Capstone Report: Quantified Self

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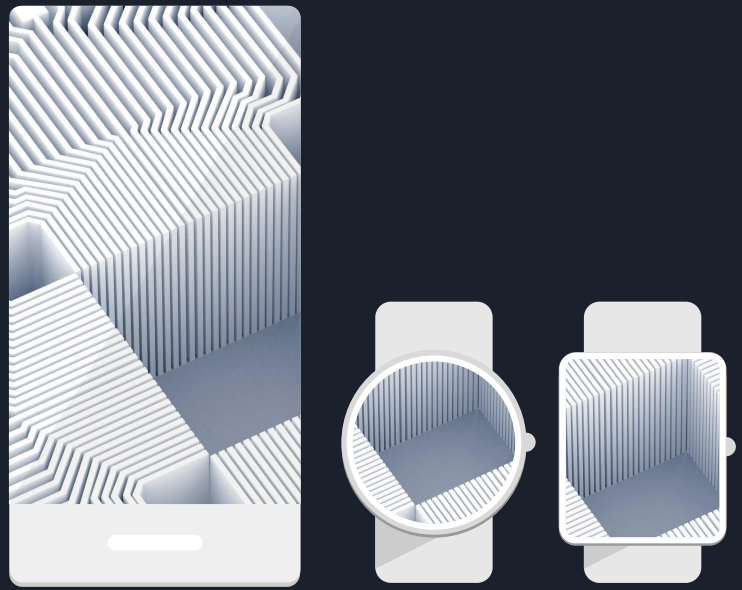
Overview



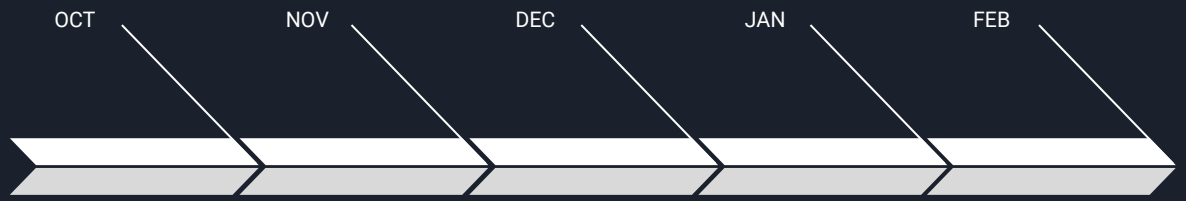
The Quantified Self movement, coined by *Wired*'s Gary Wolf and Kevin Kelly in 2007, incorporates wearable consumer technology in order to monitor personal metrics such as heart rate, sleep patterns, and physical activity. The hope is those that monitor personal metrics will be inspired to improve their metrics by improving their health habits.

For six years, I've used various FitBit devices and become more active. Several months ago, I started using a FitBit Flex 2 and began tracking my sleep as well as collecting more granular data about my activity.

With this data, I will answer the following questions:

- Are there relationships between my own activity, sleep patterns, and sleep quality?
- What are my sleep and activity patterns?
- What steps can I take to improve my health patterns?

The Data



The following variables were observed over the course of October 2017 through February 2018, 120 days in total:

1. Date
2. Calories burned
3. Steps
4. Distance
5. Minutes sedentary
6. Minutes lightly active
7. Minutes fairly active
8. Minutes very active
9. Activity calories
10. Start time
11. End time
12. Minutes asleep
13. Minutes awake
14. Number of awakenings
15. Time in bed

Data Limitations

My sleep data can be misleading in that wearable devices measure sleep according to movement and lying still is recorded as sleep when, in reality, sleep may not be occuring. In addition, my device does not measure sleep stages - REM vs. light vs deep sleep - as other devices do.

Because my device can only detect arm movement recorded by the accelerometer, it does not record other activities such as stationary bike rides, strength training, or yoga, which all can affect calories burned as well as sleep.

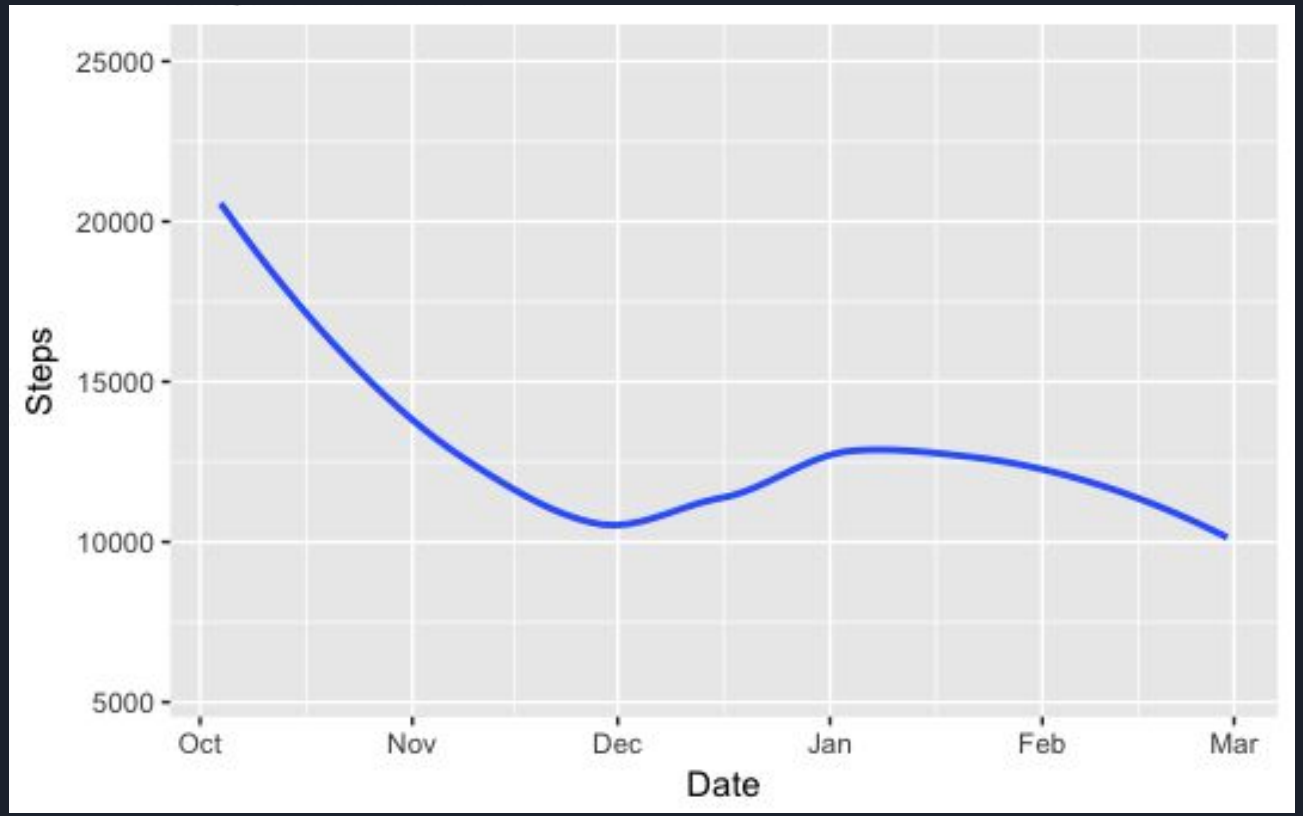
This data set also does not account for additional lifestyle factors that affect sleep and activity such as travel, stress, illness, and nutrition.

