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Middle East Technical University

Department of Statistics

FINAL PROJECT

STAT365

SAMPLING AND SURVEY TECHNIQUES

FACTORS THAT AFFECT THE ACADEMIC SUCCESS OF METU STUDENTS

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ABSTRACT

It is the dream of many students to study in a well-established and respected school like Metu. However, it can be said that studying in such a high-level school has many academic difficulties. Despite all these difficulties, METU students make great and various efforts to achieve success in their education life. As a result of these efforts, each student reaches a different level of success. For this reason, the factors that can affect academic success are a matter of great curiosity and this report includes the analysis of the data obtained from a small sample of METU students in order to satisfy this curiosity. While making these analyzes, it has been assumed that the academic achievement of METU students is based on their average. Consequently, according to the results of the statistical analysis, the variables affecting the academic success of the METU students were determined. Understanding these variables is important both for students to seek different ways to achieve academic success and for educators to develop strategies to help students succeed, which makes this report worth reading.

1.INTRODUCTION

The main aim of this study is to determine the factors affecting the academic success of METU students. For this purpose, it was desired to prepare a questionnaire to be directed to METU students. To better understand what should be in the content of the questions in the questionnaire, a literature review was carried out and as a result, it was seen that there could be many variables that affect academic success. As a result of the articles or sample surveys examined, it was concluded that the most important factor in the academic success of the students was the socio-economic status of their families, especially their income. In addition, in the articles examined in this review, it is said that the students' study duration, study method or frequency of attending classes, as well as behavioural characteristics such as smoking and nightclub participation, greatly affect their success. Finally, the most important conclusion drawn from the literature review is that the best variable that can show the academic success criterion is the CGPA of the students. Therefore, the main dependent variable in the analyzes mentioned in this report is the average of the students. As a result, a questionnaire consisting of 39 questions was prepared after various factors such as education and financial situation of families, time management, types of electronic devices, accommodation, social life, sleep patterns, study plans and methods that should be asked to the students in the questionnaire were determined. Out of 800 METU students reached by post-stratification sampling method, 207

filled the questionnaire and a response rate of 25.87 was obtained. The 57-column data set obtained thanks to the survey included a lot of information about the students. For example, if the demographics of data are examined, it can be observed that women, 3rd-grade students and students whose average is between 2.5 and 3.5 have a higher participation rate than others. To carry out the analysis of the data more easily and understandably, it was decided to examine the factors affecting the academic achievement of METU students by dividing them into certain categories namely Accommodation, Time Management, Socio Economic, Learning Style, Social Life and Health, and various research questions were created for each category. These questions can be listed as follows:

1- Does the student's accommodation (dorm, etc.) influence their academic success?

2- Does the daily working time affect the student's CGPA?

3- Does being planned affect the student’s academic achievement?

4- Do the education levels of parents make a difference in CGPA?

5- How does the financial situation of the students affect their academic success?

6- Is t the type of technological devices students have important on CGPA?

7- Does listening to classical music while studying affect CGPA?

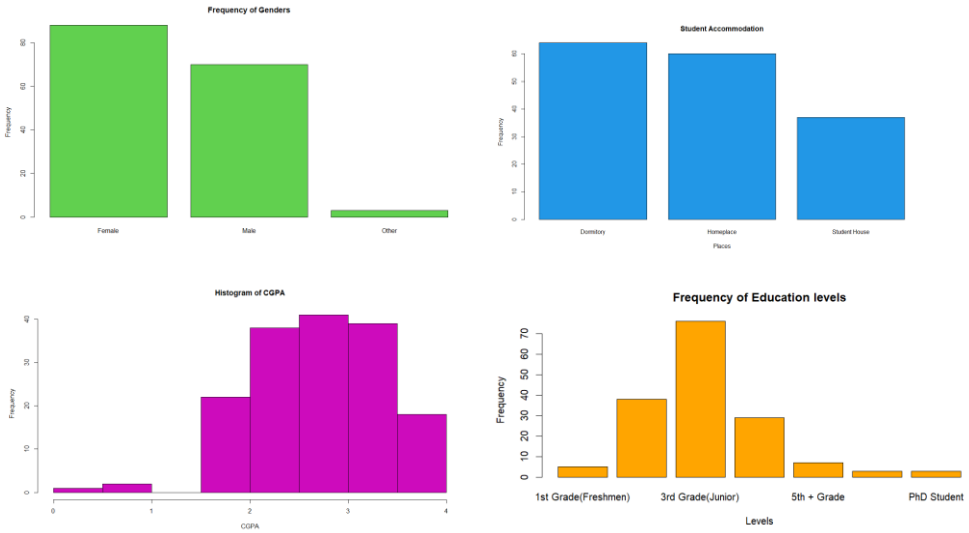
8- Is there a relationship between students' study methods and their academic achievements?

9- Does personality type (being an introvert or extrovert) have an effect on CGPA?

10- Is the average of students participating in academic student clubs higher than non-academic clubs?

11- Does sleeping time have an effect on CGPA?

As a consequence of the analysis which was made by using ANOVA, Hypothesis testing and Linear Regression, it was concluded that some of the factors examined for the academic success of METU students had a positive or negative effect on this success and some had



2.METHODOLOGY/ANALYSIS

To test if there is a factor, which has a significant influence on students' CGPA, some statistical methods and analyses were used. For the research questions, these analyses and methods include ANOVA test, mean, outlier, hypothesis testing. Also, visualization methods, including bar graph, boxplot, scatter plot, and line graph, mosaic plot, lollipop graph were used to display some results from our data.

