Reproducible Research: Peer Assessment 1

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Loading and preprocessing the data

```
# Package dependencies (uncomment and install if necessary)

# install.packages("data.table")
# install.packages("lubridate")
library(data.table)
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
##
## The following objects are masked from 'package:data.table':
##
##     hour, mday, month, quarter, wday, week, yday, year
```

```
# set the working directory (replace path accordingly)
setwd("/Users/adakemia/Documents/Academic/Coursera/DataScienceSpecialization/05ReproducibleResearch/Pro

# List and check for necessary files
url <- "https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2Factivity.zip"
zfile <- "activity.zip"
file <- "activity.csv"

if (!file.exists(file)) {
        if (!file.exists(zfile)) {
                method <- switch(Sys.info()[['sysname']],
                                 "Windows" = "internal",
                                 "Darwin" = "curl",
                                 "Linux" = "wget",
                                 "auto")
                download.file(url, destfile=zfile, method)
                }
        unzip(zfile, exdir="./")
}

# Read files into data.table object
data <- fread(file, sep=",", stringsAsFactors=F, header=T,
              na.strings="NA", colClasses=c("numeric","character","character"))
# Check structure of data
str(data)
```

```
## Classes 'data.table' and 'data.frame':   17568 obs. of  3 variables:
##  $ steps   : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ date    : chr  "2012-10-01" "2012-10-01" "2012-10-01" "2012-10-01" ...
##  $ interval: chr  "0" "5" "10" "15" ...
##  - attr(*, ".internal.selfref")=<externalptr>
```

```
# Process data

# Set date formatting (lubridate package)
data[,date := ymd(date)]
```

```
##        steps       date interval
##     1:    NA 2012-10-01        0
##     2:    NA 2012-10-01        5
##     3:    NA 2012-10-01       10
##     4:    NA 2012-10-01       15
##     5:    NA 2012-10-01       20
##    ---
## 17564:    NA 2012-11-30     2335
## 17565:    NA 2012-11-30     2340
## 17566:    NA 2012-11-30     2345
## 17567:    NA 2012-11-30     2350
## 17568:    NA 2012-11-30     2355
```

```
# Data quality checks

# Check for missingness
colSums(is.na(data))
```

```
##    steps     date interval
##     2304        0        0
```

