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An Analysis of the Factors that Influence Success Rates of Honors College Students

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An Analysis of the Factors that Influence Success Rates of Honors College Students

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Abstract

University honors programs provide students with challenging yet rewarding opportunities. Pursuing honors often offers students opportunities (such as access to uique coursework or specialized mentorship) that are not available to the general student popultion. However, honors programs also hold students to more or higher educational milestones in order to graduate with honors. Data from the University of Araksas Fayetteville (UAF) suggest students who start in honors as new freshmen typically graduate at rates much higher than students who were not honors freshmen. However, the percentage of those honors freshmen who complete their honors requirements is much lower than those who graduate at all. The objective of this study is to better identify the factors that largely impact an honors student's liklihood of graduating and of graduating with honors.

A neural network analysis was conducted on 13 factors that were expected (either based on literature or preliminary T-test and chi square test analyses) to influence an honors freshman's likelihood of graduating, with and without honors. Final results suggest that 1st Term GPA and major have the largest explanatory impact on graduation with honors, while 1st Term GPA has a significantly larger impact compared to other explanatory varaiblebs on graduating at all. With little to no explanatory impact from ethnic or gender variables, results imply there is no ethnic or gender bias in UAF honors program success. While this analysis lacks information related to potentially important variables such as prior research experience, service-learning experience, and study abroad that likely contribute positively to retention and success, this study establishes a good baseline model for predicting student success that can be built upon in further research.

Introduction and Background

Successfully completing an undergraduate degree program with honors is a commendable achievement for a college student. Having the title of *Honors Student* while in college has its benefits. For example, at University of Arkansas Fayetteville (UAF), students have access to a specialized network of similar academically driven peers as well as a dedicated honors faculty who guide honors students through the challenging, yet rewarding, process of an honors program, particularly the thesis experience. In general, collegiate honors programs provide the opportunity for students to attain a specialized education to better prepare them for their future endeavors. More often than not, the endeavors these honors students pursue are related to higher education (e.g. graduate school, medical school, law school, etc.). Pursuing honors can expose undergraduate students to authentic and proper research methods as well as correct thesis writing and development (Clauss, 2011), which is what can give these students the competitive edge over others when applying for post-baccalaureate programs. Honors students also tend to develop a closer relationship with their professors due to the fact that they are more likely to reach out to them outside of required class time to discuss general political or social issues that are not necessarily related to the subject of the class (Clauss, 2011). Perhaps most importantly, graduation rates of honors students are about 8% higher compared to non-honors students (Keller & Lacy, 2013). A similar study showed that honors students had a 64% graduation rate with the same median SAT score as compared to a 48% graduation rate of non-honors students (Slavin, Coladarci, & Pratt, 2008). With so many benefits of completing an honors program while in college, it should be easy to justify the completion of said program.

With these benefits, however, come high expectations of those students. At UAF, each of the six undergraduate colleges manages its own Honors Program for students in its majors. While

the course requirements vary across programs, all students are required to complete a thesis. The Honors College at UAF complements the efforts of the individual programs by providing honors students access to unique curriculum, research and study abroad funding and guidance in engaging in a research experience domestically or abroad. A recent informal analysis of 2012 incoming freshmen at UAF suggests that while students who are in honors graduate from the university at much higher rates than those who were never in honors (86.4% vs 59.9%, respectively) the percentage of those graduating students who actually completed their honors programs was 39% (UAFHC, 2019). Another study focused on a different institution (Campbell, 2008) found honors completion rates as low as 18.45%. While changes made in the UAF Honors Programs in recent years (particularly the introduction of milestones in the second and third years) seem to have increased retention and completion rates, no formal study has yet examined these and other factors that could influence completion rates.

To assist in the analysis of factors that influence completion rates, one approach will utilize an artificial neural network (ANN). ANN analyses have become popular in recent years due to the growth of big data (Tester, 2019). It is much more complex to interpret results from ANN analyses compared to the more traditional regression analysis. Essentially, ANNs function similar to the human brain in that the network aims to learn patterns in the data in order to be able to make accurate predictions for an outcome (Frankenfield, 2020). There are multiple ANN configurations that are used in parameter estimation of the effects that various explanatory variables have on a dependent variable (Tester, 2019). A neural network of relationships between the explanatory variables and the dependent variable, and a relative variable impact of each explanatory variable, are determined using Multi-Layer Feedforward Networks (MLFN) and Probabilistic Neural Networks (PNN)/Generalzied Regression Neural Nets (GRNN) with Palisade Corporation's

Neural Tools v 8.0 (NT) software (Palisade, 2015). PNN/GRNN is a more simplistic network training set up compared to that of the MLFN as it does not utilize hidden neural layers to assign weighted relationships to the variables as MLFN does. Instead, PNNs adjust parameters to minimize the sum of squared prediction errors to train the data (Palisade, 2015). In this study, PNN/GRNN was used. Different percentages of the data can be selected for testing once the training is completed in order to reduce the percent error of bad predictions from the neural network. The impact of choosing different percentages of data for testing and training is left to the results section.

Purpose, Need, and Objectives

The purpose of this study is to identify factors that influence completion of an Honors Program at UAF. It is hoped that results can be used by the UAF Honors College and Honors Program administrators to better predict whether a prospective student will successfully complete their honors program and, therefore, provide needed assistance that leads to higher competition rates. Results might also be used by students who are interested in understanding what it takes to complete honors and therefore increase his/her odds of succeeding while in an honors program.