Normality Tests

To check normality, 4 different tests were performed. These tests are as follows.

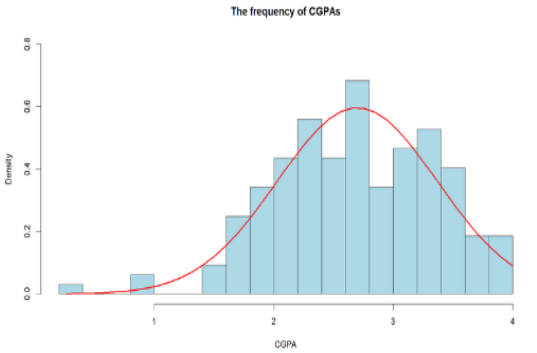


Figure 5: The frequency of CGPAs

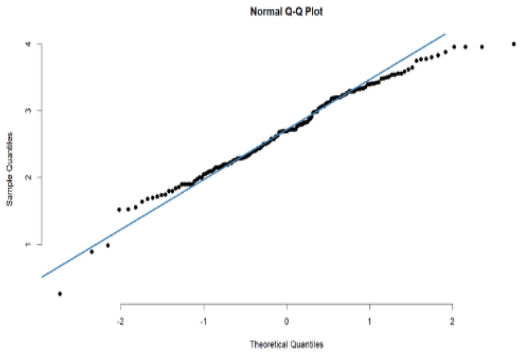


Figure 6: Normal Q-Q Plot

For the first test, CGPA values of the students were selected from dataset and Frequency graph of the CGPA values of students was sketched. When we examine the figure 5, it is clear that the graph is not roughly "bell-shaped". So, it cannot be said that data is normally distributed. Then, for the second test, the Normal Q-Q was sketched and if we look at the figure 6, it may be seen that there are big deviations in right tail of the Q-Q plot. So, it is not normally distributed either.

Table 1:Shapiro-Wilk Normality Test

```
        Shapiro-Wilk normality test

data:  CGPA
W = 0.9819, p-value = 0.03337
```

Table 2:Kolmogorov- Smirnov Test

```
        One-sample Kolmogorov-Smirnov test

data:  CGPA
D = 0.91711, p-value < 2.2e-16
alternative hypothesis: two-sided
```

To check normality, two more tests were conducted. These tests are Shapiro-Wilk normality test and One-sample Kolmogorov-Smirnov test. As a result, since in these two tests p-value is smaller than 0.05 the data is not normally distributed.

However, hypothesis tests were conducted by assuming that our data is normally distributed.

3.RESULTS AND FINDINGS

3.1 Time Management

Research Questions:

- Does the daily working time affect student's CGPA?
- Does being planned affect student's CGPA?

For the first research question, the effect of students' daily working time on their success was analyzed. Information of the students' daily study time values in minutes were selected from dataset. There were 5 different categories in the survey in grouping working minutes. As a result of the survey, students were classified according to their answers. To measure success, students' CGPA values were taken as a dependent variable in this research question.

The following graph represents the distribution of the students' CGPA values according to their working time.

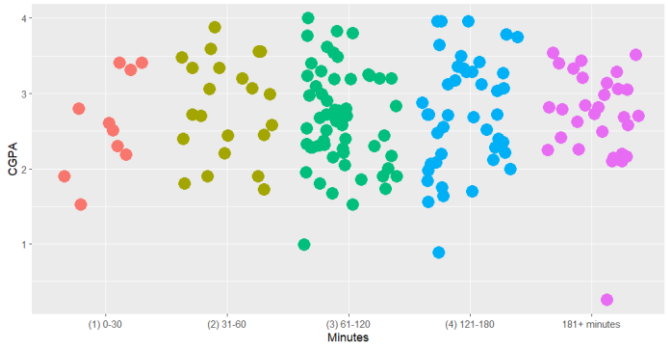


Figure 7: Distribution of the students' CGPA

In the following box-plot, the distribution of students' CGPA values is combined with the range of students' CGPA values according to their daily working time.

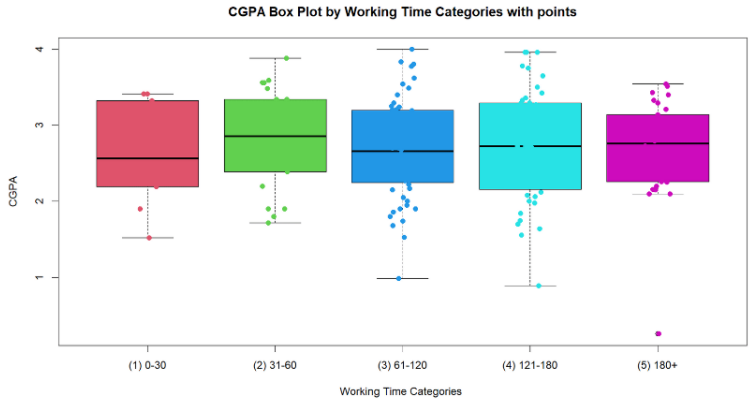


Figure 8: Box Plot of students'CGPA

To analyze the effect of working time on Students' CGPA values, hypotheses are stated as the following.

H_0: The mean CGPAs of students who have different daily working time are equal.

H_A: The mean CGPAs of students who have different daily working time are not equal.

After applying ANOVA, the following result was obtained in R.

