Homework 2
Problem 4
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I certify that I have personally done the coding, generated the figures and written the report without aid from anybody else, and that I have not plagiarized, self-plagiarized, or used AI-generated text. I certify that I have acknowledged any sources I used to complete this assignment. ARM.

1 Part 1: Response

Comment from HW 1: "Interesting experiment. I would suggest that you also record exercise intensity and heart rate using a fitness tracker, since that probably also affects sleep. Most smartwatches also estimate sleep quality, so I would use that as well. As for self-report measures of sleep quality, please use a validated instrument."

How I Addressed it: It seems that most of the issues arise from not having a proper instrument to measure the variables I am measuring. To fix all the issues including measuring heart rate, intensity, sleep quality, and other beneficial metrics I have ordered a fitness tracker that will help me collect the data. Once I have the tracker, I will also add the corresponding columns into my current spreadsheet or figure out a way to export the data from the tracker into my spreadsheet where I am tracking everything. I will also use the Karolinska Sleepiness scale for my self-reporting.

2 Part 2: Motivation

Being active is a very important part of my life. I've played sports my entire life and ran competitive track in high school. I am active almost every single day whether I am running, lifting, or rock climbing (Sometimes I'll play a different sport like badminton or soccer). I am curious to see how my active lifestyle affects my sleep quality and sleep time. This is especially important because sleep is crucial for recovery and overall health. Understanding the relationship between time and type of exercise and sleep quality can help me optimize my workout schedule. For example, if I find that running helps me get better sleep at night, I might start running the day before I have exams. Or maybe lifting weights at night before bed could disrupt my sleep and sleep latency and therefore, I won't lift weights the day before an exam. I am expecting to find my ideal workout schedule to maximize sleep and recovery from this experiment.

3 Part 3: Background

Exercise has long been known for its multitude of health benefits, especially sleep. However, the timing and intensity can have varying results on the quality of sleep. There are several arguments for exercising in the morning, afternoon, or evening. For example, "exercise in the morning or afternoon stimulates earlier melatonin release and shifts the circadian rhythm forward. Exercising in the morning also adds the benefit of exposure to sunlight, helping stabilize the circadian rhythm and makes it easier to fall asleep (Dr. Rehman)." In contrast the argument for exercising at night has less compelling evidence. As said by Dr. Parthasarathy in his paper, "How to get deep sleep": "For most people, doing strenuous exercise within four hours of bedtime can disrupt sleep due to the increase in stress hormones that keep the brain awake." However, another study done by the Sleep Foundation found that exercising in the evening 90 – 120 minutes before bed "provokes a sharp rise in body temperature followed by a gradual cooling, which mimics the natural fluctuations of the circadian rhythm and paves the way for sleep." After reading several documents and studies the consensus is that generally doing intense exercise in the morning and afternoon result in a good night's sleep while doing light aerobic exercise in the evening may also help with sleep quality and sleep time. As for how this background review will affect the design of the experiment, I will start mixing up the times I do certain exercises. I will do aerobic exercise at night and intense exercise in the morning

and vice versa to collect enough data to come to a conclusion about how the timing and intensity of exercise affects sleep.

4 Part 4: Experimental Design

The independent variables are time of exercise, duration of exercise, and intensity of exercise. These dependent variables will be collected using a smart watch fitness tracker. The data from the watch will then be uploaded to a spreadsheet for easy collection and data analysis. The dependent variables are sleep time and sleep quality. These will also be measured by the smart watch fitness tracker. I will also be using the Pittsburgh Sleep Quality Index (PQSI) questionnaire for self-reporting the quality of sleep. The data will be collected every day for around two and a half months.

5 Part 5: Hypothesis

My hypothesis is that the days where I have an intense workout at night will be the days where I have the worst quality sleep. Any other days where I exercise in the morning or afternoon or do light aerobic exercise, for example, a run, in the evenings will be days that I have good sleep.

6 Part 6: Data Analysis

As a preface to this data analysis, the data used here is data I collected before implementing any of the fixes suggested in homework 1.

Figure 1 shows the correlation matrix between duration of exercise, sleep quality, and sleep time. We can see the interesting part of the matrix is the correlation coefficient between duration of exercise and sleep quality. This is especially interesting because it is a negative correlation showing that if the duration of exercise increases the corresponding sleep quality decreases. Of course, it is still early in the experiment, and nothing can be said for sure, but this is just an interesting trend found through the preliminary data analysis.