Factors that Influence Honors Completion

Other studies have examined factors that can be influential in a student completing a honors program. The literature suggests that high school GPA (Campbell & Fuqua, 2008; Savage, Raehsler & Fiedor, 2014; Mcdonald & Gowkoski, 1979; Clark et al., 2018; McKay, 2009; Megert, 2005; Goodstein & Szarek, 2013; Diaz, Farruggia, Wellman, & Bottoms, 2019; Bowman & Culver, 2019), SAT/ACT score (McKay, 2009; Mcdonald & Gowkoski,1979; Goodstein & Szarek

2013; Clark et al., 2018; Roufugalas, 1993), high school class rank (Campbell & Fuqua, 2008), first semester college GPA (Campbell & Fuqua, 2008;), gender (Campbell & Fuqua, 2008; Mortenson, 2008; Dinan, 2016) first year college housing (Campbell & Fuqua, 2008; Goodstein & Szarek 2013), high school size (Keller & Lacy, 2013), credit hours earned through AP or CLEP exams (Fechheimer, Webber & Kleiber,2017), college GPA (Fechheimer, Webber, K. & Kleiber, 2017) socioeconomic status (Campbell, 2009), first year experience in college (Fechheimer, Webber, & Kleiber, 2017), in or out of state residency (Keller & Lacy, 2013) first generation college student status (Keller & Lacy, 2013), ethnicity (McKay, 2009), academic major (Pritchard & Wilson, 2003; Keller & Lacy, 2013; Savage, Raehsler, & Fiedor, 2014; Bowman & Culver, 2018), size of entering class (Keller & Lacy, 2013; Savage, Raehsler, & Fiedor, 2014), age (in years) (Diaz et al., 2019), parents' income (Diaz et al., 2019), writing placement, first-year credits earned, first to second-year retention (Diaz et al., 2019), prestige of honors college and university (Brown, Winburn, & Sullivan-Gonzalez, 2018), college choice satisfaction, high school study methods, high school activities, high school socializing, high school teacher interaction, high school volunteering, paying job in high school, alcohol consumption in high school, smoking in high school, highest intended degree, whether or not the university is a research university, psychological well-being, social political involvement (Bowman & Culver, 2018), and a student's overall academic commitment (Clark et al., 2018) are important factors to examine in determining whether a student will graduate with honors or not. Most studies that have been conducted in the past tend to focus on three to eight factors to gather data for and perform an analysis of the factors' effect on honors student success. The most common factors identified are SAT/ACT score, high school GPA, and gender.

Methods

The research process began by acquiring an initial data set of all incoming freshmen from the years 2004 to 2018 from the University of Arkansas Information Systems personnel. This dataset[1] contained nearly 59,000 data points with 60 observations for each data point which included demographic academic performance and graduation information. From the initial dataset, those students who did not enter the University with honors were removed from the 59,000. The data set included graduation semesters through fall 2018. Because the focus of this study is to examine graduation rates of incoming honors students, students who entered in Fall 2015 or later were also removed because there were insufficient data to be able to effectively interpret 4-year graduation rates from these students. A list of all collected variables and their definitions are included in the appendix. Once the initial data changes were made, an additional 25 variables were created from the collected data. While some of the variables are briefly explained here, a list of additional variables, their definitions and their calculations, are available in the appendix.

ChangeCollege and *ChangeMajor* are dichotomous variables that indicate whether or not a student has changed majors and/colleges at least once between their first freshmen year term and last graduating year term[2]. *Grad4Yrs* and *Grad6Yrs*, also dichotomous, reflect whether or not a student graduated in four or six years, respectively. Similarly, *HonorsGrad4Yrs* and *HonorsGrad6Yrs* reflect the subset of four- and six-year graduates who also completed the honors program.

[1] Names and IDs were not included in the dataset in order to protect the identity of each student.

[2] Manual adjustments were made on certain majors that were reported as major changes according to the basic criteria but were not actually major changes. For example, those who started as a "First Year Engineering" student and graduated with an engineering major were reclassified as no change. Similarly, students in "Pre-Business" who graduated with a business major were reclassified as no change. A detailed list of these adjustments is provided in the appendix.

Financial need was examined with a number of categorical variables. *PellStafford* places students in one of three possible groups: 1) holding both a Pell Grant and Stafford Loan, 2) holding either a Pell Grant or Stafford Loan, and 3) holding neither. A second related variable (*PellStafford2*) further restricts students into two groups: 1) qualifying for either or both of the Stafford Loan and Pell grant, or 2) qualifying for neither. *UnmetNeedRank* places a student's unmet financial need in one of four categories ranging from $0 need to $10,000 or more. Details about the variable calculation and output value meaning can be found in the appendix.

Geographic location was also examined several ways. *RegionStateRank* ranks a student's geographic location on a scale of 0 to 3 based on U.S. Census regions. *BorderStateRank* depicts whether a student lives in Arkansas/border state or not. *StateRank* ranks a student's location in the state of Arkansas or not on a scale of 0 to 1.

Other variables relate to student academic success in high school. *HSGPARank* ranks high school GPA on a scale of 1 to 4. *APCreditsRank* ranks a student's number of AP credits earned on a scale of 0 to 4. *AP Credit* reduces the number of categories to two – having less than 16 hours of AP Credits or 16+ hours. *ACTRank* depicts whether a student's ACT (or ACT score converted from an SAT score) is 32 or higher. Another variable (*HS GPA*) was created to classify students whose GPA in high school was 4.0 or greater.

Students' parental education status was examined through several variables. *PGradRank* places students in a category based on the number of parents/guardians (zero, one or two) who have graduated from college. *ParentGrad* reduces the number of categories to two – having any parent/guardian graduates or none. *ParentAlum* categorizes similarly, but this time based on the number of parents/guardians (zero, one, two) who are University of Arkansas alumni.

Once all variables were created, Chi squared and t-tests were run in the SAS software to determine what variables were significantly related to graduating at all and graduating with honors. The purpose of running these tests was to try to narrow down the list of variables that might be used in the final models. As such, most tests were conducted as chi square tests. The chi-squared value describes how well each observation explains the variation in the observed dependent variable. It is an important value that helps identify the key observational variables that are pivotal in the student's outcome. Therefore, two chi square analyses were run in SAS to determine whether significant differences existed in each of the variables mentioned above: 1) between students who graduated and did not (in a variable named *GradEver*), and 2) among students who graduated with honors, graduated without honors, or left the university before graduating (in a variable named *HonorsGradorLeft*). Two similar analyses were conducted as paired t-tests using the variable *firsttermGPA.* The paired t-test identifies significant differences but when using variables where at least one is continuous, such as *First SemesterCollegeGPA.*

Once the SAS analysis was complete, Palisade's Neural Tools was utilized to perform a neural network variable impact analysis on two different models similar to those in the SAS analysis: Model 1 utilized Honors Grad or Not as the dependent variable; Model 2 utilized Grad6Yr as the dependent variable. In order to determine the explanatory variables to be used in the final two neural network analysis models, several sets of trial runs were conducted under different testing conditions and different variable combinations until the percentage of bad predictions from the model appeared to reach a minimum. Variables that were continuous but had been placed into categories for the statistical testing were utilized here in their original form. Based on chi square and t-test results, it was hypothesized that *firsttermGPA, Grad Major, Entry Major, HSGPA, ACTComp, Unmet Need, PellStafford, Grad 4Yrs, Gender, APCredits, APCourses,* and

ethnicities of undergrepresented would all be important to both models. For Model 1, *Grad 4Yrs* was also hypothesized to be an important variable, and was thus included.