Table 3: Output of Anova

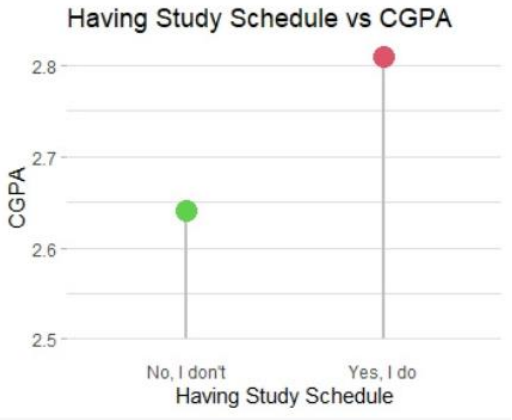
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
data2$`23`	4	0.52	0.1298	0.284	0.888
Residuals	156	71.19	0.4564		

One-way ANOVA test was conducted to determine the effect of working time on students' CGPA values. As a result of the ANOVA, p-value is determined as 0.888.

Since p-value is greater than 0.05, we fail to reject Null Hypothesis and we may conclude that there was no statistically significant difference between mean CGPAs of students who have different working time.

For the second research question, the effect of keeping a daily/weekly/monthly schedule on the success of students was analyzed. To measure success, students' CGPA values were taken as a dependent variable. The mean CGPAs of the students who have and have not a study schedule were selected from the dataset and the graph that shows the difference between these

two groups was sketched. The following graph represents the difference between mean CGPAs of the students who have study schedule and the students who have not.



For analyzing the effect of having a study schedule, hypotheses are stated as follows.

H_0: The mean CGPAs of students who have study schedule are less than or equal to who have not.

H_A: The mean CGPAs of students who have study schedule are greater than who have not.

Figure 9: Mean CGPA of students who have study Schedule and do not have

A Z-test was performed to determine the effect of having study schedule. As a result of Z-test the rejection region for a one tailed test is any value above 1.96. The z value was found 1.99. Since it is above 1.96, it is in the rejection region. Since test statistics is greater than z-critical, the decision is to reject Null Hypothesis and there is enough evidence to say that the mean CGPAs of students who have study schedule greater than the students who have not.

After this result, to go one step further, we aimed to find that is there a tool that makes a difference among students who have study schedule. In the survey questionnaire, it was asked whether the agenda is used by the students, which is the most popular tool for making schedule. This question only asked for the students who have a study schedule.

The following graph represents the difference between mean CGPAs of the students who use agenda regularly and the students who do not.

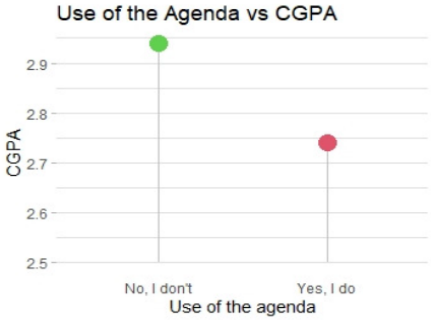


Figure 10

For analyzing the effect of using agenda regularly, hypotheses are stated as follows.

H_0: The mean CGPAs of students who use agenda is less than or equal to students who do not.

H_A: The mean CGPAs of students who use agenda is greater than the students who do not.

A Z-test was conducted to determine the effect of using agenda regularly. As a result of Z-test, the rejection region for a one tailed test is any value above 1.96. The z value was found -1.006.

Since it is not below above 1.96, it is not in the rejection region. The decision is fail to reject Null Hypothesis and there is not enough evidence to say that the mean CGPAs of students who use agenda regularly is greater than the students who do not use agenda regularly.

After all these findings, it can be said that having a schedule is important but there is not enough evidence to say that agenda usage is important for CGPA.

3.2 Socio Economic Part

Research Questions:

- Do education levels of parents make a difference on CGPA?
- Does income affect students' CGPA?
- Is the type of technological devices students have important on CGPA?

To determine if education levels of parents influence students' CGPA, according to education levels of parents, students were grouped (The groups can be seen in Figure 11.). 14 groups were created for the education level of both mothers and fathers.

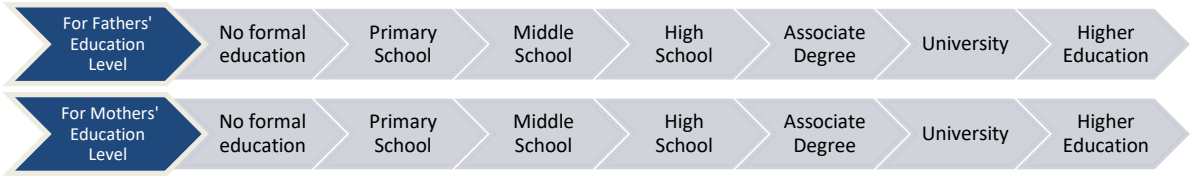


Figure 11: Student Groups

Then, the means of students' CGPA in these groups were found and the result were shown in the bar graph (The bar graph can be reached from Figure 12.).

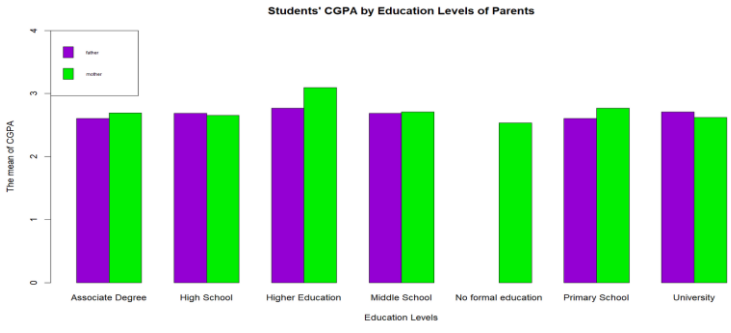


Figure 12: Students' CGPA by education levels of parents

Ross (2017) determines that two-way ANOVA test should be used to test if several factors affect the result. Therefore, considering that the education level of the parents are two

different factors that can affect the CGPA, it was desired to be controlled with tho-way ANOVA test. For two-way ANOVA test, the following hypotheses were created.

