An Explanation of College Grade Point Average Variation

Connor Daly
Fairfield University
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I. Abstract

This paper aims to analyze the relationships between grade point averages (GPAs) and particular habits and demographics of college students. The data used in this analysis comes from a sample of 116 Fairfield University undergraduate students who voluntarily partook in a survey. The quantitative variables included in the dataset are students' cumulative GPAs, Scholastic Aptitude Test (SAT) scores, average number of hours spent sleeping per night, average number of hours spent studying per day, average number of classes skipped per month, and average number of alcoholic drinks consumed per week. The qualitative variables studied include the students' genders, years at Fairfield (i.e. freshman, sophomore, junior, or senior), whether or not the students are varsity athletes, whether or not the students pursue double majors, and the schools in which the students study at Fairfield (i.e. college of arts and sciences, school of business, school of engineering, or school of nursing). From a regression analysis, it is concluded that some of these variables affect student GPAs. Specifically, SAT scores are found to positively impact student GPAs, while gender, field of study, and number of classes skipped per month are found to negatively affect student GPAs.

Keywords: Grade point averages · College students · Study habits · Sleeping habits · Fairfield University · SAT scores · Athletes

JEL Classification: C12 · C21 · I26

II. Introduction

The college experience is unlike that of any other part of an individual's life. Specifically, undergraduate students spend every minute of every day surrounded by some of their closest friends, which is why many refer to college as the most social period of one's life. Although all students attend college in order to graduate with a degree and consequently obtain an impactful and sufficiently paying job, it is inevitable that this novel experience affects students' overall lifestyles and habits. For example, students may get to college and begin prioritizing the social piece of school instead of the academic side. On the other hand, students may feel more pressure to perform well academically than they felt in high school, given that they or their families now pay thousands of dollars for them to receive a meaningful education.

For better or for worse, students' lives drastically change when they enter college, and much research has been done regarding how one is able to predict success in college for a given student. Kobrin, Patterson, Shaw, Mattern and Barbuti (2008), who are research scientists for College Board, have found that students SAT scores and high school GPAs are the two best indicators in predicting student success at the college level. One may speculate that this is because of the great degree of adjustment that college freshmen undergo. Because all freshmen are exposed to the same new set of experiences, nobody has a firm grasp of how to manage college life immediately.

Therefore, students' first semester GPAs and inherent intelligence levels are likely correlated because there is a tremendous amount of variation in the study habits of college freshmen. Some freshmen study any chance they get, while other students wait it out to see if studying is actually necessary in college, as they may have scraped by high

school with minimal study habits. Consequently, because it is difficult to predict how much and/or how well a particular student will study when he or she enters the novel college setting, it is likely that first semester GPAs will highly reflect one's natural intelligence. Since natural intelligence levels can be measured through SAT scores or high school GPAs, it makes sense that these are two of the most accurate variables when predicting academic performance in college.

Habits that students pick up as they progress through college have also been shown to impact student GPAs. Particularly, college students are notorious for partaking in alcohol consumption during their college years. Despite only being of legal drinking age for about one third of their college years, many students pick up the habit of drinking while in college. Pritchard and Wilson (2003) have done significant research about social and emotional factors affecting college grade point averages. They found that such factors, particularly the frequency at which alcohol is consumed in college is highly (negatively) correlated with GPAs. Pritchard and Wilson argue that the conventional variables account for some of the variation in academic success, but they certainly do not completely explain the variation. These authors proceed to state that there is minimal existing research regarding the relationship of college students' emotional and social well-being with their academic success, which prompted them to investigate further.

In addition to exploring habits and rituals that impact grade point averages of college students, this paper also aims to analyze the grade point averages of various demographics of students. Some hypothesize that student athletes have better time management skills and consequently earn higher GPAs than those who are not collegiate athletes. Additionally, one can speculate that the GPA of one gender, on average, is

greater than that of the other gender. Finally, one may theorize that students who pursue a double major in college are more motivated than those pursuing the conventional single major, and consequently earn higher GPAs. On the other hand, the double major students likely have a significantly higher workload than the single major student, thus prohibiting one's high degree of motivation from having a positive effect on his or her grade point average. Therefore, the aforementioned qualitative variables are used in this regression analysis, and are investigated through the use of dummy variables.

When interpreting grade point averages, we must err on the side of caution. That is , self-reported grade point averages are subject to imperfect storage and retrieval from memory, so it is inevitable that some individuals unknowingly report inaccurate grade point averages. Moreover, according to Kobrin, Patterson, Shaw, Mattern and Barbuti (2008), it is likely that some students knowingly inflate their grade point averages in such surveys, which is a bigger issue than the former. Although one's grade point average may be statistically low, the student may report a greater value in order to reflect what he or she believes to be his or her true capability or skill level. Therefore, we must take the self-reported grade point averages in this data into account when determining any margins of error.

