9 4/14/2~   10460    6.74    6.74       0    2.44   0.400    3.91       0
## 4 1.50e9 4/15/2~    9762    6.28    6.28       0    2.14   1.26     2.83       0
## 5 1.50e9 4/16/2~   12669    8.16    8.16       0    2.71   0.410    5.04       0
## 6 1.50e9 4/17/2~    9705    6.48    6.48       0    3.19   0.780    2.51       0
## # ... with 5 more variables: VeryActiveMinutes <dbl>,
## #   FairlyActiveMinutes <dbl>, LightlyActiveMinutes <dbl>,
## #   SedentaryMinutes <dbl>, Calories <dbl>, and abbreviated variable names
## #   1: ActivityDate, 2: TotalSteps, 3: TotalDistance, 4: TrackerDistance,
## #   5: LoggedActivitiesDistance, 6: VeryActiveDistance,
## #   7: ModeratelyActiveDistance, 8: LightActiveDistance,
## #   9: SedentaryActiveDistance
```

```
colnames(daily_activity)
```

```
##  [1] "Id"                       "ActivityDate"
##  [3] "TotalSteps"               "TotalDistance"
##  [5] "TrackerDistance"          "LoggedActivitiesDistance"
##  [7] "VeryActiveDistance"       "ModeratelyActiveDistance"
##  [9] "LightActiveDistance"      "SedentaryActiveDistance"
## [11] "VeryActiveMinutes"        "FairlyActiveMinutes"
## [13] "LightlyActiveMinutes"     "SedentaryMinutes"
## [15] "Calories"
```

```
n_unique(daily_activity$Id)
```

```
## [1] 33
```

```
sum(duplicated(daily_activity))
```

```
## [1] 0
```

```
# daily_sleep

head(daily_sleep)
```

```
## # A tibble: 6 x 5
##           Id SleepDay              TotalSleepRecords TotalMinutesAsleep TotalT~1
##        <dbl> <chr>                             <dbl>              <dbl>    <dbl>
## 1 1503960366 4/12/2016 12:00:00 AM                 1                327      346
## 2 1503960366 4/13/2016 12:00:00 AM                 2                384      407
## 3 1503960366 4/15/2016 12:00:00 AM                 1                412      442
## 4 1503960366 4/16/2016 12:00:00 AM                 2                340      367
## 5 1503960366 4/17/2016 12:00:00 AM                 1                700      712
## 6 1503960366 4/19/2016 12:00:00 AM                 1                304      320
## # ... with abbreviated variable name 1: TotalTimeInBed
```

```
colnames(daily_sleep)
```

```
## [1] "Id"                 "SleepDay"           "TotalSleepRecords"
## [4] "TotalMinutesAsleep" "TotalTimeInBed"
```

```
n_unique(daily_sleep$Id)
```

```
## [1] 24
```

```
sum(duplicated(daily_sleep))
```

```
## [1] 3
```

```
# daily_steps

head(daily_steps)
```

```
## # A tibble: 6 x 3
##           Id ActivityDay StepTotal
##        <dbl> <chr>           <dbl>
## 1 1503960366 4/12/2016       13162
## 2 1503960366 4/13/2016       10735
## 3 1503960366 4/14/2016       10460
## 4 1503960366 4/15/2016        9762
## 5 1503960366 4/16/2016       12669
## 6 1503960366 4/17/2016        9705
```

```
colnames(daily_steps)
```

```
## [1] "Id"          "ActivityDay" "StepTotal"
```

```
n_unique(daily_steps$Id)
```

```
## [1] 33
```

```
sum(duplicated(daily_steps))
```

```
## [1] 0
```

```
# daily_intensities

head(daily_intensities)
```

```
## # A tibble: 6 x 10
##       Id Activ~1 Seden~2 Light~3 Fairl~4 VeryA~5 Seden~6 Light~7 Moder~8 VeryA~9
##    <dbl> <chr>      <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 1.50e9 4/12/2~     728     328      13      25       0    6.06   0.550    1.88
## 2 1.50e9 4/13/2~     776     217      19      21       0    4.71   0.690    1.57
## 3 1.50e9 4/14/2~    1218     181      11      30       0    3.91   0.400    2.44
## 4 1.50e9 4/15/2~     726     209      34      29       0    2.83   1.26     2.14
## 5 1.50e9 4/16/2~     773     221      10      36       0    5.04   0.410    2.71
## 6 1.50e9 4/17/2~     539     164      20      38       0    2.51   0.780    3.19
## # ... with abbreviated variable names 1: ActivityDay, 2: SedentaryMinutes,
## #   3: LightlyActiveMinutes, 4: FairlyActiveMinutes, 5: VeryActiveMinutes,
## #   6: SedentaryActiveDistance, 7: LightActiveDistance,
## #   8: ModeratelyActiveDistance, 9: VeryActiveDistance
```

```
colnames(daily_intensities)
```

```
##  [1] "Id"                       "ActivityDay"
##  [3] "SedentaryMinutes"         "LightlyActiveMinutes"
##  [5] "FairlyActiveMinutes"      "VeryActiveMinutes"
```

```
##  [7] "SedentaryActiveDistance"  "LightActiveDistance"
##  [9] "ModeratelyActiveDistance" "VeryActiveDistance"
```

```
n_unique(daily_intensities$Id)
```

```
## [1] 33
```

```
sum(duplicated(daily_intensities))
```

```
## [1] 0
```

```
# hourly_steps

head(hourly_steps)
```

```
## # A tibble: 6 x 3
##           Id ActivityHour          StepTotal
##        <dbl> <chr>                     <dbl>
## 1 1503960366 4/12/2016 12:00:00 AM       373
## 2 1503960366 4/12/2016 1:00:00 AM        160
## 3 1503960366 4/12/2016 2:00:00 AM        151
## 4 1503960366 4/12/2016 3:00:00 AM          0
## 5 1503960366 4/12/2016 4:00:00 AM          0
## 6 1503960366 4/12/2016 5:00:00 AM          0
```

```
colnames(hourly_steps)
```

```
## [1] "Id"           "ActivityHour" "StepTotal"
```

```
n_unique(hourly_steps$Id)
```

```
## [1] 33
```

```
sum(duplicated(hourly_steps))
```

```
## [1] 0
```

First impressions of the data:

daily_activity: 15 columns * 940 Rows (33 unique id's, 0 duplicates)

daily_sleep: 5 columns * 413 Rows (24 unique id's, 3 duplicates)

daily_steps: 3 columns * 940 Rows (33 unique id's, 0 duplicates)

daily_intensities: 10 columns * 940 Rows (33 unique id's, 0 duplicates)

hourly_steps: 3 columns * 22099 Rows (33 unique id's, 0 duplicates)

*Data includes column names with upper and lowercase letters as well as duplicates and inconsistent dates.

Data cleaning

- Cleaning column names to only feature lowercase letters

