Analysis of Video Game Impact and Attitudes in College Students

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0. Contribution Statement

Both Ayaan Saifi and Antony Sikorski contributed evenly to the project. The R code was evenly split, and each author contributed equally to the write-up of the report. The advanced analysis was additionally evenly split between the two. That said, specific primary contributions are as follows:
Ayaan Saifi was the primary contributor for Questions 1, 2, and 5.
Antony Sikorski was the primary contributor for Questions 3, 4, and 6.

1. Introduction

In this study, we examine two data sets collected from two surveys that wished to quantify the general usage of video games in college students based on a number of variables, and a follow-up survey. The follow-up survey asked those students why they like or dislike playing video games.

The target population of the students in the first survey was roughly 3,000 to 4,000 students in statistics courses at UC Berkeley. The survey wanted to determine the extent of how video games impact and are present in the students, and which aspects of video games they like and dislike. A guarantee was given that anonymity would be preserved for responses on the survey. During the Fall semester of 1994, 95 students out of the total class size of 314 were randomly selected to be surveyed, yet only 91 completed the survey. The other 4 nonrespondents are labeled as such in the data set. The follow up survey continued on by asking students why they like or dislike playing video games, and was provided multiple choices for each of the three questions that it asked. The survey asked what types of games students play, why they play those games, and what they don't enjoy about the video games that they do choose to play.

Using the data collected from these two surveys, we analyzed the data to gain a better understanding of the extent to which students play video games, and how it impacts them, in order to provide useful information to the designers of a new computer lab for students. This useful information would act as an aid in the decision of whether or not the creation of the computer lab will benefit students, and if the lab were to be built, what should it include.

Throughout our analysis we perform multiple different calculations and tests to get an accurate sense of how many students like and play video games, and how often they do so. We also explore the different reasons that students like and dislike video games based on multiple factors, including their own survey responses to that direct question. We found that the majority of students like video games, and a bit less than half actually played in the week before the exam. It was found that students primarily use video games to relax, and the effects of gender, owning a computer, and how busy a student is make little impact on their enjoyment of video games. Finally, our advanced analysis investigates whether or not students who play videogames expect lower grades. The calculations were done for both students who like video games, and those who played the week before the survey, and no statistically significant evidence was found to determine that those who play video games expect lower grades. This analysis led us to advocate for a new computer lab being built, and the popularity of different video game genres was analyzed to determine which games to install in the lab.

2. Basic Analysis

2.1. Data Processing

Methods:
The data was loaded with R. The cleaning of our data mainly pertained to identifying nonresponding survey participants in both the *VideoData* and *VideoMultiple* data sets, and removing the observations of participants that had not provided data for our variables of interest.

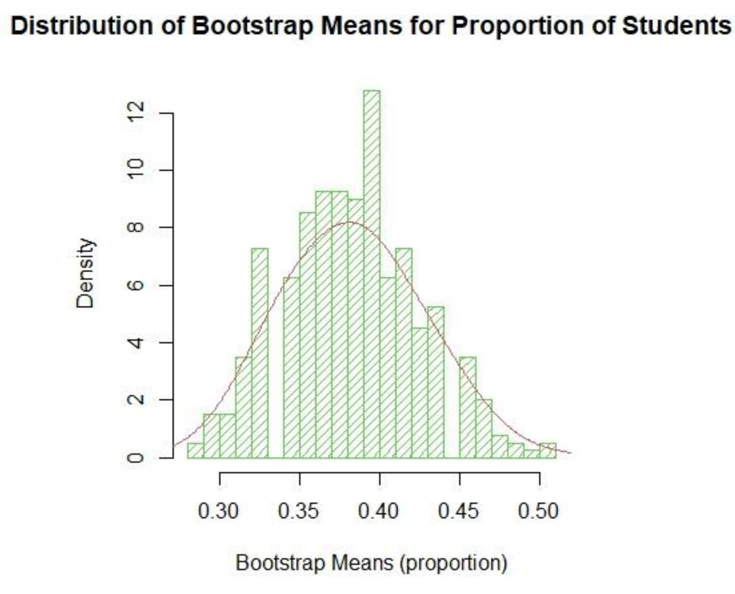
Analysis:
The *VideoData* and *VideoMultiple* data sets originally had 91 observations each. However, 4 participants did not respond to any of the questions in the *VideoMultiple* data set. Therefore, these observations were removed, resulting in 87 remaining observations in *VideoMultiple*. The observations of participants who did not respond to variables that were needed for portions of our analysis were also removed as deemed necessary.