Activity Analysis

The mean number of daily steps during the time period is 12,855, 29% above the commonly cited 10,000 steps a day recommendation.

Steps for this time period range from 2,018 on Saturday, December 2, 2017 to 60,681 on Sunday, November 5, 2017, the day of New York City Marathon.

Steps Over Time

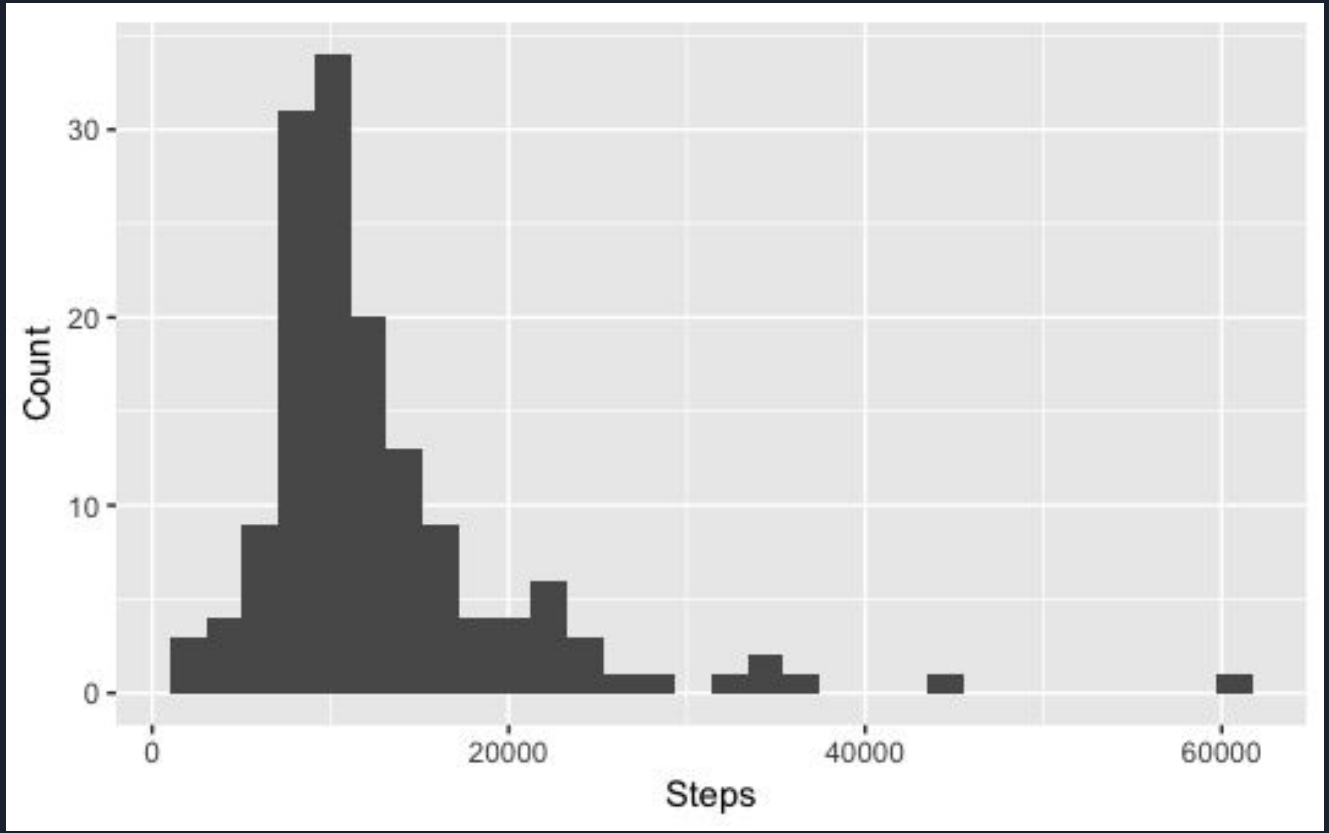


Steps by Day of Week

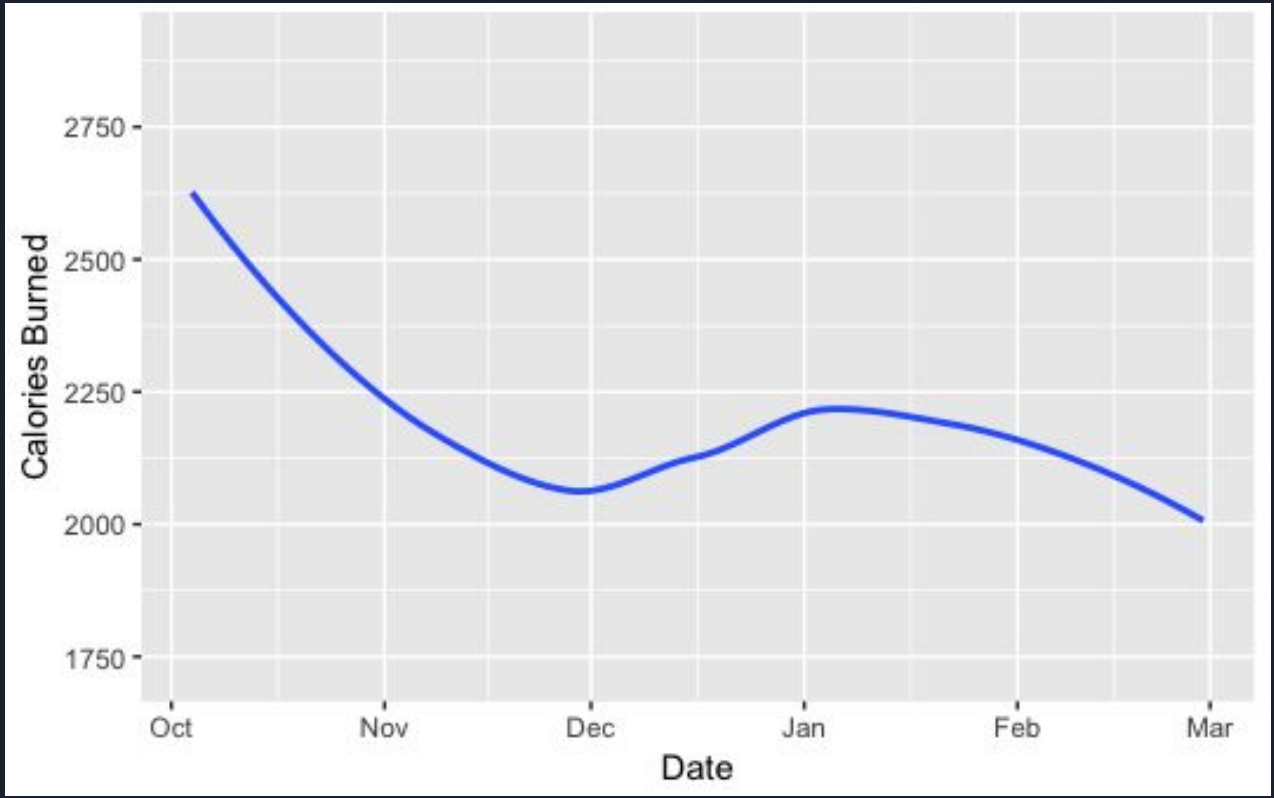
Day of Week	Mean Steps
Monday	9,160
Tuesday	10,181
Friday	11,441
Wednesday	13,652
Thursday	13,656
Saturday	15,247
Sunday	16,608

Day of Week	Median Steps
Monday	9,621
Tuesday	9,643
Friday	9,826
Wednesday	11,223
Thursday	13,054
Saturday	13,463
Sunday	14,978