```
# Cleaning column names

clean_names(daily_activity)
```

```
## # A tibble: 940 x 15
##            id activity~1 total~2 total~3 track~4 logge~5 very_~6 moder~7 light~8
##         <dbl> <chr>        <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
```

```
##  1 1503960366 4/12/2016    13162    8.5     8.5        0    1.88   0.550    6.06
##  2 1503960366 4/13/2016    10735    6.97    6.97       0    1.57   0.690    4.71
##  3 1503960366 4/14/2016    10460    6.74    6.74       0    2.44   0.400    3.91
##  4 1503960366 4/15/2016     9762    6.28    6.28       0    2.14   1.26     2.83
##  5 1503960366 4/16/2016    12669    8.16    8.16       0    2.71   0.410    5.04
##  6 1503960366 4/17/2016     9705    6.48    6.48       0    3.19   0.780    2.51
##  7 1503960366 4/18/2016    13019    8.59    8.59       0    3.25   0.640    4.71
##  8 1503960366 4/19/2016    15506    9.88    9.88       0    3.53   1.32     5.03
##  9 1503960366 4/20/2016    10544    6.68    6.68       0    1.96   0.480    4.24
## 10 1503960366 4/21/2016     9819    6.34    6.34       0    1.34   0.350    4.65
## # ... with 930 more rows, 6 more variables: sedentary_active_distance <dbl>,
## #   very_active_minutes <dbl>, fairly_active_minutes <dbl>,
## #   lightly_active_minutes <dbl>, sedentary_minutes <dbl>, calories <dbl>, and
## #   abbreviated variable names 1: activity_date, 2: total_steps,
## #   3: total_distance, 4: tracker_distance, 5: logged_activities_distance,
## #   6: very_active_distance, 7: moderately_active_distance,
## #   8: light_active_distance
```

```
daily_activity <- rename_with(daily_activity, tolower)

clean_names(daily_sleep)
```

```
## # A tibble: 413 x 5
##            id sleep_day             total_sleep_records total_minutes_~1 total~2
##         <dbl> <chr>                               <dbl>            <dbl>   <dbl>
##  1 1503960366 4/12/2016 12:00:00 AM                   1              327     346
##  2 1503960366 4/13/2016 12:00:00 AM                   2              384     407
##  3 1503960366 4/15/2016 12:00:00 AM                   1              412     442
##  4 1503960366 4/16/2016 12:00:00 AM                   2              340     367
##  5 1503960366 4/17/2016 12:00:00 AM                   1              700     712
##  6 1503960366 4/19/2016 12:00:00 AM                   1              304     320
##  7 1503960366 4/20/2016 12:00:00 AM                   1              360     377
##  8 1503960366 4/21/2016 12:00:00 AM                   1              325     364
##  9 1503960366 4/23/2016 12:00:00 AM                   1              361     384
## 10 1503960366 4/24/2016 12:00:00 AM                   1              430     449
## # ... with 403 more rows, and abbreviated variable names
## #   1: total_minutes_asleep, 2: total_time_in_bed
```

```
daily_sleep <- rename_with(daily_sleep, tolower)

clean_names(daily_steps)
```

```
## # A tibble: 940 x 3
##            id activity_day step_total
##         <dbl> <chr>             <dbl>
##  1 1503960366 4/12/2016         13162
##  2 1503960366 4/13/2016         10735
##  3 1503960366 4/14/2016         10460
##  4 1503960366 4/15/2016          9762
##  5 1503960366 4/16/2016         12669
##  6 1503960366 4/17/2016          9705
##  7 1503960366 4/18/2016         13019
##  8 1503960366 4/19/2016         15506
##  9 1503960366 4/20/2016         10544
## 10 1503960366 4/21/2016          9819
```

```
## # ... with 930 more rows
```

```
daily_steps <- rename_with(daily_steps, tolower)

clean_names(daily_intensities)
```

```
## # A tibble: 940 x 10
##            id activity~1 seden~2 light~3 fairl~4 very_~5 seden~6 light~7 moder~8
##         <dbl> <chr>        <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1 1503960366 4/12/2016      728     328      13      25       0    6.06   0.550
##  2 1503960366 4/13/2016      776     217      19      21       0    4.71   0.690
##  3 1503960366 4/14/2016     1218     181      11      30       0    3.91   0.400
##  4 1503960366 4/15/2016      726     209      34      29       0    2.83   1.26
##  5 1503960366 4/16/2016      773     221      10      36       0    5.04   0.410
##  6 1503960366 4/17/2016      539     164      20      38       0    2.51   0.780
##  7 1503960366 4/18/2016     1149     233      16      42       0    4.71   0.640
##  8 1503960366 4/19/2016      775     264      31      50       0    5.03   1.32
##  9 1503960366 4/20/2016      818     205      12      28       0    4.24   0.480
## 10 1503960366 4/21/2016      838     211       8      19       0    4.65   0.350
## # ... with 930 more rows, 1 more variable: very_active_distance <dbl>, and
## #   abbreviated variable names 1: activity_day, 2: sedentary_minutes,
## #   3: lightly_active_minutes, 4: fairly_active_minutes,
## #   5: very_active_minutes, 6: sedentary_active_distance,
## #   7: light_active_distance, 8: moderately_active_distance
```

```
daily_intensities <- rename_with(daily_intensities, tolower)

clean_names(hourly_steps)
```

```
## # A tibble: 22,099 x 3
##            id activity_hour         step_total
##         <dbl> <chr>                      <dbl>
##  1 1503960366 4/12/2016 12:00:00 AM        373
##  2 1503960366 4/12/2016 1:00:00 AM         160
##  3 1503960366 4/12/2016 2:00:00 AM         151
##  4 1503960366 4/12/2016 3:00:00 AM           0
##  5 1503960366 4/12/2016 4:00:00 AM           0
##  6 1503960366 4/12/2016 5:00:00 AM           0
##  7 1503960366 4/12/2016 6:00:00 AM           0
##  8 1503960366 4/12/2016 7:00:00 AM           0
##  9 1503960366 4/12/2016 8:00:00 AM         250
## 10 1503960366 4/12/2016 9:00:00 AM        1864
## # ... with 22,089 more rows
```

```
hourly_steps <- rename_with(hourly_steps, tolower)
```

- Removing duplicates from daily_sleep

```
# Removing duplicates

daily_sleep <- distinct(daily_sleep)

# Checking if all duplicates are removed

sum(duplicated(daily_sleep))
```

```
## [1] 0
```

- Correcting consistency of dates across all data

```
# Correcting consistency of dates

daily_activity <- daily_activity %>%
  rename(date = activitydate) %>%
  mutate(date = as_date(date, format = "%m/%d/%Y"))

daily_sleep <- daily_sleep %>%
  rename(date = sleepday) %>%
  mutate(date = as_date(date, format = "%m/%d/%Y %I:%M:%S %p"))

daily_steps <- daily_steps %>%
  rename(date = activityday) %>%
  mutate(date = as_date(date, format = "%m/%d/%Y"))

daily_intensities <- daily_intensities %>%
  rename(date = activityday) %>%
  mutate(date = as_date(date, format = "%m/%d/%Y"))

hourly_steps <- hourly_steps %>%
  rename(date_time = activityhour) %>%
  mutate(date_time = as.POSIXct(date_time, format = "%m/%d/%Y %I:%M:%S %p", tz = Sys.timezone()))
```

Transforming data

- Merging data from daily_activity and daily_sleep

