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Profiling Hope

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Abstract

Boys Hope Girls Hope (BHGH) is a nonprofit organization that strives to help students in middle school and high school build character and reach their full potential in the classroom. This organization accepts 18 students into their residential program who are bright, motivated, and who come from challenging household situations and provides them with an education and living accommodations throughout their high school career. BHGH created a new program in 2007 called Hope Prep that allowed more students to participate, and therefore created a need for a more efficient way to sort through the larger number of applicants. Since BHGH prides itself on developing students into young adults with good character, I have used a character development survey to act as the dependent variable that will allow BHGH to determine which students to accept into the program.

I have chosen a Likert-type scale survey to measure character development since I will be able to associate a numerical value with the results, which will represent an overall score, and allow an easy comparison of the Hope Prep program student applicants' characters. In order to create a model that will provide BHGH a more efficient way to determine which applicants could benefit the most from their program, I have created a hypothetical prediction model based on simulated data. This model can be used to predict how much the students' characters will develop if accepted into the program. I was able to combine two data sets that were provided to me by BHGH to create a file that contains background information about some Hope Prep

program applicants as well as current Hope Prep members. The background information that I have for the students includes gender, school, region, grade, Math OGT scores, Reading OGT scores, and BHGH test scores for various disciplines. I had to impute many of the OGT test scores in order to create a more complete data set for my prediction model. After imputing the test scores, I created random survey test scores to represent the possible character development of each of the students from the beginning of the program to the end. I then used a linear regression model to create an equation that would use the background information and a pre-program survey test score to predict a post-program test score. Although this prediction model cannot be used by BHGH in its current state due to the heavy reliance on simulated data, this model shows BHGH what they could do with an infusion of real data.

Background

Boys Hope Girls Hope was founded in 1977 by Father Paul Sheridan. Father Sheridan's purpose in creating this program was to help young people develop in the spirit of "cura personalis" or the whole person ("History"). This program was developed to help remove young people from extremely challenging home situations and allow them to learn and grow in a safe and loving environment. In 2007, BHGH created a new program that expanded upon their current residential program. This program, Hope Prep, offers academic and advisory classes for 65 middle school students for 6 weeks each summer. During my previous work with BHGH as part of the requirements for my final project in the John Carroll course MT422, Applied Statistics, I obtained a file containing background information about some of the Hope Prep applicants. After meeting with BHGH again for this current project, they were able to provide me with more information about some of the current Hope Prep students.

The data that I have from BHGH includes demographic and academic background information about the students. For each student, BHGH recorded their gender, the school they are attending, what region their school is in, their Math and Reading OGT test scores, and their scores to the BHGH school subject tests. Unfortunately, since I got one of the data files last year, many of the applicants from my old file did not match the current Hope Prep members in the new file. This caused problematic holes in my data, since the new file containing information about the current program members did not include OGT test scores. I decided to use the OGT test scores in my analysis because those test scores are included in the students' applications, so I needed to use a form of imputing data in order to fill in the students' missing Math OGT and Reading OGT test scores.

During the summer I met with BHGH to discuss how I could help them with their increasing need to be able to sort through the large number of applicants to the Hope Prep program. While my last project with BHGH focused on what the current background information could tell us about the students, this project is aimed at how we can use this background information to measure or predict the students' characters. BHGH is very focused on developing their students into young adults who are ready for their post-high school path, so a project that is centered around BHGH's ability to develop their students' characters is exactly what they were looking for. When I met with BHGH, I promised to create a statistical model that would help them predict how much students' characters would develop during the program, and thus create a way for them to streamline the acceptance process. I have been able to do this with the help of my advisor, Dr. Thomas Short, and this prediction model can be used in the future, with the addition of real data, to help BHGH during the application process.

Literature Review

Before beginning my project, I did some research to find out if there was any work already done similar to what I promised to do for BHGH. One previous study that I found during my research evaluated the success of a program called Project Heart, Head, Hands (H^3). This study, like my own, uses a character asset survey as a "pre-post measure of student character development" and also focuses on student school climate and student grade changes (Burton et al. 20-26). Although my project did not include the student school climate and student grade changes, I found this study to be important to keep in mind because it brought up a possible result-skewing problem. This study discovered the "character asset maturational effect," which caused the results of their study to show that the H^3 program has a minimal or negative effect on the students' character development (Burton et al. 5). The maturation effect explains the phenomenon by claiming that "as students mature, they tend to have progressively lower performances on character asset measures" because younger students have a greater desire to please adults and therefore respond to the survey in ways that are deemed more socially desirable (Burton et al. 5). I have not addressed this issue because I did not distribute any surveys to students, but the creator of the finalized model needs to be aware of this issue, since it could cause an apparent decrease in the students' characters from the beginning of the Hope Prep program to the end.