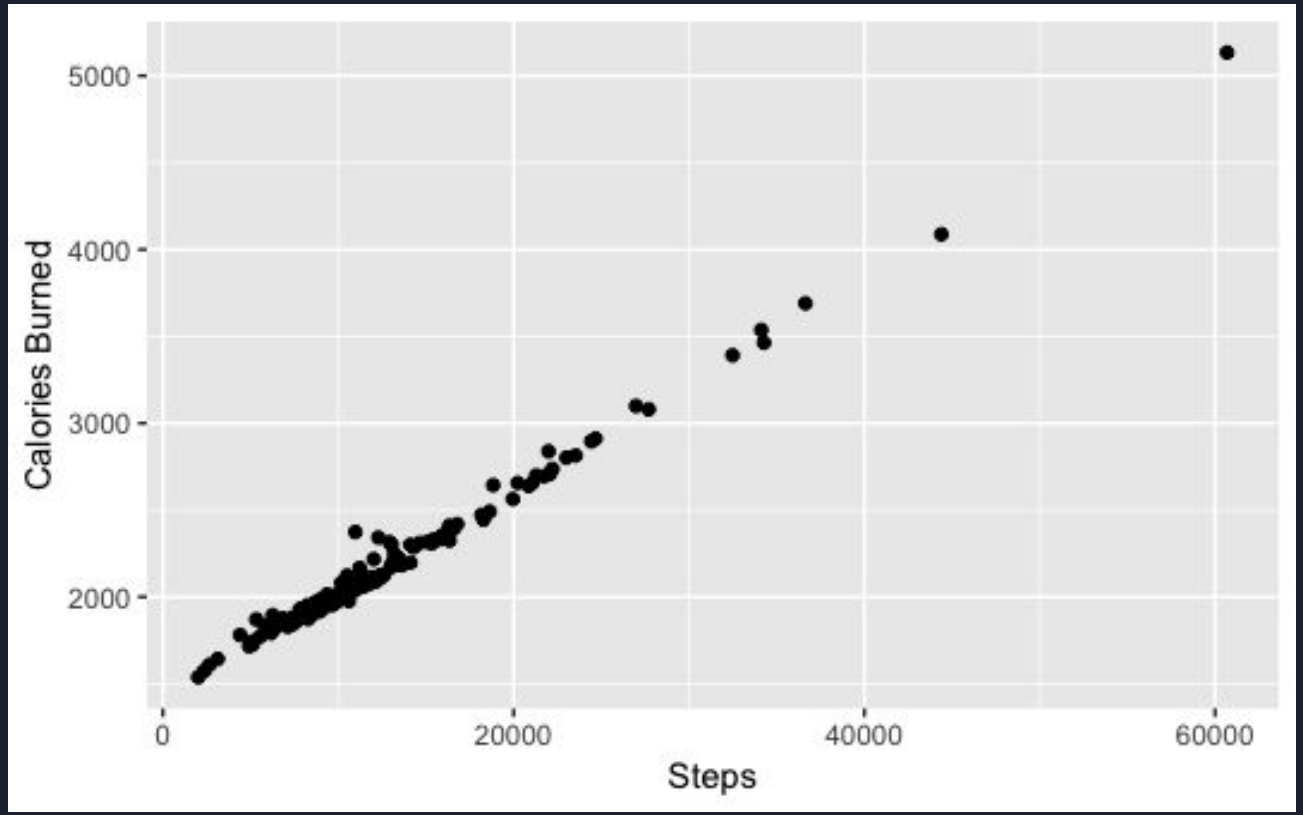
Step Volume Frequency



Calories Burned Over Time



Steps & Calories Burned

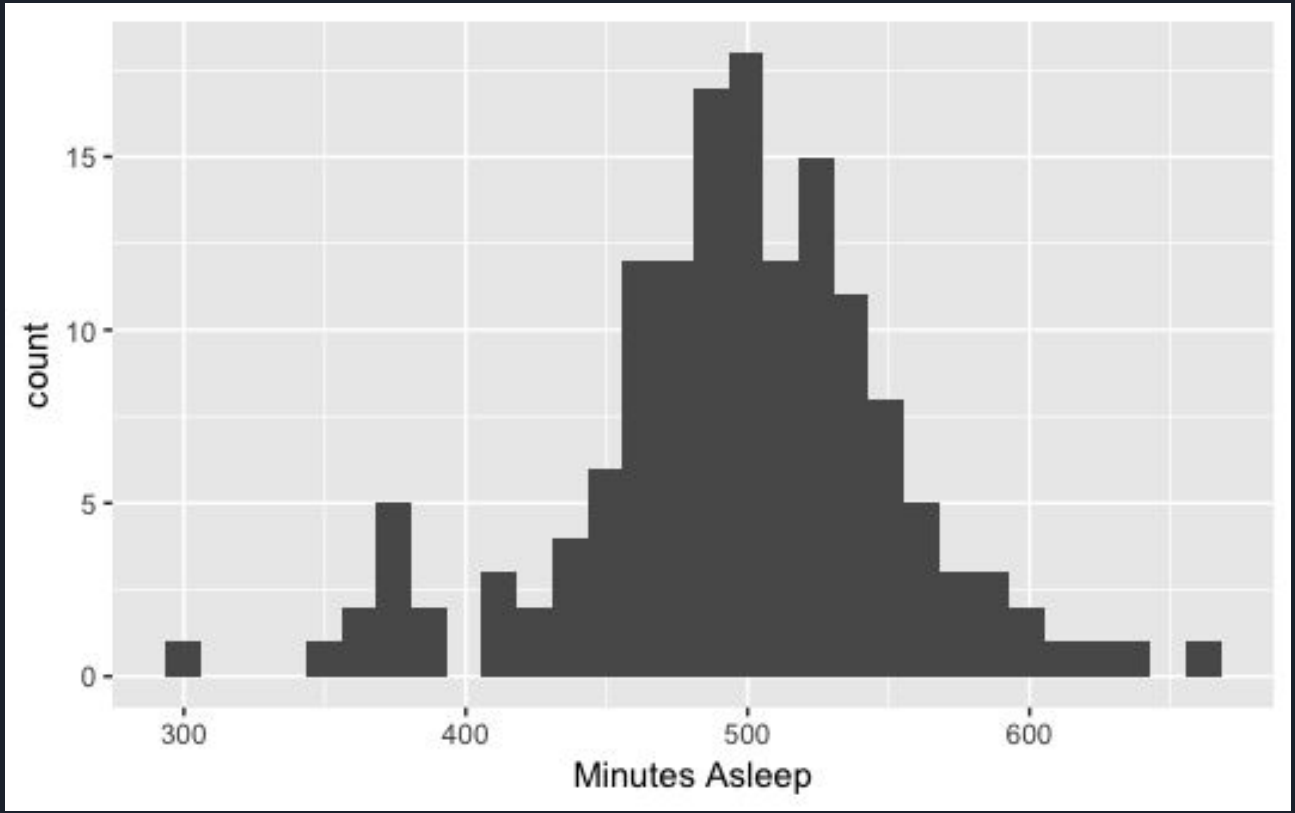


Sleep Analysis

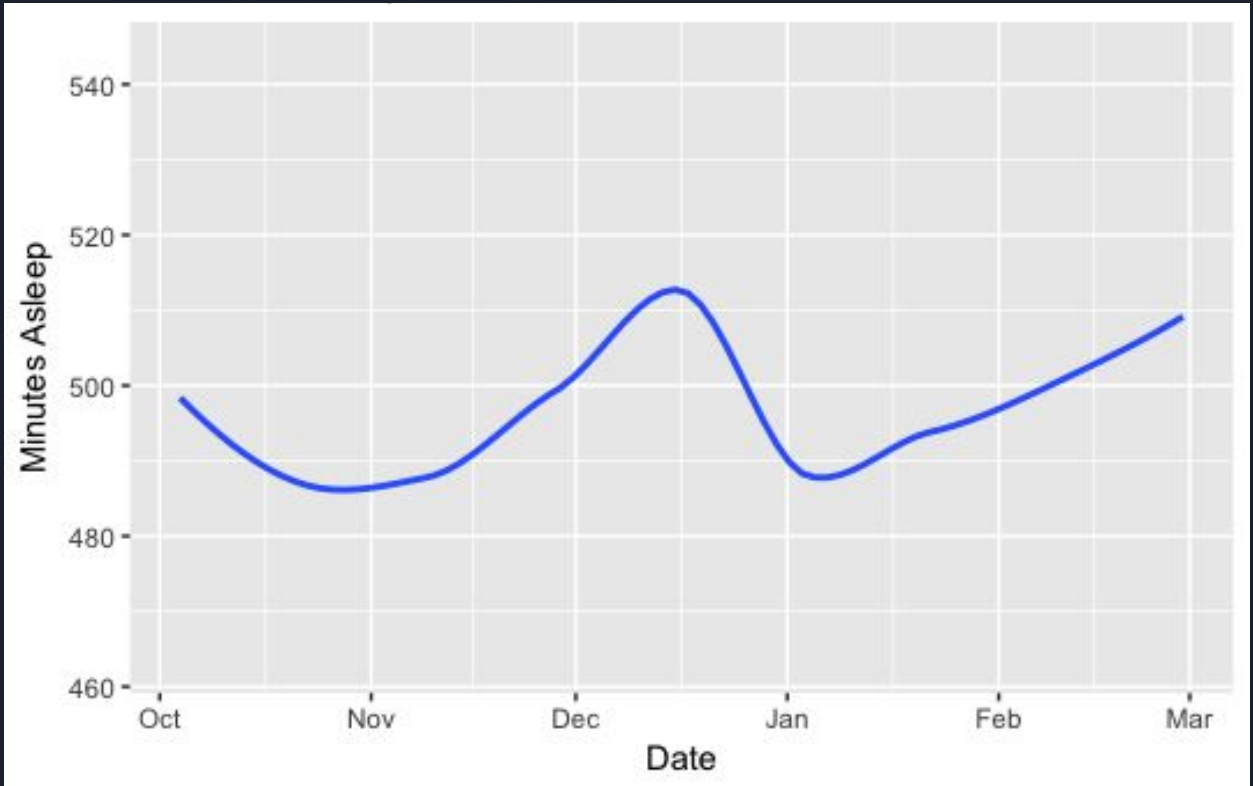
The mean number of time asleep during the time period (October - February) studied is 