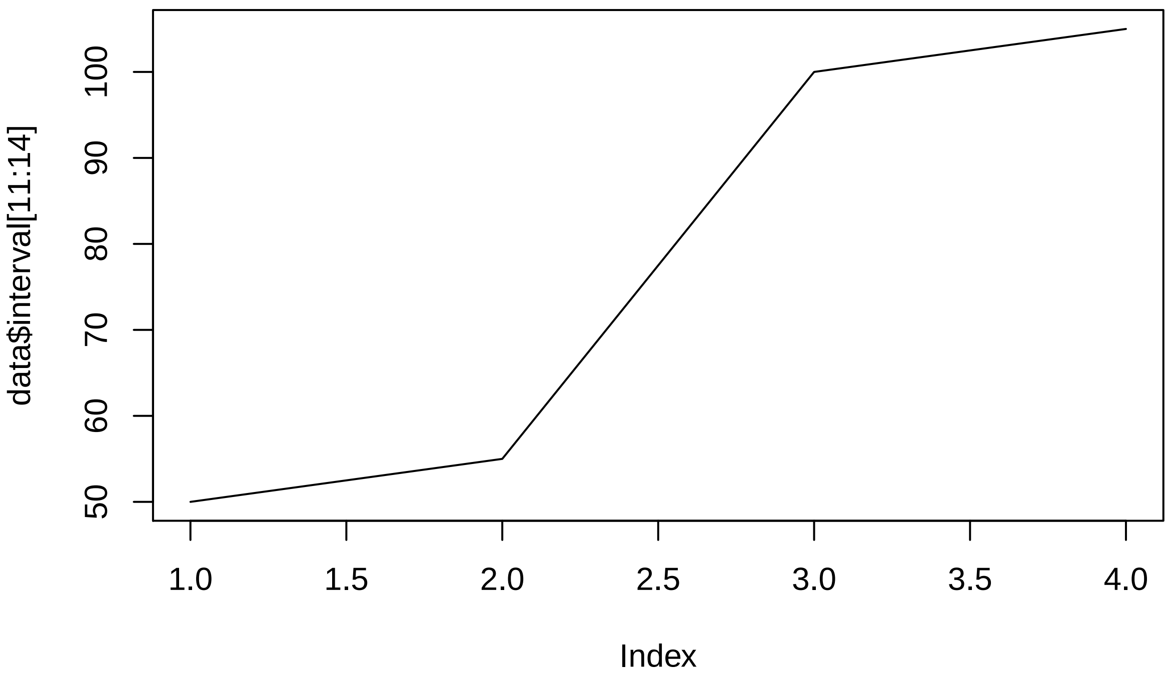
```
# Percent missing
sum(is.na(data$steps)) / nrow(data) * 100
```

```
## [1] 13.11475
```

```
# Check timeseries
data[,unique(date)]
```

```
##  [1] "2012-10-01 UTC" "2012-10-02 UTC" "2012-10-03 UTC" "2012-10-04 UTC"
##  [5] "2012-10-05 UTC" "2012-10-06 UTC" "2012-10-07 UTC" "2012-10-08 UTC"
##  [9] "2012-10-09 UTC" "2012-10-10 UTC" "2012-10-11 UTC" "2012-10-12 UTC"
## [13] "2012-10-13 UTC" "2012-10-14 UTC" "2012-10-15 UTC" "2012-10-16 UTC"
## [17] "2012-10-17 UTC" "2012-10-18 UTC" "2012-10-19 UTC" "2012-10-20 UTC"
## [21] "2012-10-21 UTC" "2012-10-22 UTC" "2012-10-23 UTC" "2012-10-24 UTC"
## [25] "2012-10-25 UTC" "2012-10-26 UTC" "2012-10-27 UTC" "2012-10-28 UTC"
## [29] "2012-10-29 UTC" "2012-10-30 UTC" "2012-10-31 UTC" "2012-11-01 UTC"
## [33] "2012-11-02 UTC" "2012-11-03 UTC" "2012-11-04 UTC" "2012-11-05 UTC"
## [37] "2012-11-06 UTC" "2012-11-07 UTC" "2012-11-08 UTC" "2012-11-09 UTC"
## [41] "2012-11-10 UTC" "2012-11-11 UTC" "2012-11-12 UTC" "2012-11-13 UTC"
## [45] "2012-11-14 UTC" "2012-11-15 UTC" "2012-11-16 UTC" "2012-11-17 UTC"
## [49] "2012-11-18 UTC" "2012-11-19 UTC" "2012-11-20 UTC" "2012-11-21 UTC"
## [53] "2012-11-22 UTC" "2012-11-23 UTC" "2012-11-24 UTC" "2012-11-25 UTC"
## [57] "2012-11-26 UTC" "2012-11-27 UTC" "2012-11-28 UTC" "2012-11-29 UTC"
## [61] "2012-11-30 UTC"
```

```
plot(data$interval[11:14], type="l")
```



```
data[11:14]
```

