**Kottu.saikumar  
mail:kottusaikumar@2003**

**Student Academic Performance Prediction Report**

**Summary**

We studied student performance in Math and Portuguese subjects to understand which factors influence their final grades and whether we can predict these grades using machine learning.

We used data from:

* 395 students who took the Math course
* 649 students who took the Portuguese course
* 382 students who took both courses

Main Finding:  
It is difficult to accurately predict student grades. Even our best models could explain only 18 to 22 percent of the differences in final grades. This means that many other factors outside the data likely affect student performance.

**Methodology**

**About the Data**

* No missing or duplicate values
* Each student had 33 features such as study time, number of past failures, family background, health, and more

**Data Processing**

* Converted text categories (like yes or no) into numbers
* Encoded other text fields like school, job, and guardian into numerical values
* Used around 30 features to build models for each subject

**Machine Learning Models Used**

1. Linear Regression – a basic model
2. Decision Tree – captures more complex patterns
3. Random Forest – a powerful model that combines multiple decision trees

We tuned the models and tested them using cross-validation to ensure fair results.

**Key Findings**

**Grades Overview**

* Average Math final grade was 10.4 out of 20
* Average Portuguese final grade was 12.5 out of 20
* Students who did well in one subject tended to do fairly well in the other (moderate positive correlation)

**Factors That Affected Performance the Most**

For Math:

1. Absences – more absences led to lower grades
2. Number of previous failures – strong negative impact
3. Health – students in better health scored higher
4. Time spent going out – more social time often led to lower scores
5. Age – older students tended to have lower grades

For Portuguese:

1. Number of previous failures – most important factor
2. Absences – students who attended more classes did better
3. School type – some schools performed better than others
4. Father's education level – more educated fathers related to better performance
5. Alcohol use on weekends – more drinking was linked to lower grades

Shared important factors across both subjects:

* Past academic failures
* Class attendance
* Age
* Father's education
* Health status
* Free time and social habits

**Model Performance**

Best model: Random Forest

For Math:

* R squared score: 0.18
* Mean Absolute Error: about 3.4 points
* This means the model can predict the final grade within plus or minus 3.4 points on average

For Portuguese:

* R squared score: 0.22
* Mean Absolute Error: about 2.0 points
* This means the model can predict the final grade within plus or minus 2.0 points on average

Limitations:

* The models only explain part of the grade variation
* The models perform less accurately for students with very high or very low grades
* Portuguese grades were easier to predict than Math grades

**Recommendations**

For Schools:

* Monitor and reduce student absences early
* Give extra support to students who have failed before
* Consider health and wellness as part of academic support

For Families:

* Help children maintain regular attendance
* Act quickly if a student struggles or fails
* Encourage a healthy balance between social life and study time
* Support students’ health and involve family members in their education

**Limitations and Suggestions for Future Work**

Current Limitations:

* The models do not capture all the personal or environmental factors that affect grades
* Motivation, teaching quality, and learning style are not included in the dataset

Future Suggestions:

1. Collect more detailed data, including study habits, home environment, and teacher feedback
2. Use more advanced models like deep learning for complex patterns
3. Build systems that give early warnings if a student’s performance starts to drop

**Conclusion**

Academic performance is influenced by many factors. While it is hard to predict grades perfectly, this study shows that some key areas matter a lot, such as attendance, past academic failures, and family support.

These insights can help schools and families provide better support for students. However, every student is different, and no model can replace personalized attention and care.

Final Thought:  
Success in school is not just about study time. It also depends on health, support from family and teachers, and consistent effort.