The Relation between GPA and Financial Need, Standardized Test Scores, First Generation, and Ethnicity

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Executive Summary

One problem with considering the relation between a single variable, such as financial need, and GPA is that those single variables are often correlated with other variables such as ethnicity, first-generation status, and standardized test scores, which are also related to GPA. The correlation among those variables is problematic because it becomes difficult to know how much each variable individually contributes to GPA. This report examines the relative contribution of standardized test scores, financial need, first-generation status, and ethnicity to cumulative grade point average. The estimates reflect the unique contribution of each variable, permitting consideration of the relative size of each effect independent of the others. Records of over 6,000 students who matriculated from 2005 to 2016 are considered. The analysis indicates that each of the above factors significantly contributes to GPA, but sometimes in unexpected ways. The strongest relation was observed for standardized test scores. For every 100-point increase (on the 800-point scale of one part of the SAT), GPA increased 0.23 points [although see below for an exception for Black students]. First Generation status lowered GPA by 0.12 points [although see below for an exception for Asian students]. Ethnicity also played a role, with GPAs 0.2 lower for Black students, 0.12 lower for Hispanic students, and 0.08 lower for Asian students. Student financial need (measured as the percent of the total cost of attendance not covered by their expected family contribution) had only a small contribution: 0.05 GPA points lower across the entire range of percent need (0 to 1).

Estimating the Relation of Predictors to GPA

Table 1 below shows the regression coefficients from a linear model predicting GPA [1]. These coefficients represent the change in GPA for each unit in the "unit" column. They are presented in order of descending absolute value.

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[1] This model was selected from a two-stage process of 1) using a stepwise selection procedure to find the best combination of main effects and two-way interactions from among the predictor set percent need, SAT, first generation, Asian, Black, and Hispanic; 2) using Repeated K-Fold Cross Validation to test that model on many subsamples of the data, which produces less biased regression estimates and reduces the risk of effects due to extreme values. Regression was conducted after mean-centering SAT and percent need to

Table 1: Estimated Effect of Each Predictor on GPA

GPA	unit
+0.23	Every 100-point increase in mean SAT
-0.2	Black
+0.15	Both Asian and First Gen
-0.12	Hispanic
-0.12	First Generation
-0.1	Every 100-point increase in mean SAT for Black students
-0.08	Asian
-0.05	0% vs. 100% difference in percent need

Ethnicity

Black, Hispanic, and Asian ethnicity are each related to lower GPA. Black students had a GPA that was 0.2 points lower than average, Hispanic students a GPA that was 0.12 points lower, and Asian students a GPA that was 0.08 points lower.

First Generation

First generation status was related to a GPA reduction of 0.12 points. One interesting exception to this pattern is among students who are both first-generation and Asian. For those two predictors, we would expect a decline in GPA of 0.2 points. However, there was a significant interaction between Asian ethnicity and first-generation status such that 0.15 points are added back. Thus, the predicted GPA reduction for first-generation Asian students is only 0.05 points and is thus no different from the reduction expected for Asian ethnicity alone. For Asian students, first-generation status does not appear to be negatively related to GPA.

SAT

As described below in the "Data" section, ACT and SAT standardized test scores were converted to the post-2016 SAT metric and are in units of a single 800-point test. The regression coefficient in Table 1 for SAT indicates that for every 100-point increase in SAT, GPA increases 0.23 points. So, a student with an SAT of 750 would be expected to have a GPA that is 0.23 points higher than a student with an SAT of 650. One exception to this pattern is for Black students, for whom there was an interaction with SAT. The 0.23 gain in GPA for every 100 SAT points is reduced by 0.1 for Black students, resulting in a gain of only 0.13 for every 100 SAT points for Black students.

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reduce collinearity with interaction effects. The coefficients in the table are the means from the models estimated for each subsample.

Percent Need

After considering the other predictors in the model, the difference in GPA between a student with a Percent Need of 0 (no need) and 1 (100% need) is only 0.05. This is surprising given the strong relationship between percent need and GPA observed in earlier research. Figure 1 below shows the original strong relationship between percent need and cumulative GPA with the blue line (a moving average). The red line shows the relationship between percent need and cumulative GPA after adjusting GPA[2] for the factors in Table 1. The solid line is a moving average and the dotted line is a linear model that reflects the 0.05 regression coefficient.

