ANALYZING DINNER TIMINGS & SLEEP DURATION

Statistics 365

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I. Introduction

During my freshman and sophomore years of college, it seemed that my dinner time and the amount of sleep that I obtained were related to each other. Currently, as a junior in college, I wanted to analyze whether there is a pattern between the time when I choose to eat dinner, and the amount of sleep I obtain. Eating dinner involves food preparation and cleanup afterwards, which is why dinner time is an influential part of my day.

The research question of interest: Does the time at which I eat dinner during the evening affect the amount of sleep that I am able to obtain?

This document will outline the data collection process, the results of the data collection, and a summary including an analysis of the results on my sleep duration based on dinner time.

II. Data and Methods

This study took place at my college house in San Luis Obispo. I collected the data during a 3-week period between October 6th, 2024, and October 26th, 2024. I used the timer app on my iPhone to record the amount of sleep that I received every night. Before going to sleep, I started the timer on my phone and noted down the time when I went to sleep. I stopped the timer after I woke up the next morning and used the notes app of my phone to record the total hours and minutes that I spent sleeping, the previous day's dinner time (5 PM or 7 PM), along with the date, day of week, whether there was a major exam, and whether I had an illness that night.

I intended on having 21 observations total between the 3-week period of October 6th,2024 and October 26th, 2024. My original plan was to have 21 notecards, 10 with 5 PM dinner time and 11 with 7 PM dinner time, and to choose a note card at random each morning to determine my dinner time. Unfortunately, I was busy getting ready for class every morning, and I forgot to do this some days. This left me with 10 total observations instead of 21 total observations. Five observations are 7 PM dinner time days, and the other five observations are 5 PM dinner time days. As a result, I have fewer observations to work with for my data analysis and missing data for days during the 3-week period in which I did not collect data.

After I finished collecting my data using my iPhone Notes app, I stored the data in an excel spread sheet and converted the total amount of time I slept from total hours to total minutes. I then used the excel spreadsheet for data analysis in R Studio Software, shown below.

Date	Dinner Time	BedTime	Wake Up T	Total Sleep	Day of Week	Major Exam	Illness	Day Status	Additional Notes
10/8/2024	7:00 PM	12:00 AM	7:16 AM	436	Tuesday	N	N	Weekday	
10/9/2024	5:00 PM	11:00 PM	7:00 AM	360	Wednesday	N	Y	Weekday	Woke Up Between 4 AM - 6 AM due to head cold!!
10-Oct	7:00 PM	9:30 PM	7:00 AM	570	Thursday	N	Y	Weekday	Extra Fatigue due to Head Cold
10/12/2024	5:00 PM	11:30 PM	6:45 AM	436	Saturday	N	N	Weekend	
10/14/2024	5:00 PM	12:00 AM	7:00 AM	420	Monday	N	N	Weekday	
10/20/2024	5:00 PM	11:30 PM	7:00 AM	390	Sunday	N	N	Weekend	
10/22/2024	7:00 PM	1:00 AM	11:30 AM	630	Tuesday	N	N	Weekday	it looks like I got a lot more sleep than normal this day
10/24/2024	5:00 PM	1:00 AM	7:30 AM	390	Thursday	Y	N	Weekday	Studied super hard for my computer science quiz
10/25/2024	7:00 PM	2:00 AM	7:15 AM	315	Friday	Y	N	Weekday	Studied for an important midterm happening the following Monday
10/26/2024	7:00 PM	1:45 AM	7:00 AM	315	Saturday	Y	N	Weekend	Studied for an important midterm happening the following Monday

The 5 PM and 7 PM Dinner times were color coded in Yellow and Orange. Sleep durations that were lower or higher than average was color coded in blue. Initially, I did not include the Day Status Variable on my table. However, while doing data analysis, I found it beneficial to identify the trends in sleep duration between Weekends and Weekdays, as I tend to have a busier schedule during the Weekdays.