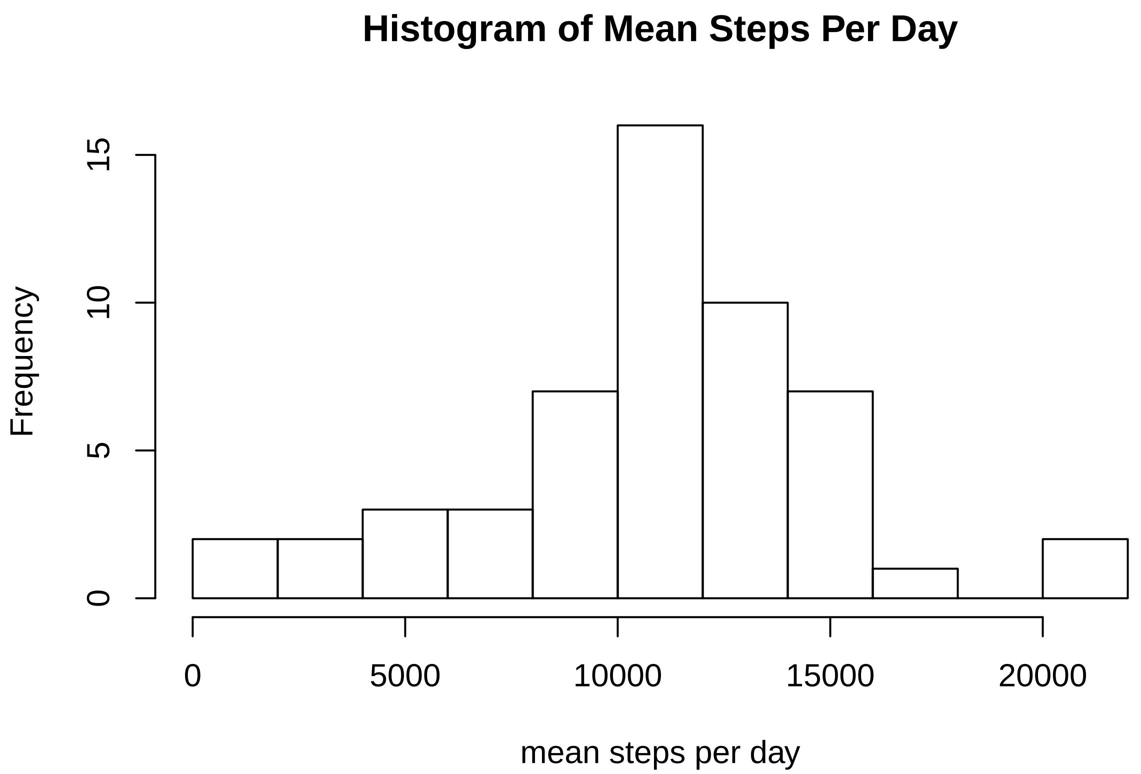
```
##    steps       date interval
## 1:    NA 2012-10-01       50
## 2:    NA 2012-10-01       55
## 3:    NA 2012-10-01      100
## 4:    NA 2012-10-01      105
```

```
# Fix hour/min anomaly
```

What is mean total number of steps taken per day?

First, we can take a wide view via a histogram. We can see several things from the histogram:
The shape is relatively normal
Due to normality, we would expect mean and median to be fairly close
We would expect the mean and median to fall roughly just over 10,000 steps

```
hist(data[,sum(steps), by=date]$V1, breaks=8,
     main="Histogram of Mean Steps Per Day",
     xlab="mean steps per day")
```



Next, we can compare to the actual mean and median for the entire period. As expected, the mean and median are very close and just over 10,000 steps.