After the nueral network models were created, a live prediction analysis was conducted on the variable with the largest explanatory impact for Model 1. This live prediction was conducted to identify the threshold value for which the likelihood of graduating with honors changes from no to yes. In constructing the prediction model, other included numerical variables were held constant at their average value. Categorical values within the model were held constant at the variable's most frequent value. Predictions were made for students whose entry and graduation major were the same for 19 popular majors[3] in order to capture the diversity of students' majors at U of A. Analyses are also needed on other variables in Model 1 and for all of Model 2 but that will be the subject of future research.

Results

Preliminary Testing of Variables

Results suggest that the higher a student's ACT score, number of AP courses and credits and high school GPA, the greater a student's likelihood to graduate from college (Table 2), which is reflective of what was found in previous literature. By the same token, students who have at least one parent that is a college graduate or an alumnus of the University of Arkansas also have a higher likelihood to graduate college (Table 2), as do students with a higher first term college GPA (t test p value of <0.001), similar to what was found in previous literature. Those students who: i) qualify for a Pell Grant or Stafford Loan; or, ii) are a first-generation college student; or, iii) have

[3] Due to the nature of the data, where all freshmen begin as "first year engineering" major students but graduate with one of X specific engineering degrees, these data could not be evaulabuated with our methods that require entry and graduation major to be the same. Further analysis is needed to understand how the variables of study impact engineering majors.

a greater financial need; or iv) are male are less likely to graduate college (Table 2). While previous studies suggested that gender was significant in determining whether a student graduated or not, none of the studies singled out which gender performed better, as indicated in this study (Campbell & Fuqua, 2008; Mortenson, 2008). Previous literature also noted that ethnicity was a significant factor, but this study did not identify ethnicity as significant (McKay, 2009).

According to the HonorsGradorLeft SAS report, the higher a student's ACT score, number of AP courses and credits, and high school GPA, the greater a student's likelihood to graduate college with honors (Table 1), which is consistent with previous literature. Students who have at least one parent that is a college graduate or an alumnus of the University of Arkansas and who graduated within 6 years also have a higher likelihood to graduate college with honors (Table 1). Based on previous literature, I did not expect to find that students who graduate within 6 years have an increased chance to graduate in general. Those students who qualify for a Pell Grant or Stafford Loan, who are a first-generation college student, who have a greater financial need, who change college or major, who are African-American, and who are male are less likely to graduate college (Table 1). I assumed from prior research that these variables, with the exception of changing college or major, would be significant, but I did not know whether the effect would be positive or negative. I did not find any literature that included changing college or major as a significant factor in the research, but I expected to find that there would be a significant negative impact if a student did change college or major.

Artificial Neural Network Analyses

Figure 1 shows the explanatory variable impacts, with minimum and maximum error bars included, for Model 1 (graduating with or without honors) given the chosen set of 14 explanatory variables. Variable impacts are defined as the percentage of variation in the dependent variable

observed as a function of changes in each of the fourteen different explanatory variables used in this model. The range in each explanatory variable's impact occurs as a result of training the network 10 times using a different randomly selected set of testing observations each time. Figure 2 represents the same for Model 2 (graduating in 6 years or not) given the chosen set of 13 explanatory variables. Data used for Model 2 also underwent 10 separate network trainings. To determine how much data to use for training the network -- which determines the number of observations that remain to test the predictive accuracy of the network -- a sensitivity analysis was conducted on both models once the set of explanatory variables had been chosen. Figures 3 and 4 show the predictive accuracy of the models for 20-40% of observations used for testing or alternative 80-60% of observations used for training, respectively. Using 20% and 40% of observations for testing lowered both the percentage of bad predictions on average and the range of bad predictions for Models 1 and 2, respectively.

Some similarities among explanatory variable impacts were found across both models. First, a student's *FirstTermGPA* and *GradMajor* ranked first and second, respectively, in variable impact for both models. Across model runs (training of networks), these two variables explained on average 40.9% of variable impact on Honors Graduation (Model 1) and 76.5% of variable impact on graduating at all (Model 2). Unexpectedly, neither gender, nor individual ethnicities of underrepresented groups, nor *FirstGen* status had a meaningful (in terms of explanatory power) impact on explaining whether a student graduated (Model 2) or graduated with honors (Model 1), which suggests that enthnicity and gender in and of themselves are not good predictors of program success. Given the selected percentage of testing and training observations, Model 1 had an average bad prediction rate of 27.8%. Whereas Model 2 had an average bad prediction rate of

1.5%, which is expected due to the fact that first term GPA had such a large explanatory impact in Model 2.

Once a network is trained, Neural Tools allows prediction of outcomes when any of the explanatory variables are changed and is termed a 'live prediction'. Table 3 shows the results from the last trained network for each model to determine the impact of *FirstTermGPA* on graduation outcome for subsets of groups holding all other explanatory variables at either their most frequent categorical choice or average numerical value for a subset of 19 different majors. It is important to note that the model will not predict graduating with or without honors exactly the same across networks trained with a different set of randomly chosen training data points. With that caveat in mind, the user of the information also needs to keep in mind the prediction accuracy. Shown in Table 3 are *FirstTermGPA* thresholds where the dependent variable (graduate or not) changes as a result of having changed *FirstTermGPA* along with a prediction accuracy at that GPA level. Table 3 also reports the prediction accuracy or likelihood that the specific trained network chosen provides the correct result given the explanatory variables used when the *FirstTermGPA* is a 4.0. Table 3 thus provides an assessment of relative differences across majors and portrays changes in likelihood of accurate predictions. At the *FirstTermGPA* threshold the prediction accuracy is near 50% for all majors as the strength of the model increase as GPA moves to lower or higher values than the *FirstTermGPA* threshold. Intuitively this makes sense as the *FirstTermGPA* threshold is the tipping point for the model outcome.