Below, a variables table outlines all variables that were analyzed in the excel spreadsheet.

| Variable Name	Description	Type	Values / Range
Date	Date when I slept, indicating the Month, Day, and Year	Date Format Month / Day / Year	3 Week Period Between 10/8/2024 – 10/26/2024
Dinner Time	The time at which I ate dinner	Categorical	5 PM or 7 PM
Bed Time	The time when I went to sleep	Numerical	Typically, between 10:00 PM and 1:00 AM
Wake Up Time	The time when I woke up the next day	Numerical	Typically, between 7:00 AM and 9:00 AM
Total Sleep Duration	The amount of sleep that I received in one night	Numerical Units: Minutes	Total Sleep Duration range is between 315 minutes and 630 minutes
Day of Week	The Day of the Week	Categorical	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday
Major Exam Status	Indicates whether there was a major exam that required studying	Categorical	Yes or No
Illness Status	Indicates whether I had an illness that night	Categorical	Yes or No

Day Status	Indicates whether the day is a weekday or a weekend	Categorical	Weekday or Weekend
Additional Notes	A section that allows me to reflect on special circumstances that could have potentially affected the amount of sleep I received.	Brief Sentences	Example: "Extra fatigue due to head cold" "Woke Up between 4 AM – 6 AM due to head cold"

R studio was used to construct various dot plots, box plots, and statistical computations of mean and standard deviation. I also utilized a Two Sample T Test to see whether there was a statistically significant difference in the mean sleep duration time between the 5 PM and 7 PM Dinner Time days. Using a Two Sample T Test meets the validity condition of independence as the sleep duration of one night is not affected by the sleep duration of another night. Notecards were used to randomize the days in which I would eat at 5 PM vs. at 7 PM, so the randomness condition is met.

III. Results and Discussion

Graph & Summary Statistics for Explanatory Variable of Dinner Time and Response Variable of Total Minutes Slept

Measure (Minutes)	5:00 PM Dinner	7:00 PM Dinner
Average	399	453
Standard Deviation	29.55	144.39
n (Sample Size)	5	5

Dinner Timing and Sleep Duration
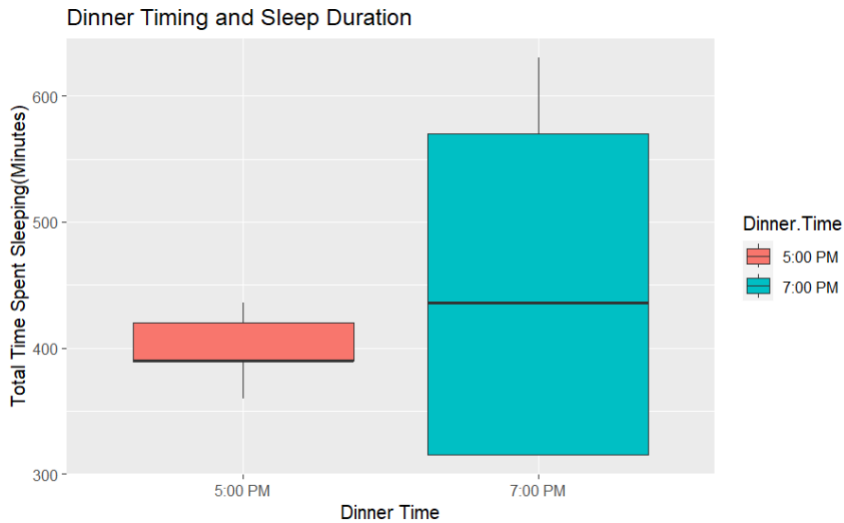
According to the data I obtained less sleep on nights when my dinner time was 5 PM, compared to when my dinner time was 7 PM. On days with dinner times of 5 PM, I slept for 399 minutes on average and on days with dinner times of 7 PM, I slept for 453 minutes on average. These results are surprising as I was anticipating that the average time slept for the 5 PM dinner time days would be higher than the average time slept for the 7 PM dinner time days.