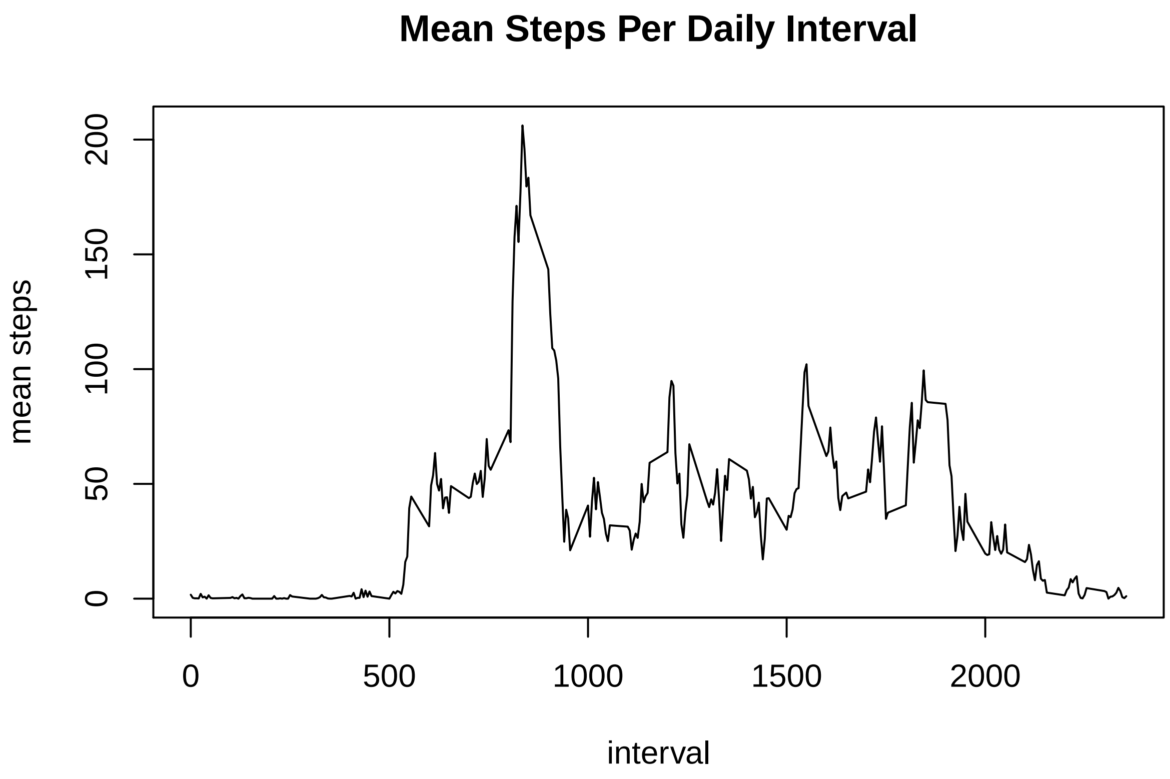
```
data[, .(sum = sum(steps)), by=date][,.(median = median(sum, na.rm=T),
                                        mean = mean(sum, na.rm=T))]
```

```
##    median     mean
## 1:  10765 10766.19
```

What is the average daily activity pattern?

```
ts <- data[, .(mean = round( mean(steps, na.rm=T), 2)), by=interval]

plot(ts$mean ~ ts$interval, type="l", main="Mean Steps Per Daily Interval",
     xlab="interval", ylab="mean steps")
```



