# Some analysis on fitbit sleep data

I am putting my emphasis and analysis in greater detail on sleep data with compare to fitness data. This is intraday data which includes all measures like activity, calories, sleep and steps. I will focus from now on just on the sleep data; other measures might be integrated in later stages.

The data from an intraday sleep file looks like this:

```
2016-03-13 22:46:00,3
2016-03-13 22:47:00,3
2016-03-13 22:48:00,2
2016-03-13 22:49:00,2
2016-03-13 22:50:00,1
…
2016-03-14 07:03:00,1
2016-03-14 07:04:00,1
2016-03-14 07:05:00,1
```

We can now obtain the same data or download from their website and it is better to remember the values that are mapped like this: 0= none (no measure taken), 1= sleeping, 2= restless, 3= awake. The first diagram I plotted is for getting an overall grasp of the most important measures. It shows the distribution of each one using a simple histogram. Sleep efficiency is the percentage ratio between sleeping minutes and total minutes in bed (inefficiency is then simply the complementary percentage).

These histograms are weird to generalize actual exact data, but some generic observations can give a more intuitive feeling and immediate understanding, for example for this dataset we could observe that:

- I am awake on average 3 times per night

- Generally fall asleep in less than 10 minutes

- 30 minutes restless per night, getting a sleep efficiency of about 90%

- In bed between 7 to 9 hours, brought down to an average of 7.30 for actual sleep hours.
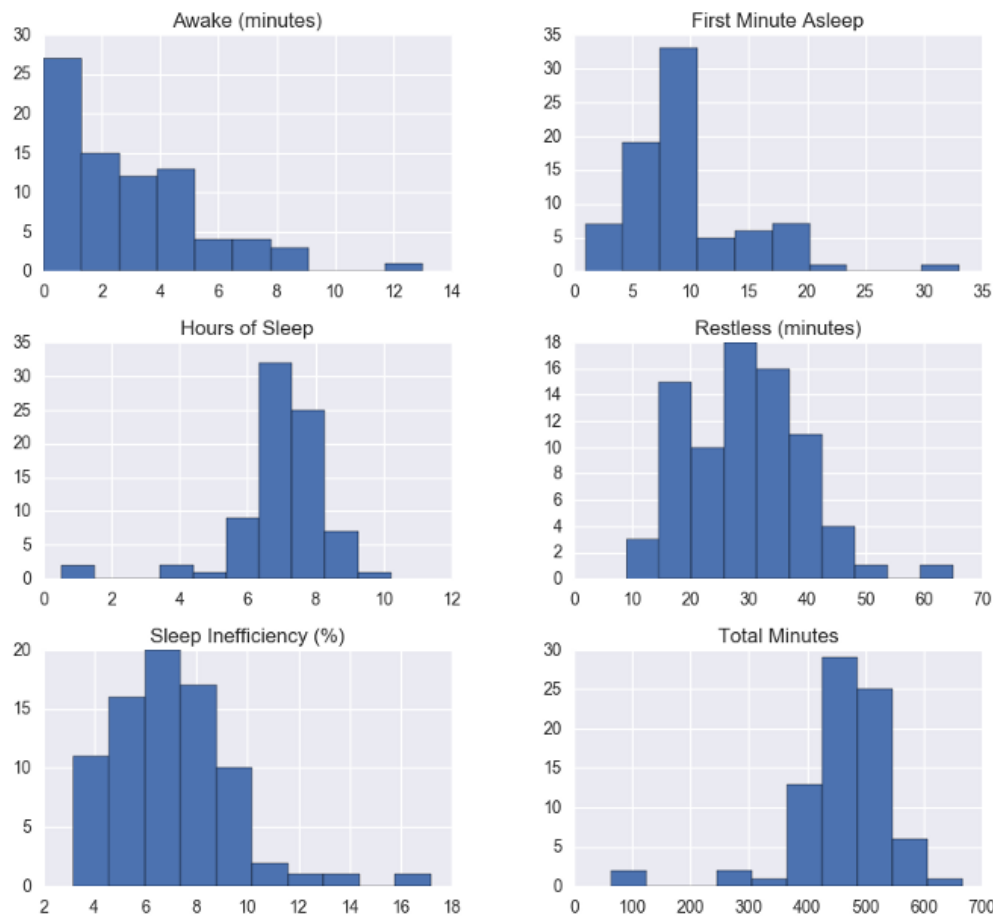
**Histograms showing measures distribution, using a default 10 bins.**

The next diagrams are for showing how measures vary during different time periods. I personally believe that day-of-week and month are the most relevant ones for this case, and of course, if one have collected enough data, one can starts working by year to see how one's sleep patterns are changing.