```
# Merging data

daily_activity_sleep <- merge(daily_activity, daily_sleep, by = c('id','date'))
```

- Adding a column for week days

```
# Adding a column for weekdays

daily_activity_sleep <- daily_activity_sleep %>%
  mutate(week_day = weekdays(date))
```

7. Preview of clean data

```
# Preview of Clean data

head(daily_activity)
```

```
## # A tibble: 6 x 15
##           id date       totals~1 total~2 track~3 logge~4 verya~5 moder~6 light~7
##        <dbl> <date>        <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 1503960366 2016-04-12    13162    8.5     8.5        0    1.88   0.550    6.06
## 2 1503960366 2016-04-13    10735    6.97    6.97       0    1.57   0.690    4.71
## 3 1503960366 2016-04-14    10460    6.74    6.74       0    2.44   0.400    3.91
## 4 1503960366 2016-04-15     9762    6.28    6.28       0    2.14   1.26     2.83
## 5 1503960366 2016-04-16    12669    8.16    8.16       0    2.71   0.410    5.04
## 6 1503960366 2016-04-17     9705    6.48    6.48       0    3.19   0.780    2.51
## # ... with 6 more variables: sedentaryactivedistance <dbl>,
## #   veryactiveminutes <dbl>, fairlyactiveminutes <dbl>,
## #   lightlyactiveminutes <dbl>, sedentaryminutes <dbl>, calories <dbl>, and
```

```
## #   abbreviated variable names 1: totalsteps, 2: totaldistance,
## #   3: trackerdistance, 4: loggedactivitiesdistance, 5: veryactivedistance,
## #   6: moderatelyactivedistance, 7: lightactivedistance
```

```
head(daily_sleep)
```

```
## # A tibble: 6 x 5
##           id date       totalsleeprecords totalminutesasleep totaltimeinbed
##        <dbl> <date>                 <dbl>              <dbl>          <dbl>
## 1 1503960366 2016-04-12                 1                327            346
## 2 1503960366 2016-04-13                 2                384            407
## 3 1503960366 2016-04-15                 1                412            442
## 4 1503960366 2016-04-16                 2                340            367
## 5 1503960366 2016-04-17                 1                700            712
## 6 1503960366 2016-04-19                 1                304            320
```

```
head(daily_steps)
```

```
## # A tibble: 6 x 3
##           id date       steptotal
##        <dbl> <date>         <dbl>
## 1 1503960366 2016-04-12     13162
## 2 1503960366 2016-04-13     10735
## 3 1503960366 2016-04-14     10460
## 4 1503960366 2016-04-15      9762
## 5 1503960366 2016-04-16     12669
## 6 1503960366 2016-04-17      9705
```

```
head(daily_intensities)
```

```
## # A tibble: 6 x 10
##           id date       sedent~1 light~2 fairl~3 verya~4 seden~5 light~6 moder~7
##        <dbl> <date>        <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 1503960366 2016-04-12      728     328      13      25       0    6.06   0.550
## 2 1503960366 2016-04-13      776     217      19      21       0    4.71   0.690
## 3 1503960366 2016-04-14     1218     181      11      30       0    3.91   0.400
## 4 1503960366 2016-04-15      726     209      34      29       0    2.83   1.26
## 5 1503960366 2016-04-16      773     221      10      36       0    5.04   0.410
## 6 1503960366 2016-04-17      539     164      20      38       0    2.51   0.780
## # ... with 1 more variable: veryactivedistance <dbl>, and abbreviated variable
## #   names 1: sedentaryminutes, 2: lightlyactiveminutes, 3: fairlyactiveminutes,
## #   4: veryactiveminutes, 5: sedentaryactivedistance, 6: lightactivedistance,
## #   7: moderatelyactivedistance
```

```
head(hourly_steps)
```

```
## # A tibble: 6 x 3
##           id date_time           steptotal
##        <dbl> <dttm>                  <dbl>
## 1 1503960366 2016-04-12 00:00:00       373
## 2 1503960366 2016-04-12 01:00:00       160
## 3 1503960366 2016-04-12 02:00:00       151
## 4 1503960366 2016-04-12 03:00:00         0
## 5 1503960366 2016-04-12 04:00:00         0
## 6 1503960366 2016-04-12 05:00:00         0
```

```
head(daily_activity_sleep)
```

```
##           id       date totalsteps totaldistance trackerdistance
## 1 1503960366 2016-04-12      13162          8.50            8.50
## 2 1503960366 2016-04-13      10735          6.97            6.97
## 3 1503960366 2016-04-15       9762          6.28            6.28
## 4 1503960366 2016-04-16      12669          8.16            8.16
## 5 1503960366 2016-04-17       9705          6.48            6.48
## 6 1503960366 2016-04-19      15506          9.88            9.88
##   loggedactivitiesdistance veryactivedistance moderatelyactivedistance
## 1                        0              1.88                     0.55
## 2                        0              1.57                     0.69
## 3                        0              2.14                     1.26
## 4                        0              2.71                     0.41
## 5                        0              3.19                     0.78
## 6                        0              3.53                     1.32
##   lightactivedistance sedentaryactivedistance veryactiveminutes
## 1                6.06                       0                25
## 2                4.71                       0                21
## 3                2.83                       0                29
## 4                5.04                       0                36
## 5                2.51                       0                38
## 6                5.03                       0                50
##   fairlyactiveminutes lightlyactiveminutes sedentaryminutes calories
## 1                  13                  328              728     1985
## 2                  19                  217              776     1797
## 3                  34                  209              726     1745
## 4                  10                  221              773     1863
## 5                  20                  164              539     1728
## 6                  31                  264              775     2035
##   totalsleeprecords totalminutesasleep totaltimeinbed  week_day
## 1                 1                327            346   Tuesday
## 2                 2                384            407 Wednesday
## 3                 1                412            442    Friday
## 4                 2                340            367  Saturday
## 5                 1                700            712    Sunday
## 6                 1                304            320   Tuesday
```

Analysis

Questions we will be asking in order to identify trends and patterns:

1. How often do users use their devices in a month?
2. Time spent in bed vs time spent asleep
3. The relationship between steps and amount of sleep
4. On which days of the week are users most active?
5. What is the correlation between steps and calories?
6. Which times of the day are users most active?

Summary of data

Initial Analysis

Customers' average daily steps are 7638, their average distance is 5.490, and their average calories are 2304.

The average amount of sleep every night is around 6 hours, which is only suitable for some age groups and not for others.

The main finding from this process is that there are 33 users who update their daily activity, 24 users who update their sleep activity.

1. How often do users use their devices in a month?