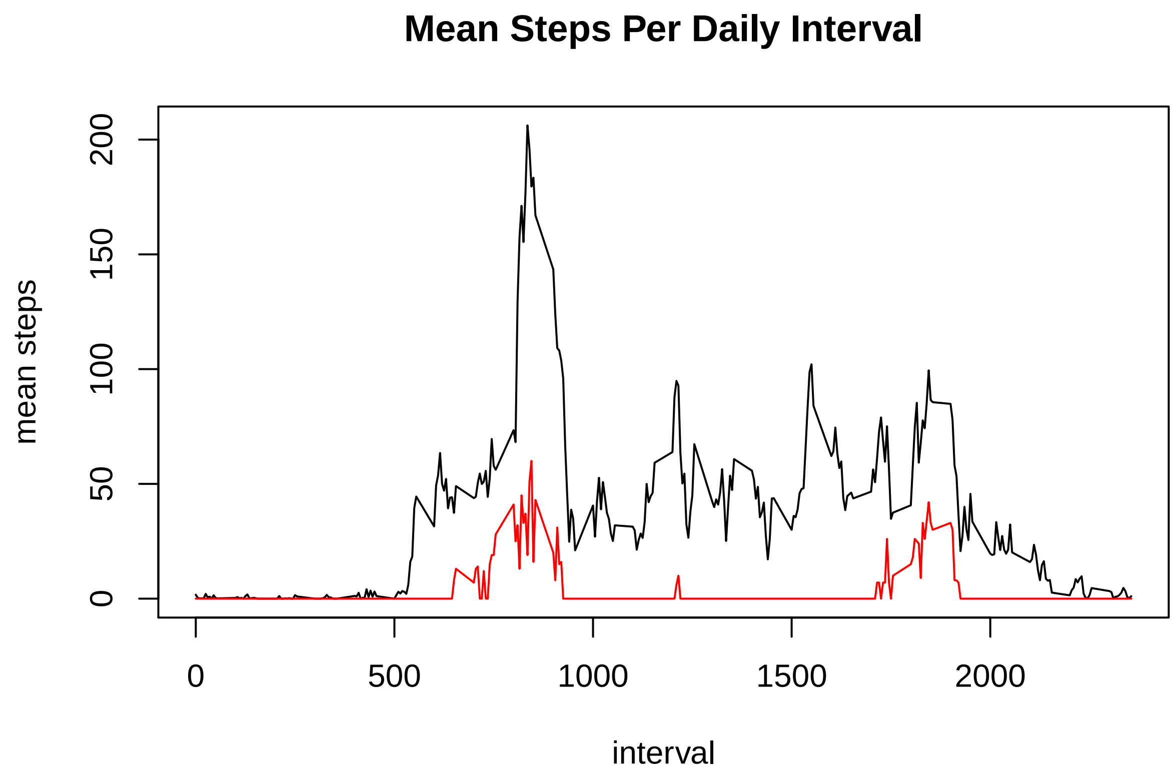
```r
ts[which.max(mean)]
```

```
##    interval   mean
## 1:      835 206.17
```