The standard deviation for sleep duration for 5 PM dinner times was 29.55 minutes and the standard deviation for sleep duration for 7 PM dinner times was 144.39 minutes. The 5 PM dinner time has a lower variability in the total minutes spent sleeping compared to the 7 PM dinner time. The box plot above also shows a visual representation for the spread of the sleep durations for the 5 PM and 7 PM dinner times. The duration spent sleeping was more spread out for the 7 PM dinner timings compared to the 5 PM dinner timings. The large spread for 7 PM dinner timings convey that other variables were involved that potentially affected my sleep duration. These other variables include spending nights studying for a major exam and having illnesses like head colds. This results in an unclear analysis of the relationship between dinner timings and sleep duration, as we cannot directly tell how the dinner timings affect sleep duration if other variables are also involved. Therefore, having random assignment of dinner timings for each day helps to balance out the results.

4

Sleep Duration by Date and Dinner Time
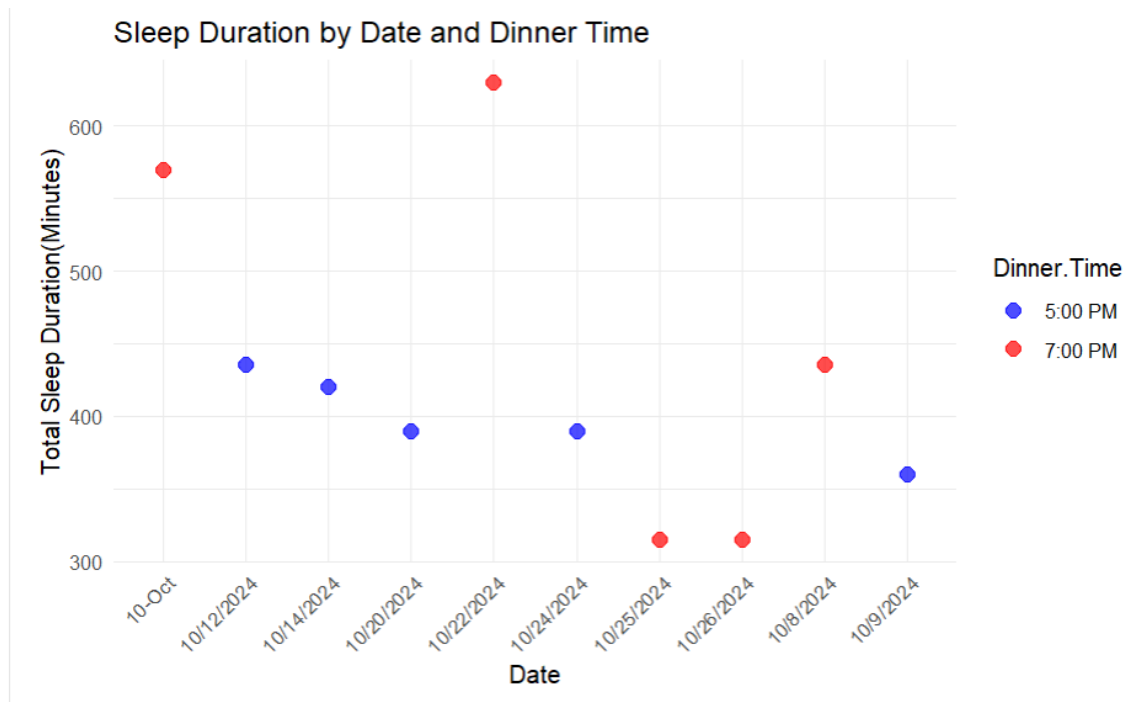
The figure above shows the number of hours I spent sleeping each day during a 3-week period, starting on October 8th, 2024, and ending on October 26th, 2024. Generally, it appears that as the days during the three-week period progressed, the amount of sleep that I received decreased. The days with 5 PM dinner times display a consistent number of minutes spent sleeping, as supported by the standard deviation above. However, 2 days with 7 PM dinner times display higher than average total time I spent sleeping, or lower than average total time spent sleeping, contributing to a larger standard deviation value. The variables of Exam Studying and Illness could have potentially influenced these outlier values.