```
# Calculate how often users use their devices in a month

colnames(daily_activity_sleep)
```

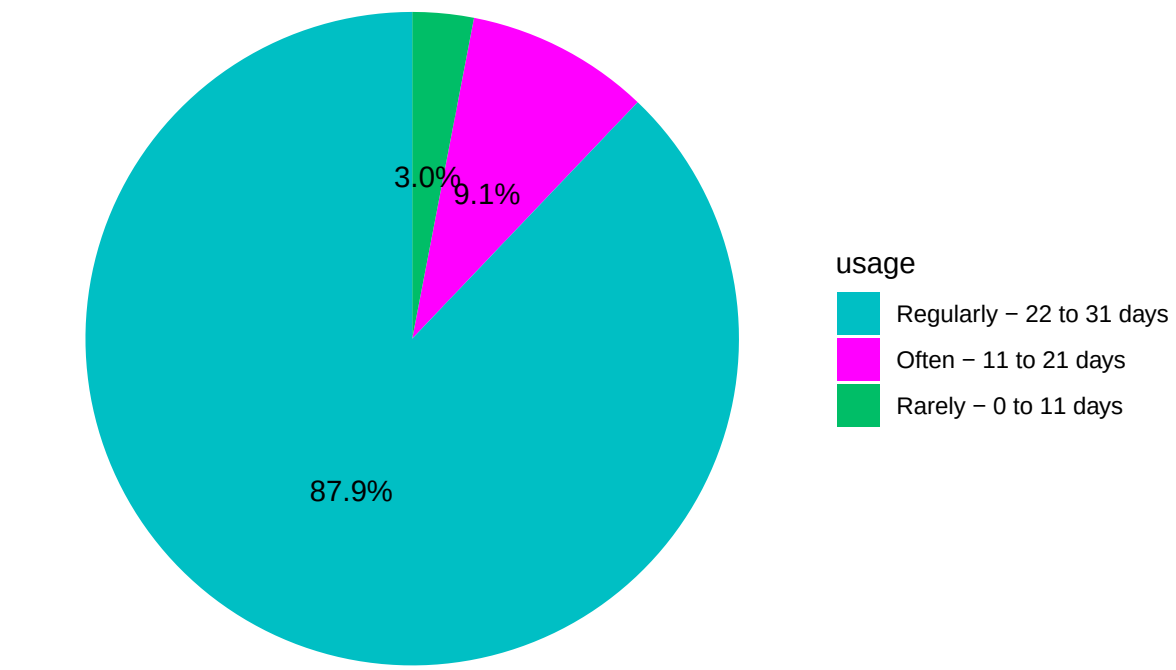
```
##  [1] "id"                       "date"
##  [3] "totalsteps"               "totaldistance"
##  [5] "trackerdistance"          "loggedactivitiesdistance"
##  [7] "veryactivedistance"       "moderatelyactivedistance"
##  [9] "lightactivedistance"      "sedentaryactivedistance"
## [11] "veryactiveminutes"        "fairlyactiveminutes"
## [13] "lightlyactiveminutes"     "sedentaryminutes"
## [15] "calories"                 "totalsleeprecords"
## [17] "totalminutesasleep"       "totaltimeinbed"
## [19] "week_day"
```

```
user_type <- daily_activity %>%
  group_by(id) %>%
  summarise(days_used = n())

user_type <- user_type %>%
  mutate(usage = case_when(
    days_used >= 0 & days_used < 11 ~ "rarely"
    ,days_used >= 11 & days_used < 21 ~ "often"
    ,days_used >= 21 ~ "regularly"))
```

```
# Converting to percentage for easier visualization

user_type_percent <- user_type %>%
  group_by(usage) %>%
  summarise(total = n()) %>%
  mutate(totals = sum(total)) %>%
  group_by(usage) %>%
  summarise(total_percent = total / totals) %>%
  mutate(labels = scales::percent(total_percent))

user_type_percent$usage <- factor(user_type_percent$usage, levels = c("regularly", "very often",
                                                                      "often", "rarely"))
```

```
# Visualizing how often users use their devices in a month

plot1 <- ggplot(user_type_percent, aes(x="", y= total_percent, fill = usage))+
  geom_bar(stat = "identity", width = 1)+
  coord_polar("y", start = 0)+
```

```
  theme_void()+
  geom_text(aes(label = labels),
            position = position_stack(vjust = 0.5))+
  scale_fill_manual(values = c("#00BFC4","#FF00FF","#00BE67"),
                    labels = c("Regularly - 22 to 31 days",
                               "Often - 11 to 21 days",
                               "Rarely - 0 to 11 days"))+
  labs(title = "Device usage in a Month")

plot1
```



Findings:

Most of the users use their devices regularly in a month but there are a few user that rarely use their devices. This suggests that users who own smart fitness devices will most probably use them on a regular bases.

2. Time spent in bed vs time spent asleep

```
# Calculate the time it takes for users to fall asleep

time_to_sleep <- daily_sleep %>%
  mutate(time_taken = (totaltimeinbed - totalminutesasleep)- 10)

time_to_sleep <- time_to_sleep %>%
  group_by(id) %>%
  summarise(avg_time_taken = mean(time_taken))
```

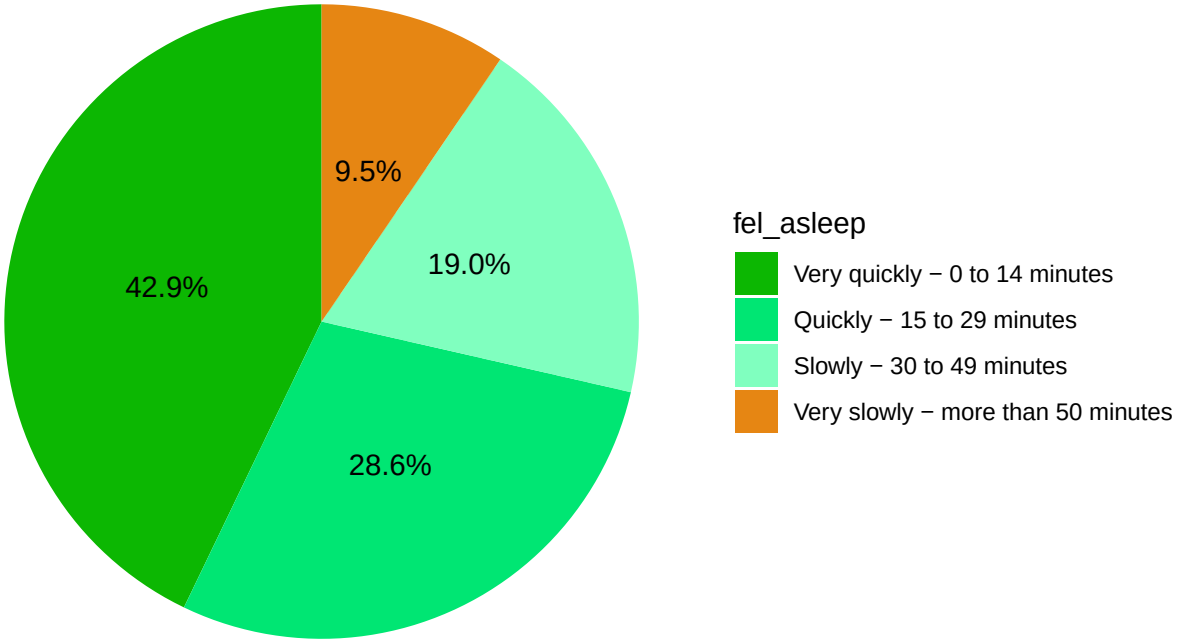
```
# Categorizing users based on amount of minutes it takes to fall asleep
```