We can speculate a bit on this results, noticing that—differently than expected—sleep inefficiency tends to go down toward the weekend, and up and ready again on Monday —looks like working makes sleep worse. Moreover TGIF might be the cause of the lowest average in terms of minutes before falling asleep for the week.

It's always tricky to get insight from such data, for example Thursday seems a bad day in terms of restless time, but most likely just because is the day that gets more overall time in bed (total minutes).
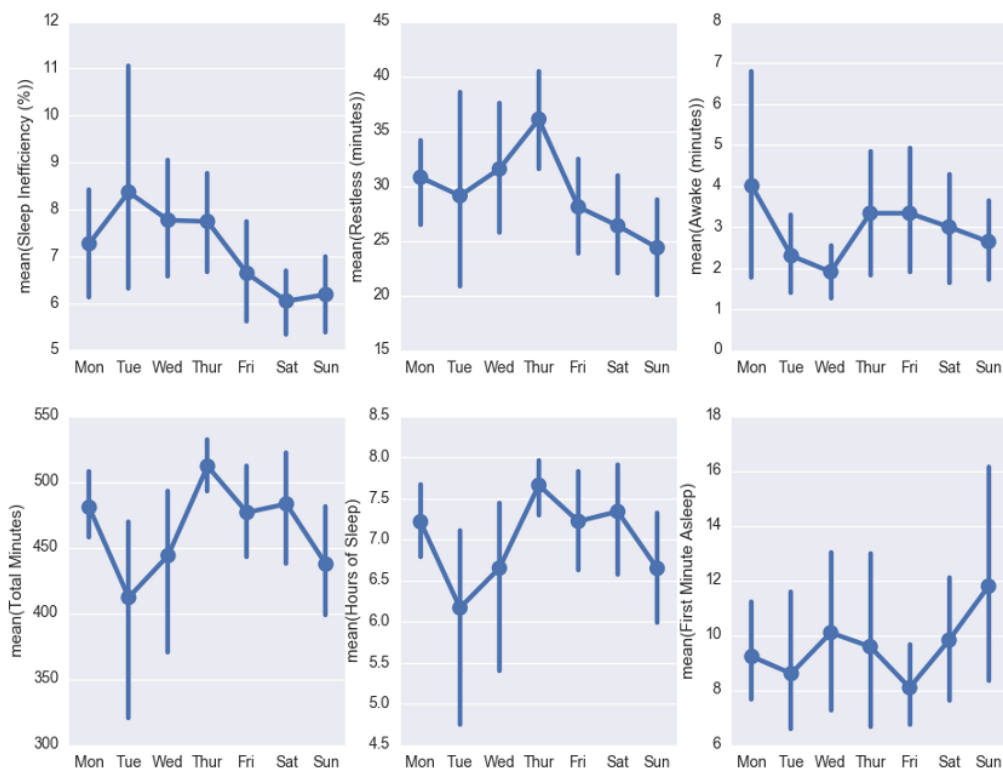
**Point plot of different measures by day of week, showing the estimated mean and confidence intervals.**

Monthly stats might help to spot variations determined by some new habits, or by some change in daily life. Was moving the bed so it faces north a good idea? Going to the gym two times per week? Reading before sleep? What about that increase in partying and related alcohol consumption? Notice that some changes—take the last plot—are more likely to simply create outliers, than to affect the average results in a significant way, unless one is really going for it!

