# Reproducible Research Assignment 1

Geons

Sunday, January 10, 2016

## Preparation :

```
# Clean up before start / tabula rasa (optional)
rm(list=ls())

# Load needed libraries - can be done later as well
library(knitr)
library(plyr)
library(ggplot2)
library(lattice)

# check the workdir and reset if needed
getwd()

## [1] "E:/reproducible_research/assignment_1"

setwd("e:/reproducible_research/assignment_1")
```

## Loading and preprocessing the data

We will load the data to initiate processing ##### 1. Unzip if necessary and read the data

```
if(!file.exists('activity.csv')){
    unzip('activity.zip')
}

data <- read.csv("activity.csv", colClasses = c("integer", "Date", "factor"))
```

##### *2. Reformat the Date column & eliminate NA's*

```
data$month <- as.numeric(format(data$date, "%m"))

cleanData <- na.omit(data)
```

## What is mean total number of steps taken per day?

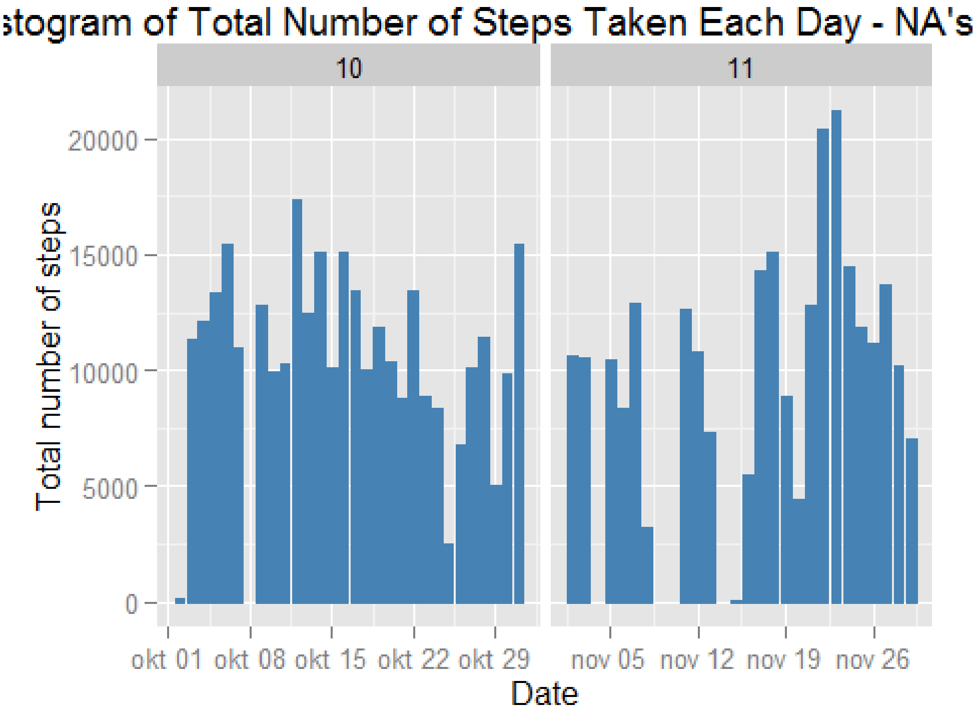
For this part of the assignment, you can ignore the missing values in the dataset.