Graph and Summary Statistics for Other Potential Explanatory Variables and Response Variable of Sleep Duration:

Day of Week and Sleep Duration

Day Status	Mean Amount of Time Slept (Minutes)	Standard Deviation for Amount of Time Slept (Minutes)	Sample Size (n)
Weekday	446	114	7
Weekend	380	61	3

Relationship Between Day Status and Duration Slept(Minutes)
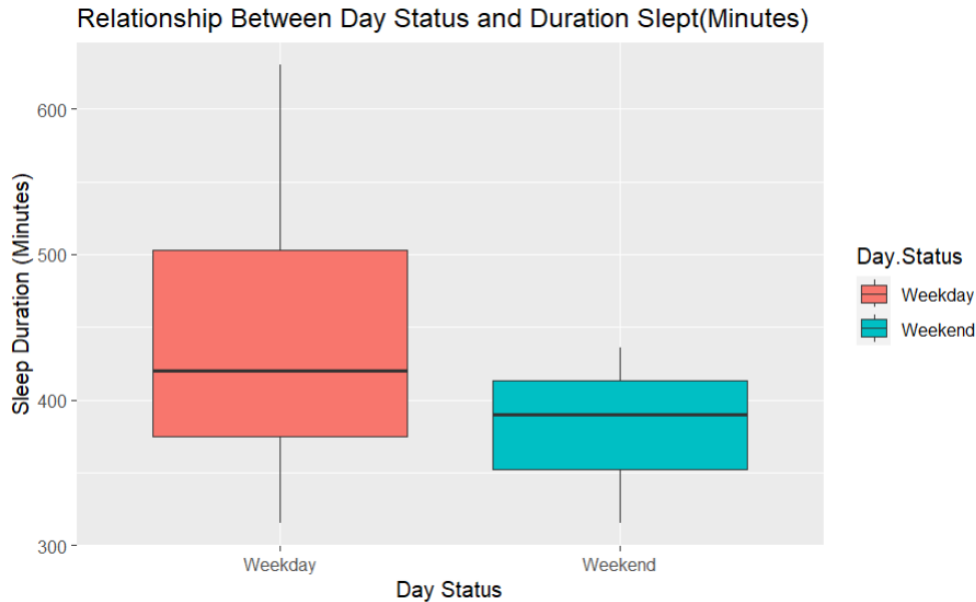
Here, I am analyzing how the day of the week could potentially impact the amount of sleep that I obtain. I have grouped Monday, Tuesday, Wednesday, Thursday, and Friday nights into the 'Weekday' section. I have grouped Saturday and Sunday nights into the 'Weekend' section. I then constructed box plots to show a visual idea of the spread and average amount of sleep I get on certain days of the week. The Weekday box plot displays a larger spread in total minutes of sleep compared to the Weekend box plot. The Average Amount of Sleep Time of 446 minutes for the Weekdays is surprisingly larger than the 380 minutes of sleep obtained on the Weekends. Prior to data collection, I expected the average amount of sleep to be higher on Weekends than Weekdays, as I don't attend class on Weekends.

Illness Status and Sleep Duration

| Illness Status (Y/N)	Average Amount of Sleep (Minutes)	Standard Deviation of Amount of Sleep (Minutes)	Group Sizes (n)
Yes	465.0	148.5	2
No	416.5	98.8	8

Illness Status and Sleep Duration
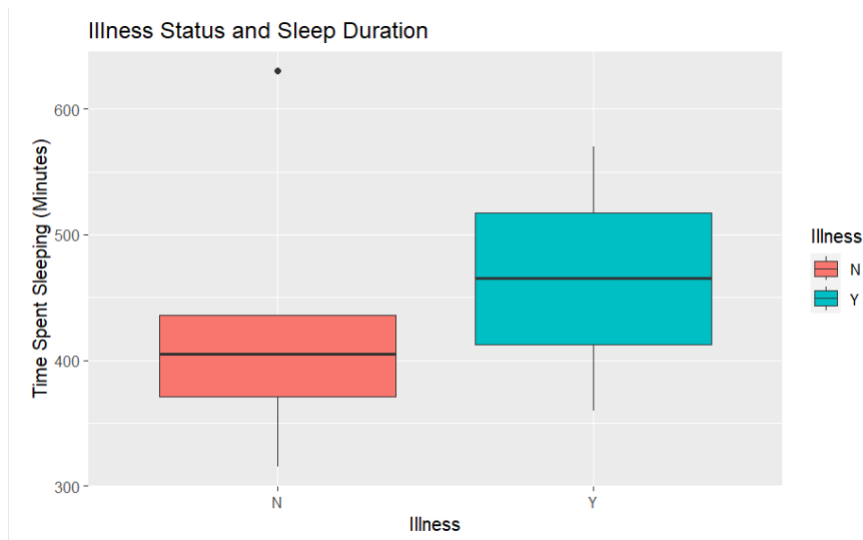
Here, I assessed how illness status and sleep duration are related to each other. I constructed the box plot above to give a visual representation of the spread and average of total minutes slept. The boxplot shows that the spread of the minutes spent sleeping when I had an illness was larger compared to the spread of minutes spent sleeping when I did not have an illness. On average, the data is conveying that I spent more hours sleeping during nights when I had an illness compared to nights when I did not have an illness. I believe that I needed more rest on nights when I felt ill, which is why I expected this outcome. Therefore, there is some evidence that the amount of sleep that I obtain is related to whether I have an illness that night.