At UAF, students must maintain a 3.5 cumulative GPA in order to graduate with honors[4]. Interestingly, the data suggest that students must earn a first term GPA higher that that (in some cases, considerably higher) in order to graduate with honors. Students in phsychology (3.53) and

[4] For students in architecture, landscape design and interior design, the cumulative GPA needed to graduate from honors falls to 3.33 after their fifth semester in their program.

English (3.59) had *FirstTermGPA* thresholds lower than students pursuing kinesiology (3.86), chemistry (3.74), and animal science (3.72). On average, across majors included, this model suggests a first term GPA of roughly 3.65 is a good predictor for graduating with honors.

The fourth column of Table 3, shows the prediction percentage of the model, given the various combinations of entry and grad majors, if a student were to obtain a 4.00 first term GPA. It is expected that the prediction accuracy for students with a first semester GPA of 4.00 to be higher for those where the threshold GPA is lower. However, it is also important to consider that for a given major subset, the number of random observations chosen for training can be different than for other major subsets, and it is important to consider that first term GPA might not have as large of a variable impact for a given major subset as is depicted for the model as a whole. The prediction percentage value for English majors is the greatest (72.56%) at a first term GPA value of 4.00. This implies that the model will be able to predict an English student graduating with honors, given values of explanatory variables in the model, around 70% of the time. The prediction percentage value is the lowest for journalism (65.19%) as an entry and graduating major with a 1st term GPA value of 4.00. Thus, the prediction model implies that it can correctly predict a journalism student entering and graduating with honors about 65% of the time with the given explanatory variable values. In the final column of Table 3, the rate at which students graduated with honors for each of the 19 major combinations is also listed. This value represents the percentage of students from the data set that graduated with honors who were enrolled in and graduated in the given majors.

In the final column of Table 3, the rate at which students graduated with honors for each of the 19 major combinations is also listed. This value represents the percentage of students that graduated with honors who were enrolled in and graduated in the given majors.

Summary and Conclusion

The purpose of this study was to identify factors important to graduting within six years as well as grauating with honors. Based on the literature review and a preliminary analysis of the data using t-tests and chi squire tests, it was hypothesized that first term GPA, the students first major on campus, the major from which a student graduated, high school GPA, ACT score, number of AP credits, various measurements of financial need, gender, enthnicity and first generation status would all be important predictors in the models. Results for Model 1 suggest that first term college GPA, entry and graduation majors, number of AP courses taken and high school GPA have the most explanatory impact for graduating with honors. Results for Model 2 suggest that graduation after six years can primarily be predicted by examing the first term college GPA. Unexpectedly, demographic variables related to gender, ethnicity, financial need and first generation status had little explanatory impact within either model.

In utilizing the results from this study, the honors college could potentially develop a threshold protocol to ensure students who are "at risk" are addressed at an adequate time to help ensure their success in the long run. For example, one protocol could include setting minimum first semester GPA values for different majors which honors college faculty can use as a guideline to determine whether the student should be contacted at the end of the first semester (if the student is at or below that GPA threshold) to try to ensure the student still graduates with honors. An additional recommendation would be to ensure students are aware of particular first semester GPA

thresholds. Including this information in early orientation presenations to set expectations for students could potentially cause a boost in desire to perform at an increased level (especially for the first semester) for students to ensure they succeed. However, student perception of this information must also be considered. Some students who do not meet the first semester GPA threshold may believe they do not have any chance for success and, thus, choose to leave the honors program. Therefore, it is important to convey to students that the threshold value is not a definitive value that students must meet. Rather, it is to be used more as a means for faculty to identify when students need that extra boost of encouragement.

Limitations to this study exist as well. Other factors that have an effect on a student's success include undergraduate research experience, high school research experience, study abroad, and service learning experience. These factors could not be included in the models used due to limitations in the data collected. Further studies should be conducted which include data for these particular variables either through creation of new models or expansion of current models. Additionally, students who enter as engineering majors make up a large portion of first year students in honors. However, it was difficult to include these students in the model to perform a live prediction analysis due to the way the data structures engineering majors. When students plan to major in a specific field of engineering, the university classifies the student as "first year engineering" when they begin, but when students graduate, the student's classification will be a particular engineering field (e.g. chemical engineering or mechanical engeineering). Therefore, an engineering student's graduating major will practically always be different than their graduating major (with a few exceptions for students who come in with enough college credits to already have an engineering classification). Furthermore, there are a large number of major combinations that could be utilized in conducting a live prediction analysis of the neural network models, which

would lead to time constraints in being able to determine a legitimate threshold GPA for the purposes of predicting a student's success. Time is also a large constraint on being able to further reduce the prediction error for the neural network models in this study. As the technology behind neural network analysis continues to develop over time, the model outcomes could potentially be obtained more quickly and with greater accuracy as machine learning becames more advanced.

Further evaluation of these models, particularly focusing on the majors that were not included, should be conducted to get a more accurate explanatory variable impact on students graduating with honors. New models could also be constructed that use more current data and data collected form other varaibles that were not included. Further studies are needed in order to be able to create a more accurate and effecient predictor for honors student success.

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Table 1. Statistical Significance of Chi-Squre Tests on Various Factors Associated with an Honors Student Graduating with or without Honors or Leaving the University