H_0 : All mean of students' CGPA in the groups are equal.

H_1 : At least one mean of students' CGPA in the groups are different from other groups.

After applying two-way ANOVA test, the following results were obtained in R.

Table 4: Output of Anova

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Education_level_of_mother	7	3.06	0.4378	0.952	0.469
Education_level_of_father	5	0.58	0.1161	0.252	0.938
Residuals	148	68.07	0.4599		

According to these results, the null hypothesis cannot be rejected since the p-values of the mothers' and fathers' education levels are bigger than 0.05. Thus, it was concluded that there was no enough evidence to show significant difference between the mean of students' CGPA grouped according to parents' education levels. This means the education levels of parents do not influence students' CGPA.

To test if income affect students' CGPA, students were grouped by income levels determined (Income levels can be seen in Figure 13.).

Poor	Near Poor	Lower Middle	Middle	Upper Middle	Near Rich	Rich
• 0-999 TL	• 1000-1999 TL	• 2000-2999 TL	• 3000-3999 TL	• 4000-4999 TL	• 5000-5999 TL	• More than 6000 TL

Figure 13: Students groups by income levels

To find if there is a outlier in these groups, bar graph and scatter graph were shown together in Figure 14. It was determined that there is no outliers in these groups.

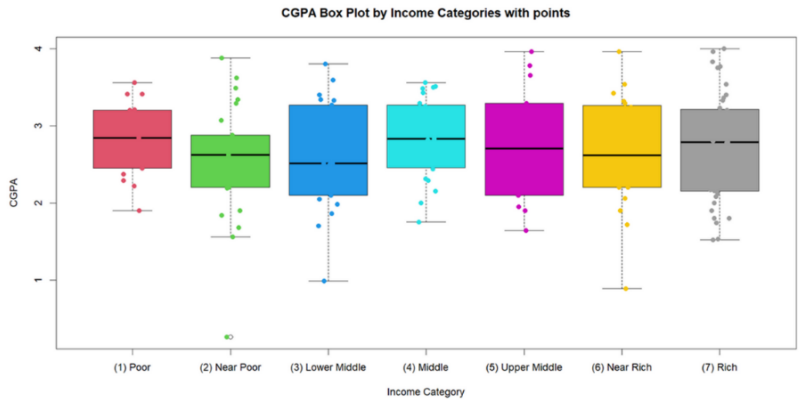


Figure 14: CGPA Box plot

Then, the mean of students' CGPA in these groups were calculated and these results were shown in the point graph (Point graph can be reached from Figure 15).

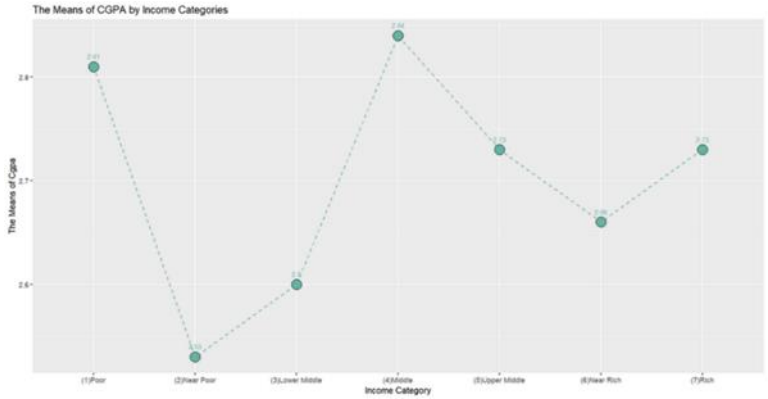


Figure 15: The means of CGPA by income categories

To test if there is a significant difference between the means of students' CGPA in the income levels groups, one-way ANOVA test was applied. For one-way ANOVA test, the hypotheses are the following.

H_0 : All mean of students' CGPA in the groups by income levels are equal.

H_1 : At least one mean of students' CGPA in the groups by income levels are different from other groups.

After applying one-way ANOVA test, the following results were obtained in R.

Table 5: Output of Anova

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
datas$`10`	6	1.71	0.2850	0.627	0.709
Residuals	154	70.00	0.4546		

According to these results, the null hypothesis cannot be rejected since the p-value of income levels is bigger than 0.05. Thus, it was concluded that there was no enough evidence to show significant difference between the mean of students' CGPA grouped by income levels. This means the income levels of parents do not have a effect on students' CGPA.

To specify if the type of technological devices students have is important on CGPA, students were grouped by the number and the type of technological devices (Groups can be reached from Figure 16.).

All of them	•Having both tablet and computer
Laptop/computer	•Having only computer
Tablet	•Having only tablet

Figure 16: Groups of electronic devices

To control if these groups have any outliers, bar graph and scatter graph were shown together in Figure 17. It was found that second group (Laptop/Computer) has outliers. However, these outliers were ignored since they did not affect the mean of the group significantly.