Exam Status and Sleep Duration

Exam Status (Y/N)	Average Amount of Sleep in Minutes	Standard Deviation of Amount of Sleep in Minutes	Sample Size (n)
Y	340	43.3	3
N	463	98.8	7

Relationship Between Exam Preparation(Y/N) and Duration Slept(Minutes)
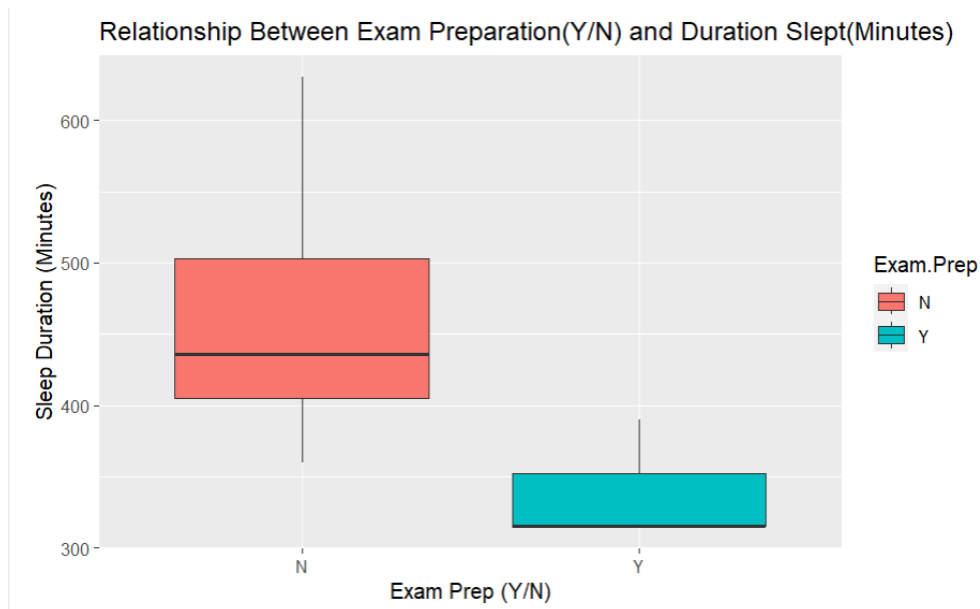
Here, I assessed how major exam schedules and sleep duration are related to each other. According to the graph, it appears that I received significantly less sleep on nights where I had to study for an exam, compared to nights where I did not have to study for an exam. Therefore, there is some evidence that Exam Prep is related to the amount of sleep that I obtain.

Confidence Intervals, Sample T Test, and Statistics

Software output from R Studio is shown below. I used Welch's Two Sample T-Test to calculate the confidence intervals, p values, and t values to analyze whether the difference in the mean amount of time sleeping between the 5:00 PM dinner time group and the 7:00 PM dinner time group is statistically significant.

```
        Welch Two Sample t-test

data:  Total.Sleep.Time..Minutes. by Dinner.Time
t = -0.81928, df = 4.3345, p-value = 0.4553
alternative hypothesis: true difference in means between group 5:00 PM and group 7:00 PM
is not equal to 0
95 percent confidence interval:
 -231.5639  123.5639
sample estimates:
mean in group 5:00 PM mean in group 7:00 PM
            399.2                 453.2
```