Factor	Graduated with Honors		Graduated without Honors		Left University		P-Value	Number of Observations	Observations Missing
	Demographic[1]	Non-Demographic[2]	Demographic[1]	Non-Demographic[2]	Demographic[1]	Non-Demographic[2]			
	%	%	%	%	%	%			
BorderStateRank	33.8	36.3	50.1	44.8	16.2	16.9	0.3950	7627	167
Caucasian	34.1	31.8	49.8	50.7	16.1	17.5	0.4197	7665	129
Change College	27.3	43.8	72.7	56.2	0.0	0.0	<.0001	6426	1368
Change Major	38.8	42.2	61.2	57.8	0.0	0.0	0.0053	6426	1368
African American	20.4	34.1	60.2	49.7	19.4	16.1	0.0111	7665	129
Asian	39.9	33.7	45.8	50.0	14.4	16.3	0.0813	7665	129
Hispanic	30.8	34.1	54.0	49.7	15.2	16.2	0.4260	7665	129
Native American	26.2	34.2	55.0	49.7	18.8	16.1	0.0611	7665	129
Ethnicity Two or More	31.7	34.0	50.8	49.8	17.5	16.2	0.7753	7665	129
Unknown Ethnicity	43.5	33.9	30.4	49.9	26.1	16.2	0.1526	7665	129
FirstGen College Student	24.7	35.9	51.3	49.7	24.0	14.5	<.0001	7592	202
Gender (Male=Demographic; Female=Non-Demographic)	28.8	39.2	52.9	46.8	18.3	14.0	<.0001	7665	129
Grad 4 Yes or Not	45.0	14.0	55.0	40.7	0.0	45.4	<.0001	7667	127
Grad 6 Yes or Not	41.2	0.4	58.8	8.8	0.0	90.8	<.0001	7667	127
Pell Grant	24.5	35.4	49.4	49.9	26.1	14.7	<.0001	7667	127
Stafford Loan	22.4	38.0	54.7	48.2	22.90	13.9	<.0001	7667	127
StateRank	34.5	33.0	49.9	49.7	15.6	17.3	0.1271	7627	167
AP Credit (16+ hours = demographic)	54.2	33.0	36.4	52.3	9.5	14.7	<.0001	5064	2730
Parent Grad (1+ parent = demographic)	35.7	24.7	49.8	51.1	14.5	24.2	<.0001	7414	380
HS GPA (4.0+ = demographic	44.8	19.6	44.6	56.8	10.5	23.6	<.0001	7656	138
ACT Rank (32+ is demographic	47.6	26.2	39.8	55.8	12.6	18.1	<.0001	7484	310
Parent Alum (1+ = demographic)	36.3	33.1	52.2	49.4	11.4	17.4	<.0001	7411	383
PellStafford (any need is demographic)	23.9	39.1	53.2	48.2	22.9	12.7	<.0001	7667	127

[1] Demographic represents a value of 1 for the given variable.

[2]Non-Demographic represents a vlue of 0 for the given variable.

Table 2. Statistical Significance of Various Factors Associated with an Initial Honors Student Graduating or Not Graduating

Factor	Graduated		Did Not Graduate		P-Value	Number of Observations	Observations Missing
	Demographic[1]	Non-Demographic[2]	Demographic	Non-Demographic			
	%	%	%	%			
BorderStateRank	83.8	83.1	16.2	16.9	0.6692	7627	167
Caucasian	83.9	82.5	16.1	17.5	0.3572	7665	129
African American	80.6	83.9	19.4	16.14	0.3552	7665	129
Asian	85.6	83.7	14.4	16.3	0.3800	7665	129
Hispanic	84.8	83.8	15.2	16.2	0.6710	7665	129
Native American	81.2	83.9	18.8	16.1	0.3054	7665	129
Ethnicity Two or More	82.5	83.8	17.5	16.2	0.6300	7665	129
Unknown Ethnicity	73.9	83.8	26.1	16.2	0.1969	7665	129
FirstGen College Student	75.9	85.6	24.0	14.5	<.0001	7592	202
Gender (Male=Demographic; Female=Non-Demographic)	81.7	86.0	18.3	14.0	<.0001	7665	129
Pell Grant	73.9	85.3	26.1	14.7	<.0001	7667	127
Stafford Loan	77.1	86.2	22.9	13.9	<.0001	7667	127
StateRank	84.4	82.7	15.6	17.3	0.0581	7627	167
AP Credit (16+ hours = demographic)	90.5	85.3	9.5	14.7	<.0001	5064	2730
Parent Grad (1+ parent = demographic)	85.5	75.8	14.5	24.2	<.0001	7414	380
HS GPA (4.0+ = demographic	89.4	76.4	10.6	23.6	<.0001	7656	138
ACT Rank (32+ is demographic	90.5	85.3	9.5	14.7	<.0001	5064	2730
Parent Alum (1+ = demographic)	88.6	82.6	11.4	13.5	<.0001	7411	383
PellStafford (any need is demographic)	77.1	87.3	22.9	12.7	<.0001	7667	127

[1] Demographic represents a value of 1 for the given variable.

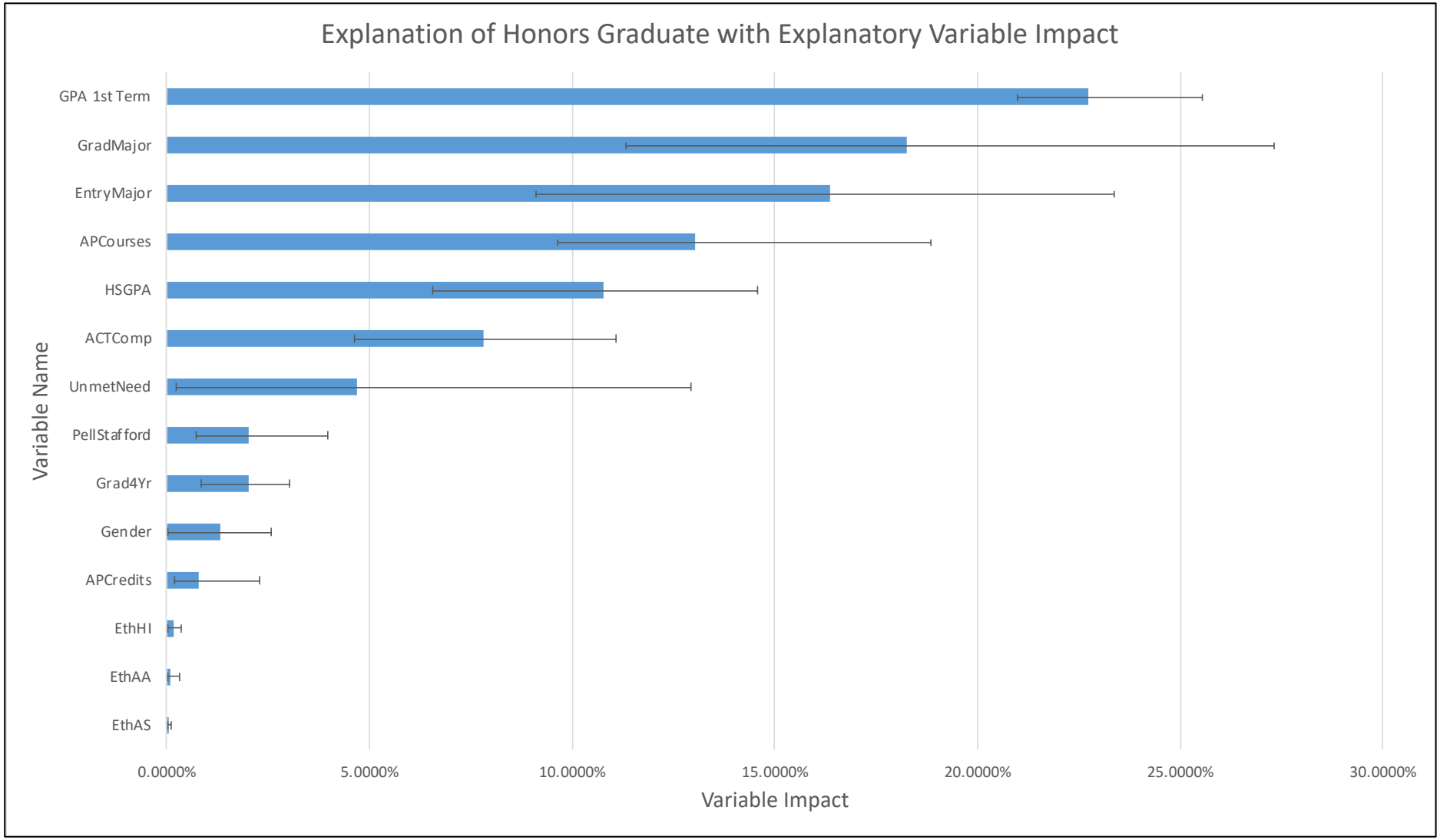
[2]Non-Demographic represents a vlue of 0 for the given variable.