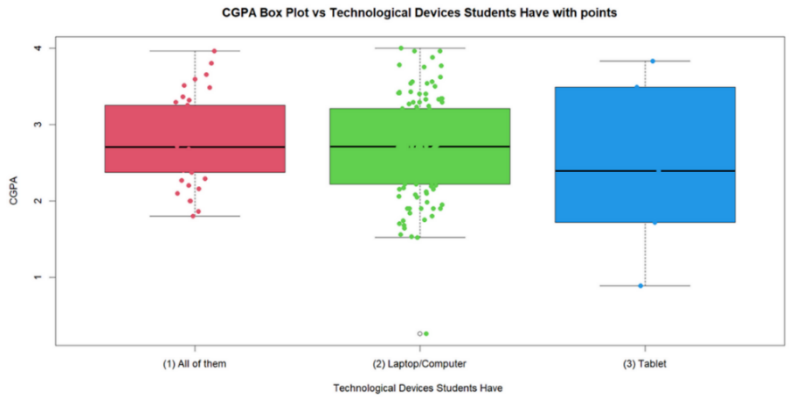


Figure 17: CGPA box plot

Then, the mean of students' CGPA in these groups were found and these results were demonstrated in the lollipop graph (Lollipop graph is in Figure 18).

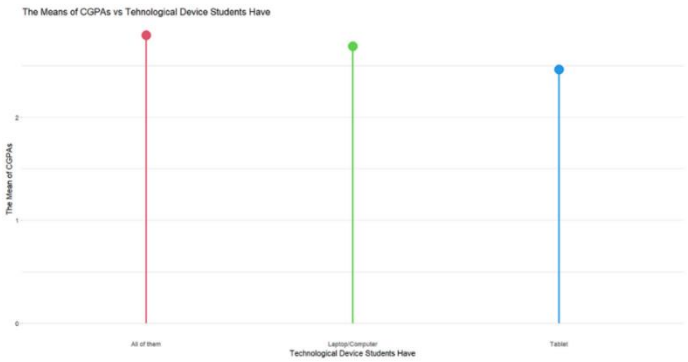


Figure 18:The means of CGPAs vs Technological Devices

To test if there is a significant difference between the means of students' CGPA in these groups, one-way ANOVA test was applied. For one-way ANOVA test, the hypotheses are the following.

H_0 : All mean of students' CGPA in the groups are equal.
H_1 : At least one mean of students' CGPA in the groups are different from other groups.

After conducting one-way ANOVA test, R gived the following results.

Table 6: Output of Anova

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
data3$`9`	2	0.64	0.3188	0.735	0.481
Residuals	157	68.14	0.4340		

According to these results, the null hypothesis cannot be rejected since the p-value is bigger than 0.05. Thus, it was concluded that there was no enough evidence to show significant difference between the mean of students' CGPA in these groups. This means that the type of technological devices students have is not important on CGPA.

3.3 Learning Style

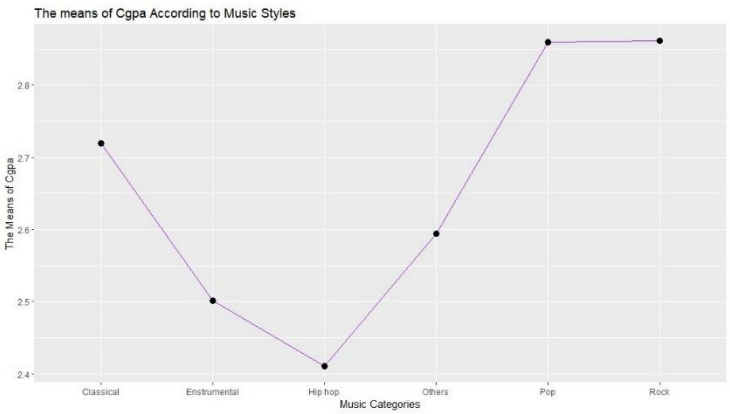
Research Questions:

- Does listening to classical music while studying affect CGPA?
- Is there a relationship between students' study methods and their academic achievements?

For the first research question;

Does listening to classical music while studying affect CGPA?

Table 7 : The Means of Cgpa According to Music Styles



The following table shows the mean cgpa values of music styles. In society, there is a perception that students who listen to classical music are generally more successful. Looking at the table, it is seen that the overall grade point averages of those who listen to classical music are not as high as expected. To see if listening to classical music while studying affects CGPA, a two-sided z-test was applied. Difference between CGPA of students who listen to classical music while studying and those who do not were compared. Hypotheses are stated as the following.

H_0: mean CGPA of students who listen to classical music while studying = mean CGPA of students who do not listen to classical music while studying

H_A: mean CGPA of students who listen to classical music while studying ≠ mean CGPA of students who do not listen to classical music while studying

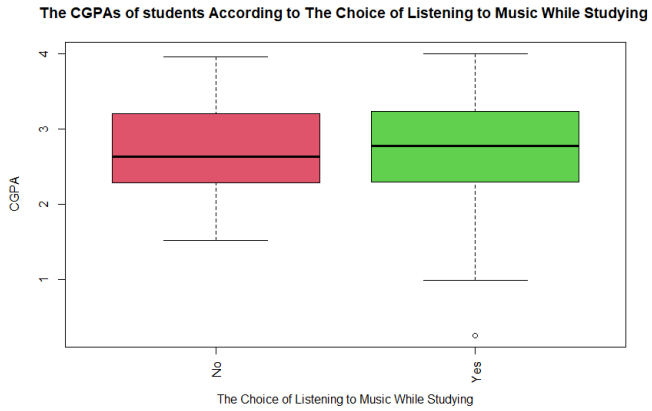
For alpha=0.05, the rejection regions for a two tailed test is any value below -1.96 or above 1.96. The z value found is 0.3438124. Since it is not below -1.96 or above 1.96, it is not in the rejection region. Thus, fail to reject the null hypothesis. It means hypothesis test are not statistically significant. It can be said that there is no significant difference between mean CGPA of students who listen to classical music while studying and who do not.