##### *1. Make a histogram of the total number of steps taken each day*

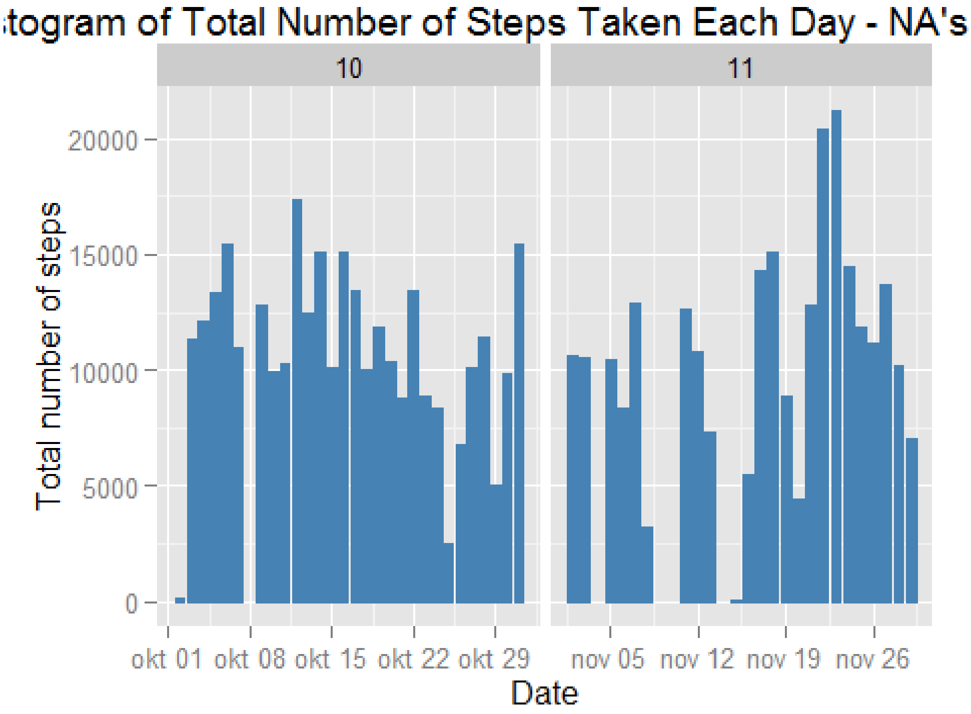
```
# First plot with NA's
ggplot(data, aes(date, steps)) +
    geom_bar(stat = "identity", colour = "steelblue", fill = "steelblue",
width = 0.8) +
    facet_grid(. ~ month, scales = "free") +
    labs(title = "Histogram of Total Number of Steps Taken Each Day - NA's
included", x = "Date", y = "Total number of steps")
```

```
## Warning: Removed 576 rows containing missing values (position_stack).
```

```
## Warning: Removed 1728 rows containing missing values (position_stack).
```



```
# Second plot without NA's - out of curiosity ...
ggplot(cleanData, aes(date, steps)) +
    geom_bar(stat = "identity", colour = "steelblue", fill = "steelblue",
width = 0.8) +
    facet_grid(. ~ month, scales = "free") +
    labs(title = "Histogram of Total Number of Steps Taken Each Day - NA's
excluded", x = "Date", y = "Total number of steps")
```



*2. Calculate and report the mean and median total number of steps taken per day*

The mean total number of steps taken each day is :

```
dailytotalSteps <- aggregate(cleanData$steps, list(Date = cleanData$date),
FUN = "sum")$x
mean(dailytotalSteps)

## [1] 10766.19
```

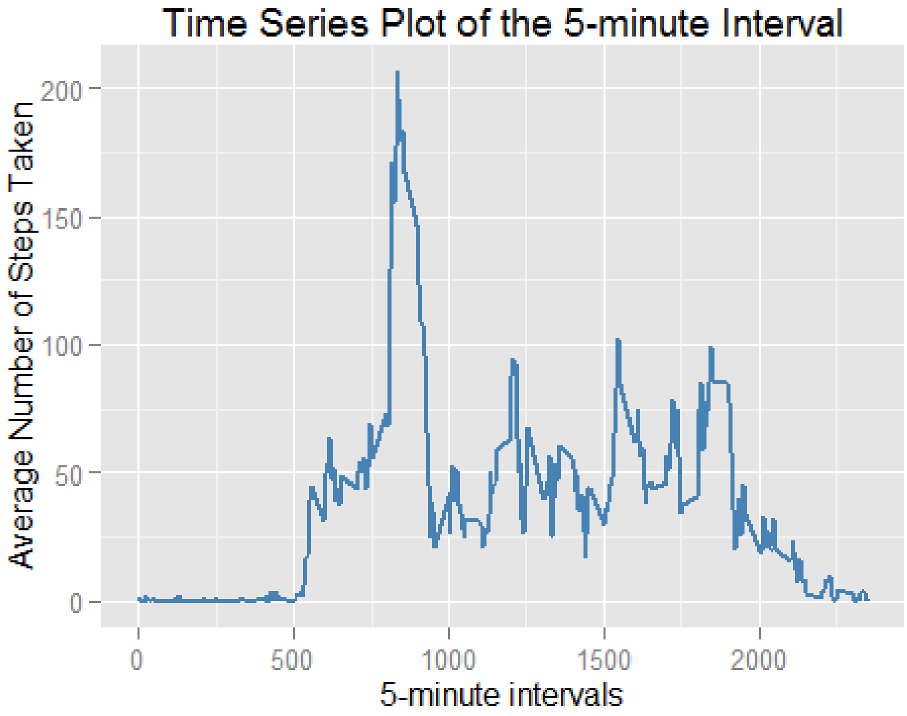
Median total number of steps taken per day:

```
median(dailytotalSteps)

## [1] 10765
```