Table 3. NeuralTools Live Prediction Model Results for Honors Graduate with 1st Term GPA Manipulation and Actual Graduation with Honors Rate

EntryMajor[1]	GradMajor	GPA1stTerm Threshold (Prediction Percentage)	GPA1stTerm at 4.00 Prediction Percentage	Grad with Honors Rate
BIOL	**BIOL**	3.64 (50.43%)	69.17%	56.08%
CHEM	**CHEM**	3.74 (50.98%)	76.27%	64.08%
FINN	**FINN**	3.65 (50.33%)	69.37%	56.67%
ARCH	**ARCH**	3.63 (50.33%)	69.60%	45.45%
ANSC	**ANSC**	3.72 (50.91%)	71.02%	34.29%
AGBS	**AGBS**	3.66 (50.82%)	68.91%	40.00%
KINS	**KINS**	3.86 (50.67%)	70.00%	29.41%
PSYC	**PSYC**	3.53 (51.18%)	72.24%	44.00%
INTB	**INTB**	3.61 (50.15%)	71.39%	58.33%
JOUR	**JOUR**	3.67 (50.72%)	65.19%	27.78%
ENGL	**ENGL**	3.59 (50.45%)	72.56%	57.78%
ANTH	**ANTH**	3.63 (50.40%)	70.24%	58.33%
ACCT	**ACCT**	3.65 (50.60%)	72.44%	53.85%
PLSC	**PLSC**	3.66 (50.72%)	68.94%	46.30%
MUSC	**MUSC**	3.66 (50.58%)	68.65%	48.98%
MATH	**MATH**	3.65 (50.37%)	69.00%	51.35%
PHYS	**PHYS**	3.66 (50.42%)	69.32%	54.29%
MGMT	**MGMT**	3.63 (50.08%)	69.45%	31.25%
MKTG	**MKTG**	3.69 (50.72%)	70.44%	36.11%

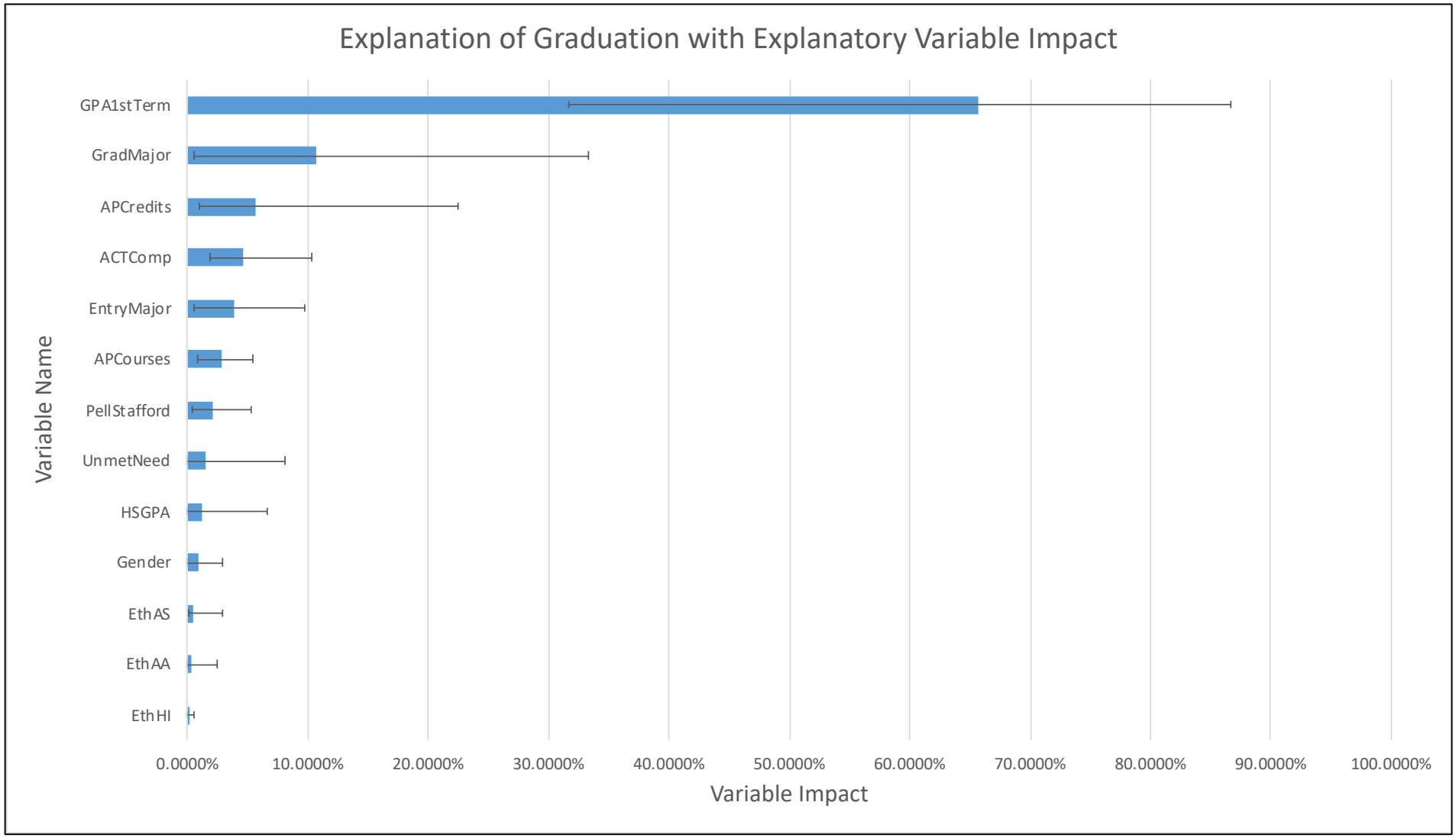
[1] BIOL = biology; CHEM = chemistry; FINN = finance; ARCH = architecture; ANSC = animal science; AGBS = agricultural business; KINS = kinesiology; PSYC = psychology; INTB = international business; JOUR = journalism; ENGL = english; ANTH = anthropology; ACCT = accounting; PLSC = political science; MUSC = music; MATH = mathematics; PHYS = physics; MGMT = management; MKTG = marketing