A day per day diagram is also good to possibly spot more general trends. How do you sleep now that you moved to your new house, to another country, or with someone else?
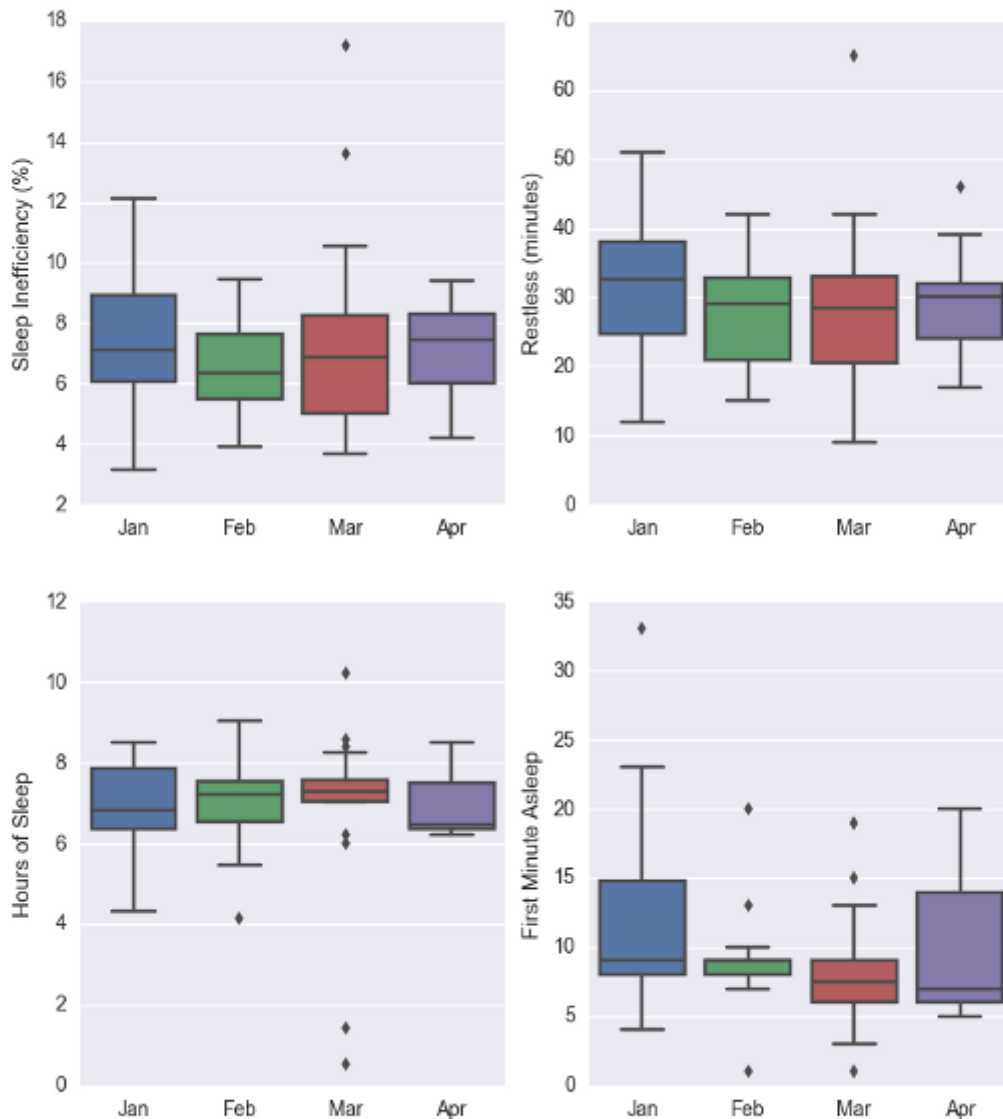
**Boxplots for a sample of monthly sleep measures.**

Finally I did some experiments using heatmaps, counting values for all records in order to spot some patterns. I was curious to check if there is a time during the night when one tend to wake up, or when one is often restless. This can be approached in two ways: using the actual time as index (x axis), or using the minutes as index, meaning that all data is realigned based on the first minute you fall asleep, and for each successive minute we just apply an incremental of one. This can be used to spot that—for whatever reason—one always tend to wake up after 50 minutes you feel asleep, no matter the actual time you went to sleep—yes you are weird, but the better you know.

The truth is that the results don't add much to what I was already expecting: the more I stay in bed the more I am restless, and how quick I fall asleep does not influence any other variable in a relevant way. We might find more interesting correlations considering measures other than sleep, like heart rate or daily steps count.

**Some Recommendations:**

Given all this results, and tables, and stats and diagrams, did I end up achieving my goal of a better sleep? Frankly, not really; mostly for a very simple reason: seems I already sleep well enough. I sure had fun playing with this task but I didn't get some great insight about sleeping patterns, some habits I might change in order to achieve 100% sleep efficiency (is it actually a thing?).

There are many more things that need to be analyzed though, and I will sure keep track of future data, to spot if something new is going on with my sleep, and act accordingly.