After concluding that listening to classical music while studying did not have a significant effect on CGPA, this research has been taken a step further and the effect of listening to music while studying on the GPA was investigated. To investigate this, a two-sided z-test was applied. Hypotheses are stated as the following.

H_0: mean CGPA of students who listen to music while studying = mean CGPA of students who do not listen to classical music while studying

H_A: mean CGPA of students who listen to music while studying ≠ mean CGPA of students who do not listen to classical music while studying

The z value found is 0.230516. Since it is not in the rejection region,fail to reject the null hypothesis. Thus, It can be said that there is no significant difference between CGPA average of students who listen to music and who do not while studying. Thus, It can be concluded that even listening to music while studying does not have a significant effect on CGPA.

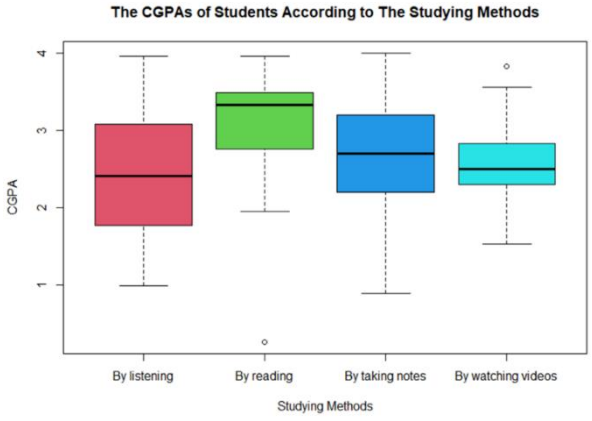


In addition, the following boxplot shows the CGPA distributions of students according to the choice of listening to music while studying. It is seen that there is no significant difference between the CGPAs of students who listen to music and those who do not while studying according to boxplot.

Figure 19: The CGPAs of Students According to the Choice of Listening to Music While Studying

For the second research question;

Is there a relationship between students' study methods and their academic achievements?



The following boxplot shows the students' CGPA distribution according to their studying method. Studying methods are divided into 4 parts listening, reading, taking notes and watching videos. The data's minimum, maximum, median and quartile values can be seen.

Figure 20: The CGPAs of Students According to Studying Methods

In the bar plot, the mean CGPAs of the studying methods can be seen. As you can see, averages are very close to each other. This makes it questionable whether there is a significant difference between these means.

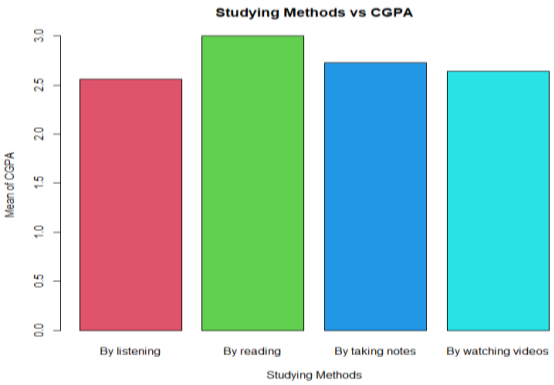


Figure 21: Studying Methods vs CGPA

One way anova test was performed to find out whether there was a significant difference between the means of CGPA according to 4 studying methods. CGPA is taken as dependent variable. Hypotheses are stated as the following.

H_0 : $\mu_1 = \mu_2 = \mu_3 = \mu_4$
H_A : At least one μ_i different

μ_1 : mean CGPA of students studying with listening method

μ_2 : mean CGPA of students studying with reading method

μ_3 : mean CGPA of students studying with taking notes method

μ_4 : mean CGPA of students studying with watching videos method

After applying one -way ANOVA test, the following results were obtained in R.