Conclusion:
The removal of 4 observations in the *VideoMultiple* data set results in the loss of approximately 4% of our data in the set. However, this loss of data was unavoidable due to the nonrespondent nature of the observations. We were still able to perform thorough analysis with the remaining data.

2.2. Estimating the Fraction of Students who Play Video Games

Methods:
To estimate the fraction of students who played video games, we first chose to produce a bootstrap population from our sample of 91 respondents. We repeated this process 400 times, each time creating a sample with a student population of 314. To complete the point estimate, we simply found the mean of our bootstrap means, which would tell us the average fraction of students who played video games in the week before the exam. To create an interval estimate, we first had to prove the normality of our distribution of bootstrap means. To do this, we will utilize the Kolmogorov-Smirnov test, along with quantile-quantile plots. After proving that our distribution of bootstrap means is approximately normal, we can then compute a 95% confidence interval for the mean fraction of students who played video games in the week prior to the survey.

Analysis:
To begin, after creating the bootstrap population, we plot a histogram of the bootstrap means in order to provide a visual representation of the distribution.



In order to perform an interval estimate, we must prove that our distribution is approximately normal, so we perform a Kolmogorov-Smirnov test, and to visualize this concept we created a Q-Q plot (Appendix, Figure 1). We perform the Kolmogorov Smirnov test with a null hypothesis that the normal distribution is a good parent fit for our bootstrap means, and an alternative hypothesis that it is not a good fit for a parent distribution.The Kolmogorov Smirnov test provides a p-value of 0.1302.
To provide a point estimate for the average proportion of time spent playing video games, we find the mean of our bootstrap means, which tells us that approximately 38.27% of students

played video games in the week before the survey. Since approximate normality has been demonstrated, we perform a 95% confidence interval, calculated by using

$$(\bar{X} - z_{\alpha/2}\frac{s}{\sqrt{n}}, \bar{X} -+ \frac{s}{\sqrt{n}})$$

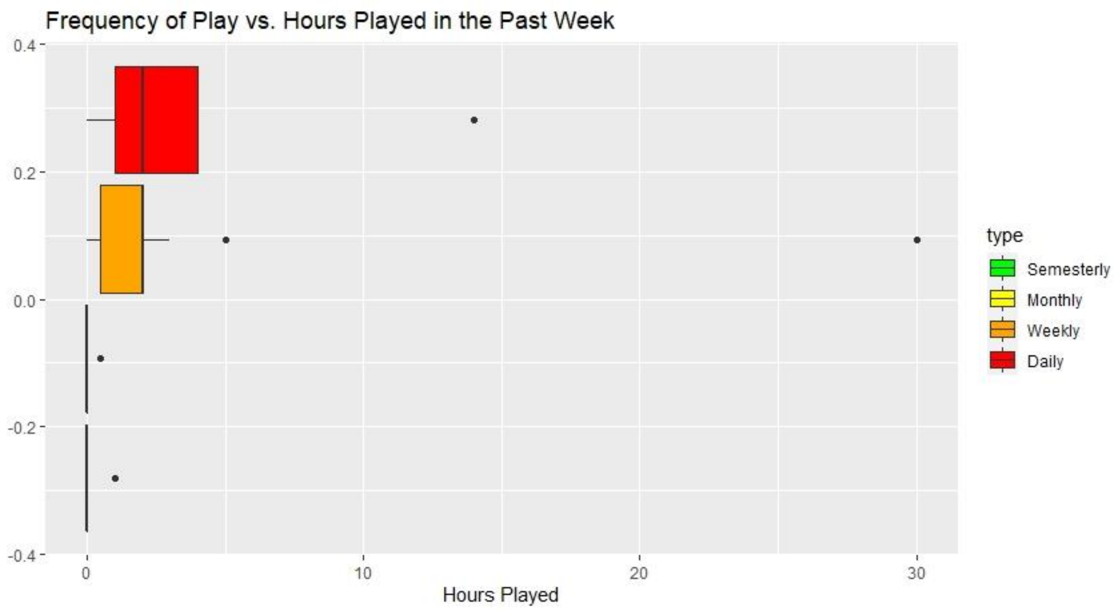
In addition to this, we perform another 95% confidence interval using a quantile estimate. Our results are: (0.3007985, 0.4645311), and (0.3076923, 0.4615385), respectively.

