Title: Predicting Academic Success: Machine Learning Analysis of Student, Parental, and School Efforts

Author: Yingying Zhang
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1. Introduction

Academic success is influenced by multiple factors, including student engagement, parental involvement, and institutional support. This study applies machine learning techniques to determine the relative impact of these factors on student performance. Using data from the **China Education Panel Survey (CEPS)**, the research identifies key predictors of academic achievement through a comparative analysis of multiple ML models.

2. Dataset and Features

The study utilizes the CEPS dataset, which includes:

- **Student Efforts**: Study hours, participation in extracurricular activities, attendance, self-discipline.
- **Parental Efforts**: Parental education level, involvement in homework, frequency of discussions about school performance.
- **School Efforts**: Teacher qualifications, class size, availability of academic resources, institutional policies.

3. Machine Learning Models Used

Four machine learning algorithms were employed to analyze and predict academic success:

- **Lasso Regression**: Used for feature selection and identifying the most significant predictors.
- **Random Forest**: Applied for handling non-linearity and ranking feature importance.
- **AdaBoost**: Utilized to improve prediction accuracy by combining weak learners.
- **Support Vector Regression (SVR)**: Selected for its robustness in handling high-dimensional data.

4. Findings and Analysis

- **Random Forest emerged as the best-performing model**, effectively capturing complex relationships between student, parental, and school efforts.
- **Parental involvement, especially in early education, showed the highest correlation with academic success**.
- **Student self-discipline and study habits were strong predictors of performance, surpassing institutional factors in impact**.
- **Machine learning models highlighted that while school infrastructure matters, parental support and student motivation are more influential.**

5. Conclusion and Future Directions

The study demonstrates that ML techniques can effectively predict academic success by analyzing various effort-related factors. Future research could integrate real-time behavioral data and apply deep learning models for more dynamic predictions.

6. References

Yingying Zhang. "Predicting Academic Success: Machine Learning Analysis of Student, Parental, and School Efforts." *Asia Pacific Education Review*, March 2025.