**Abstract**

Depression is a prevalent mental health condition characterized by persistent sadness, lack of interest in daily activities, and impaired functioning. It is influenced by various demographic, psychosocial, and environmental factors, including academic pressure, socioeconomic status, and sleep deprivation. This project aims to predict depression using machine learning methods based on demographic and survey data collected from undergraduate students. The study employed multiple classification methods, including Logistic Regression, Decision Trees, Random Forest, and ensemble techniques. The Random Forest algorithm emerged as the most effective, offering the highest accuracy and robust predictive capabilities. The analysis was conducted in R Studio using R Markdown to ensure reproducibility. This study underscores the potential of machine learning in identifying at-risk populations and highlights the Random Forest model's effectiveness in predicting depression based on survey data.

**Introduction**

Depression is a complex mental health disorder that affects millions globally and is particularly prevalent among university students. Characterized by symptoms such as persistent sadness, feelings of worthlessness, and loss of interest in activities, depression can significantly impact academic performance and overall well-being. Various factors contribute to its development, including academic stress, socioeconomic challenges, and comorbid mental health conditions. Previous research has emphasized the importance of identifying depression early, particularly in student populations, where the condition often goes undiagnosed or untreated

This study seeks to predict depression among undergraduate students using demographic and survey data, applying advanced machine learning methods. Utilizing R Studio and R Markdown, the project implemented various classification models, including Logistic Regression, Decision Trees, and ensemble methods. Random Forest proved to be the most effective, demonstrating superior accuracy and robustness. By leveraging these tools, this study aims to identify key predictors of depression and offer a reliable method for early detection, contributing to improved mental health outcomes in academic settings.

Depression among students is influenced by a range of factors, including academic pressure, socioeconomic status, sleep deprivation, and comorbid mental health conditions, all of which significantly impact their Health-Related Quality of Life (HRQoL). A study of 5,535 students across 26 U.S. colleges revealed that female, minoritized, and lower socioeconomic status students reported lower HRQoL, with gender and sexual orientation being key influences. Additionally, comorbid mental disorders, such as anxiety and depression, universally reduced HRQoL, underscoring the compounded impact of multiple stressors. While the study focused on college students, the findings suggest similar trends are likely in younger populations, emphasizing the need for tailored interventions to support vulnerable groups facing compounded mental health challenges.

Academic stress has significant mental health consequences, particularly for students in competitive environments such as engineering programs in India. A study of 395 engineering students revealed that academic amotivation mediates the relationship between stress and mental health, often leading to anxiety, depression, and feelings of inadequacy. Factors like parental pressure, identity centrality, and upward social comparisons exacerbate stress levels, with male students reporting better mental health but lower extrinsic motivation compared to female students. Parental expectations and the pressure to excel in coaching classes frequently lead to mental exhaustion, even before college, creating a cycle of stress and deteriorating well-being. The study emphasizes the role of Self-Determination Theory (SDT) in understanding how intrinsic and extrinsic motivation affect students' resilience to stress. Addressing these challenges requires targeted interventions to reduce stress, foster healthy motivation, and provide gender-specific support systems for students in high-pressure academic settings.

Anxiety and depression are prevalent among school students, as highlighted by a study conducted by Malak and Khalifeh (2018) involving 800 students aged 12-18 years from 10 public schools in Amman, Jordan. The research revealed that 42.1% of students experienced anxiety, while a significantly higher proportion, 73.8%, exhibited symptoms of depression. Internet addiction emerged as the most prominent predictor of both mental health issues, indicating a strong link between excessive online activity and psychological distress. Other risk factors included school class and sociodemographic variables. The study emphasized the urgent need to raise awareness about student mental health among educators, parents, and stakeholders, advocating for the establishment of counseling programs and mental health support systems within schools. These findings align with global concerns about the impact of digital technology on adolescent mental health and underscore the importance of targeted interventions to mitigate these effects.

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