Another study similar to my project was Ann Person *et al.*'s "Survey of Outcomes Measurement in Research on Character Education Programs." This study assesses multiple character education programs and the surveys they use to measure character development. I was able to use this study to determine what kind of survey I would need to use for my project. By refining my survey search to only those surveys similar to the ones discussed in Person *et al.*'s

study, I was able to find the *Character in Action Survey*. The youth *Character in Action Survey* consists of four dimensions: pro-social attitudes, social climate, experience of caring community, and character in action. Each of these dimensions contains questions that focus on monitoring the "students' views and experiences of character development" (Davidson and Khmelkov 1). Splitting up the survey into multiple dimensions was appealing to me since this would allow BHGH to determine the strong and weak character assets for each of their students. I chose not to use this particular survey since the reliability of the survey was not tested, but I was able to use this dimensional formatting of the survey in my project with the use of Jennifer Johns' *Character Development Survey*, as discussed later.

Methods and Results

In order to create the prediction model that BHGH would like to use during their application process, I needed to simulate the values of the dependent variables as well as some of the missing independent variables. Since this statistical model is built on simulated data, the results represent a pilot study. The resulting prediction model that I have created can be used as a prototype for a model that BHGH can create when they have collected real data.

The first set of data that I had to simulate was the missing Math and Reading OGT test scores for the current Hope Prep students. Although the students' OGT test scores are sent in with their application to the Hope Prep program, they were not included in the data file shared with me. To fill in this missing data, I created a linear regression model in the statistical programming environment R to use the Math and Reading BHGH test scores to estimate the Math and Reading OGT test scores, which is the technique I chose to impute the missing values. Since a linear regression model is used to create the final prediction model, I chose to use the linear regression model to impute the missing variables as to keep my methods consistent. A linear regression model takes the variables that are indicated as "predictors" or the independent

variables, which I have chosen to be the BHGH Math and Reading test scores, and uses them to create an equation that the interpreter of the model can use to predict the values for the dependent variables, which are the Math and Reading OGT test scores. Some of the students had both OGT test scores and BHGH test scores, so the scores were able to be paired and entered into R. Since I am just using this linear model to fill in the missing values that can be easily exchanged with actual values later, I am not worried about the significance of the predictors.

After entering the linear regression model command into R, I was able to determine an equation for estimating the OGT test scores. The program R returned an intercept value of 365.6 and a coefficient value of 3.92 for the Math scores, which allowed me to create the following equation:

Math OGT test score = 365.6 + 3.92*BHGH Math test score.

By using the above equation, I was able to estimate the students' missing Math OGT test scores by entering their BHGH Math test scores into the equation and recording the result. Similarly, I was able to create the following equation for Reading OGT test scores:

Reading OGT test score = 393.3 + 3.29*BHGH Reading test score.

After filling in the missing OGT test scores, I had to research character development surveys. BHGH currently gives their Hope Prep students fill-in-the-blank surveys that are used to measure the student's character; however, this type of survey allows for a large variance of interpretations. The interpreter of the survey would need to be the same every time and "rate" the students on a specified scale of comparison for this type of survey to be an appropriate form for my analysis. Since the BHGH staff often changes, I wanted to find a survey that could be easily and uniformly interpreted to allow for a numerical value to be associated with a student's character.

A previous study done by Jennifer Johns, a member of the Utah State Office of Education, uses a Likert-type scale survey called the *Character Development Survey* and I was able to slightly manipulate this survey to fit BHGH's needs. I chose to use this survey because it measures kindness and caring, respect and responsibility, and fairness and honesty, which are traits that are reflective of one's character, which is something BHGH is trying to develop in each of their students. I also chose this survey because she measured its reliability, which is very important when using survey results as a dependent variable in my analysis. Johns explains in her report that the reliability coefficient for her survey ranges from 0.70 to 0.88, as measured by Cronbach's Alpha, for students, showing that this survey can be deemed reliable (Johns 60). Cronbach's Alpha is a measure of the overall reliability of the survey test as a whole, rather than the reliability of each individual question, since it tests the internal consistency of the survey. Therefore, I am reasonably certain that my survey is reasonably reliable since I only slightly changed some of the questions to questions that are very similar. When I found the survey online I tried to contact Johns and other members of the Utah State Office of Education to ask their permission to use the *Character Development Survey*, but I was unsuccessful in reaching them. Since my project did not require me to distribute or show the survey to anyone, I proceeded with the hypothetical analysis based on the survey. If BHGH wishes to use the *Character Development Survey* in the future, I will encourage them to gain the appropriate permission in order to distribute the survey to their students.