Conclusion:
It appears that approximately 38% of students played video games in the week before the survey was taken. This already shows a high frequency of video game usage. When testing for normality, The Kolmogorov Smirnov test provides a p-value of 0.1302, which is greater than our significance level $\alpha = 0.05$, and our Q-Q plot (Appendix) is similar to $y = x$, so we assume the parent distribution to be normal. Since the bootstrap means were approximately normal, we performed our two confidence interval tests. The similarity of the confidence intervals allows us to have stronger confidence in their accuracy. Again, analyzing the confidence intervals (0.3007985, 0.4645311), and (0.3076923, 0.4615385), along with the point estimate of 0.3827 allows us to conclude that a little less than half of the student population plays video games.

2.3. Comparing Frequency of Play to Time Spent Playing

Methods:
To begin, our objective was to compare the daily, weekly, monthly, and semesterly frequencies of playing video games compared to the number of hours played in the last week. We created a data frame for the different frequencies so that we could order the data properly and then visualize the different frequencies using a boxplot.

Analysis:
We present a visual comparison of the different frequencies of play as compared to the play reported in the week prior to the survey.



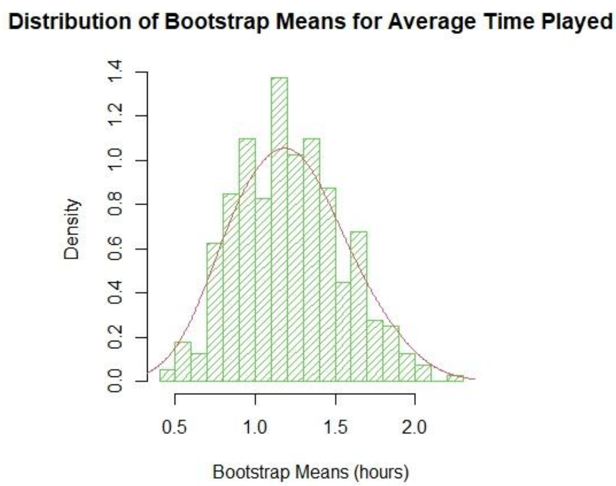
Conclusion:
Analysis of the different frequencies gives conclusions that are quite predictable. Those who play more frequently had the highest number of reported play hours in the last week, and this continued in decreasing order from the daily to the semesterly category. Both the weekly and daily column had extreme outliers, yet these were not significant enough to make changes to the general trend. Given the information that the survey was a week before the exam may have a strong influence on both this conclusion and the one for the last investigation. The effect is quite general, and should theoretically lower both the proportion of students who reported playing last week, which would decrease all of the hours in the frequency calculations. This creates an under-estimate for how much students truly play video games, because we assume that students who wish to perform better on the test will use discipline and either reduce their video game play time, or completely remove it from that week.

2.4. Estimating the Average Time Spent Playing Video Games

Methods:
To estimate the average amount of time spent playing video games, our methods are extremely similar to our estimation of the proportion of students who play video games. We perform the same bootstrap analysis with 400 repetitions that each create a sample with a student population of 314 students. The mean of each bootstrap was found, and the mean of all of those was found for the point estimate. A histogram was created to provide a visual representation of this data. Yet again, we tested the bootstrap mean distribution for normality using the Kolmogorov Smirnov test and a QQ plot with the Gaussian distribution. The distribution was proven to be

normal, and we found our 95% confidence interval estimate using the same two methods as for the first investigation.

Analysis:
We first plot our histogram of means of average amount of time played using our bootstrap method.