Table 8 : One – Way Anova Test

```
                     Df Sum Sq Mean Sq F value Pr(>F)
as.factor(data$`35`)   3   3.32  1.1056   2.538 0.0586 .
Residuals            157  68.40  0.4356
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Since p-value = 0.0586 is greater than 0.05, the result is non-significant. It can be said that fail to reject H_0. Thus, when the mean CGPAs were compared according to their studying methods, it was concluded that there was no significant difference between them. To conclude, there is no significant relationship between students' study methods and academic achievements.

3.4 SOCIAL LIFE PART

RESEARCH QUESTIONS:

- Does personality type have an effect on CGPA?
- Is the average of students participating in academic student clubs higher than non-academic clubs?

When the effect of social life on academic success is examined, the first research question is Does personality types affect academic success?

In order to investigate the effect of personality type on academic achievement, a test is being conducted on the average CPAs of people who have both personality types. As a general opinion, it is known that extrovert people are more successful people because their social skills are more developed.

The hypothesis is stated as follows

H_0: The mean CGPAs of introvert people is less than or equal to the mean CGPAs of extrovert people

H_A: The mean CGPAs of extrovert people is greater than the mean CGPAs of introvert people

Since the Z value turns out to be 1.06, we cannot reject our H0 hypothesis. there is not enough evidence to say that the mean CGPAs of extrovert people are greater than the mean CGPAs of introvert people. in other words, the CGPAs of introverted people is higher than extroverts, as can be seen in the graph, although the two values are very close to each other, the average of introverted people is higher in Figure 1.

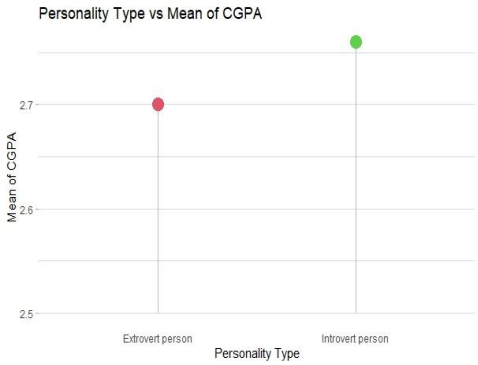


Figure 22 :Personality type vs mean of CGPA

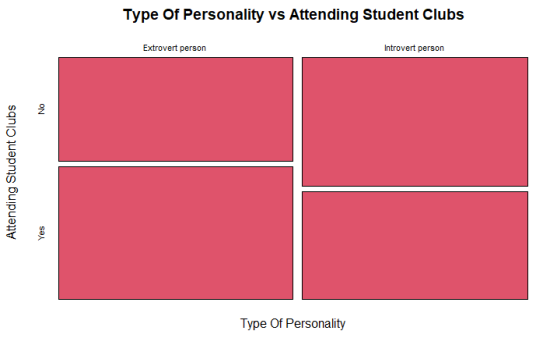


Figure 23:Type of personality vs Attending Student Clubs

When it is looked at their participation in student clubs according to their personality type, it is seen in the mosaic graph that introverted people say no more. (Figure 23)

According to another research question, when we examined the effect of participating in student clubs on academic achievement.

It is being tested which types of clubs are more effective among those who participate in the clubs since the CGPAs of people who participate in the clubs and do not participate are almost equal. As a general opinion, it is known that academic clubs have a positive impact on our academic achievement; a hypothesis test was conducted to see this. The hypothesis is stated as follows

H_0: The mean CGPAs of students who go to academic clubs is less than or equal to the mean CGPAs of students who go to non-academic clubs.

H_A: The mean CGPAs of students who go to academic clubs is greater than the mean CGPAs of students who go to non-academic clubs.

Z-value is 2.36 which is higher than 1.96. So,we reject the null hypothesis as a result, the mean CGPAs of people who go to academic clubs is higher than the mean CGPAs of students who go to non-academic clubs. The highest mean CGPAs belongs to academic clubs and the lowest average belongs to students who go to sports clubs in Figure4.

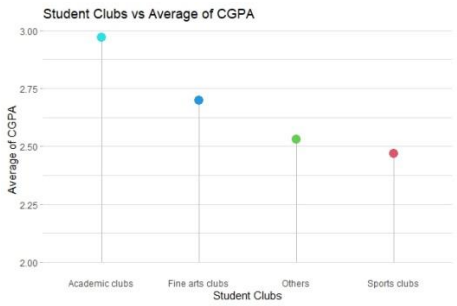


Figure 24: Students Club vs Average of CGPA

3.5 HEALTH PART

RESEARCH QUESTION:

- Does sleeping time have an effect on CGPA?

In the health part, firstly, the participants were asked questions on 3 different topics.These are getting sick , drinking alcohol and doing sport.In these questions the participants were asked to rate their frequency.Frequency rates were determined as Never , Very rarely, Occasionally , Frequently, Very frequently.After this step ,CGPAs averages of each frequency ratio were

calculated.For each frequency ratio, 3 different line graphs were created and analyzed.They were shown in the point graphs.

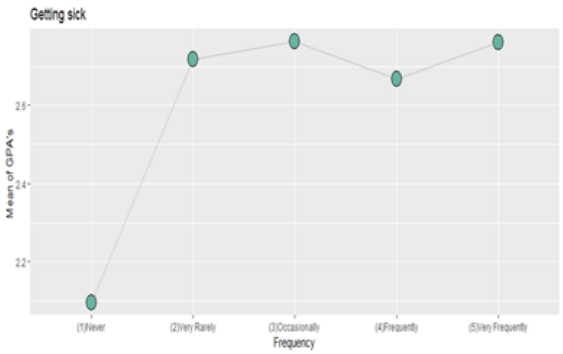


Figure 25: Getting sick vs CGPA

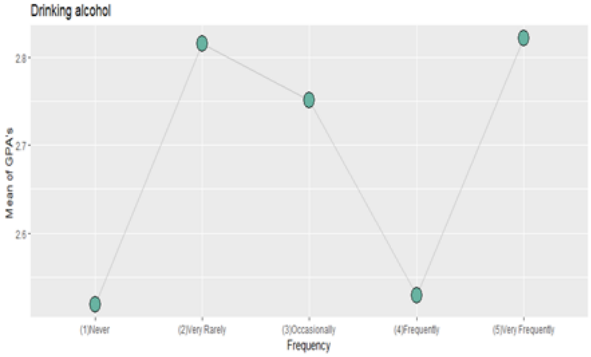


Figure 26: Drinking alcohol vs CGPA

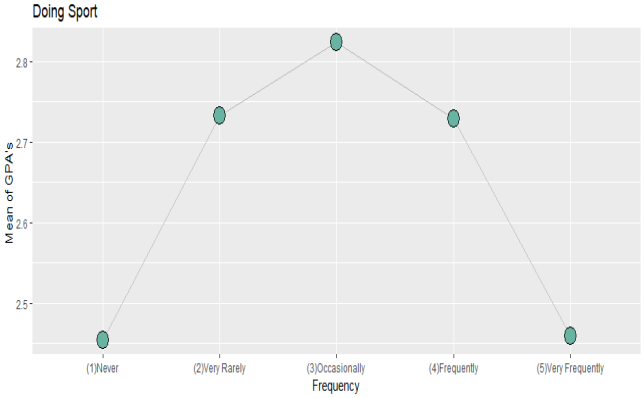


Figure 27: Doing sport vs CGPA

As a result of the analyzes made,

