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Comparative Analysis of Mental Health Survey Using Various Machine Learning Techniques

Sahil Tomar
CSE-AIT
Chandigarh University
Mohali, India

Shashank
CSE-AIT
Chandigarh University
Mohali, India

Aryan Negi
CSE-AIT
Chandigarh University
Mohali, India

Dhruv
CSE-AIT
Chandigarh University
Mohali, Ind

Abstract*— Mental well-being in the corporate sector is paramount for employee productivity and satisfaction. This research presents a comparative analysis of mental health surveys utilizing various machine learning techniques to offer insights crucial for targeted interventions. Using a variety of techniques, including Decision Trees, Regression, Support Vector Machines, we systematically evaluate predictive accuracy, feature importance, and model interpretability. Our study unveils key determinants influencing employees' mental health, facilitating tailored strategies for fostering psychological well-being. Through rigorous benchmarking, we identify the most effective approaches for predicting and understanding mental health outcomes, empowering organizations to proactively address workforce mental health challenges.

Keywords*— Mental health, corporate sector, machine learning, comparative analysis, predictive accuracy, feature importance, model interpretability, targeted interventions.

I. INTRODUCTION

In contemporary corporate environments, the significance of employee mental health cannot be overstated, as it profoundly impacts organizational productivity and employee well-being. Mental health surveys serve as crucial tools for assessing and addressing these concerns. This study aims to conduct a comprehensive comparative analysis of mental health surveys using diverse machine learning techniques. By evaluating predictive accuracy, feature importance, and model interpretability across various algorithms, this research seeks to uncover nuanced insights into the determinants of employee mental well-being. The findings are anticipated to inform targeted interventions and strategies aimed at enhancing psychological wellness in the workplace.

Hardware Specifications:

The Study utilize a high performance computing setup , comprising an Intel Core i7 processor running at a frequency of 3.5 GHz, paired with 16 GB of DDR4 RAM. Data storage and processing were facilitated by a solid-state drive (SSD) with a storage capacity of 512 GB, operating within the Windows 10 environment. Furthermore, to enhance computational efficiency, an NVIDIA GeForce RTX 3080 graphics processing unit (GPU) with 10 GB of GDDR6X memory was employed. These hardware configurations were instrumental in providing the requisite computational prowess and memory resources essential for conducting thorough machine-learning analyses on extensive datasets.

Software Specifications:

The research utilized a range of software tools and libraries tailored for machine learning and data analysis tasks. Python programming language, specifically version 3.9, served as the primary scripting language for algorithm implementation and data manipulation. Key libraries included scikit-learn for machine learning algorithms, pandas for data preprocessing, and matplotlib/seaborn for data visualization. Additionally, Jupyter Notebook provided an interactive computing environment for code development and documentation. All analyses were conducted using the Anaconda distribution to ensure compatibility and ease of package management. These software specifications facilitated efficient experimentation and robust analysis of mental health survey data.

Problem Overview:

Mental health issues in the corporate sector have become increasingly prevalent, adversely affecting employee well-being and organizational productivity. Traditional methods of assessing and addressing these concerns often lack efficiency and effectiveness. Moreover, the complex interplay of various factors influencing mental health outcomes necessitates a more nuanced approach. This research aims to tackle these challenges by conducting a comparative analysis of mental health surveys using advanced machine learning techniques. By identifying key determinants and evaluating predictive models, the study seeks to provide actionable insights for implementing targeted

interventions to enhance employees' psychological well-being in corporate environments.

II. LITERATURE REVIEW

[1] This study compares machine learning techniques for predicting stress levels among employees in workplace environments. Random forests, gradient boosting machines, and artificial neural networks are among the methods evaluated for predicted accuracy and robustness.

[2] This research compares machine learning techniques for identifying early signs of depression in corporate surveys. Various algorithms, including decision trees, support vector machines, and ensemble methods, are evaluated for their sensitivity and specificity.

[3] This study compares machine learning algorithms for predicting burnout among employees in the workplace. Various techniques, including logistic regression, support vector machines, and deep learning models, are evaluated for their accuracy and generalization performance.

[4] This meta-analysis compares the effectiveness of machine learning techniques for mental health assessment in workplace settings. The study synthesizes findings from multiple research articles to identify trends and best practices in the field.

[5] This research compares supervised learning models, including random forests, gradient boosting machines, and artificial neural networks, for predicting mental health outcomes in corporate environments. The study evaluates model performance and feature importance.