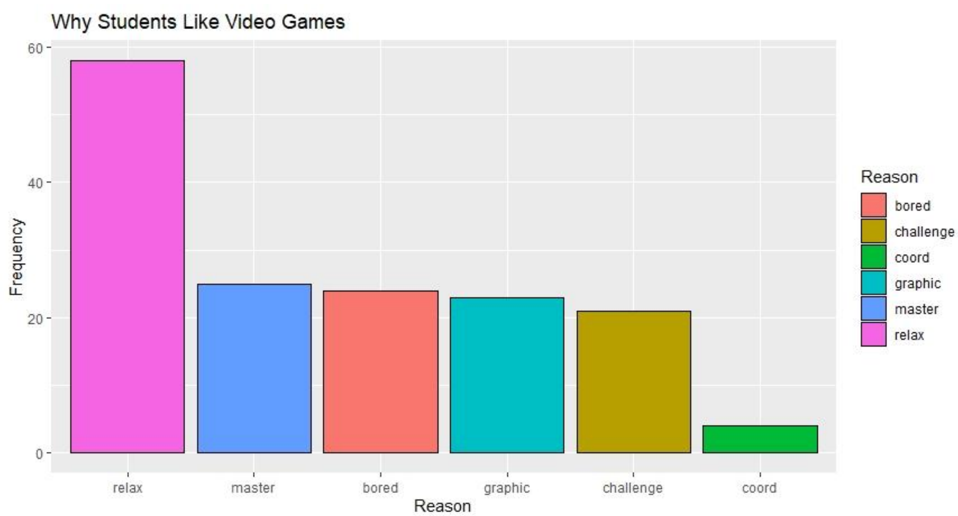
We perform the Kolmogorov Smirnov test, which gives a p-value of 0.1157, which greater than our α=0.05, and our Q-Q plot (Appendix, Figure 2) is quite similar to a straight line, so the distribution can be assumed to be approximately normal. After this, we find our interval estimate using both the quantile method, and the normal 95% confidence interval method. Our results are (0.6203846, 1.8803571), and (0.5795065, 1.8511913).
Our point estimate for the mean is done by taking the mean of the bootstrap means, with a value of 1.215349 hours spent playing video games each week.

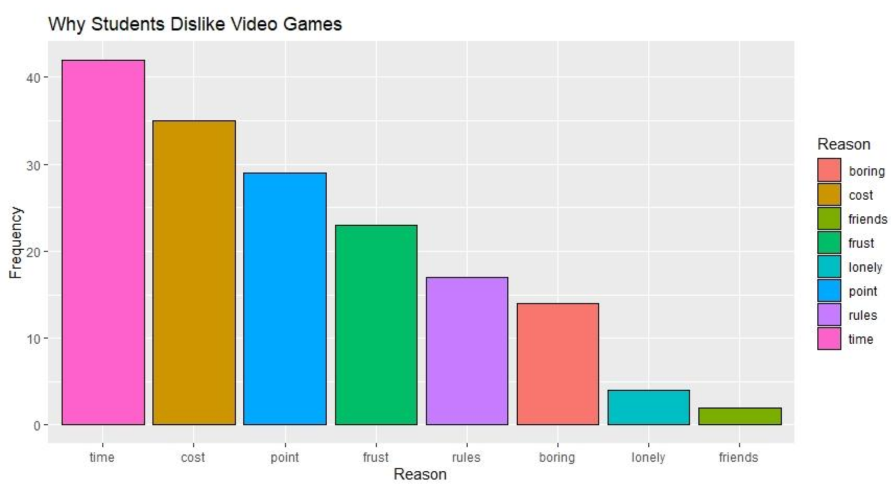
Conclusion:
The average amount of hours played in the week before the exam is approximated to be about 1.2 hours, which is 1 hour and 12 minutes. When we tested for normality, the QQ plot appeared to be similar to the line y=x, and the Kolmogorov Smirnov test showed a p-value of 0.1157, meaning we could conclude that our distribution of bootstrap means was approximately normal. The interval estimates were both quite similar, increasing our confidence in their accuracy, and gave a result of approximately 0.6 to 1.9 hours being played per week. This allows us to see that the average amount of time spent playing video games by students is quite low, and does not take up alot of their time during the week.

2.5. Analysis of Attitude towards Video Games

Methods:
To analyze the general attitude towards video games, we first compared the proportions of students who like and dislike video games, and then followed by demonstrating the different reasons why students like and dislike them with visual representations via histograms. In order to better estimate like vs dislike, we compressed the 5 survey responses into two different categories of like and dislike, and removed those that had never played video games.

Analysis:
To begin, we split the data and calculate the proportions of students who like and dislike video games: Our resulting proportions are:
Like: 0.7666667
Dislike: 0.2222222
We then plot the reasons that students like, and dislike video games in two separate histograms to see the primary reasons that students choose to play.



