Tracking Cardiovascular Health in Heart Failure Patients Using Digital Health Technologies

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Introduction

This project seeks to create an alternative measure to serial cardiorespiratory fitness measurements for tracking cardiovascular health by monitoring vitals in heart failure patients using wearable technology and machine learning algorithms.

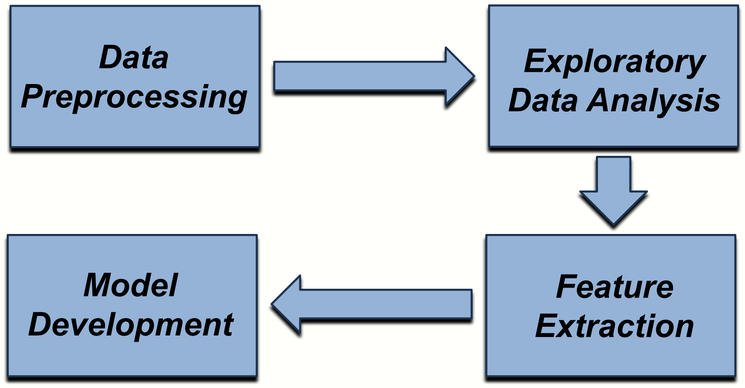
Materials & Methods

Methods

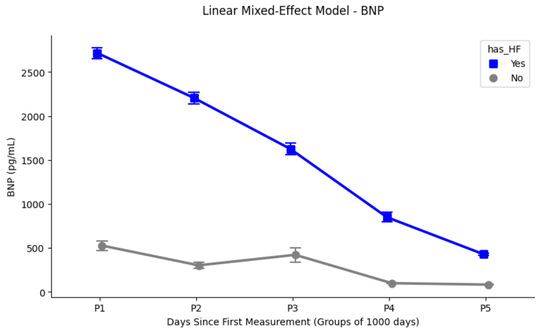
- Data Preprocessing – clean data
- Exploratory Data Analysis –observe general patterns in the data through statistical analysis
- Feature Extraction – choosing proper input variables for model
- Model Development - train traditional ML models and observe output

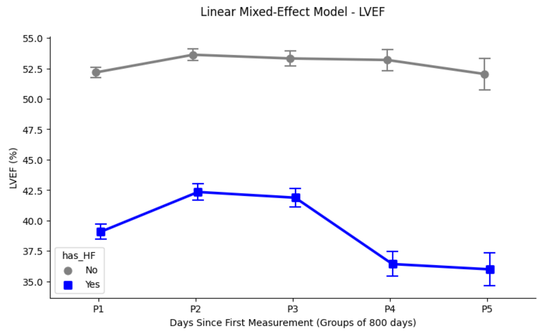
Materials

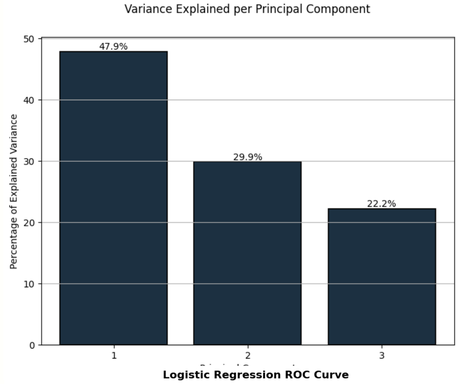
- All of Us dataset – NIH funded dataset with clinical, wearable and genomic data from over 800,000 people

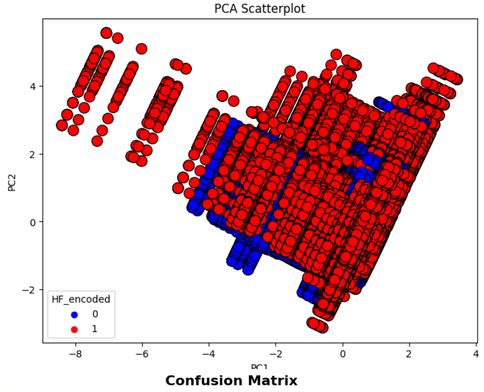


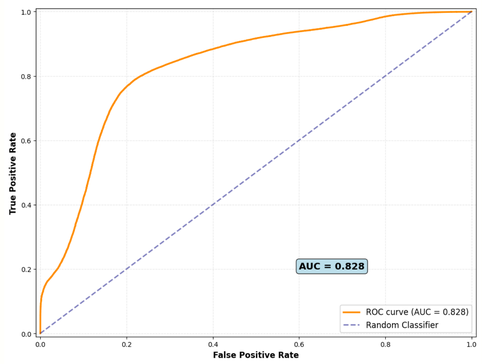
Results

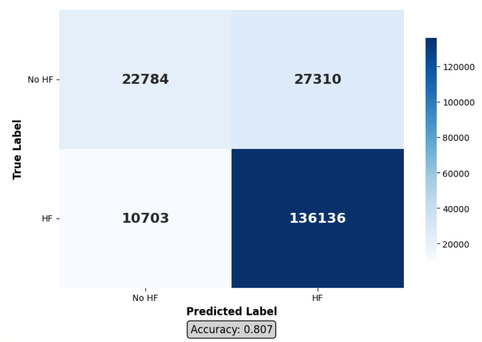












Conclusions

From the linear mixed-effect model, it can be observed that there is a statistically significant difference in BNP and LVEF trajectories over time between individuals with HF and those without. The PCA analysis shows that 78% of the variance in the data can be explained using two principal components. The ROC curve & confusion matrix from the logistic regression model show that it is capable of reliably predicting heart failure based on the given data, but its predictive power can be improved with better quality data, more advanced data, or hyperparameter tuning.

Future Work

Future work on this project could include exploring other machine learning models as well as hyperparameter tuning to enhance the performance created in this project based on the current features. Other types of clinical and wearable data, such as sleep data or daily step count, could be explored as potential features, and more features could be extracted from heart rate variability data. Deep learning models can be developed to handle more advanced data, like imaging data, and other traditional classification ML models can be tested and have their performance evaluated to see which is the best.

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