

Indiana High Ability Students

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Abstract—Students across the country are analyzed since the beginning of their academic careers for potential scholarly success. High ability students are often identified in elementary school due to increased performance in comparison to their peers. They exemplify a stellar understanding of the material and typically are within higher percentiles in state qualification exams. This study concentrates on the demographics displayed by high-ability students within the state of Indiana. Data provided by the Indiana Department of Education prompted testing of how gender itself played a role in the number of high ability students there are, and whether or not there was a causal explanation for a higher intake of high ability students of a specific gender.

Keywords—*high ability students, school, county, Indiana Education*

I. INTRODUCTION

Students across the country begin their academic journey typically at similar education levels. However, as students progress through the school system they are evaluated through test scores and general surveying of their grades. Based on these previous parameters, schools assign high-performing students to high-ability courses or to entirely separate individual classes. These courseloads can begin in elementary school and extend their way until high school. In the state of Indiana, high ability students are categorized beneath the following guidelines:

Performs at, or shows the potential for performing at, an outstanding level of accomplishment in at least one domain when

compared to other students of the same age, experience, or environment; and:

Is characterized by exceptional gifts, talents, motivation, or interests (IC 20-36-1-3). [5]

We chose to analyze high-ability student data due to the availability of datasets provided by the Department of Education as well as the prominence of high-ability courses among high schools and colleges throughout the entire nation. It is also interesting in general to see the background of high-ability students and whether or not there are certain patterns within each background that this may be linked to, and the overall potential of a student for academic success.

II. BACKGROUND RESEARCH

Background research focused on categorizing information from a high-level perspective explanation of differences in high-ability students to low-level perspectives.

Prior research we observed studied the implications of certain factors like gender and whether that provided extra benefit for students. Vicki Bartosik Stocking and David Goldstein from Duke University's talent acquisition program designed a study held to observe differences between the academic success of males and females. The program selected participants based on SAT test scores from students across southeast and midwestern states in the United States. Selected participants then were assigned to courses from various subjects as history, languages, mathematics, and writing. Students were then evaluated after the completion of the course for their proficiency in material learned, as well as their general attitude throughout the entirety of the course. From these scores, it was found that there was no significant

difference between females and males in terms of performance [2].

Bartosik Stocking and Goldstein expected to find similar findings to previous ideas that traditional gender roles in the classroom would inhibit performance. However, each respective gender performed almost equally well in the opposite gender role courses [2].

Academic aptitude has been studied time and time again with differing results being debated among researchers. Researchers Cristina Tulbure and Codruța Gavrilă analyzed this point of tension once again discussing the possibility of gender affecting academic achievement. However, Tulbure and Gavrilă mention that the largely presented consensus is that academic aptitude cannot solely be attributed to gender, but is based on multiple factors such as a student's health, their psychological motivation, and their field of study [3]. Instead of heading for the same approach, the study observed the potential for emphasis of academic underachievement or overachievement based on gender. Students within the study were analyzed for the previously mentioned factors through a personality questionnaire that was specifically catered to understand the sixteen different types of personalities as well as the different types of learning strategies. These kinds of intellectual tests were selected for their ability to be translated into previous success within secondary education, which would later manifest itself into undergraduate experiences [3].

Results were analyzed using a "Bravais - Pearson (r) correlation coefficient value and identification of t-test value for independent samples" [3]. Findings from the study concluded a stark contrast emphasizing academic overachievement within females and academic underachievement within males. Tulbure and Gavrilă speculate this difference may be attributed to the social conformity associated with the female organizations. Additionally, the authors note the possibility of females handling demands more efficiently than males, who under traditional societal norms are more independent [3]. The switch to higher education could thus prove difficult for males. These findings were further supplemented by the correlation between gender personalities and achievement based on the

Bravais-Pearson correlation [3]. This found that females were more incentivized to complete work with a relaxing attitude. Underachieving males on the other hand had a common trait regarding a need for independence and repulsion towards subservience, including the academic sense. This in combination with lower self-esteem values found within the tests for males was seen as a deterrent to their academic achievement [3].