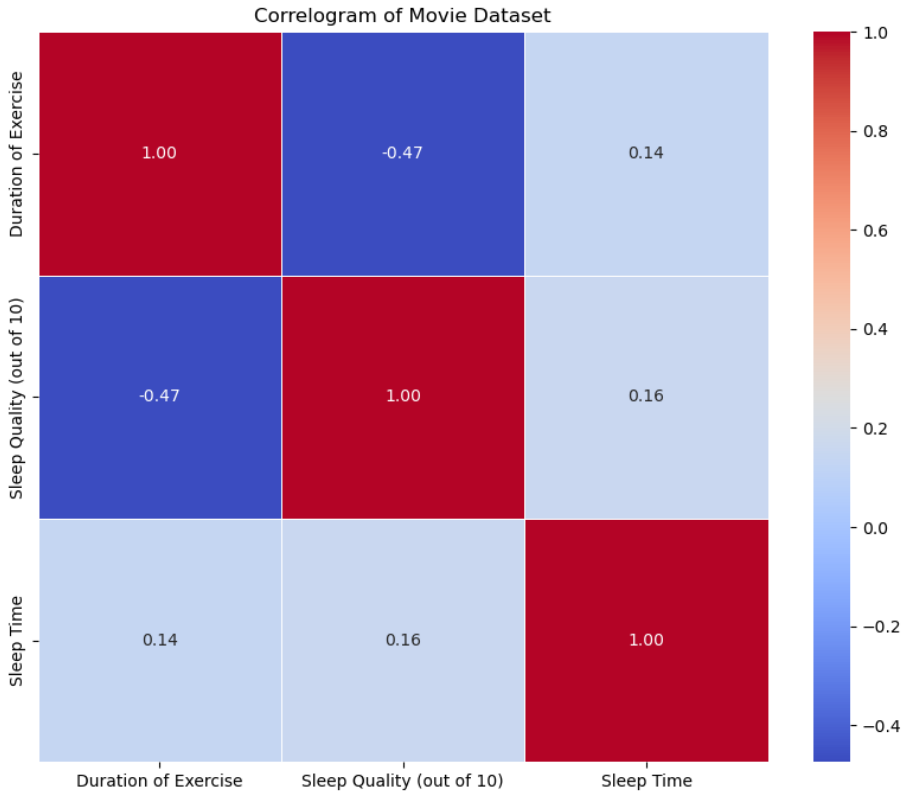

Figure 1. Correlation matrix between duration of exercise, sleep quality, and sleep time

Figure 2 is a scatter plot showing intensity vs sleep time. Because intensity was recorded as a categorical data point, it was converted to 1 meaning easy, 2 meaning moderate, and 3 meaning intense levels of exercise. Most of my days exercising is moderate exercise which is why we see so many data points in the middle. As the data collection process goes on there will be more data points to analyze for easy and intense exercise. At this stage of the semester long project no correlation or trend can be seen with respect to intensity of exercise and how that affects sleep time.

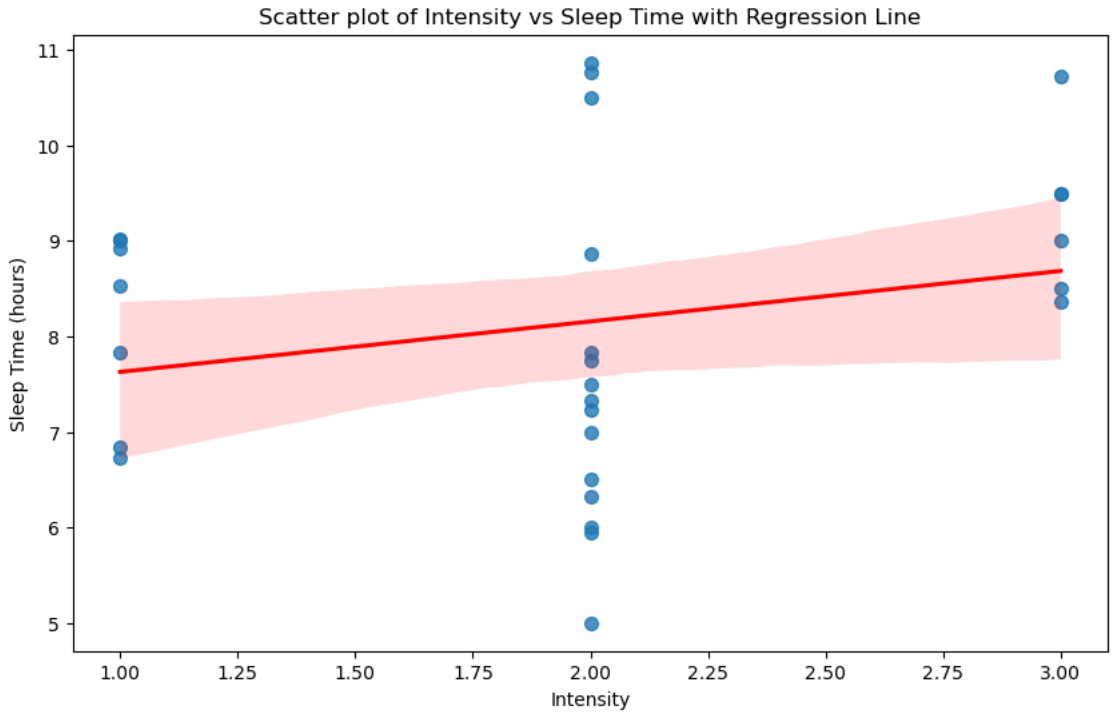

Figure 2. Scatter plot showing Intensity vs Sleep time

7 Resources used to achieve this goal

Canvas Homepage: Homework template

Python Libraries: NumPy, pandas

8 References

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