## What is the average daily activity pattern?

*1. 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)*

```
avgSteps <- aggregate(cleanData$steps, list(interval =
as.numeric(as.character(cleanData$interval))), FUN = "mean")
names(avgSteps)[2] <- "meanOfSteps"

ggplot(avgSteps, aes(interval, meanOfSteps)) +
    geom_line(color = "steelblue", size = 0.8) +
    labs(title = "Time Series Plot of the 5-minute Interval", x = "5-minute
intervals", y = "Average Number of Steps Taken")
```



*2. Which 5-minute interval, on average across all the days in the dataset, contains the maximum number of steps?*

The 5-minute interval that contains on average the most steps is :

```
avgSteps[avgSteps$meanOfSteps == max(avgSteps$meanOfSteps), ]

##     interval meanOfSteps
## 104      835    206.1698
```

## Imputing missing values

The presence of missing days may introduce bias into some calculations or summaries of the data. ##### 1. Calculate and report the total number of missing values in the dataset (i.e. the total number of rows with NAs) The total number of rows with NAs:

```
sum(is.na(data)) # or sum(!complete.cases(data)) would also work

## [1] 2304
```

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

For example, you could use the mean/median for that day, or the mean for that 5-minute interval, etc.

I chose to use the median for that 5-minute interval to fill each NA value in the steps column. So first i need to create an overview of the median steps

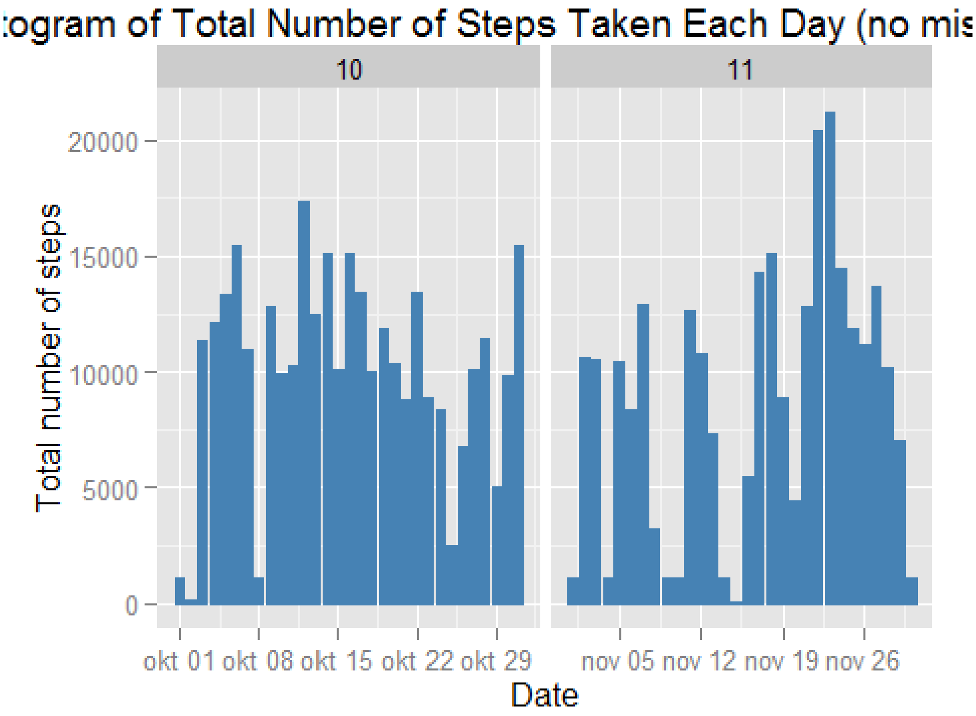
```
medianSteps <- aggregate(cleanData$steps, list(interval =
as.numeric(as.character(cleanData$interval))), FUN = "median")
names(medianSteps)[2] <- "medianOfSteps"
```

