Document 3: Predictive Analytics and Student Outcomes

Title: Early Warning Systems: Using Machine Learning to Predict and Prevent Student Attrition

Abstract:

Student retention is a critical challenge for higher education institutions worldwide. This thesis presents a comprehensive study of machine learning approaches for predicting student attrition and informing targeted interventions. Using data from 10,000 students across multiple cohorts, we develop predictive models that identify at-risk students with 85% accuracy. The research demonstrates that early warning systems, when combined with proactive academic advising, can significantly improve retention rates. We explore various ML algorithms including logistic regression, random forests, and gradient boosting, comparing their performance and interpretability. Our findings show that engagement metrics and academic performance patterns are the strongest predictors of student success. Implementation of our framework across three pilot institutions resulted in a 12% improvement in retention rates.

Chapter 1: Background and Context

Student attrition remains a persistent problem in higher education, with average graduation rates varying significantly across institutions. Many universities lack systematic approaches to identifying at-risk students early enough for meaningful intervention. Traditional advisory models are reactive rather than proactive, often engaging students only after academic difficulties become apparent. Artificial Intelligence and machine learning offer new possibilities for data-driven student support.