```r
time_to_sleep <- time_to_sleep %>%
  mutate(fel_asleep = case_when(
    avg_time_taken >= 0 & avg_time_taken < 15 ~ "very quickly"
    ,avg_time_taken >= 15 & avg_time_taken < 30 ~ "quickly"
    ,avg_time_taken >= 30 & avg_time_taken < 50 ~ "slowly"
    ,avg_time_taken >= 50 ~ "very slowly"))
time_to_sleep$fel_asleep <- factor(time_to_sleep$fel_asleep, levels = c("very quickly","quickly","slowl
time_to_sleep <- drop_na(time_to_sleep)
```

```r
# Converting to percentages to visualize easier

time_to_sleep_percent <- time_to_sleep %>%
  group_by(fel_asleep) %>%
  summarise(total = n()) %>%
  mutate(totals = sum(total)) %>%
  group_by(fel_asleep) %>%
  summarise(total_percent = total/totals) %>%
  mutate(labels = scales::percent(total_percent))
```

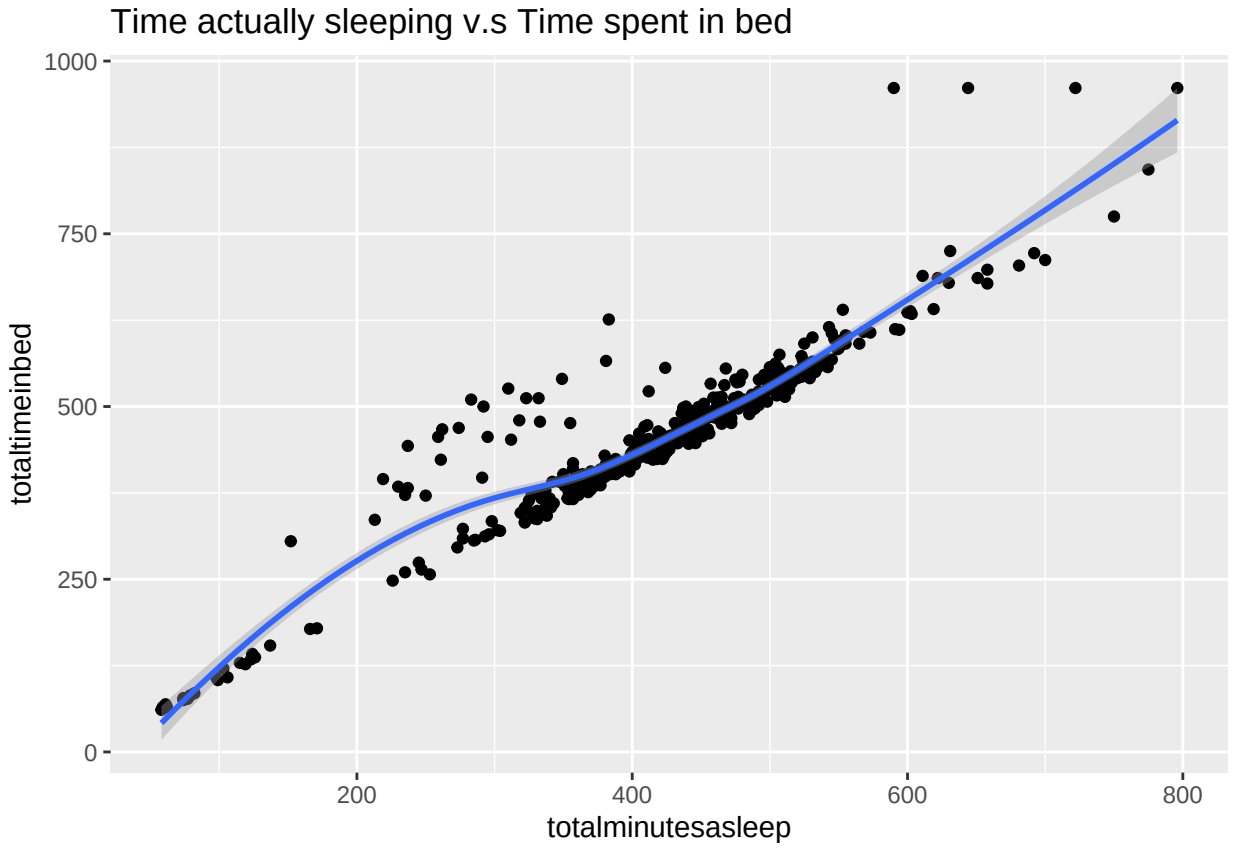
```r
# Visualizing time it takes for users to fall asleep

plot2 <- ggplot(time_to_sleep_percent, aes(x="", y= total_percent, fill = fel_asleep))+
  geom_bar(stat = "identity", width = 1)+
  coord_polar("y", start = 0)+
  theme_void()+
  geom_text(aes(label = labels),
            position = position_stack(vjust = 0.5))+
  scale_fill_manual(values = c("#0CB702","#00e673","#80ffbf", "#E68613"),
                    labels = c("Very quickly - 0 to 14 minutes",
                               "Quickly - 15 to 29 minutes",
                               "Slowly - 30 to 49 minutes",
                               "Very slowly - more than 50 minutes"))+
  labs(title = "Time taken to fall Asleep")

plot2
```

Time taken to fall Asleep




```
# Visualization of time spent in bed and time sleeping

plot3 <- ggplot(daily_sleep, aes(x = totalminutesasleep, y = totaltimeinbed)) + geom_point() + geom_smoo
plot3
```

```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



Findings:

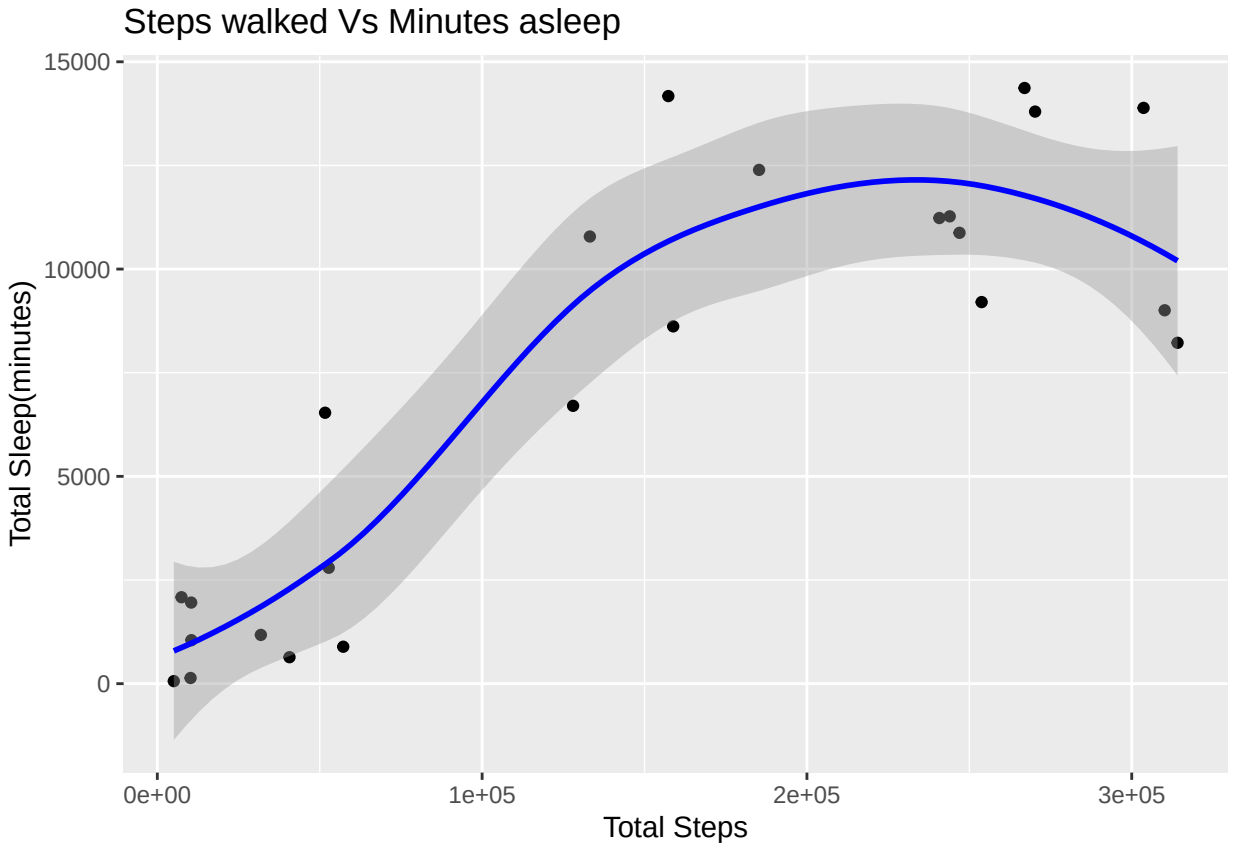
Most of the users fall asleep quickly after going to bed however there are a small percentage of users that takes a long while to fall asleep.

3. The relationship between steps and amount of sleep

```
# Correlation between Steps walked and amount of sleep

daily_steps_sleep <- daily_activity_sleep %>%
  group_by(id) %>%
  summarise(total_steps = sum(totalsteps), total_sleepminutes = sum(totalminutesasleep))
```

```
# Visualizing Correlation between steps and sleep

plot4 <- ggplot(daily_steps_sleep, aes(x= total_steps, y= total_sleepminutes))+
  geom_point(fill = "green")+
  geom_smooth(color = "blue")+
  labs(title = "Steps walked Vs Minutes asleep", x= "Total Steps", y= "Total Sleep(minutes)")

plot4
```

```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



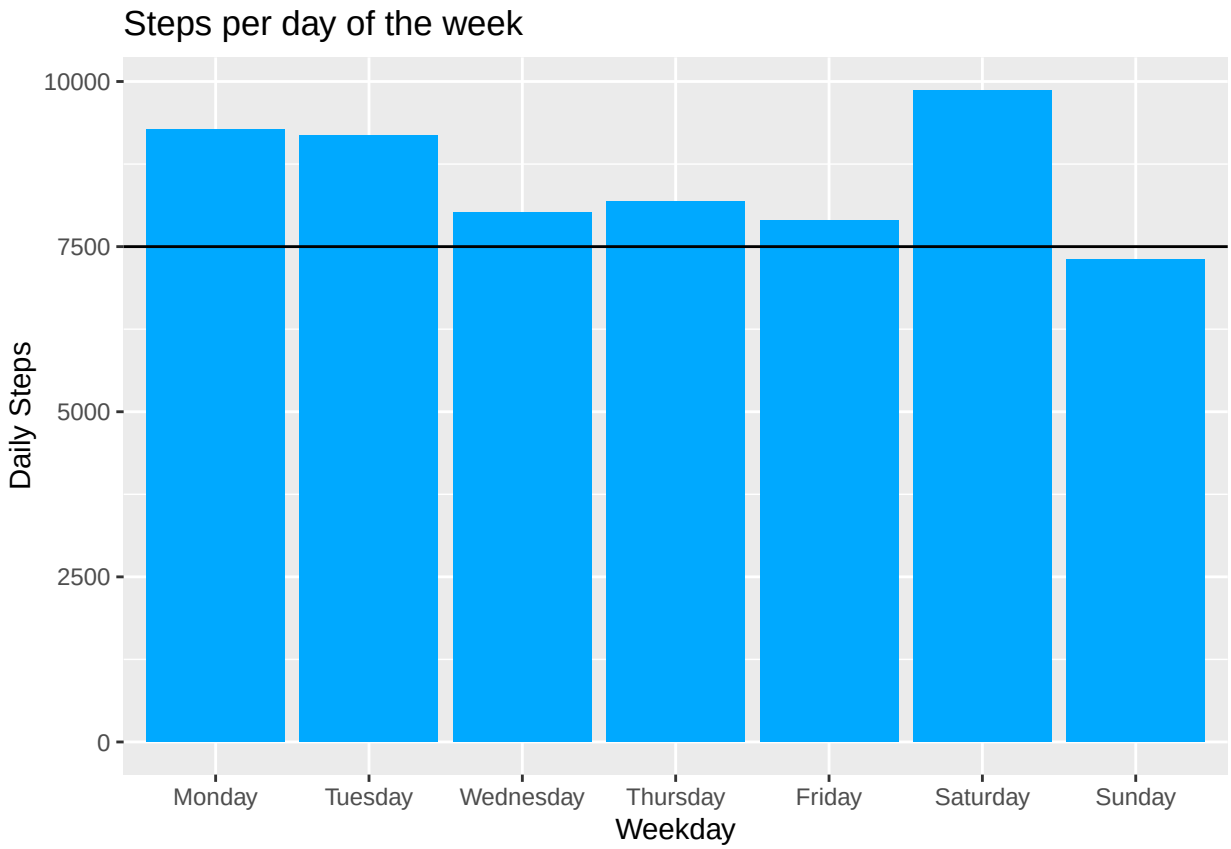
Findings:

There is a positive relationship between the amount of sleep and the number of steps of users. This suggests that taking more steps during the day will lead to better sleep during the night.

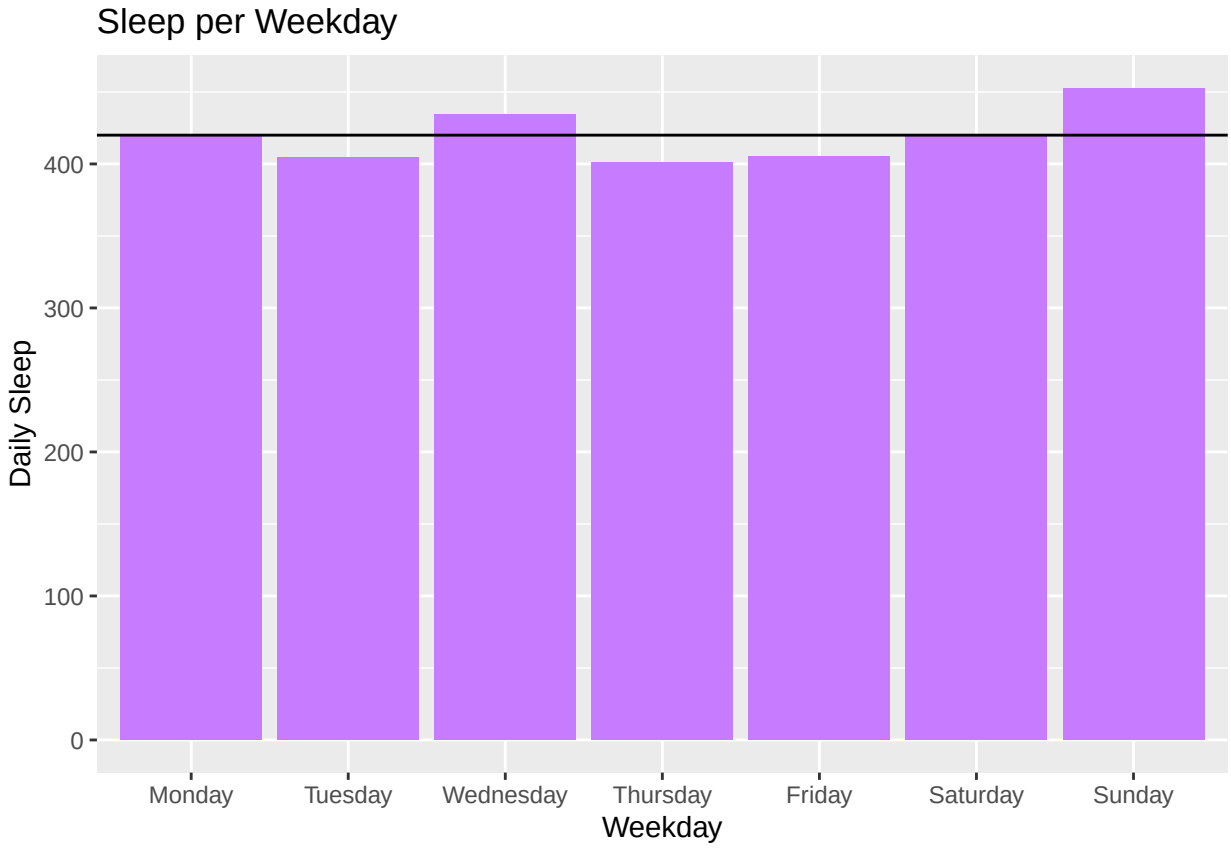
4. On which days of the week are users most active?