Another potential link seen between gender and academic achievement is the attention and impulse control differences seen between respective sexes. Authors Masoumeh Alavi1, Jyi H. Seng, Mohamed S. Mustafa, Mohd T. Ninggal, Mansour Amini, and Adibah A. Latif from the Universiti Teknologi Malaysia studied the effects of attention span between each sex [1]. Previous studies offer conflicting data, but some have witnessed a general trend. Results from the aforementioned author's study displayed males having far lower attention spans. However, the regression coefficient found between gender and attention spans was not significant. The same result was found for impulse control in relation to gender [1]. A possible reason for a lack of significance between gender and the respective variables was discussed by the authors as males having sufficient control over regulating their attention spans to maintain their academic achievement. [1].

III. OBJECTIVE & DATA DESCRIPTION

The objective of this project is to study high-ability students in the state of Indiana broken down by gender.

The data utilized within our study is provided by the Indiana Department of Education. This information is collected every year for data analysis purposes used by the state for student performance and progress across time. State results go back to 2013 for specific subsections of information. However, a majority of the information provided is from the past three years. Other resources provided by the Department of Education include the following school and corporation reports: ILEARN, ISTEP+, I AM, and IREAD-3 exam scores. There are also specific State A-F reports from grade results from a corporation and separate school level. In-depth information on high school exams such as IB and AP exams is also on display.[6] Student data is

organized based on the individual school they are a part of, each school is assigned to a specific corporation. Corporations are each located within a specific county that is then compared with all counties in the state.

State exams are issued to observe corporation, school, and student competency within the varying subject matter. The subject matter is chosen through Indiana Academic Standards. LEARN as outlined by the Indiana Department of Education tests the aptitude of the following topics:

- English/Language Arts (ELA) (Grades 3-8)
- Mathematics (Grades 3-8)
- Science (Grades 4 and 6)
- Social Studies (Grade 5)
- Biology*

While ILEARN specifically targets students from elementary and middle school to test for proficiency, ISTEP is solely focused on high school students. ISTEP proficiency centers on the proficiency of 10th graders in mathematics and English/language arts.

The I AM examination, a.k.a. Indiana's Alternate Measure tests students who have cognitive disabilities in elementary school up to high school. The Indiana Department of Education also provides specific subjects tested for proficiency:

- English/Language Arts (Grades 3-8 and 10)
- Mathematics (Grades 3-8 and 10)
- Science (Grades 4, 6, and Biology)
- Social Studies (Grade 5)

Finally, the IREAD-3 is specifically catered towards reading evaluation and determination. Third-grade students are tested in the spring every year to determine their reading abilities.

IV. METHODOLOGY

Within data mining, there are many techniques that can be used in order to gather information off of data sets but they are all dependent on what kind of answers someone would want from that data set and also other variables in that data set such as missing data. For our primary data mining technique, we are using a decision tree. Decision trees were created by JR. Quinlan based

on an algorithm called ID3. This algorithm would employ entropy and information gain in order to create the decision tree itself.

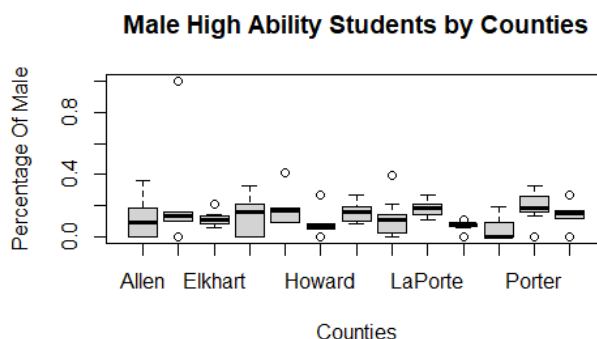
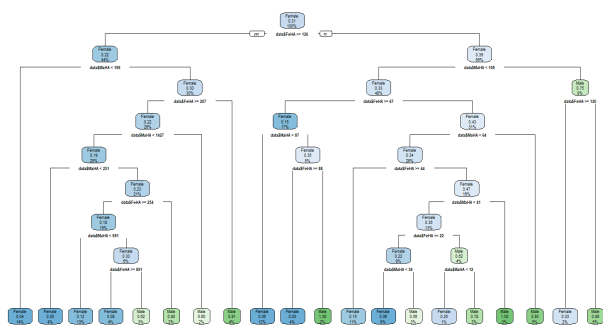
Decision trees can be used to visually represent decision choices and decisions that can be made within a data set. It is also worth mentioning that decision trees can be made manually through the use of a pen and paper or they can be made by using software such as the programming language R. These decision trees are a supervised learning method and are also a classification technique which is a systematic approach to building classification models based on an input data set. For a decision tree to get started, we would have to select a class label from the data set first. To explain what a class label is, it is the outcome that we want to predict based on earlier nodes on the tree. After a class label is selected, we would have to select which attributes we would want the class label to make a decision from.