8 hours, 16 minutes, 10% above the commonly cited recommended 7-8 hours of sleep per night recommendation.

Time asleep for this time period ranges from 4 hours, 54 minutes on Thursday, November 9, 2017, the night before an early flight to start a vacation, to 10 hours, 56 minutes on Saturday, December 30, 2017, a day on which an early nap bled into sleep time.

Minutes Asleep Frequency



Minutes Asleep Over Time



Minutes Asleep by Day of Week

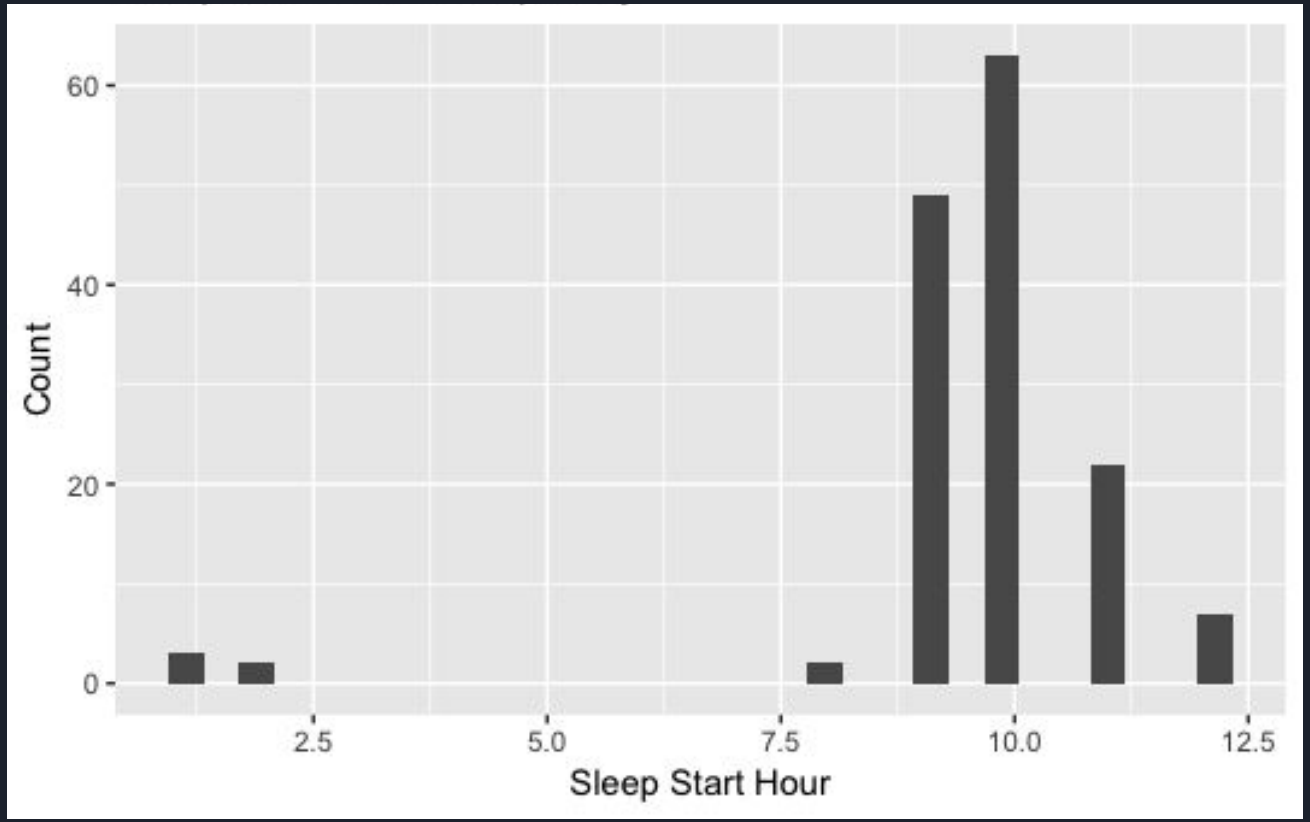
Day of Week	Mean Minutes Asleep
Tuesday	470
Thursday	479
Wednesday	488
Sunday	500
Monday	504
Friday	515
Saturday	517