Once I manipulated the *Character Development Survey* to fit my project's needs, I created simulated survey test results for each student. I gave each student a pre-program and post-program survey test result. The pre-program survey test result represents an applicant's answers to the survey before being accepted into the program and the post-program survey test

result represents the student's answers to the survey after completing the Hope Prep summer program. If BHGH wishes to use my model to assist them during the application process, they will have to distribute the *Character Development Survey* to the applicants and make it a requirement for applying to the Hope Prep program. This would allow BHGH to compare the pre-program and post-program survey results to measure how much each student's character has changed over the course of the program.

The final step in my analysis was to create the prediction model that BHGH could use to be more efficient when determining which students to accept into the Hope Prep program. After some discussion with my advisor Dr. Short, I decided to use gender, region, Math OGT test score, Reading OGT test score, and pre-program survey test score as the independent variables in my analysis to predict the post-program survey test score, or the dependent variable. I chose to use the post-program survey test score as the dependent variable, instead of the change in the pre-program and post-program survey scores, because I wanted BHGH to be able to determine which students would have the best character at the end of the program if accepted. If BHGH so chooses, it would be an easy modification to make the change in survey test scores the dependent variable rather than the post-program survey test score, so the model would be predicting how much this measure of character could develop during the program. It is up to BHGH to choose whether they would like to accept into their program the students who would have the best character at the end of the program, or those whose character would develop the most during the program, but for my analysis I chose the former.

I used a linear regression model in R to build an equation that BHGH can use to predict the post-program survey test score for each student applicant. I used the students' gender, region, Math OGT test score, Reading OGT test score, and the simulated pre-program survey test score

as the predictors in my model. The linear regression model takes these designated predictors, or independent variables, and uses them to create an equation that the interpreter of the model can use to predict values for the dependent variable. The resulting model that I was able to obtain from R to predict the students' post-program survey test scores is below:

Predictor:	Coefficient:
Intercept	7.5
Quantitative Variables:	
Pre_Program Survey Score	0.81
Math OGT Score	0.07
Reading OGT Score	0.003
Categorical Variables:	
Gender = Male	-0.22
Region = Chester	-0.80
Region = Cleveland	-0.45
Region = Cuyahoga Falls	-2.16
Region = Euclid	-2.92
Region = Hunting Valley	+1.37
Region = Parma Heights	+1.87
Region = University Heights	+4.84

The above model is split into multiple categories because each type of variable affects the model differently. The intercept acts as a constant in the equation and the coefficients for the

quantitative variables (Pre-Program Survey Score, Math OGT Score, and Reading OGT Score) act as slopes for their corresponding variables' inputs. When a linear regression model is made, R chooses one of the categorical data values to set equal to zero and then the interpreter of the model must make adjustments if the categorical value of the inputs is different from the designated value. I was able to determine from R that the female gender and Akron region were the categorical variables that were set at zero, and that the adjustments that must be made to the prediction equation are the coefficients for the categorical data for students who are not both female and from Akron. That is, a female student from University Heights must add 4.84 to the equation containing the quantitative variables and intercept.

The linear regression model in R not only provided the above model to predict the post-program survey test scores, but it also gave p-values for the independent variables to allow me to assess the statistical significance of the post-program survey test score. Since the model was made to predict a variable that was based on simulated data, it is not surprising that the only statistically significant predictor of the post-program survey score is the pre-program survey score. With the addition of real data, one will be able to recreate this prediction model and then remove any insignificant predictors from the new equation to create a more accurate prediction model. To do this, one would need to remove the least significant predictor of post-program survey test score from the model and continue to do this until what is left are only statistically significant predictors of the post-program survey test score. The finalized prediction model will be able to predict how much the students' characters will change throughout the program, and will thus allow BHGH an efficient way to screen through applicants.

Conclusion

My final statistical model can be used to show BHGH what can be done with the data they currently collect from applicants along with the addition of a survey similar to the *Character Development Survey*. The first step in my analysis was to find the *Character Development Survey* that would allow me to measure students' characters in a numerical way. When the students take the *Character Development Survey*, they choose an answer for each question based on a scale from 1 to 3, and therefore the interpreter of the survey will be able to easily associate a numerical value to the students' characters. Although I chose to use this survey in my analysis, BHGH could easily replace this survey with another Likert-type scale survey as long as they can verify the new survey's reliability. After I chose the *Character Development Survey*, I simulated survey results for each of the students to represent the students' characters during the application process and the students' characters after completing the Hope Prep program. The simulated post-program survey test scores were used as the dependent variable in my analysis since BHGH prides itself on developing students' characters. By choosing a character survey as the dependent variable, my resulting hypothetical statistical model will allow BHGH to predict how much their students' characters will develop during the program. Once BHGH collects the data needed for this model, they can create another linear regression model like the one I have created to predict the applicants' characters at the end of the Hope Prep program. BHGH can use this statistical model during the application process because they can use the students' background information and pre-program survey test scores to highlight the students who could potentially benefit the most from the program.

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