Is there a relationship between cell phone usage prior to bedtime and sleeping patterns?

IB Mathematical Studies Paper

Internal Assessment

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Introduction:

In current day, many people are constantly connected to their cell phones while being awake. In fact, according to an article in the Huffington Post, *How Mobile Phones Affect Sleep* have shown that using a cell phone prior to when you fall asleep greatly interferes with both the length and quality of your overall sleep. Specifically, people use their cell phones as their alarm clock, causing them to get on their phone to set their alarm each night before bed. By doing so, it is so easy to get drawn into the other features that the phone provides, hence overextending the time spent on your phone.

Above all, utilizing your phone before you go to sleep is an incredibly activating habit that severely hinders the quality and length of your slumber. Personally, I chose to investigate the correlation between cell phone usage prior to bedtime and sleeping patterns, because this topic is highly prevalent in my day to day life. I think that by uncovering the truth behind technology it will change the way I view my cell phone and overall aid to a more healthy and stable sleep life.

Statement of Task:

The investigation will track the relationship between cell phone usage prior to bedtime by recording the length and quality of sleep that participants undergo. The execution of this investigation will consist of asking a variety of adults and teenagers to record the hours they have slept per night. The intent of this project will aim to determine the relationship that cell-phone usage prior to bed has upon sleeping patterns (the hours and quality of sleep).

Note: I chose to only include teenagers and adults in this experiment in hopes to receive the most imperative results. Teenagers often overuse their cell-phones, which leads to compulsively exercising their devices prior to bed. Similarly, adults utilize their phones regularly and I am eager to see the results based upon such.

This data will be collected over the course of two weeks and monitored carefully by the participants. During the first week, individuals will be allowed to use their phones freely. However, throughout the second week participants will be asked to refrain from using their devices thirty minutes prior to when they go to sleep.

The relationship between cell-phone usage prior to bedtime and sleeping patterns will be analyzed by subtracting the mean of the first week by the mean of the second week. By doing so, we will be able to detect if cell-phone use before one goes to sleep affects the hours of sleep they receive.

Personal Expected Outcome:

I believe that the individuals who partake in this investigation will experience heightened separation anxiety from their cell phones during the second week of the study. However, I anticipate that some people will show no variation of sleeping patterns between the two weeks of the investigation due to a long term acclimation to their devices. Above all, I think that this investigation will show specific changes in the quality of sleep as opposed to the overall quantity of sleep, but each participant's results will vary.

(Ho): Null Hypothesis: Technology does not affect sleep.

(HA): Alternative Hypothesis: Technology affects sleep.

Methodology:

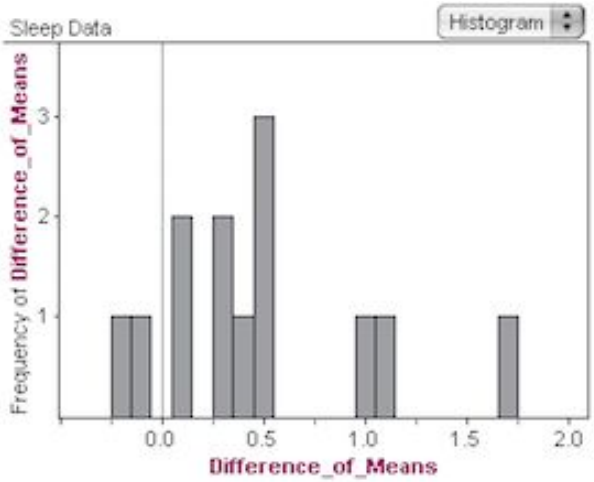
This is the process followed in order to find the relationship between cell-phone usage prior to bedtime and sleeping patterns.

- Seven adults and six teenagers were asked to record their sleep over the course of two weeks, in order to determine if utilizing cell-phones before bedtime affects sleeping patterns.
- Participants were asked to monitor not only the quantity of sleep they received per night, but also to place emphasis on the quality of sleep that was received as well.
- The participants results were then placed into spreadsheets and organized by contrasting the total means from the first and second week.
- The mathematical process of the "One-Sample T-test" was carried out.
- Additionally, the outliers of the investigation were examined and the IQR formula rule materialized to provide support and clarity

Data Collection:

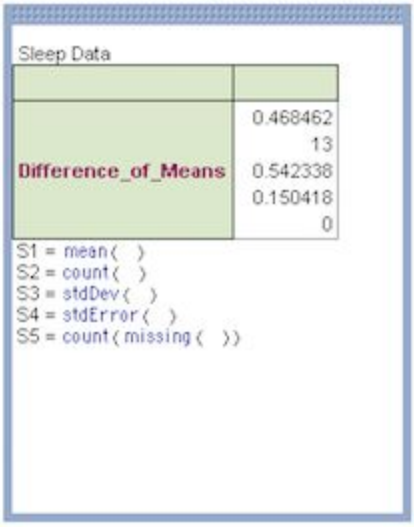
Table 1

This table shows the mean difference from week 1 and week 2.