Sleep Start & End Hour

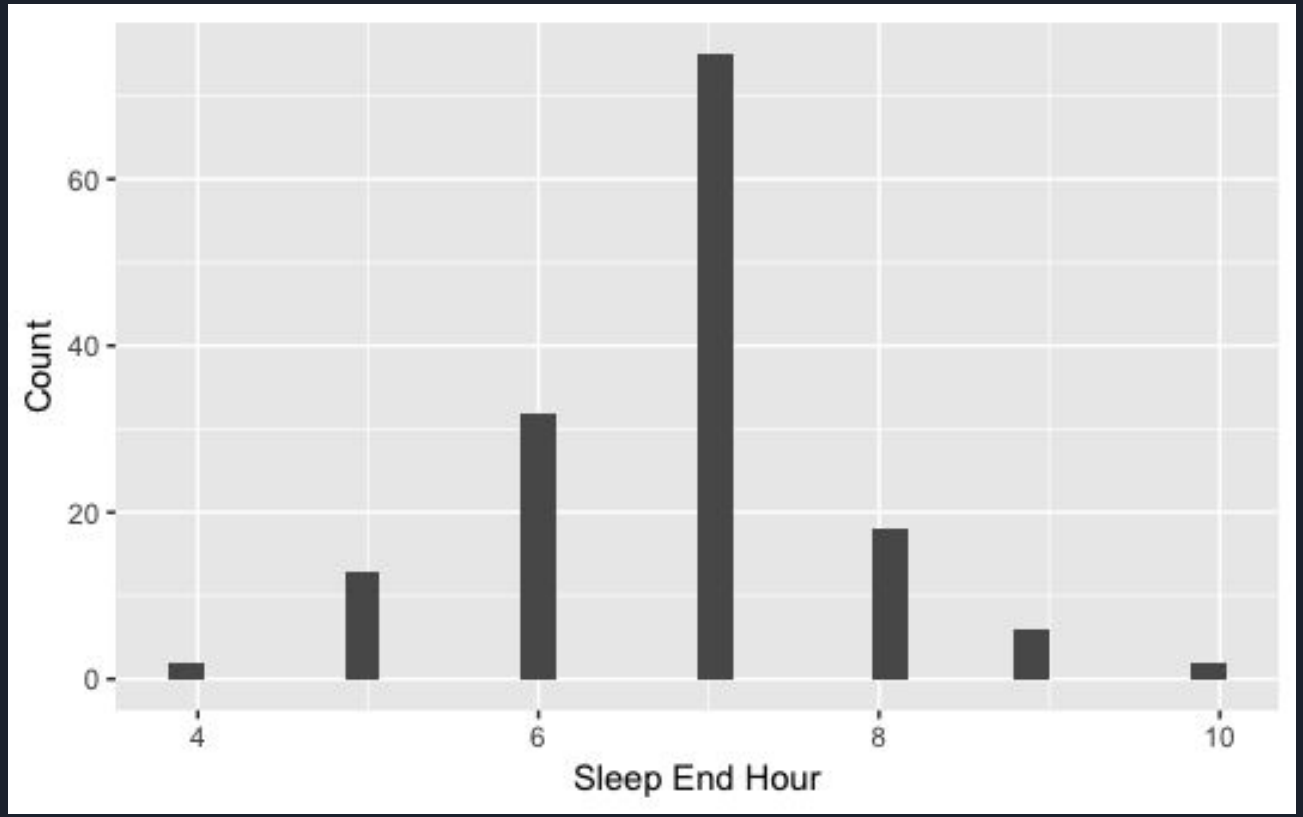
Day of Week	Mean Sleep Start Hour
Tuesday	9.29
Sunday	9.33
Wednesday	9.50
Monday	9.52
Saturday	9.57
Friday	9.86
Thursday	10.10

Day of Week	Mean Sleep End Hour
Tuesday	6.24
Thursday	6.57
Wednesday	6.73
Sunday	6.86
Friday	6.95
Monday	6.95
Saturday	7.38