[6] This study compares the performance of machine learning algorithms in the early detection of mental health issues using workplace survey data. Various techniques, including logistic regression, decision trees, and k-nearest neighbours, are evaluated for their predictive accuracy.

[7] This research compares the effectiveness of machine learning techniques, including decision trees, support vector machines, and ensemble methods, in predicting mental health risks in workplace settings. The study examines the predictive accuracy and interpretability of each method.

[8] This study investigates the effectiveness of deep learning models, such as convolutional neural networks and recurrent neural networks, in predicting mental health outcomes. The research compares the performance of deep learning techniques with traditional machine learning algorithms.

[9] This research compares support vector machines and logistic regression models in analyzing mental health survey data. The study evaluates the performance of both techniques in terms of predictive accuracy and feature importance.

[10] This study compares the performance of different machine learning algorithms in predicting mental health outcomes based on workplace survey data. Various techniques, including decision trees, random forests, and neural networks, are evaluated for their accuracy and interpretability.

III. PROPOSED SYSTEM

The proposed system for conducting the Comparative Analysis of Mental Health Survey Using Various Machine Learning Techniques consists of several key components designed to facilitate comprehensive data analysis and model evaluation.

- **Data Acquisition and Preprocessing Module:** This module is responsible for acquiring mental health survey data from corporate environments. Data preprocessing techniques such as cleaning, normalisation, and feature engineering will be used to assure data quality and preparation for analysis.
- **Machine Learning Model Selection Module:** The system will include a module for selecting and configuring various machine learning algorithms suitable for mental health analysis. Decision trees, support vector machines, logistic regression, neural networks, and ensemble methods will be considered for their predictive capabilities.
- **Model Training and Evaluation Module:** This session will consist of training selected machine learning models on pre-processed data and assessing their performance using appropriate evaluation measures such as accuracy, precision, recall, and F1-score. Cross-validation techniques will be used to determine model generalisation.
- **Comparative Analysis Framework:** The system will perform a comparative analysis framework to systematically benchmark the performance of each machine learning algorithm. Metrics including predictive accuracy, feature importance, and model interpretability will be compared across different algorithms.
- **Visualization and Interpretation Module:** To aid in the interpretation of results, the system will include a module for visualizing key findings and insights derived from the comparative analysis. Graphical representations such as bar charts, and decision trees will be utilized to enhance interpretability.
- **Recommendation Engine:** Based on the comparative analysis results, the system will generate recommendations for the most effective machine learning techniques for predicting and understanding mental health outcomes in corporate settings. These recommendations will guide the implementation of targeted interventions to improve employees' psychological well-being.
- **Extensibility and Scalability:** The proposed system will be designed with scalability and extensibility in mind, allowing for the integration of additional machine learning algorithms and modules in the future. This flexibility ensures that the system can adapt to evolving research needs and incorporate advancements in the field of mental health analysis.

IV. METHODOLOGY

The methodology is structured into several phases, each focusing on specific tasks and objectives:

1. **Data Collection:** Obtain mental health survey data from corporate environments through partnerships with organizations willing to share anonymized data. Ensure compliance with ethical guidelines and data privacy regulations.
2. **Data Preprocessing:** Remove missing values, outliers, and inconsistent data from the collected data. As needed, carry out feature scaling and data normalisation. Analyse exploratory data to learn more about the properties of the dataset.
3. **Feature Selection and Engineering:** Using domain expertise and a review of the literature, determine pertinent features associated with mental health outcomes. To choose informative features and, if necessary, engineer new ones, use methods like principal component analysis (PCA), feature importance ranking, and correlation analysis.
4. **Machine Learning Model Selection:** Choose from a variety of machine learning techniques, such as Regression Techniques, decision trees, support vector machines, that are appropriate for analysing the survey.
5. **Model Training and Evaluation:** To guarantee representative class distributions, divide the pre-processed data into training and testing sets. Each machine learning model that has been chosen should be trained on the training set, and its performance should be assessed on the testing set using suitable evaluation metrics.
6. **Cross-Validation:** Use cross-validation methods to reduce overfitting and evaluate each model's generalization performance, such as k-fold cross-validation. Obtain robust performance estimates by repeating the training and evaluation process several times.
7. **Comparative Analysis:** Evaluate each machine learning technique's performance in terms of feature significance, predictive accuracy, and model interpretability in a methodical manner. Analyze the algorithms using statistical tests and visualizations to find important variations and patterns.
8. **Insights Generation:** Analyze the comparative analysis results to generate insights into the key determinants of mental health outcomes in corporate environments. Interpret the findings in the context of existing literature and theoretical frameworks to derive actionable recommendations.
9. **Validation and Sensitivity Analysis:** Validate the robustness of the findings through sensitivity analysis by varying parameters such as feature selection criteria and model hyperparameters. Conduct subgroup analysis to assess the model's performance across different demographic groups if applicable.
10. **Documentation and Reporting:** Keep comprehensive records of the approach, encompassing all stages of data preparation, model setups, assessment protocols, and analytic outcomes.