(1) Average CGPA values were reached, except never frequency, in the getting sick graph.

(2) A direct relationship could not be established between alcohol consumption and CGPA.

(3) Looking at the graph of doing sports, it was observed that it resembled a parabola. Consequently,Very frequency and Never frequency were found to have a negative effect on CGPA.

Finally, the answers given for these questions were shown using a bar graph.

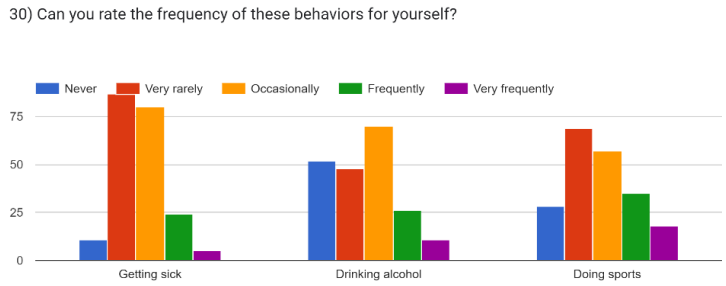


Figure 28: Answers

In the second part of the health section, the relationship between sleep duration and CGPA was examined.

Table 9: Observations of sleep times

Less than 6 hours	6-8 hours	More than 8 hours
• 4 hours	• 6 hours	• 8.5 hours
• 4.5 hours	• 6.5 hours	• 9 hours
• 5 hours	• 7 hours	• 10 hours
• 5.5 hours	• 7.5 hours	• 12 hours
	• 8 hours	

A bar graph was created to answer the research question.In the bar graph, the x-axis shows the sleep duration and the y-axis shows the CGPAs.Sleep periods were divided into 3 groups as "Less than 6 hours", "6-8 hours" and "More than 8 hours". Means of C GPAs were calculated for each period separately. The obtained results were tested by establishing a hypothesis test.

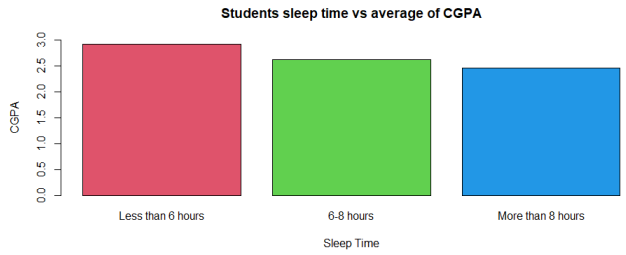


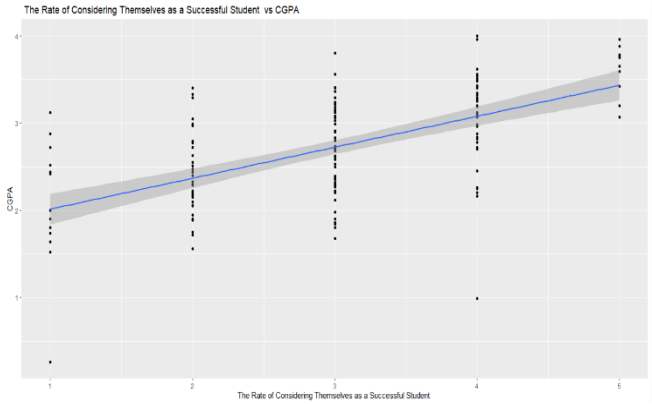
Figure 29: Sleeping time vs CGPA

H_0 : Students who sleep less than 6 hours have a lower or equal CGPA than others.

H_1 : Students who sleep less than 6 hours have a higher CGPA than others.

Z-value is 2.73. Since test-statistic is greater than the z-critical, the null hypothesis is rejected. The hypothesis test was also concluded as seen in the graph. As a result, it was observed that students who slept less than 6 hours were the most successful group.

Finally, the answer to the research question was answered by proving that sleep duration has a negative effect on CGPA.



It is understood from the following graph that there is a positive and linear trend in this graph. In other words, it is seen that as the rate of students' self evaluation as a successful student increases, their CGPA also increase. Therefore, it can be concluded that the students are conscious about their own success.

Figure 30: The rate of Considering themselves as a successful student

4.DISCUSSION/CONCLUSION

In this report, factors that may affect the academic achievement of METU students are examined. These factors are mainly Accommodation, Time Management, Socio-Economic, Learning Style, Social Life and Health. As a result of the analyzes made, it was determined that some of these variables had a significant effect on the Cgpa of the students. These variables are having a regular study plan, participating in academic societies, having an introverted personality, and sleeping less than 6 hours a day. It has been concluded that having these factors has a positive effect on the academic success of students. Likewise, it was thought that factors such as students' income, working methods, the types of electronic devices they have and the educational status of their families, their daily study duration, the place they stay, whether they listen to classical music, whether they use a calendar or not will have a positive effect on the academic success of the students. However, as a result of the tests, it was seen that these variables did not make any difference in the CGPA of the students. This is the point where we criticize ourselves and our analysis. We think that our sample number which is 207 is not enough to reflect the population. In addition, we noticed that some of the answers given to the questionnaire did not contain correct and realistic information and that many students who had just started their education life in METU and did not have an average completed the questionnaire. For this reason, we had to remove these observations from our data set in order to make more reliable results. If we had more time for this project, could reach more people and obtain more realistic data, we think that the analysis results we obtained would be different and more meaningful. To sum up, we can learn from our project that since the academic success of students can depend on so many variables, this success is a very difficult criterion to evaluate.

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