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

```
fakeData <- data
for (i in 1:nrow(fakeData)) {
    if (is.na(fakeData$steps[i])) {
        fakeData$steps[i] <- medianSteps[which(fakeData$interval[i] ==
medianSteps$interval), ]$medianOfSteps
    }
}
```

*4. 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.*

```
ggplot(fakeData, aes(date, steps)) +
    geom_bar(stat = "identity", colour = "steelblue", fill = "steelblue",
width = 0.8) +
    facet_grid(. ~ month, scales = "free") +
    labs(title = "Histogram of Total Number of Steps Taken Each Day (no
missing data)", x = "Date", y = "Total number of steps")
```



* Do these values differ from the estimates from the first part of the assignment?

The Mean and median total number of steps taken per day are :

```
fakeTotalSteps <- aggregate(fakeData$steps, list(Date = fakeData$date), FUN =
"sum")$x
fakeMean <- mean(fakeTotalSteps)
fakeMedian <- median(fakeTotalSteps)
realMean <- mean(dailytotalSteps)
realMedian <- median(dailytotalSteps)
```

Compare them with the two before imputing missing data:

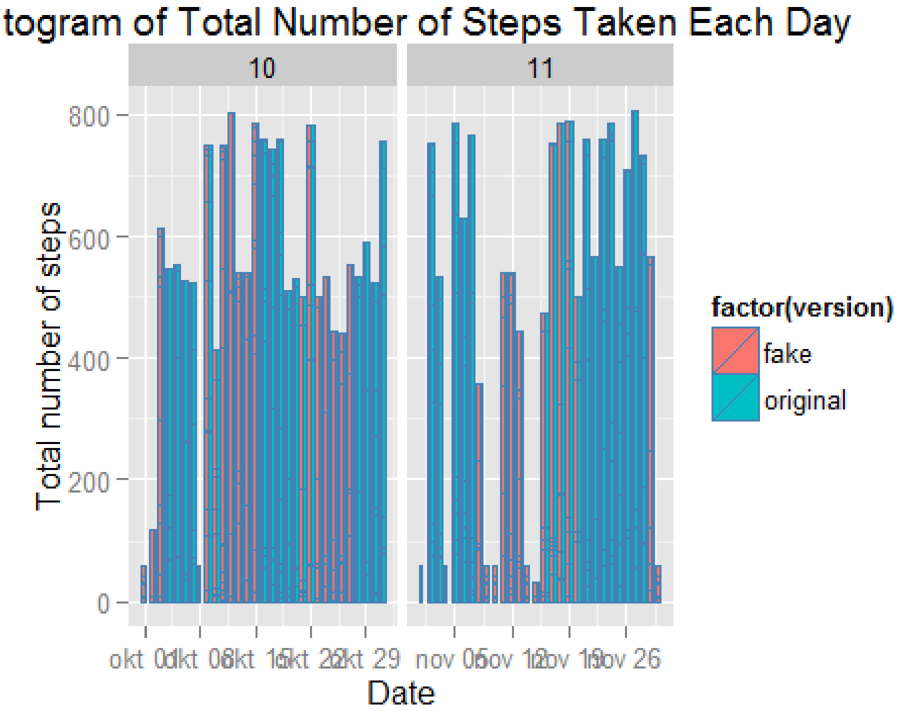
```
# I started this code block with {r, echo=TRUE, results='show',
warning=FALSE, message=TRUE}
# I would put echo = FALSE if it weren't for the assignment ... but hey it's
an exercise!
message("Substracting the real mean (", round(realMean), ") from the fake
mean (", round(fakeMean), ") gives : ", round(fakeMean - realMean) , " !)")

## Substracting the real mean (10766) from the fake mean (9504) gives : -1262
!)

message("Substracting the real median (", realMedian, ") from the fake median
(", fakeMedian, ") gives : ", fakeMedian - realMedian , " !)")

## Substracting the real median (10765) from the fake median (10395) gives :
-370 !)
```

- What is the impact of imputing missing data on the estimates of the total daily number of steps?