V. RESULTS

Figure1.: Model Choice

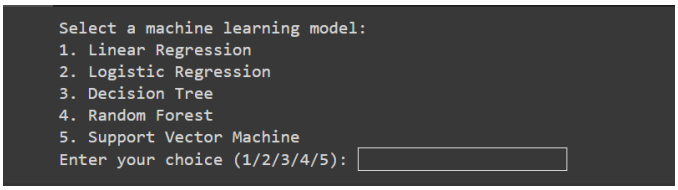


Figure 2.: Linear Regression

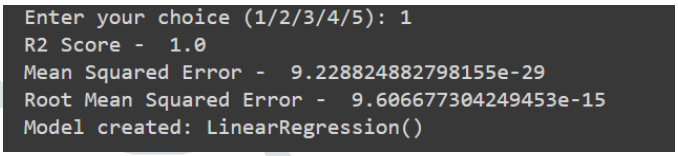


Figure 3.: Logistic Regression

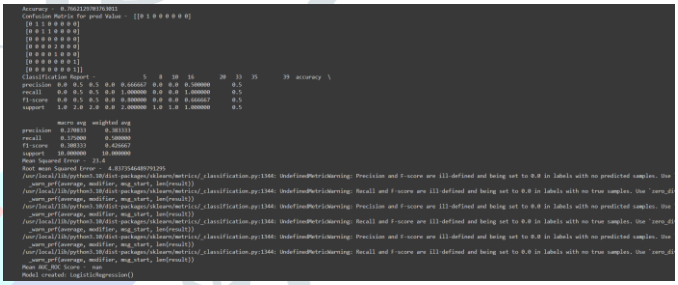


Figure 4.: Decision Tree

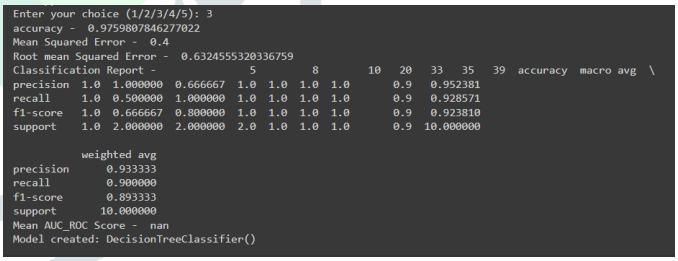


Figure 5.: Random Forest

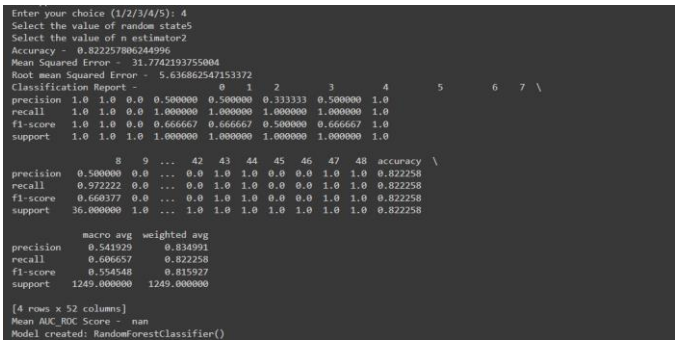
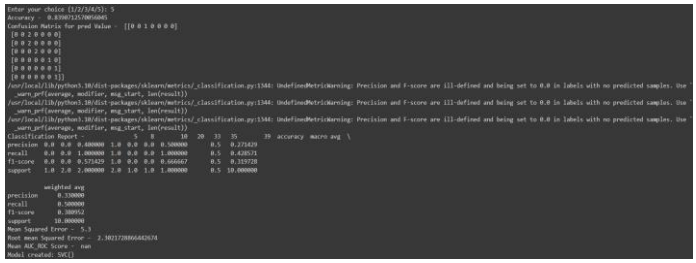


Figure 6.: Support Vector Machine



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