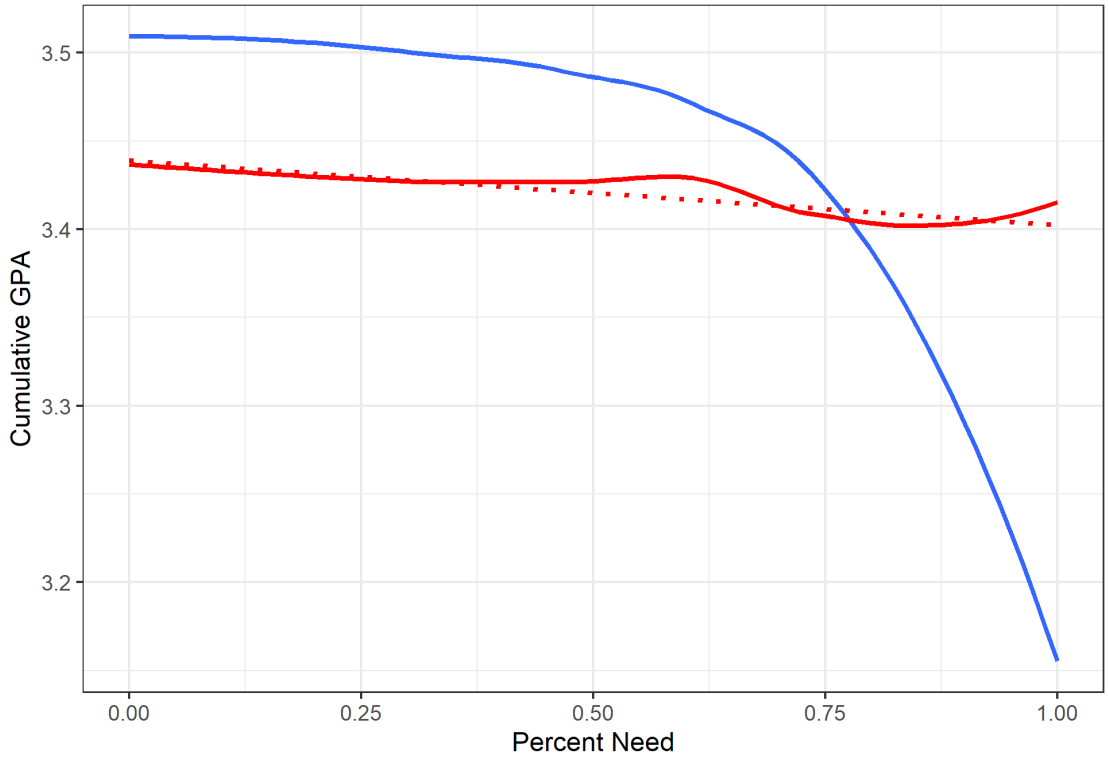

Figure 1: Actual GPA (blue) and GPA Adjusted for Ethnicity, SAT, and First Generation (red), by Percent Need

Figure 1 shows that, after adjusting for SAT, ethnicity, and first generation status, the severe downward trend in GPA after a percent need of 0.8 has been almost completely

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[2] This adjustment was estimated as the difference between actual GPA and a predicted value calculated using a mean-centered GPA. A model using a mean-centered GPA produces predicted values centered at 0, with positive values indicating points to be added to the mean in making a prediction, and negative values indicating points to be subtracted from the mean. By taking the difference between actual GPA and this predicted value, the actual value is adjusted upward by the amount predicted to be a handicap for a student, and adjusted downward by the amount predicted to be an advantage for the student.

eliminated. This suggests that the relationship between percent need and GPA may be better understood as a result of the correlation between percent need and first generation, ethnicity, and test scores.

Data

The data used in this analysis consisted of the academic records of 6,238 students who matriculated at Carleton from 2005 to 2016. Cumulative grade point averages include the records of students who both did and did not graduate, and in the latter case the average includes only the grades the student received prior to their separation from Carleton. Standardized test scores were converted to post-2016 SAT scores from ACT or earlier SAT scores when available. The mean of the verbal and mathematical sections were used whenever possible. For students who completed the pre-2016 SAT and did not complete the Writing portion, it was not possible to estimate a verbal score. In that case, their mean SAT score is based only on their math score. For other students, the mean of the verbal and math portions was taken, which puts them on an 800-point scale.