Other techniques we used were aggregation and box and whisker plots. We thought box and whiskers plots would be useful to determine the Interquartile values of each county. Aggregation of data helped us determine the percent mean of each county. This helped us further unravel our analysis.

The reason why we are using a decision tree as our primary method is the nature of our data set. Our data set has missing data in it and by using a decision tree, we will still be able to come to an outcome despite the missing data. Another reason why we are using a decision tree as our primary method is that it is relatively straightforward to implement with our data set.

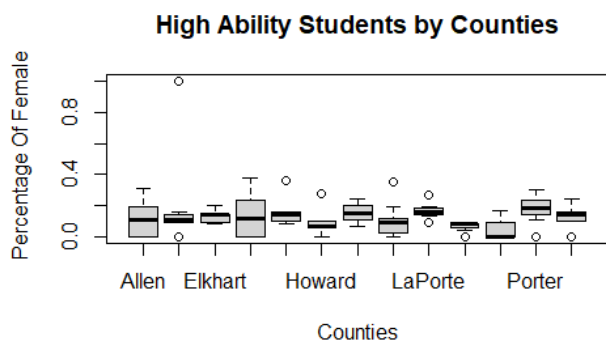
V. ANALYSIS & RESULTS

High ability students in Indiana are more likely to be female. While conducting research on this topic it's important to keep in mind that our data was separated between female and male high ability students. Challenges from this will be discussed in future sections. We found using decision trees that females were more highly to be the high ability students with more than 70% of the descriptive labels in our decision tree coming out to female. (Image found below)



(Male aggregation by county)

While doing further analysis on our data, we found that out of the fourteen counties we studies, females had a higher average of high ability in ten out of fourteen. This only further proves our hypothesis that females have a high probability of being high-ability students in the state of Indiana.



(Female aggregation by county)

In the charts provided, you can see all the counties that have more than five schools in our data set. At first glance, Delaware has a significant outlier, and Hamilton has the highest mean in the male percentages and LaPort has the highest percentages for the females. This tells us that male high-ability students seem to be located in schools that have higher test schools overall [4] and females tend to be in schools that only have the average test score according to the state. [4]

Further analysis on our data of high ability students concluded that the population of each county does not seem to have a direct impact on whether or not students, male or female, tend to be a high- ability student. Overall this data set proved to be fruitful and gave some great insight into the high-ability students of the state of Indiana.

County	PHAF	PHAM
Allen	0.120	0.118
Delaware	0.221	0.212
Elkhart	0.114	0.127
Hendricks	0.185	0.165
Hamilton	0.151	0.153
Howard	0.090	0.095
Johnson	0.160	0.153
Lake	0.102	0.092
LaPorte	0.180	0.167
Madison	0.071	0.065
Marion	0.038	0.035
Porter	0.194	0.177
Wayne	0.143	0.131

VI. CHALLENGES

Our data was in the end pretty difficult to work with. When we tried to conduct predictive analysis, it wasn't doing what we wanted it to because our data didn't work well for the type of analysis we learned in this class. We did look into other methods to be able to predict our analysis such as "K Nearest Neighbor". The reason our data was difficult to work with was that we had two columns under one category.

An example of this was for our high-ability student, we had both female and male numbers. We assumed this would make our decision trees and other analysis easier to work with, but were proven wrong when our analysis wasn't producing the number we wanted. Overall, this data was difficult to work with but did teach us about working with different types of data sets and the need for specific/ the correct methods when doing analysis on any data set.

VII. CONCLUSION/FUTURE WORK

To reflect on our hypothesis, we can conclude that females do have a higher chance of being of high ability than males.

There can be many different factors that can be inferred that can lead to that conclusion. Questions to ask for possible research would be things like:

- Does the environment affect if a female will be a high-ability student?
- Are small population towns or are high population towns more likely to have high-ability female students?
- Does a paid lunch or reduced lunch determine if a student is of high ability?

In the future, we want to implement free or reduced lunch statistics in our analysis to answer the

question of if a paid or free lunch determines if a student will be of high ability.

We also want to refine our methodology and techniques to get an even clearer picture of the analysis than the one that we currently have. The process of this could even include picking a similar high-ability student-based dataset but with added numerical attributes.

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