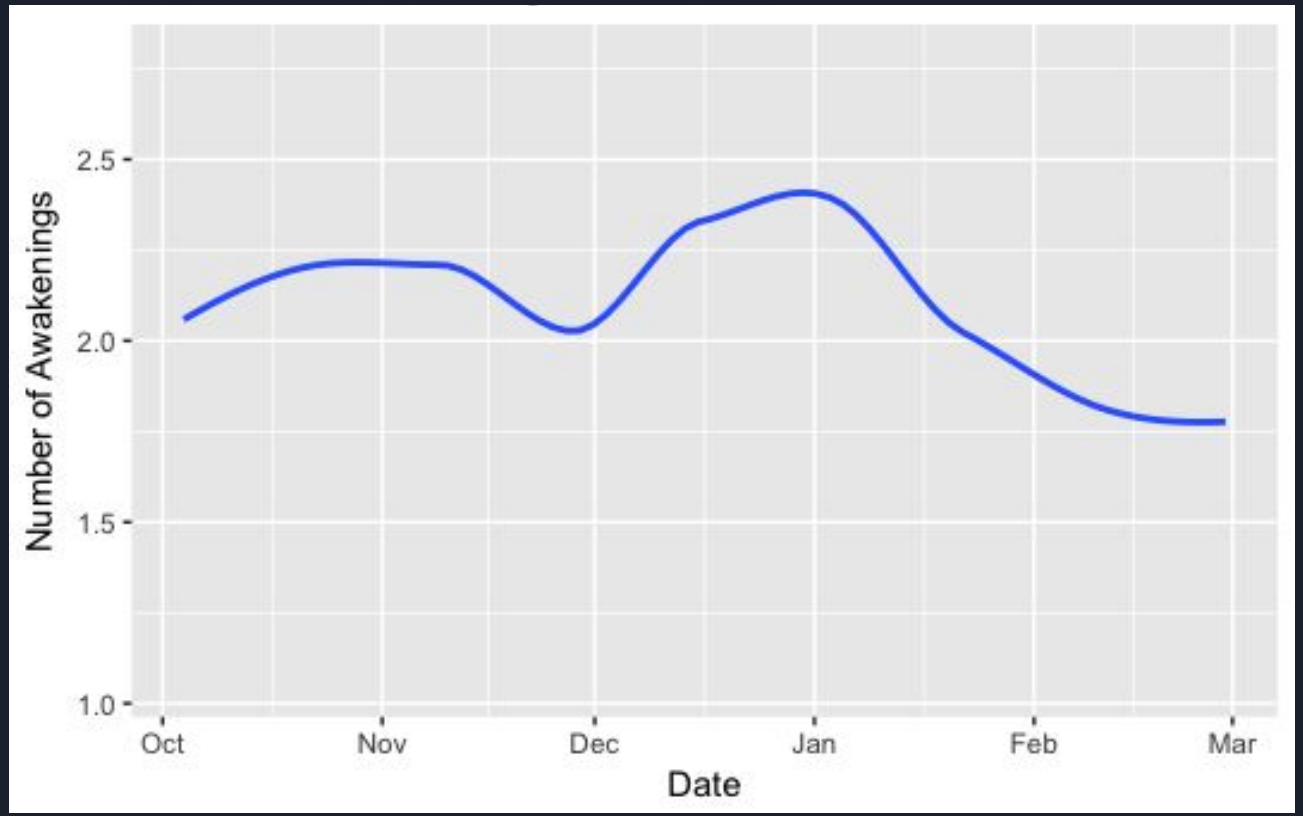
Sleep Start Hour Frequency



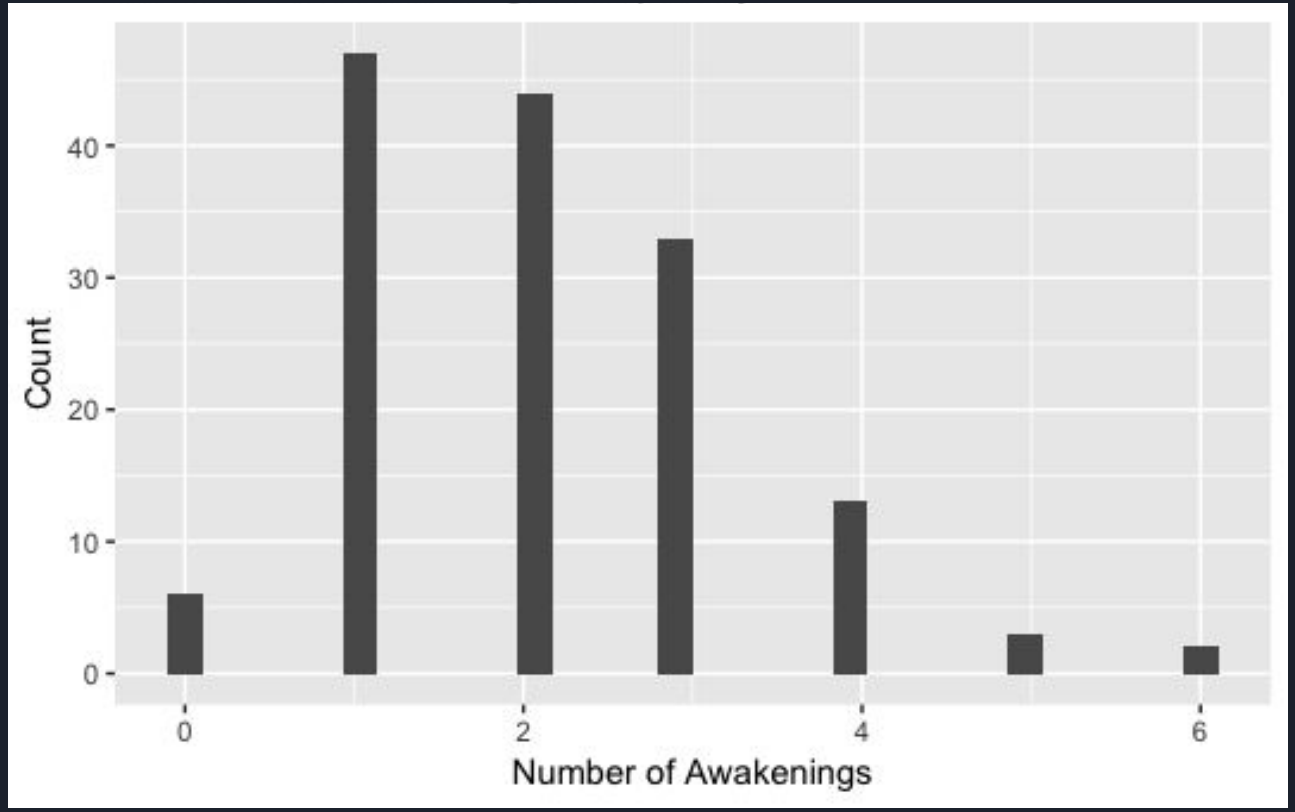
Sleep End Hour Frequency



Number of Awakenings Over Time



Number of Awakenings Frequency

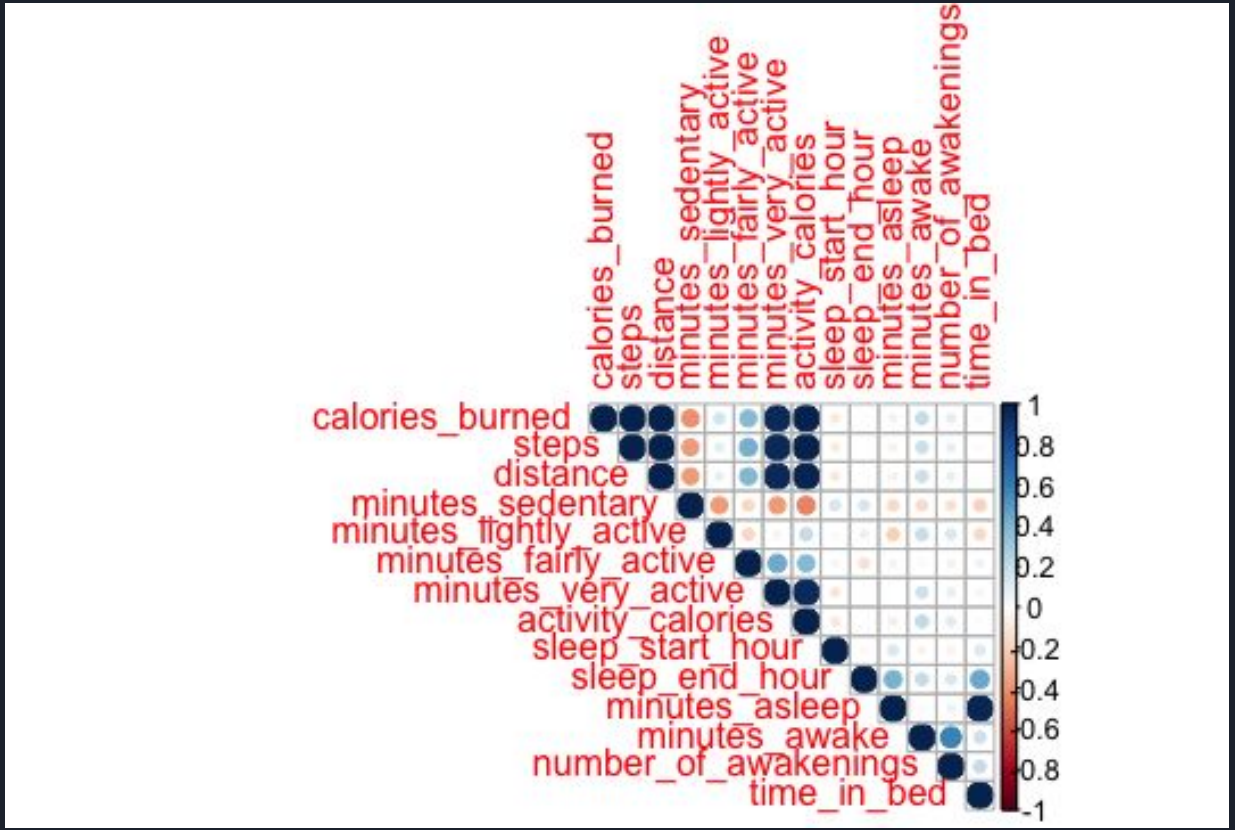


Activity & Sleep Correlations

Not surprisingly, calories burned, steps, minutes fairly active, minutes very active, and activity calories are highly correlated. In addition, minutes sedentary are negatively correlated to calories burned, steps, distance, all types of active minutes, and activity calories.

Some other obvious high correlations exist between number of awakenings and minutes awake, time in bed and sleep end hour, as well as minutes asleep and time in bed.

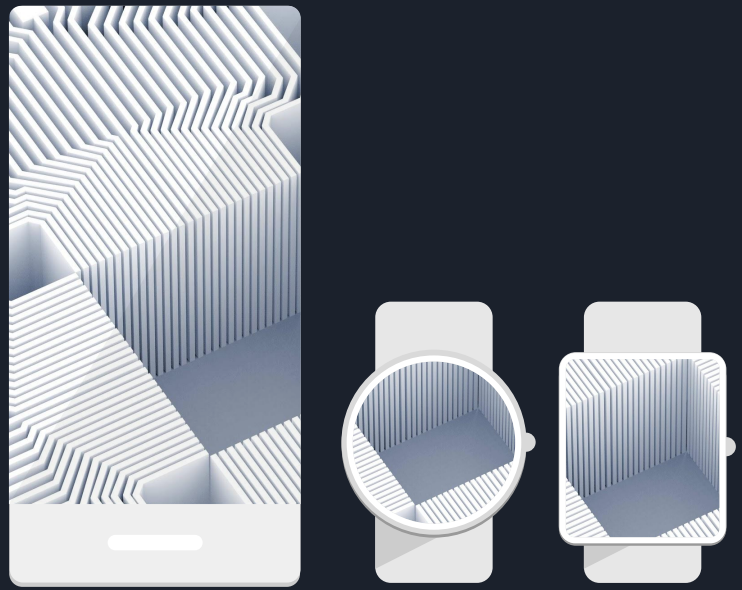
Activity & Sleep Correlations



Key Takeaways

- On average, I take close to 13,000 steps a day, but my step habits are inconsistent and fluctuate according to the day of the week as well as the time of the year
- On average, I sleep 8 hours and 16 minutes a night, but time asleep also fluctuates slightly according to the day of the week as well as the time of the year
- I will typically fall asleep between 9:30 pm and 10:00 pm, awaken two times per night, and finish sleeping between 6:30 am and 7:00 am
- There does not appear to be any significant correlations between my activity and sleep habits

Recommendations



- Strive for slightly more steps on Mondays, Tuesdays, and Fridays for more consistent step volume throughout the week
- Strive for steps in small spurts throughout the workday when step counts tend to drop
- Use the Fitbit app to strive for an hourly goal of 250 steps per hour during waking hours
- Establish a consistent bedtime, ideally around 10:30 pm Take steps to avoid sleeping more than the recommended 7-8 hours per night
- Note energy levels when sleep is reduced
    - Am I sleeping 8+ hours per night because I need to or because I allow myself to do so?
    - Can I sleep less, have more waking hours, and not feel fatigued?
- Continue to track the variables studied to observe changes in habits during one calendar year