III. Theoretical Framework

This analysis attempts to estimate the grade point averages of college students. It attempts to use factors of student life associated with college experiences to define relationships between such factors and respective grade point averages. The goal in doing so is to more precisely determine the factors that affect student GPAs either positively or negatively. Additionally, this paper aims to make sense of previous theories regarding such topics. Through a regression analysis, a goal of this paper is to either support or refute previous theories regarding relationships between grade point averages of college students and explanatory variables such as sleep, alcohol consumption, SAT scores, and others. This will hopefully provide readers with a better notion of predicting an individual's success in college, and provide the empirical evidence to help guide college students into making more appropriate decisions in order to better ensure academic success.

I hypothesize that only a few of the aforementioned variables will be statistically significant explanatory factors in respective grade point averages. Specifically, I hypothesize that there will be a positive relationship between grade point averages and the number of hours that students study per day, as well as the amount of sleep that students receive on average per night. I also hypothesize that the amount of alcohol students report consuming per week will be negatively correlated with the respective students' GPAs. Also, based on my conducted research, I believe that higher SAT scores will positively correlate to college grade point averages. Finally, I hypothesize that students pursuing a double major will, on average, have higher GPAs than do those students pursuing a single major. Therefore, my estimated model is as follows:

$$GPA = \beta_0 + \beta_1 \cdot Study + \beta_2 \cdot Sleep + \beta_3 \cdot Drinks + \beta_4 \cdot SAT + \beta_5 \cdot Double\_Major,$$

where β_1, β_2, β_4, and β_5 are positive and β_3 is negative.

My personal hypotheses are merely based off of my experience as an undergraduate student at Fairfield University. It is important to note that the data all comes from students at the same university. Therefore, one must use caution in extending the findings of this paper to the college population of a whole or to that of any other specific college or university.

IV. Data

The data used in the regression analysis for the purposes of this paper come from a survey of 116 undergraduate students at Fairfield University taken in April 2016. The surveyed variables and their respective units are summarized in the following table.

Table 1: Variables and Units

Variable	Units
Gender	Male or female
Year at Fairfield	Freshman, sophomore, junior, or senior
School at Fairfield	College of arts & sciences, school of business, school of engineering, school of nursing
Double major	Yes or no
Varsity athlete	Yes or no
Cumulative GPA	0.00 – 4.00
Sleep	Average number of hours per night
Studying	Average number of hours per day
Alcohol	Average number of drinks consumed per week
SAT score	0 – 2400
SAT_by100*	SAT score / 100

*This variable is used in the regressions to omit unnecessary decimal places, consequently simplifying the physical appearance of the coefficient estimators

Additionally, descriptive statistics of these variables are summarized in the following two tables.

Table 2: Qualitative Variables

Variable	Percentage
Male	34.5%
Female	65.5%
Freshman	37.9%
Sophomore	22.4%
Junior	6.0%
Senior	33.6%
Arts & Sciences	40.5%
Business	38.8%
Engineering	8.6%
Nursing	12.1%
Single Major	88.8%
Double Major	11.2%

Athlete	20.7%
Non-athlete	79.3%

Table 3: Quantitative Variables

Variable	Mean	Std. Deviation	Minimum	Maximum
GPA	3.41	0.40	2.16	4.00
Sleep	7.11	1.03	4.5	10
Studying	3.25	1.96	0	8
Alcohol	11.2	9.83	0	60
SAT score	1759	203.5	1170	2170

As a whole, the qualitative variables appear to be consistent with the ratios of the entire Fairfield University population. The only piece of data that inaccurately represents the Fairfield undergraduate population is the percentage of juniors. Only 7 juniors (out of 116 total participants) partook in this survey, primarily due to a limited presence of juniors in the area in which I conducted the survey. Despite having a slightly inaccurate proportion of people per year at Fairfield included in my data, I do not expect that this will have any significant impact on the overall findings of the analysis.

V. Estimation

Regression 1

In performing regression analysis, the hypothesized regression was first estimated. Again, the hypothesized regression was as follows:

$$GPA = \beta_0 + \beta_1 \cdot Study + \beta_2 \cdot Sleep + \beta_3 \cdot Drinks + \beta_4 \cdot SAT\_by100 + \beta_5 \cdot Double\_Major$$

*(SAT has been replaced with SAT_by100 for simplification purposes)

Stata yielded the following estimated model and regression output:

$$GPA = 1.80 + 0.042Study + 0.026Sleep - 0.0001Drinks + 0.072SAT\_by100 + 0.117Double\_Major$$

Source	SS	df	MS	Number of obs	=	116
				F(5, 110)	=	5.46
Model	3.64120736	5	.728241471	Prob > F	=	0.0002
Residual	14.6593479	110	.133266799	R-squared	=	0.1990
				Adj R-squared	=	0.1626
Total	18.3005553	115	.159135263	Root MSE	=	.36506