Imputing missing values

```r
# create a second imputed data set
data_imp <- data

ts2 <- data_imp[, .(median = median(steps, na.rm=T),
                    mean = mean(steps, na.rm=T)),
                by=interval]
# Compare mean and median by interval
plot(ts2$mean ~ ts2$interval, type="l", main="Mean Steps Per Daily Interval",
     xlab="interval", ylab="mean steps")
lines(ts2$median ~ ts2$interval, col="red")
```



```
data[interval == 1000]
```

```
##      steps       date interval
##  1:     NA 2012-10-01     1000
##  2:      0 2012-10-02     1000
##  3:      0 2012-10-03     1000
##  4:      0 2012-10-04     1000
##  5:      0 2012-10-05     1000
##  6:     16 2012-10-06     1000
##  7:    281 2012-10-07     1000
##  8:     NA 2012-10-08     1000
##  9:     23 2012-10-09     1000
## 10:    400 2012-10-10     1000
## 11:      0 2012-10-11     1000
## 12:      0 2012-10-12     1000
## 13:      0 2012-10-13     1000
## 14:    392 2012-10-14     1000
## 15:      0 2012-10-15     1000
## 16:      0 2012-10-16     1000
## 17:     92 2012-10-17     1000
## 18:      0 2012-10-18     1000
## 19:      0 2012-10-19     1000
## 20:      0 2012-10-20     1000
## 21:      0 2012-10-21     1000
## 22:      0 2012-10-22     1000
## 23:      0 2012-10-23     1000
## 24:      0 2012-10-24     1000
## 25:      0 2012-10-25     1000
## 26:      0 2012-10-26     1000
## 27:     0 2012-10-27     1000
## 28:     0 2012-10-28     1000
## 29:   104 2012-10-29     1000
## 30:     0 2012-10-30     1000
## 31:   122 2012-10-31     1000
## 32:    NA 2012-11-01     1000
## 33:   487 2012-11-02     1000
## 34:     0 2012-11-03     1000
## 35:    NA 2012-11-04     1000
## 36:     0 2012-11-05     1000
## 37:     0 2012-11-06     1000
## 38:     8 2012-11-07     1000
## 39:     0 2012-11-08     1000
## 40:    NA 2012-11-09     1000
## 41:    NA 2012-11-10     1000
## 42:     0 2012-11-11     1000
## 43:     0 2012-11-12     1000
## 44:     0 2012-11-13     1000
## 45:    NA 2012-11-14     1000
## 46:     0 2012-11-15     1000
## 47:    18 2012-11-16     1000
## 48:     0 2012-11-17     1000
## 49:     0 2012-11-18     1000
## 50:     0 2012-11-19     1000
## 51:     0 2012-11-20     1000
## 52:     0 2012-11-21     1000
## 53:     0 2012-11-22     1000
## 54:     0 2012-11-23     1000
## 55:     0 2012-11-24     1000
## 56:     0 2012-11-25     1000
## 57:     0 2012-11-26     1000
## 58:   207 2012-11-27     1000
## 59:     0 2012-11-28     1000
## 60:     0 2012-11-29     1000
## 61:    NA 2012-11-30     1000
##     steps       date interval
```

```
data_imp[, .(median = median(steps, na.rm=T),
                    mean = mean(steps, na.rm=T)),
                by=list(interval, wday(date))][interval==900]
```

```
##    interval wday median      mean
## 1:      900    2     71 249.85714
## 2:      900    3     36 134.00000
## 3:      900    4     14 137.50000
## 4:      900    5      0 137.75000
## 5:      900    6     16 218.14286
## 6:      900    7     20 112.14286
## 7:      900    1     15  19.14286
```

```
ts2[interval == 900]
```

```
##    interval median     mean
## 1:      900     20 143.4528
```

```
data[interval == 900]
```

```
##     steps       date interval
##  1:    NA 2012-10-01      900
##  2:     0 2012-10-02      900
##  3:     0 2012-10-03      900
##  4:     0 2012-10-04      900
##  5:   530 2012-10-05      900
##  6:    30 2012-10-06      900
##  7:    23 2012-10-07      900
##  8:    NA 2012-10-08      900
##  9:   134 2012-10-09      900
## 10:   135 2012-10-10      900
## 11:   548 2012-10-11      900
## 12:   802 2012-10-12      900
## 13:    18 2012-10-13      900
## 14:    15 2012-10-14      900
## 15:   732 2012-10-15      900
## 16:    36 2012-10-16      900
## 17:   668 2012-10-17      900
## 18:    55 2012-10-18      900
## 19:    15 2012-10-19      900
## 20:     0 2012-10-20      900
## 21:     0 2012-10-21      900
## 22:    71 2012-10-22      900
## 23:   400 2012-10-23      900
## 24:     0 2012-10-24      900
## 25:     0 2012-10-25      900
## 26:   164 2012-10-26      900
## 27:   519 2012-10-27      900
## 28:    23 2012-10-28      900
## 29:     4 2012-10-29      900
## 30:     0 2012-10-30      900
## 31:     0 2012-10-31      900
## 32:    NA 2012-11-01      900
## 33:    16 2012-11-02      900
## 34:   198 2012-11-03      900
## 35:    NA 2012-11-04      900
## 36:   363 2012-11-05      900
## 37:   433 2012-11-06      900
## 38:    28 2012-11-07      900
## 39:     0 2012-11-08      900
## 40:    NA 2012-11-09      900
## 41:    NA 2012-11-10      900
## 42:     0 2012-11-11      900
## 43:   539 2012-11-12      900
## 44:     0 2012-11-13      900
## 45:    NA 2012-11-14      900
## 46:     0 2012-11-15      900
## 47:     0 2012-11-16      900
## 48:    20 2012-11-17      900
## 49:    11 2012-11-18      900
## 50:     0 2012-11-19      900
## 51:   203 2012-11-20      900
## 52:   269 2012-11-21      900
## 53:   499 2012-11-22      900
## 54:     0 2012-11-23      900
## 55:     0 2012-11-24      900
## 56:    62 2012-11-25      900
## 57:    40 2012-11-26      900
## 58:     0 2012-11-27      900
## 59:     0 2012-11-28      900
## 60:     0 2012-11-29      900
## 61:    NA 2012-11-30      900
##     steps       date interval
```

Are there differences in activity patterns between weekdays and weekends?