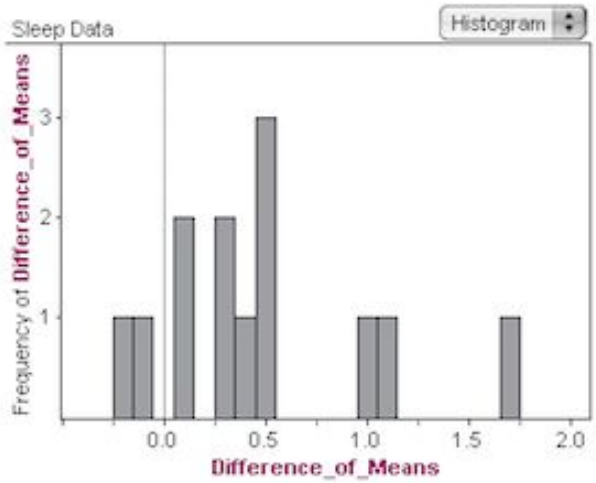


(Figure 1)

Participants	wk2-wk1 mean
Bill	0.07
Craig	0.29
Patricia	0.39
Yvonne	-0.24
Jeannine	0.5
Joy	-0.14
Joe	0.29
Remy	1.14
Ellen	0.5
Liam	1.71
Miley	1
Conner	0.5
Christiane	0.08

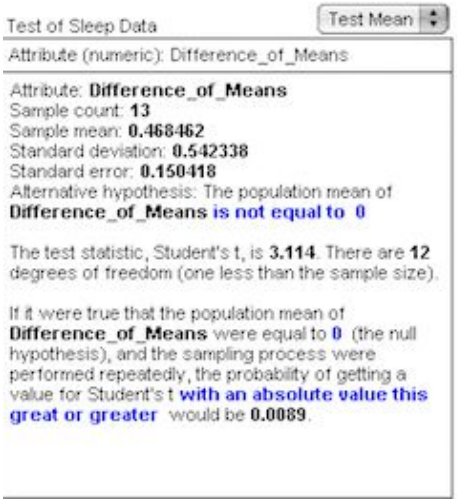


(Sleep Data Information) **(Test of Sleep Data)**



Data Analysis:

The graph above indicates that to the right of the zero line shows the people who have slept more during the second week of the experiment. In more detail, *Figure 1* visually shows the majority of the sample size to the left of the zero line, signifying that cell phone usage does in fact affect sleeping patterns.



The visual above displays the *Test of Sleep Data.* Through the software Fathom, it is showing a baseline of information that ecompasses this experiment. Because the P-value listed is **0.0089** the null hypothesis is rejected. This rejection is due primarily because **0.0089** is less than **.05**. In all, the rejection of the null hypothesis goes to show that cell-phone use prior to bedtime does in fact affect sleeping patterns.

Observations:

An outlier represents a data value that is far removed from the rest of the data values. By looking into the results from Remy, and Liam it will determine whether or not their data from this experiment hindered the investigation or maintained neutrality.

Note: If a data point is below $\mathbf{Q_1 - 1.5 \times IQR}$ or above $\mathbf{Q_3 + 1.5 \times IQR}$ it is viewed as being too far from the central values to be reasonable. (The outliers are the points that just don't seem to fit).

Calculating the IQR:

Data Set: 0.07, 0.29, 0.39, -0.24, 0.5, -0.14, 0.29, 1.14, 0.5, 1.71, 1, 0.5, 0.08

Median (Q_2): .39

Q_1: .075

Q_3: .75

Therefore…

IQR= Q3-Q1 (.75-.075)

IQR= .675

Outliers will be any points below $\underline{Q_1 - 1.5\times IQR}$
or above $\underline{Q_3 + 1.5\times IQR}$

Calculating Outliers:

$\underline{Q_1 - 1.5\times IQR}$
.075-1.5 x .675
= **-.961875** (Any point below this is an outlier)

$\underline{Q_3 + 1.5\times IQR}$

.75+1.5 x .675
= **1.7625** (Any point above this is an outlier)

Possible Outliers Being Tested Results:

Remy: 1.14
Liam: 1.71

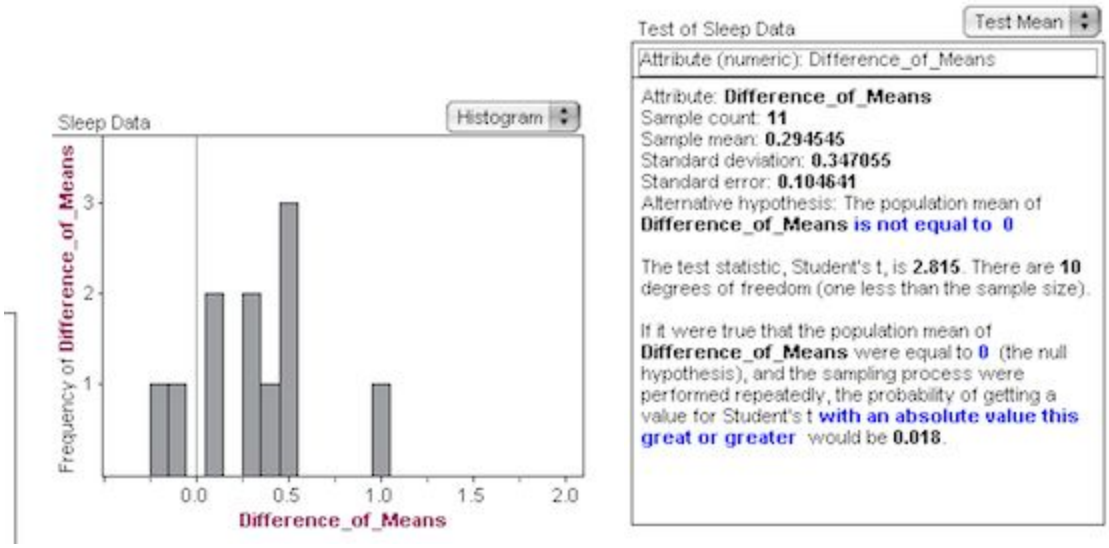
Summation of Observation:

By calculating potential outliers for this investigation has indicated that Remy and Liam's results do not hinder the conclusion. The IQR formula has shown by using the IQR formula, has revealed that (**Remy**: 1.14) and (**Liam:** 1.71) are not considered outliers.

This observation can be further looked into by analyzing the three visuals below:

Sleep Data

	Particip...	Differen...	<new>
1	Bill	0.07	
2	Craig	0.29	
3	Patricia	0.39	
4	Yvonne	-0.24	
5	Jeannine	0.5	
6	Joy	-0.14	
7	Joe	0.29	
8			
9	Ellen	0.5	
10			
11	Miley	1	
12	Conner	0.5	
13	Christiane	0.08	



It is important to note that by removing Liam and Remy from the data does not change the fact that the null hypothesis is still rejected. This rejection is because **0.018** is still less than **0.5** and therefore cell-phone use does affect sleeping patterns.

<u>One-Sample T-Test:</u>

T-TEST STATISTIC

$$t = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

$\mu \neq 0$ **This is the alternative hypothesis.**

t= 3.114 **This is called the test value. In this case it is referred to as "t".**

p= 0.0089 **This is the probability value. It is the probability of evidence against the *null* hypothesis. (The smaller this number the more chance that cell phone usage and sleeping patterns are really significantly different.)**

$\bar{x}$= 0.468462 **This is the mean of the sample data collected.**

sv= .0542338 **This is the standard deviation of the sample data collected.**

n= 13 **This is the number of data collected.**

α= 0.5 **The alpha level is a percentage referring to the chance that your answer might be wrong.**

Comparing the P-value with the Alpha Value:

P-value = 0.0089 < 0.05

This indicates that the the values of the P-value and alpha value are significantly different. Once again clarifying that the null hypothesis is rejected and the alternative hypothesis is adopted.

Thus making the variables cell-phone usage and sleeping patterns dependent.

Conclusion:

In conclusion, through the utilization of the One-Sample T-test the affectability of cell-phone usage in regards to sleeping patterns was confirmed. There was a definite dependence between these two variables shown throughout this investigation.

Furthermore, by observing graphs, figures, and potential outliers the nature of this relationship is determinable.

-Cell-phone usage prior to when an individual goes to sleep affects the quantity of the sleep they will receive.

-Through the analyzation given by the software *Fathom,* has indicated that the predicted null hypothesis was rejected with ample support and clear evidence.

This investigation did not include an element concerning the *quality* of sleep participants received. By taking this aspect into account, has shown that there is still an abundance of space for further research.

All in all, there is a relationship between cell-phone usage prior to bedtime and sleeping patterns.