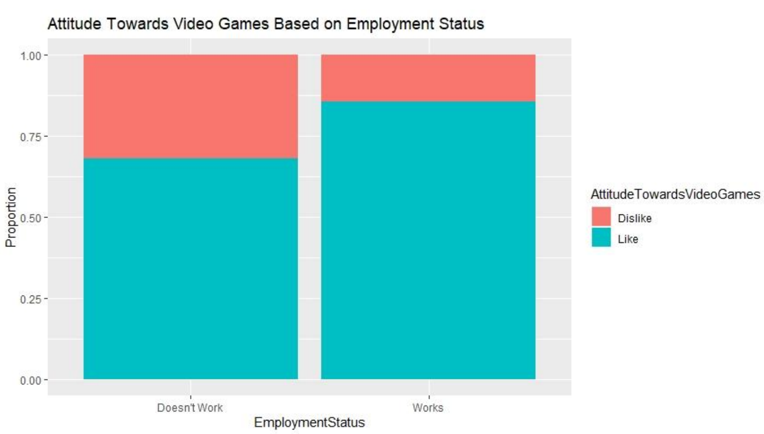


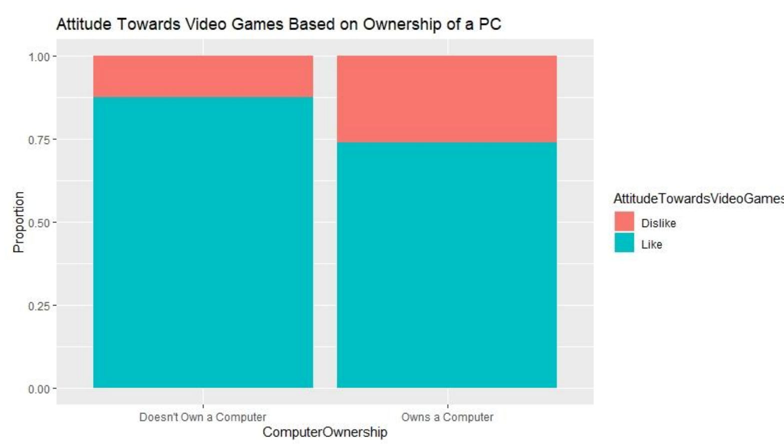
Conclusion:
It seems that the proportion of students who like to play video games is very high, and comprises about 77 percent of the student population. It also appears that the primary reason that students play video games is to relax, with the remaining reasons being quite evenly tied, and coordination being relatively insignificant. The primary reasons that students dislike video games is the amount of time they take, followed by the cost and the reason (which is most likely tied to time spent). The number of students who did not report a like or dislike is two, along with the four nonrespondents, but since this is less than 10% of our population, it is not a significantly large enough number to make us less confident in our estimates of attitudes towards video games.

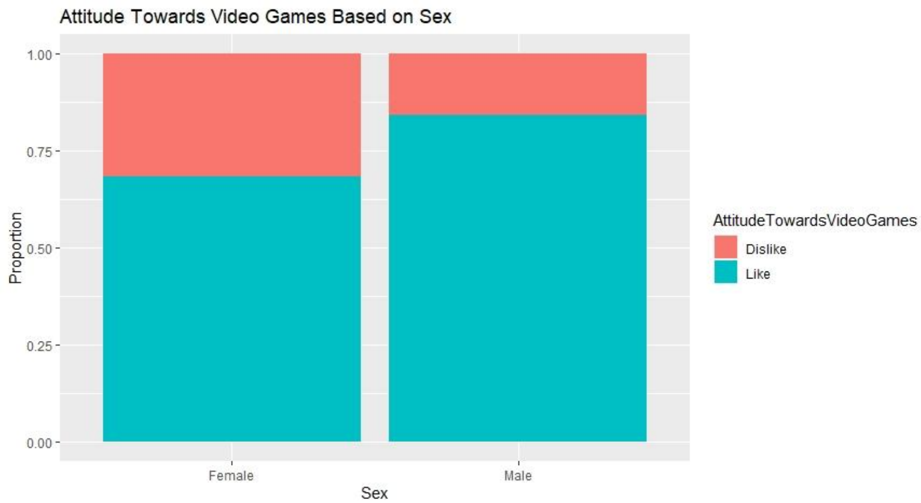
2.6. Differences Between Those who Play and don't Play Video Games

Methods:
We wish to analyze the differences between those who play and don't play video games. We used the data from our last investigation, and split responses to like and dislike. We then took the rest of the variables we wished to analyze, and turned them into binary variables to simplify analysis. After this, we plot stacked histograms of proportions of liking and disliking video games based on the variables of gender, employment status, and ownership of a computer. We do proportion significance tests on each of these variables in order to see if there is a statistical difference of liking and disliking video games.