Figure 1. NeuralTools Explanatory Variable Impact on an Honors Student Graduating with or without Honors (Model 1)



[1] Bars represent the average percent of variation in the dependent variable explained by the given explanatory variable. The error bars represent the standard deviation of the variable impacts observed across 10 model runs.

Figure 2. NeuralTools Explanatory Variable Impact on an Initial Honors Student Graduating or Not (Model 2)



[1] Bars represent the average percent of variation in the dependent variable explained by the given explanatory variable. The error bars represent the minimum and maximum of the variable impacts observed across 10 model runs.

Figure 3. Model 1 Sensitivity Analysis

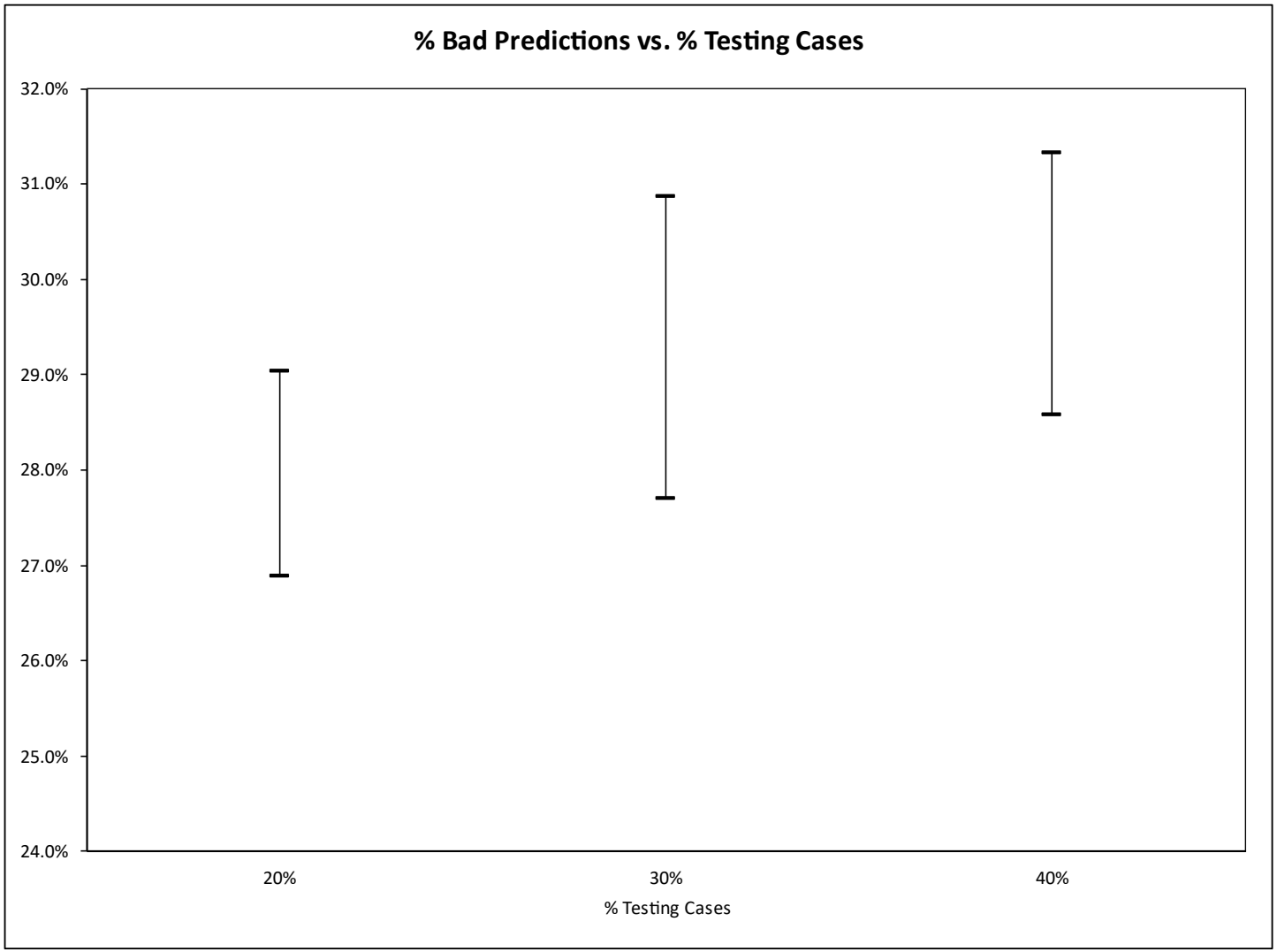
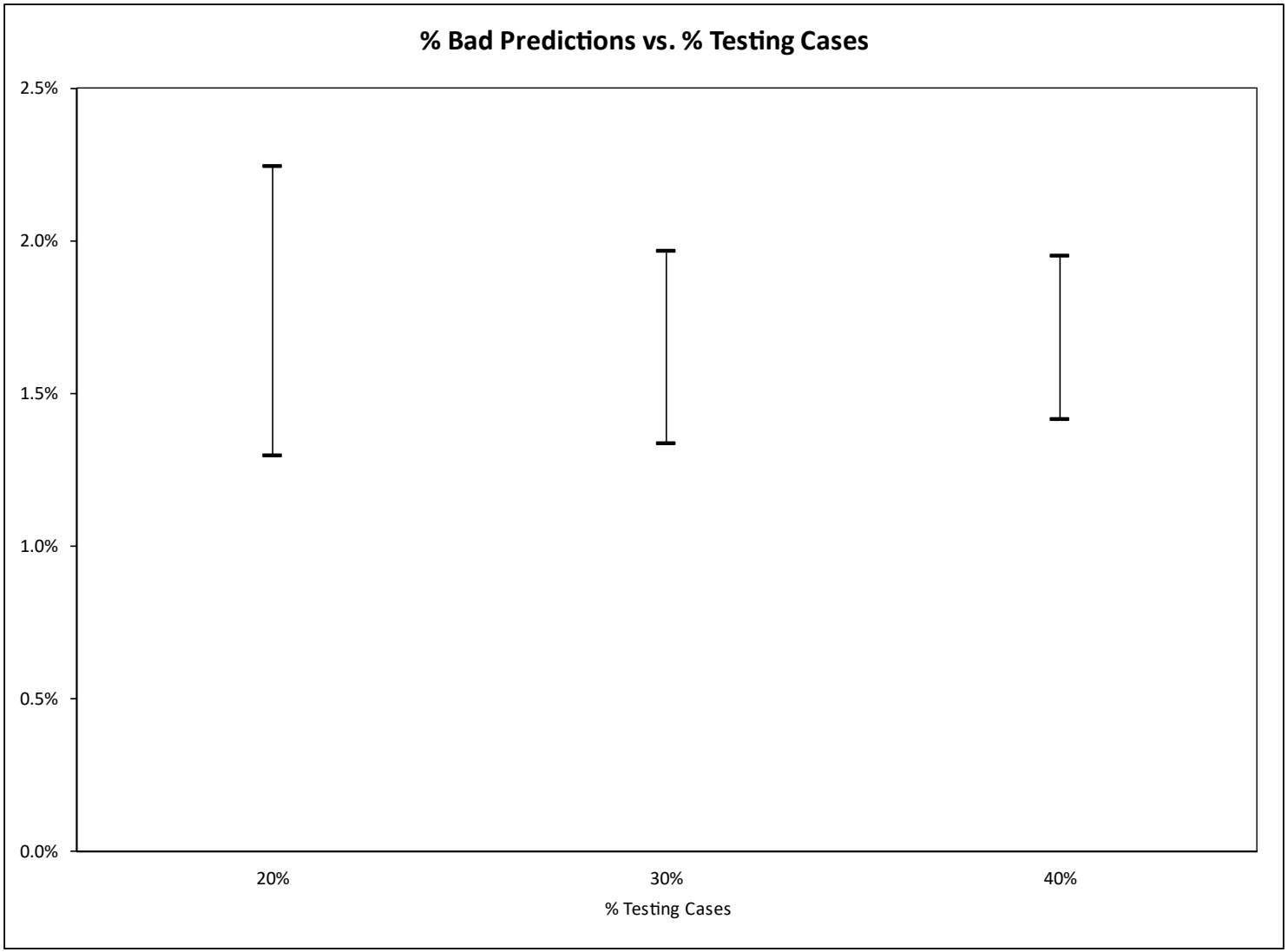


