


Chapter 13


Predictive Analytics in Educational Outcomes: Analyzing High School Students' Performance in Mathematics

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ABSTRACT

Using a large dataset that includes students' grades, demographic information, and other educational variables from three American high schools, this research work investigates the predictive modeling of students' mathematical performance. Gender, race/ethnicity, parental education, lunch subsidy status, standardized test results (math, reading, and writing), and course enrollment in test preparation are all part of the dataset. The purpose of this study is to examine the relationship between students' socioeconomic status and their mathematical achievement and to discover important predictors of this achievement using sophisticated machine learning algorithms such as ensemble methods, decision trees, and linear regression. A more complex picture of the factors that lead to mathematical achievement can be gained from the study, which uncovers illuminating relationships across demographic variables, educational interventions, and academic results. The results highlight the promise of predictive analytics for developing individualized plans to improve students' educational experiences. Educators, legislators, and future researchers can benefit from data-driven methods of educational planning and decision-making,

DOI: 10.4018/979-8-3693-3641-0.ch013

which is highlighted in the paper's examination of the findings' ramifications.

INTRODUCTION

The field of education stands out as a domain that is suitable for the use of predictive analytics, which has emerged as a revolutionary force across a variety of different industries. Understanding student performance and finding ways to improve it continues to be a primary issue for educators, legislators, and other stakeholders in the field of academic attainment. The purpose of the research paper titled “Predictive Analytics in Educational Outcomes: Analyzing High School Students' Performance in Mathematics” is to investigate the complex landscape of educational data to discover patterns, correlations, and insights that can be used to inform effective interventions and strategies that are aimed at improving mathematical competencies among high school students.

A comprehensive dataset that encompasses a wide range of variables plays a central role in this investigation. These variables include demographic factors, parental educational backgrounds, access to resources, and prior academic achievements. All of these variables are investigated for their potential impact on students' math scores. The study begins by establishing a basic understanding of the data distribution using a careful exploratory data analysis (EDA). This understanding highlights major trends, discrepancies, and the varied nature of factors that influence mathematical performance. Using this framework, the study utilizes advanced predictive modeling techniques to forecast math scores. These techniques make use of a set of models that range from Linear Regression to more complex algorithms such as Random Forest and Gradient Boosting. The comparative study of these models not only highlights the predictive powers that are inherent in the data, but also throws light on the relative relevance of individual predictors, providing a deeper knowledge of the factors that determine success in mathematics.

Through the process of synthesizing these data, the research not only contributes to the academic debate on educational analytics but also gives practical implications for educational tactics that are suited to the individual. The study recommends focused interventions that address the main reasons for underperformance so that it can pave the way for a more data-driven and individualized approach to education. This is accomplished by identifying the variables that have the most significant impact on math scores. This paper serves as a testimonial to the power of predictive analytics in unlocking the potential of educational data. It also provides a road map for harnessing this potential to cultivate an atmosphere in which every student is provided with the skills and opportunities necessary to excel in mathematics. When viewed through this lens, the research goes beyond the scope of a simple academic inquiry

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