After replacing the missing data by the median 5-min interval value, the fake mean of total steps taken per day is 1262 steps less than that of the mean of the recorded data; the new (fake) median of total steps taken per day is 370 steps less than that of the real (recorded) median.

We can also look at the difference in a graph :

```
#I first add a label (factor) to each dataset
data$version <- 'original'
fakeData$version <- 'fake'

#and bind the datasets into a new data frame allData
allData <- rbind(data, fakeData)

ggplot(allData, aes(date, steps, fill = factor(version))) +
    geom_bar(stat = "identity", colour = "steelblue", width = 0.8,
position="dodge") +
    facet_grid(. ~ month, scales = "free") +
    labs(title = "Histogram of Total Number of Steps Taken Each Day", x =
"Date", y = "Total number of steps")
```



As such the differences do not look as big. Which goes to show that graphs do not always reveal all (or that I should have chosen another graph for this illustration).

## Are there differences in activity patterns between weekdays and weekends?

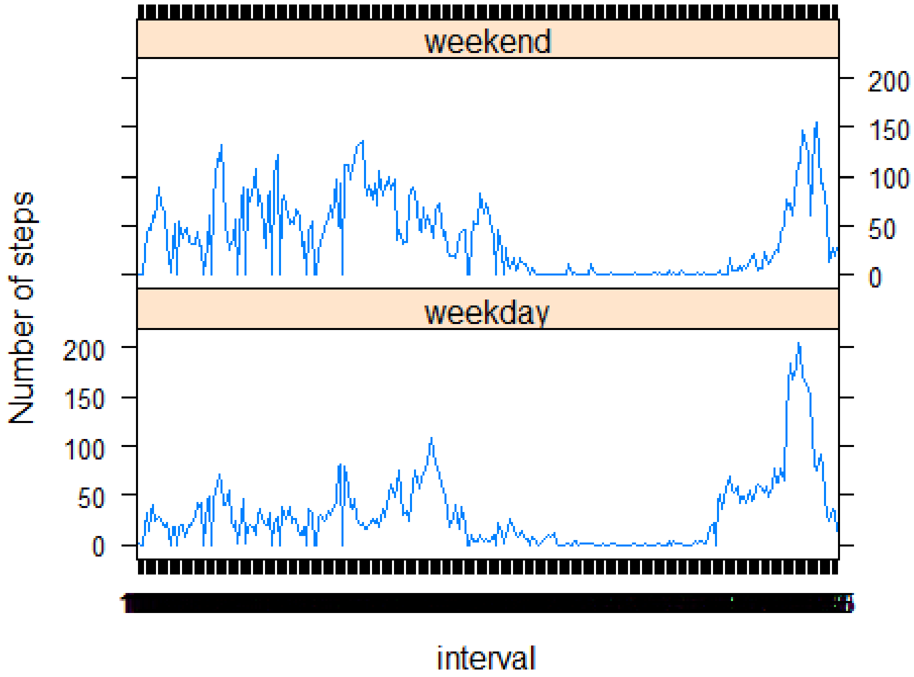
For this part the dataset with the filled-in missing values was used as instructed.

*1. 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.*

```
fakeData$dagvdweek <- weekdays(fakeData$date)
fakeData$dagvdweek[fakeData$dagvdweek =='zaterdag'| fakeData$dagvdweek
=='zondag'] <- 'weekend'
fakeData$dagvdweek[fakeData$dagvdweek !='weekend'] <- 'weekday'
fakeData$dagvdweek<- as.factor(fakeData$dagvdweek)
```

*2. Make a panel plot containing 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 weekday days or weekend days (y-axis).*

```
ppData <- ddply(fakeData, .(interval,dagvdweek), summarise, avesteps =
mean(steps))
xyplot(avesteps ~ interval | dagvdweek, data=ppData,
       type='l',
       lwd=1,
       layout=c(1,2),
      ylab = 'Number of steps')
```



There seems to be a slight difference between weekdays and weekends. Weekdays are characterised by a longer period of low activity probably corresponding to time spent at work (desk). Also sleep seems to be longer during the weekend (the really flat part of the graph).