GPA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
study	.0422097	.0180215	2.34	0.021	.0064953	.077924
sleep	.0257903	.0337522	0.76	0.446	-.0410986	.0926793
drinks	-.0001047	.0036006	-0.03	0.977	-.0072401	.0070308
SAT_by100	.0721616	.0171138	4.22	0.000	.0382461	.1060771
double_major	.1168457	.1082466	1.08	0.283	-.0976737	.331365
_cons	1.804917	.4183883	4.31	0.000	.9757693	2.634064

From these results, the hypothesis appears largely inaccurate. The only two statistically significant variables in the model are study time and SAT scores. The p-value for SAT scores is effectively 0 to three decimal places, which does support previous research that has shown SAT scores to be a very effective indicator of college grade point averages. From this regression, it appears that the amount of sleep a student receives, as well as the amount of alcohol he or she consumes, does not have a significant impact on the

respective student's GPA. Additionally, there is no statistically significant difference between the grade point averages of college students pursuing double majors and those pursuing a single major.

Regression 2

In order to better this model, sleep time and double major are omitted, while classes skipped and gender are now included as explanatory variables. The new yielded estimation and regression output are as follows.

$$GPA = 2.21 + 0.023 \cdot Study + 0.003 \cdot Drinks + 0.069 \cdot SAT\_by100 - 0.048 \cdot Skipped - 0.17 \cdot Male$$

Source	SS	df	MS	Number of obs	=	116
				F(5, 110)	=	9.03
Model	5.32738281	5	1.06547656	Prob > F	=	0.0000
Residual	12.9731725	110	.117937932	R-squared	=	0.2911
				Adj R-squared	=	0.2589
Total	18.3005553	115	.159135263	Root MSE	=	.34342

GPA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
study	.0231216	.017542	1.32	0.190	-.0116426	.0578858
drinks	.0028139	.0034976	0.80	0.423	-.0041175	.0097453
SAT_by100	.0693795	.0159833	4.34	0.000	.0377042	.1010547
skipped	-.0479287	.018137	-2.64	0.009	-.0838719	-.0119855
male	-.1666466	.0737421	-2.26	0.026	-.3127861	-.020507
_cons	2.210239	.2972364	7.44	0.000	1.621186	2.799291

From this estimation, all but two variables are statistically significant at the 10% level, those two being study time and alcohol consumption. SAT scores, classes skipped, and gender are all statistically significant independent variables, with the highest p-value being that for gender of 0.026.

Regression 3

The following model estimation consists of all statistically significant variables.

$$GPA = 2.17 + 0.070 \cdot SAT\_by100 - 0.062 \cdot Skipped - 0.17 \cdot Male + 0.175 \cdot AS + 0.20 \cdot DSB$$

Source	SS	df	MS	Number of obs	=	116
				F(5, 110)	=	10.05
Model	5.73961133	5	1.14792227	Prob > F	=	0.0000
Residual	12.560944	110	.1141904	R-squared	=	0.3136
				Adj R-squared	=	0.2824
Total	18.3005553	115	.159135263	Root MSE	=	.33792

GPA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SAT_by100	.0702176	.0156019	4.50	0.000	.0392983	.1011369
skipped	-.062479	.0180103	-3.47	0.001	-.0981711	-.0267869
male	-.1659244	.070239	-2.36	0.020	-.3051215	-.0267272
as	.1752043	.0855361	2.05	0.043	.0056917	.3447168
dsb	.20438	.0892155	2.29	0.024	.0275759	.3811841
_cons	2.173806	.2865911	7.59	0.000	1.60585	2.741762

At the 5% level, every included variable in this model is statistically significant. Therefore, with the collected data and given sample of Fairfield University undergraduate students, this model will be referred to in the following sections of this paper.

There were no extreme outliers obtained from the survey of 116 Fairfield University students. Perhaps surprisingly, there were no reported grade point averages of less than 2.16. As mentioned in the introduction section of this paper, it is likely that there may have been a small number of lower GPAs, but the students inflated their GPAs to reflect their believed true capabilities. Additionally, the surveys were given out to groups of students at a time, so a student may not have felt comfortable reporting an abnormally low GPA in front of their friends. Therefore, it is possible that the intercept of this model (2.17) is positively biased.

Although the number of drinks that students report consuming per week does not have a statistically significant impact on their grade point averages, the frequency at which they drink may very likely have an impact. Although these two variables seem to

be one in the same, they are actually very different. The magnitude and frequency may correlate with one another or not. Additionally, the magnitude of alcohol consumption may stay the same throughout college, but the frequency at which one drinks as he or she becomes older may increase. Therefore, there may be omitted variable bias present in this estimated model. The omission of drinking frequency as a variable in this model increases the model's degrees of freedom. As a result of an increase in degrees of freedom, the coefficient estimators remain unbiased and consistent, but the t-values become too large. This then makes it easier to find statistical significance when using hypothesis testing than it should be in actuality.

