HEALTHFIN AI: A UNIFIED MACHINE LEARNING FRAMEWORK FOR FINANCIAL STRESS–DRIVEN MENTAL HEALTH RISK PREDICTION

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Abstract

Financial stress is increasingly recognized as an important factor associated with psychological well-being, yet financial and mental-health indicators are often examined as separate domains. This study presents HealthFin AI, a unified machine learning framework for investigating financial stress as an indicator of mental-health risk among university students. The framework integrates financial, academic, and career-related stress indicators with supervised machine learning to support interpretable early risk screening. An anonymized dataset comprising 304 university students from Bangladesh was analysed, and mental-health symptom risk was derived from eight self-reported symptom indicators and categorized into low, moderate, and high-risk groups. Logistic Regression, Random Forest, and XGBoost models were evaluated using stratified 10-fold cross-validation. Financial-only, academic-only, career-only, combined, and unified feature configurations were compared using accuracy, precision, recall, F1-score, balanced accuracy, and ROC-AUC. For high-risk screening, the unified Random Forest achieved the highest ROC-AUC of 0.721, while the financial-plus-academic configuration achieved an F1-score of 0.396 and an ROC-AUC of 0.716. These findings indicate that financial-stress indicators contain measurable information associated with mental-health risk, while combining financial and contextual stressors can improve risk discrimination. The framework is intended for exploratory risk screening rather than clinical diagnosis, and the proposed Unified Wellbeing Index is presented as a research metric requiring further validation. The findings are limited by the self-reported, student-based Bangladeshi dataset and should not be generalized to clinical or other populations without external validation.

Keywords: Machine Learning, Financial Stress, Mental Health Risk, Explainable AI, Risk Prediction