Analysis:
We begin by plotting the three stacked histograms based on gender, employment status, and ownership of a computer.







After this, we conducted 2 sample tests for equality with proportions to determine whether or not there was a significant difference in proportions. The p-values for attitude towards video games based on employment status, computer ownership, and gender were 0.005438, 0.1708, and 0.07561, respectively.

Conclusion:

We observe that those who work prefer video games over those who don't, those who don't own a computer prefer them over those who do own a computer, and that men generally like video games more than women. Although the visual representations show differences, every single proportion test failed to fall below our $\alpha=0.05$ significance level. This means none of these variables offer a statistically significant difference in attitude towards video games, which further leads us to believe that most people enjoy video games regardless of their situation.

2.7. Comparing Expected and Target Grades

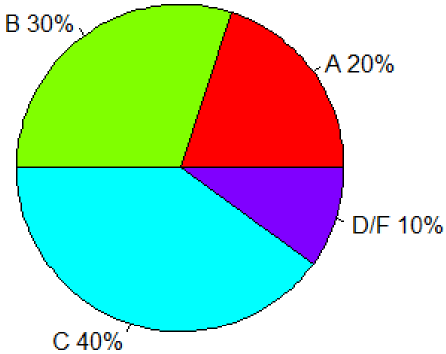
Methods:

In order to investigate the differences between the grades expected by the students, and the target distribution for the class, we first begin by finding the proportion of expected A's, B's, C's, and D's or lower for the class, and we perform a chi-square test to see how similar the two distributions are. We then factor in the four nonrespondents with the assumption that they are failing students (receiving a D or F), and perform a chi square test for this as well to observe similarities. We then visualize the target distribution, and the expected grades both with and without nonrespondents with pie charts for visual analysis.

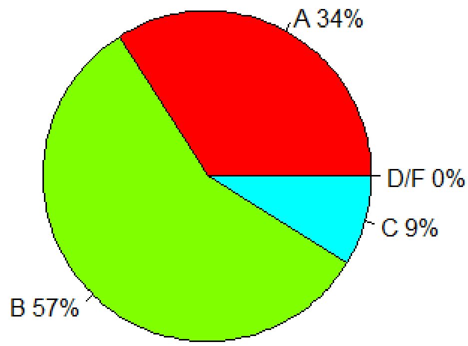
Analysis:

To begin, we show the pie charts, which are labeled with the percentages for each grade.

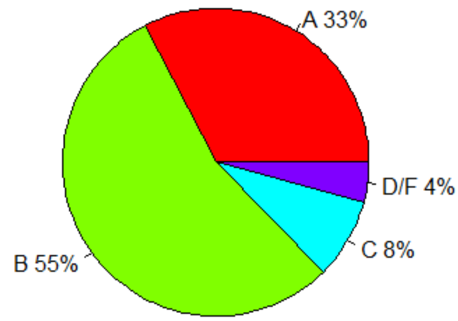
Target Distribution:



Expected:



Expected (With Nonrespondents):



We then perform our chi-squared tests for the expected grades, both with and without non respondents. The test against the target distribution without nonrespondents gives a p-value of 1.629e-13. The test with the nonrespondents factored in as failing students gives a p-value of 1.223e-11.

Conclusion:
To conclude, it seems that the students expect much higher grades than the target distribution for the class, which means many students are most likely headed towards disappointment. Visual analysis allows us to see that most students expect A's and B's, and the only students expecting to fail the class are the nonrespondents. The chi-square tests show that the distributions between both expected grades and the target grade distribution are extremely different, so we can conclude that students expect generally higher grades than the ones they will most likely receive.

3. Advanced Analysis

3.1 Searching for Effect of Video Games on Grade Expectation, Analysis of Popular Video Game Categories

Methods:
To continue our analysis, we wanted to see if we could provide a direct link between expected grades, and both or one of enjoyment and usage of video games. We used our previous binary variables of like and dislike, and found the proportions of students who like and dislike video games for each expected grade level (A,B,C,D/F). We performed the same comparison again, this time using those students who reported playing video games in the week before the exams. We wanted to see if there was a significantly detrimental effect on grade expectations based on whether or not students liked/played video games, so we performed chi-square tests against a uniform distribution of grade expectations based on the previous percentages of students who

liked and played video games. In addition, we were curious to see which video game genres students preferred, so we created a histogram of the different genres.