VI. Discussion

As previously stated, all coefficients from regression 3 are statistically significant at the 3% level. Therefore, from this regression we can conclude that SAT scores, tendency of students to skip class, gender, and the schools in which students study at Fairfield all have statistically significant effects on students' grade point averages. The dummy variables for students in the college of arts & sciences and school of business are included in the model, but those for students in the school of engineering and school of nursing are not. This is because of the nature of the sample, and actually because of the nature of the school population as well. Because there are many more students enrolled in the college of arts & sciences and school of business than there are students enrolled in engineering or nursing at Fairfield, the sample data showed a similar ratio. Therefore, we have an insufficient number of observations of engineering and nursing students, which increases the variance of the respective coefficients. Thus, the intercepts of GPAs for engineering and nursing students cannot be estimated at a significant level. It is important to note that when interpreting the coefficients of AS and DSB, the comparison group is the combination of all nursing and engineering majors who participated in this survey. This benchmark consisted of 20.7% of the surveyed individuals.

Additionally, through a regression analysis it is found that females have, on average, a grade point average that is 0.17 greater than that of the average male at Fairfield University. Perhaps this is just coincidence arising from the nature of the sample and school population that over 60% of observations are female. It may be the case that a larger sample would yield a closer margin between the average grade point

averages of students at Fairfield University, since there would then be more observations of both males and females.

As seen in regressions 1 and 2, respectively, it is interesting to note that the number of hours of sleep, as well as the number of hours studied, reported by students does not have a statistically significant effect on grade point averages. It is a bit easier to make sense of the sleeping outcome than it is to make sense out of the latter. This is because the standard deviation of average number of hours reportedly slept per night is fairly low at 1.03. With the average number of hours of sleep reported per night being 7.11, 95% of students report sleeping between 6.08 and 8.14 hours per night. From my college experience at Fairfield, I can attest that the vast majority of my friends and peers fall within this range. Therefore, since just about all students at Fairfield sleep relatively near the same number of hours per night on average, it makes intuitive sense that the amount of sleep one gets does not significantly affect his or her grade point average.

The fact that study time does not have a significant impact on one's grade point average is a bit less intuitive. As previously mentioned in this paper, one can theorize that it is the quality of one's studying, rather than its quantity, that truly affects one's academic performance and consequently his or her GPA. Although the amount of sleep and the amount of studying that students report are not found to be significant factors in determine GPAs, it is interesting to note the insignificance of their findings. As much as people harp on receiving adequate sleep to perform well in school, there may actually not exist any relationship there whatsoever.

VII. Conclusion

Analyzing the factors that affect grade point averages in college, I hypothesized that studying more, sleeping more, higher SAT scores, and the pursuit of a double major would all have positive relationships with grade point averages, while the amount that students drink would have a negative relationship with GPAs. In no run regression (even those not presented in this paper) did I find that sleep is positively correlated with grade point averages, which was one of the most surprising results of my analysis. As previous research has indicated, I, too, found that SAT scores are positively correlated with college grade point averages. Additionally, I found that females at Fairfield University have a statistically higher GPA, on average, than do male students, and students who are enrolled in the college of arts & sciences and the school of business at Fairfield all have statistically higher GPAs than do students enrolled in nursing or engineering programs.

For further research, I would recommend using a more detailed survey when collecting data. That is, break down this analysis by particular major (which would require a much bigger sample) and obtain more detailed data on alcohol consumption. There is a big difference between frequency and magnitude of alcohol consumption, and these two variables likely have different effects on GPAs. Doing so would remove any omitted variable bias in this aspect from the presented results in this paper.

VIII. References

Bridgeman, McCamley-Jenkins, Ervin (2000). "Predictions of Freshman Grade-Point Average From the Revised and Recentered SAT I: Reasoning Test". http://onlinelibrary.wiley.com/doi/10.1002/j.2333-8504.2000.tb01824.x/epdf.

Plant, Ericsson, Hill, Asberg (2004). "Why study time does not predict grade point average across college students: Implications of deliberate practice for academic performance." http://www.sciencedirect.com/science/article/pii/S0361476X04000384

Kobrin, Patterson, Shaw, Mattern, Barbuti (2008). "Validity of the SAT Predicting First Year College Grade Point Average." https://research.collegeboard.org/sites/default/files/publications/2012/7/researchreport-2008-5-validity-sat-predicting-first-year-college-grade-point-average.pdf.

Kuncel, Crede, Thomas (2005). "The Validity of Self-Reported Grade Point Averages, Class Ranks, and Test Scores: A Meta-Analysis and Review of Literature." http://rer.sagepub.com/content/75/1/63.full.pdf+html.