Figure 4. Model 2 Sensitivity Analysis



Appendix

Variable Name	Variable Definition
Demographics: Gender	Gender of student
Demographics: Eth-UN	Unknown ethnicity of student
Demographics: Eth-TM	Two or more ethnicities
Demographics: Eth-NR	Ethnicity not reported
Demographics: Eth-IN	Indian
Demographics: Eth-HW	Hawaiian
Demographics: Eth-HI	Hispanic
Demographics: Eth-FO	Foreign (International)
Demographics: Eth-CA	Caucasian
Demographics: Eth-AS	Asian
Demographics: Eth-AA	African-American
Demographics: PGrad	Depicts if a parent or both graduated college
Demographics: PAlum	Depicts if a parent or both graduated college from the University of Arkansas
Demographics: 1stGen	Depicts if studen is a first generation college student
Opportunity: Unmet Need	Depicts amount of unmet financial need of student after all scholarships & grants
Pre-Entry: HSGPA	Student's high school GPA prior to enrollment
Pre-Entry: ACT Comp	Student's standardized test (ACT/SAT) score converted to ACT scoring scale
Pre-Entry: AP Courses	Number of AP courses student took in high school
Pre-Entry: AP Credits	Quantity of college credit student received from AP courses taken in high school
Entry: College	Universtiy of Arkansas college student enrolled in upon starting college
Entry: Major	Student's declared major upon starting college
Entry: Honors	Depicts whether student began as an honors student
Honors: HGrad	Depicts whether student graduated with honors or not
GPA: 1stTerm	Student's GPA after first semester enrolled
Outcome: GradCollege	College the student belongs to upon degree completion
Outcome: GradMajor	Student's major earned and displayed on the degree
Outcome: Grad 4yrs	Depicts whether the student graduated within 4 academic years
Outcome: Grad 6yrs	Depicts whether the student graduated within 6 academic years
Changed College	Depicts whether the student chagned college within the University after enrolling, prior to graduating
Changed Major	Depicts whether the student chagned major within the University after enrolling, prior to graduating
StateRank	If state is Arkansas, then 1; if state is not Arkansas, then 0
PellStafford	Tells whether student qualifies for a Pell Grant or Stafford Loan: No aid = 0; 1 type of aid = 1; both = 2
UnmetNeedRank	Financial need < $100.00 = 0; Fnancial need > $100.00 = 1
HSGPARank	HSGPA 3.5-3.74 = 1; HSGPA 3.75-4.00 = 2; HSGPA 4.00-4.24 = 3; HSGPA > 4.25 = 4
APCreditsRank	0 AP credits = 0; 1-9 AP Credits = 1; 10-15 AP Credits = 2; 16-30 AP Credits = 3; >31 AP Credits = 4