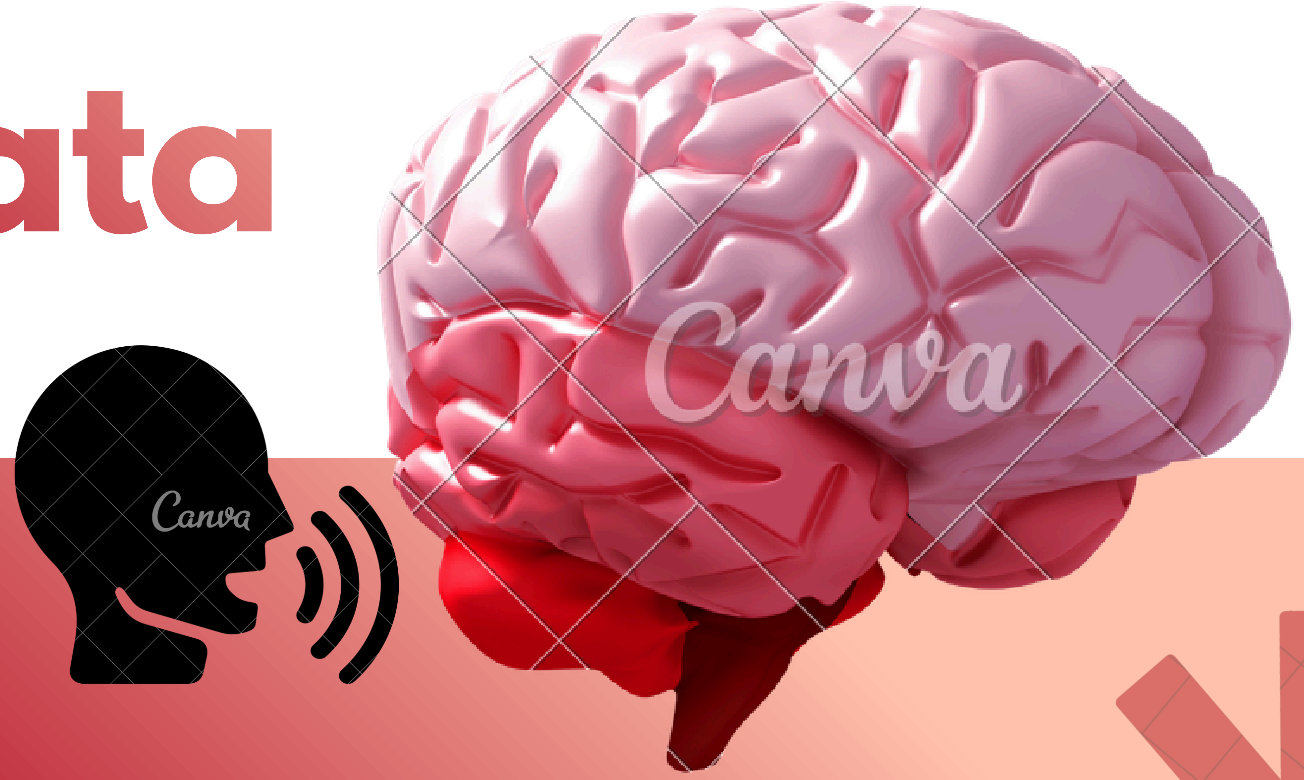
Predicting Parkinson's Disease Severity Using Voice Data



TEAM ELEVEN - 011

Zina
Meriem
Alexandra
Carmelina

Oxford Parkinson's Disease Detection Dataset

Source

Oxford Parkinson's Disease Detection Dataset
Donated on 6/25/2008
License: creative Commons Attribution 4.0 International (CC BY 4.0)

References

Exploiting Nonlinear Recurrence and Fractal Scaling Properties for Voice Disorder Detection
Little, M.A., McSharry, P.E., Roberts, S.J. et al. Exploiting Nonlinear Recurrence and Fractal Scaling Properties for Voice Disorder Detection. BioMed Eng OnLine 6, 23 (2007).

UCI Machine Learning Repository

Discover datasets around the world!

ics.uci.edu

Project Overview

What problem are we solving?

Parkinson's disease affects speech

Goal: **predict disease severity (total_UPDRS) from voice features**

Why Voice Analysis?