```
# Which days of the week are users most active

weekday_steps_sleep <- daily_activity_sleep

weekday_steps_sleep$week_day <- ordered(weekday_steps_sleep$week_day, levels = c("Monday", "Tuesday", "
                                                                                 "Friday", "Saturday",


weekday_steps_sleep <- weekday_steps_sleep %>%
  group_by(week_day) %>%
  summarise(daily_steps = mean(totalsteps), daily_sleep = mean(totalminutesasleep))
```

```
# Visualizing which days of the week users were most active

plot5 <-  ggplot(weekday_steps_sleep) +
  geom_col(mapping = aes(week_day, daily_steps), fill = "#00A9FF")+
  labs(title = "Steps per day of the week", x= "Weekday", y= "Daily Steps")+
  geom_hline(yintercept = 7500)
plot5
```




```
# Visualizing sleep per day of the week

plot6 <-  ggplot(weekday_steps_sleep)+
 geom_col(aes(x= week_day, y= daily_sleep), fill = "#C77CFF")+
 geom_hline(yintercept = 420)+
 labs(title = "Sleep per Weekday", x= "Weekday", y= "Daily Sleep")

plot6
```



Findings:

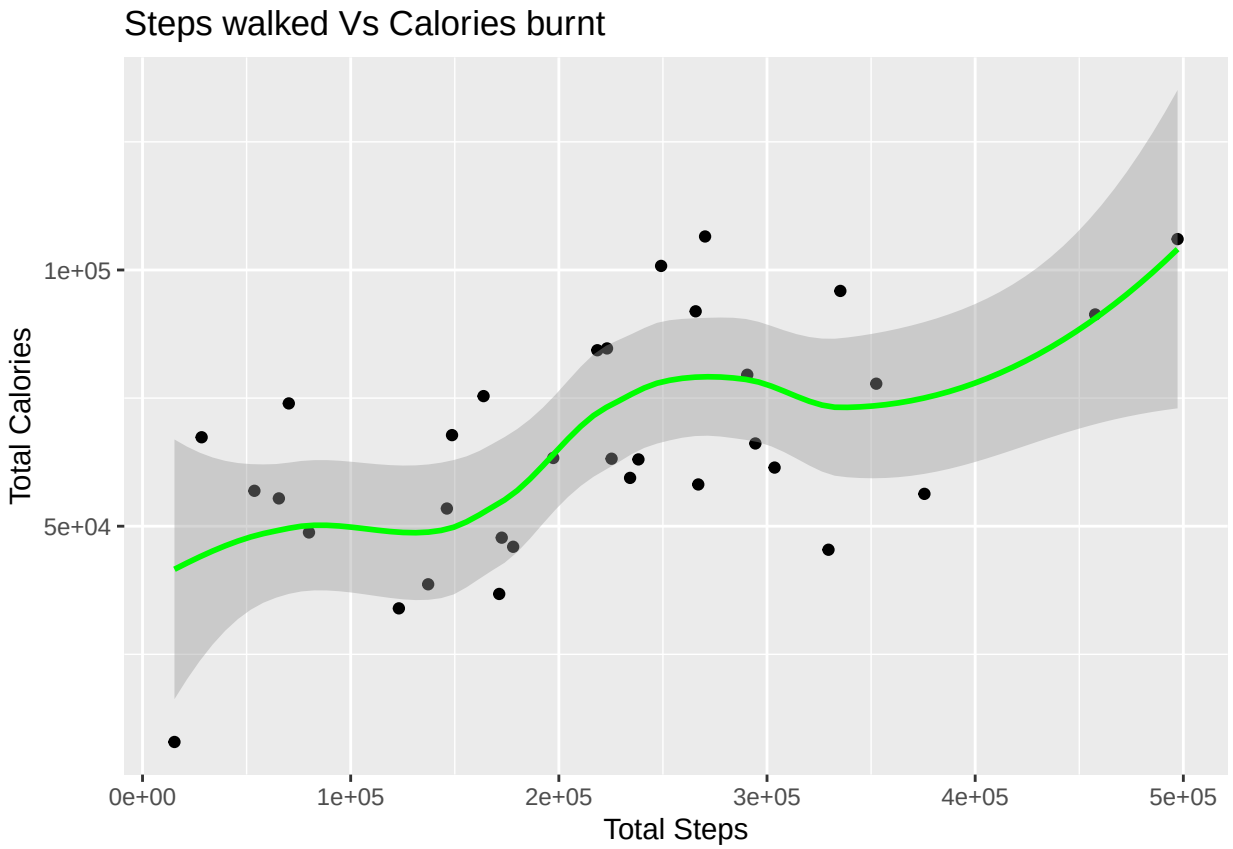
Users are most active on Saturdays while they are least active on Sundays. Users normally reach the recommended 7500 steps every day except on Sundays.

5. What is the correlation between steps and calories?