Analysis:

To begin, we start with analyzing the relationship between students who like video games, and their expected grades. According to prior calculations, we found that roughly 77% of students like video games. We first created a proportion table, and then we performed a chi-square test comparing the observed values to the idea that in each grade category, 77% of the students like video games. The values were calculated based on observed grade category size.

Observed Values:

	Dislike	Like
A	1	7
B	13	38
C	6	25

Proportion Table:

	Dislike	Like
A	0.1250000	0.8750000
B	0.2549020	0.7450980
C	0.1935484	0.8064516

```
        Chi-squared test for given probabilities

data:  c(7, 1, 38, 13, 25, 6)
X-squared = 0.84348, df = 5, p-value = 0.9742
```

The proportions seem quite similar to the expected uniform proportion of 77% for each category, and the extremely high p-value means that the two distributions are far from significantly different. We repeat the same steps for students who played/did not play.

Observed Values:

	Didn't Play	Played
A	7	1
B	35	17
C	15	16

Proportion Table:

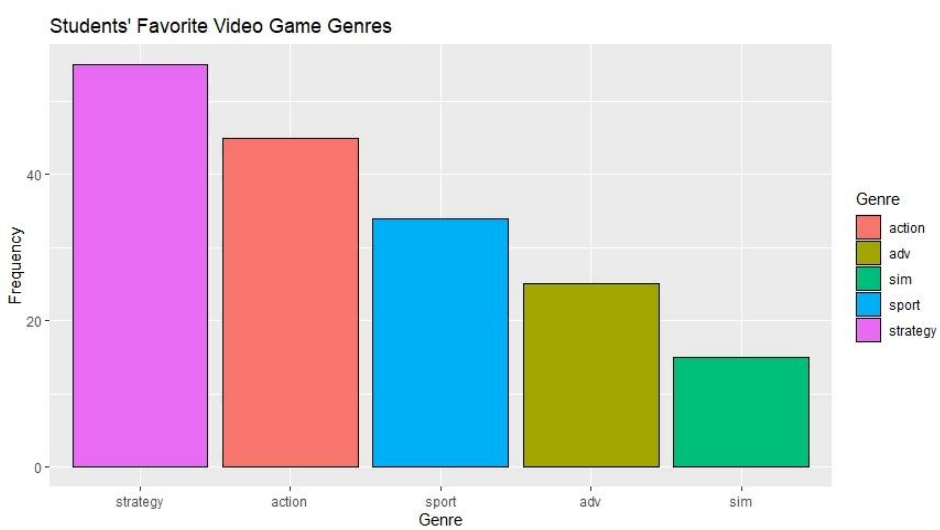
	Didn't Play	Played
A	0.8750000	0.1250000
B	0.6730769	0.3269231
C	0.4838710	0.5161290

```
        Chi-squared test for given probabilities

data:  c(1, 7, 17, 35, 16, 15)
X-squared = 5.2727, df = 5, p-value = 0.3835
```

Analysis of the proportions by eye shows that students who played video games expected lower grades, but the chi-square tests proves that the magnitude of this observation is of no statistical significance.

In addition to this, we create the histogram of video game genres that students prefer.



Conclusion:
The results of our advanced analysis support the conclusion that the grades that students expect are not lowered by them liking or playing video games. Although the ones who play showed a trend of expecting slightly lower grades, both the like and play variables did not have significant differences from the theoretical distributions in which they have no effect on the grade the student expects. In addition to this, it was found that the most popular genres of video games are strategy and action, meaning that if a computer lab were to be built, it should contain primarily those, with the other genres of sport, adventure, and simulation in descending order afterwards.

4. Discussion and Conclusion

The goal of this study was to determine the impact of video games, the extent to which they are played, and students' attitude towards them in order to provide useful information to the developers who are deciding whether or not to build a computer lab which would allow access to video games on the campus of the university. To begin, we analyzed some general facts about how prevalent video games are, finding that 38% of students reported playing them in the week before the survey, and that 77% of students say they enjoy them. The average time spent playing video games in a week was found to be roughly one hour and twelve minutes, which seems low but is influenced by the fact that some students reported only playing once a month or once a semester. Students tend to generally use video games as a way of relaxation, but their largest concern is the amount of their time that is taken up while playing them. It appeared that factors such as gender, computer ownership, and employment had no statistical influence on the enjoyment of video games, and the trend was consistent that most students used them as a fun way to relax.