Dinner Time	Avg. Sleep Duration	Standard Error	Lower Confidence Interval Limit	Upper Confidence Interval Limit	Sample Size: n
5:00 PM	399	13	371	427	5
7:00 PM	453	65	316	591	5
Difference In Means			-205.99	97.99	10

We are 95% confident that the difference in average amount of sleep received for the 5:00 PM dinner time days and the 7:00 PM dinner time days is between -205.99 minutes and 97.99 minutes. The sample means amount of sleep for the 5:00 PM dinner time days is 399 minutes, and the sample mean amount of sleep for the 7:00 PM dinner time days is 453 minutes. The confidence interval for difference in mean's lower limit is a negative value, and the upper limit is a positive value. This means that it is plausible that the difference in average number of minutes spent sleeping between the 5 PM and 7 PM dinner time groups could be 0 minutes.

The P value of 0.45 is greater than $\alpha = 0.05$, which indicates that there is not a statistically significant difference in Total Minutes of Sleep Time between the 5 PM and 7 PM dinner times.

T the value of -0.81 is close to 0, indicating that the difference in Average Total Minutes of Sleep Time for 5 PM and 7 PM dinner times is not statistically significant.

The statistics for the P Value, T Value, and Confidence Interval are like the box plot as they consistently show an overlap in the minutes spent sleeping between the 5 PM and 7 PM dinner time groups. Therefore, the difference between average sleep time not being statistically significant does not surprise me.

The strengths of having individual Confidence Intervals and Boxplots for Total Duration Slept is that we can see a clear overlap in Sleep Time for the 5 PM and 7 PM dinner times. However, 21 observations were originally expected, and only 10 observations of data were collected. This is a limitation as we there are less days to get a full idea of the typical Sleep Duration for each of the dinner times. Other factors like Illness and Exam Preparation also come in the way of truly analyzing dinner timing association to sleep, creating bias and resulting in outliers in the data set. Illness and exam preparation are confounding variables. These confounding variables impact the causation relationship if they factor into sleep duration. There is low power in assessing the true effect of my Dinner Time on the Amount of Sleep that I receive. My small sample size and relatively large variability could be contributing to the low power.

IV. Summary

In conclusion, my Dinner Time is not significantly related to my Sleep Duration. We cannot conclude that there is a causal relationship between Dinner Time and Sleep Duration as Dinner Time does not directly impact Sleep Duration. There are other factors involved that have the potential to impact how much sleep I receive. We cannot necessarily generalize findings for the entire population, as different people have different schedules and lifestyles that impact their sleep duration. Individuals who do not have obligations with family, school, work, or who do not deal with health conditions may see a more causal relationship between dinner timings and sleep duration, as there are fewer factors involved that affect their sleep duration. However, an individual who has more obligations with school, work or family may have other factors from their lifestyle that affect their sleep duration. The relationship between Dinner Timings and Sleep Duration will generally vary from person to person.

If this same study was to be conducted in the future, I would recommend that the participants make it a strict priority to note down data for every single day during the study duration. That way, participants can have a more accurate analysis on whether dinner time is directly influencing their sleep duration, or if it is simply lifestyle factors that truly influence sleep duration.

Executive Summary

Overall, the focus of this study was to analyze whether Dinner Time during the evening affects Sleep Duration. This was important to me as I wanted to see how my lifestyle and scheduling during the day affect my sleep quality. This helps me see what changes in my schedule I can make to obtain the most amount of sleep possible. I used the timer app on my iPhone to record the total amount of sleep that I received nightly and used a randomized process of pulling out cards to determine my dinner time for that day. The key finding was that there is no statistically significant difference between the amount of sleep that I obtained on days with dinner timing of 5 PM compared to days with dinner timing of 7 PM. However, there was low power, meaning that I was not able to see the true effect of Dinner Time on Sleep Duration when there could have possibly been a relationship between the two variables. My sleep duration was strongly influenced by other factors such as coping with illnesses like headaches and academic obligations. Overall, I learned that the amount of sleep that I receive is influenced by many factors, not just one factor.