```
# Correlation between steps and calories

daily_steps_calories <- daily_activity %>%
  group_by(id) %>%
  summarise(total_steps = sum(totalsteps), total_calories = sum(calories))
```

```
# Visualization of the correlation between steps and calories

plot7 <- ggplot(daily_steps_calories, aes(x= total_steps, y= total_calories), fill = blue)+
  geom_point()+
  geom_smooth(color = "green")+
  labs(title = "Steps walked Vs Calories burnt", x= "Total Steps", y= "Total Calories")

plot7
```

```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



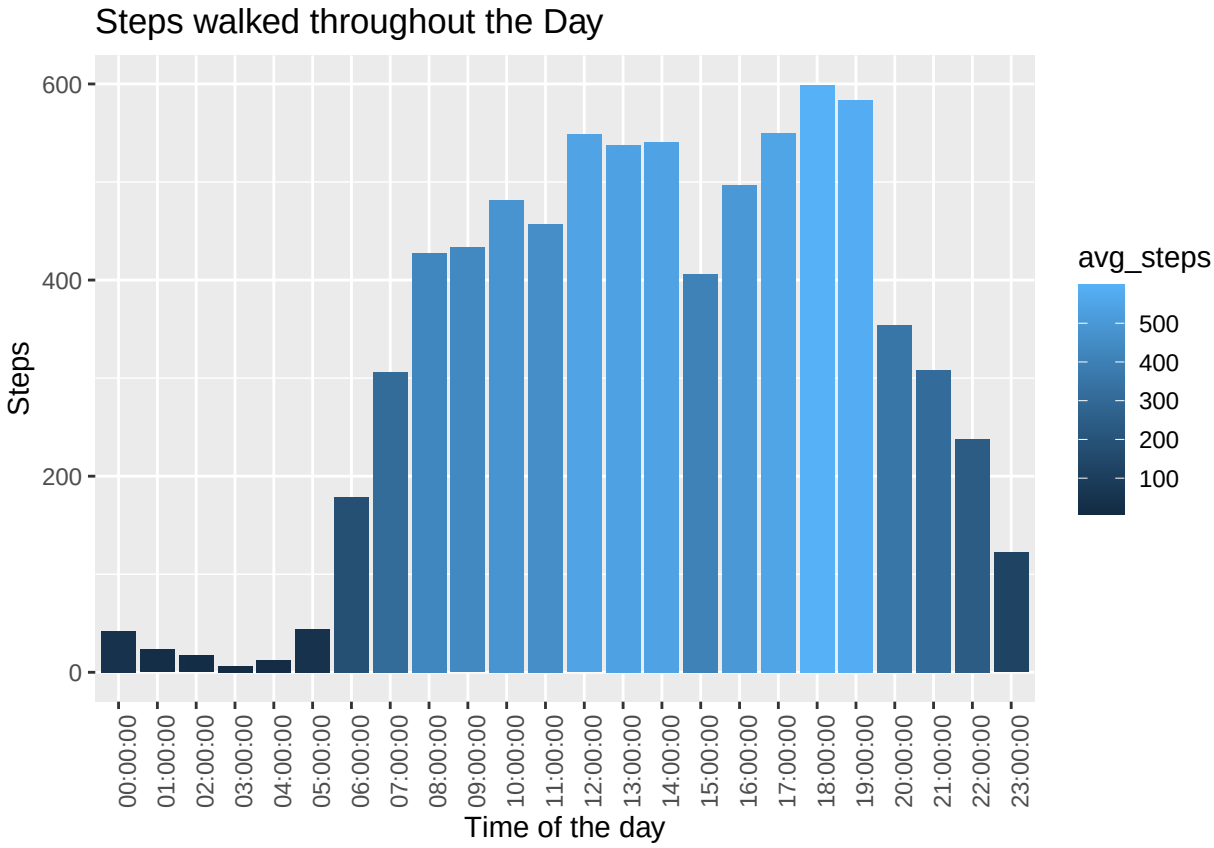
Findings:

There is a positive correlation between steps taken and calories burned. This suggests that taking more steps will ultimately burn more calories.

6. Which times of the day are users most active?

```
# Calculate which time of day users are most active by separating date and time

hourly_steps <- hourly_steps %>%
  separate(date_time, into = c("date", "time"), sep= " ") %>%
  mutate(date = ymd(date))
```

```
# Visualizing what time of day users are most active

plot8 <- hourly_steps %>%
  group_by(time) %>%
  summarise(avg_steps = mean(steptotal)) %>%
  ggplot(aes(x= time, y= avg_steps, fill = avg_steps))+
  geom_col()+
  labs(title = "Steps walked throughout the Day", x= 'Time of the day', y= "Steps")+
  theme(axis.text.x = element_text(angle = 90))

plot8
```



Findings:

Users are most active in the evening (17:00 - 19:00) and second most in the afternoon (12:00 – 14:00).

User activity declines during the night from 22:00 to 05:00.

Share

Recommendations:

- We can see that walking more steps gets you more sleep so we can recommend to our users who are having difficulties with sleep to walk more or be more active during the day time in order to get more sleep at night.
- Users are not getting the recommended 7 hours of sleep every night and an App notification at a specified bedtime might help improve the sleeping patterns of users.
- Since users do not reach the recommended numbers of steps on Sundays, we can send them notifications on Bellabeat App to complete their daily steps goal. This will motivate users and build loyalty.
- Some users are struggling to fall asleep after getting into bed, so we can publish some articles (best sleeping habits, how to improve sleep quality etc) on our website and App which may help them get the recommended sleep.
- Walking more steps burns more calories, so we can add a new feature to our app which sets a goal for the day based on your fitness goals and if the goal is not met it sends notifications to our users to complete their goal, which may help improve their fitness.