In addition to this, we were given a target distribution of grading for the class. We performed analysis on the grades that students expected to receive in the class, and found that they were drastically different from the target distribution for the class. While this does not seem like a particularly useful statistic in our case, the grade data was extremely helpful in helping us determine that there was no statistically significant difference in expected grades between those who played and liked video games, and those who did not. Because of this, we advocate for the building of a computer lab on campus, that is primarily filled with video games in the strategy genre, because this appears to be the most popular one among the students. While some may argue that it may be detrimental to the education of the students, we disagree for multiple reasons. While 77% of students reported liking them, only 38% reported playing them in the week before the survey, and this was because of a test that was coming up. In addition to this, most students simply use them as a way to relax, and actually worry about how much time they take up. In addition to this, other studies, such as "More Than Just Fun and Games: The Longitudinal Relationships Between Strategic Video Games, Self-Reported Problem Solving Skills, and Academic Grades" done by Paul J. C. Adachi, and Teena Willoughby, have performed similar experiments and surveys, and concluded that strategy based video games are beneficial to both problem solving skills and grades in school. Concluding with the fact that video games do not appear to be detrimental to grade expectation in this particular instance, it appears that building a computer lab on campus would not hurt their academics, but simply make something that most of them enjoy more readily available to them.

That said, there is much room for improvement, and future research could be done to solidify this claim. Our data has a number of notable limitations, and confounding variables, which may have had some influence on our results. To begin, the events of the survey take place a week before an exam, which most likely skewed the proportion of students that play significantly. In addition to this, the survey was conducted in a statistics course in a high level university. Those who are studying such a subject and attend such a prestigious institution most likely are both more technologically inclined and more likely to have easy access to computers. Finally, we were only given the students expected grades, which often correlate quite strongly to their received grades, but are still an entirely subjective statistic, and often do not give an accurate scope of a student's actual academics. A study could be performed after the completion of the class, which would allow us to see if our decision that video games do not have significant detrimental effects on education was correct. More research could also be done on to what extent video games influence the average college student, and what types of games could be most beneficial to their academic success.

5. Work Cited

1. Adachi, P.J.C., Willoughby, T. More Than Just Fun and Games: The Longitudinal Relationships Between Strategic Video Games, Self-Reported Problem Solving Skills, and Academic Grades. *J Youth Adolescence* 42, 1041–1052 (2013). https://doi.org/10.1007/s10964-013-9913-9

6. Appendix

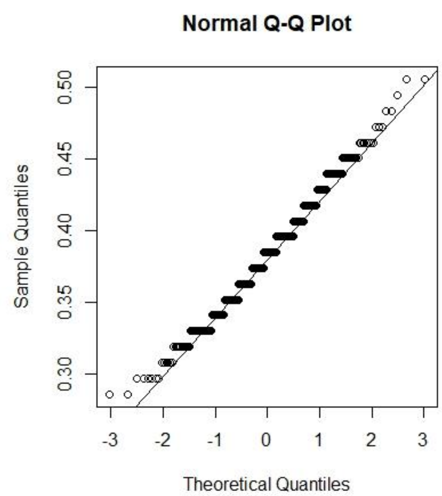


Figure 1: Q-Q Plot comparing the distribution of bootstrapped "proportion of students who play" means against a Gaussian distribution.

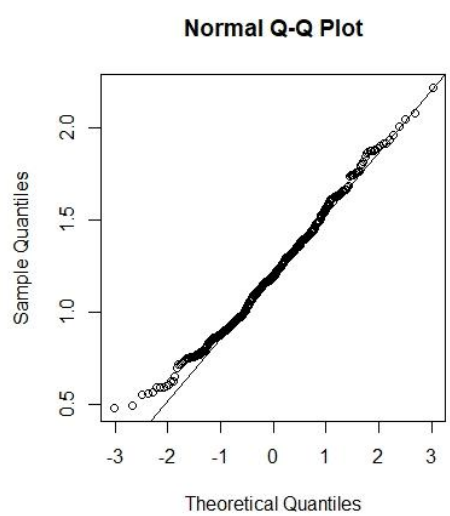


Figure 2: Q-Q Plot comparing the distribution of bootstrapped "average time played" means against a Gaussian distribution.