Voice recordings are non-invasive

Could support remote monitoring of patients

Data Selection and Preparation

Dataset characteristics

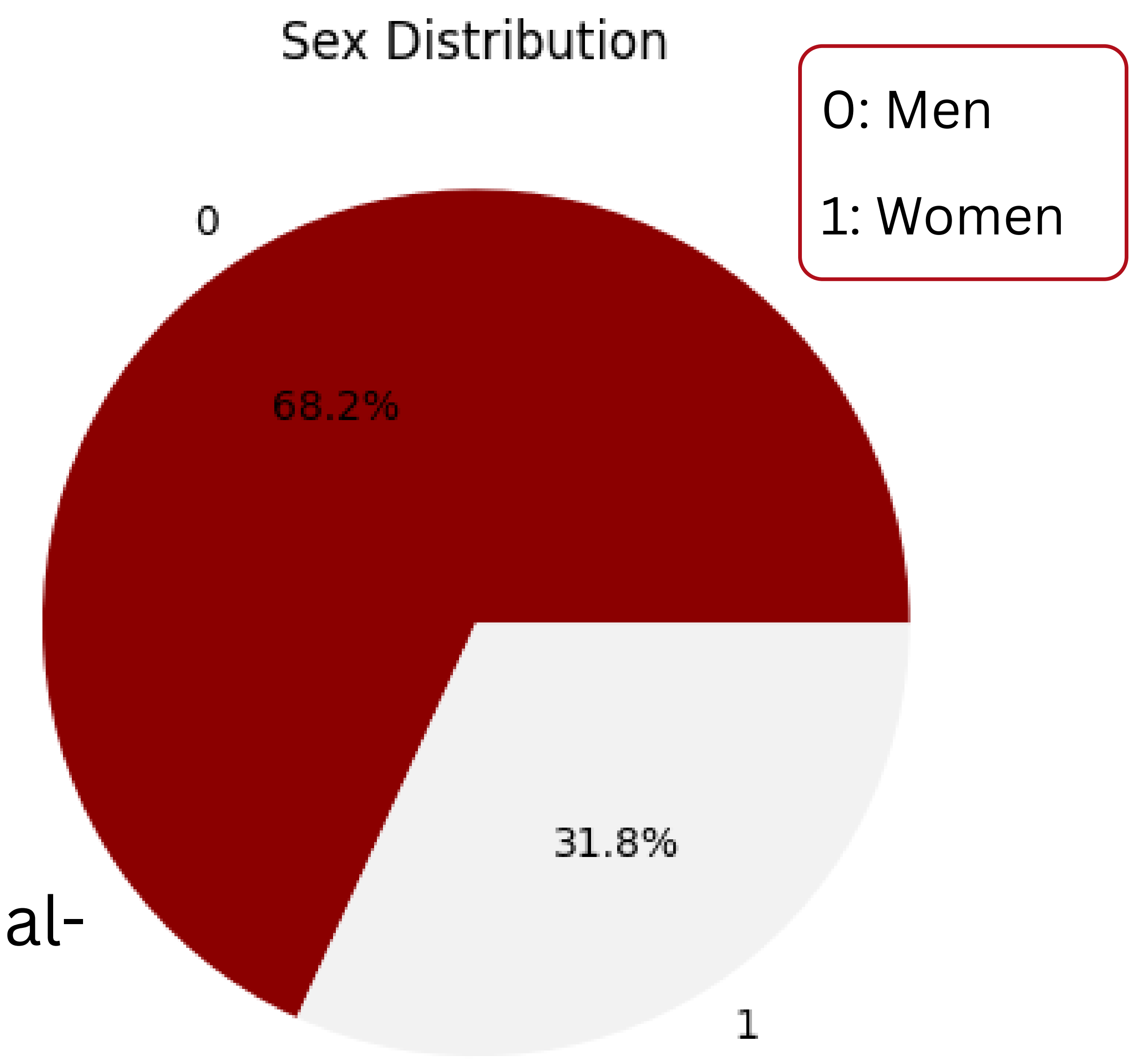
- Oxford Parkinson’s Telemonitoring Dataset
- 42 patients with Parkinson’s disease
- 5.875 voice recordings, collected remotely
- 140 average recordings per patient
- 6 month trial

Target

- total_UPDRS → overall disease severity score

Features

- Voice measurements such as jitter, shimmer and other signal-based features.



Model Building and Evaluation

MODEL SELECTION

Linear Regression

Used as a baseline model

Helps understand relationship between voice features and target (UPDRS score)

WHY THIS MODEL?

Predict a continuous value (UPDRS score) --> fits Linear Regression

Simple and interpretable

Fast training

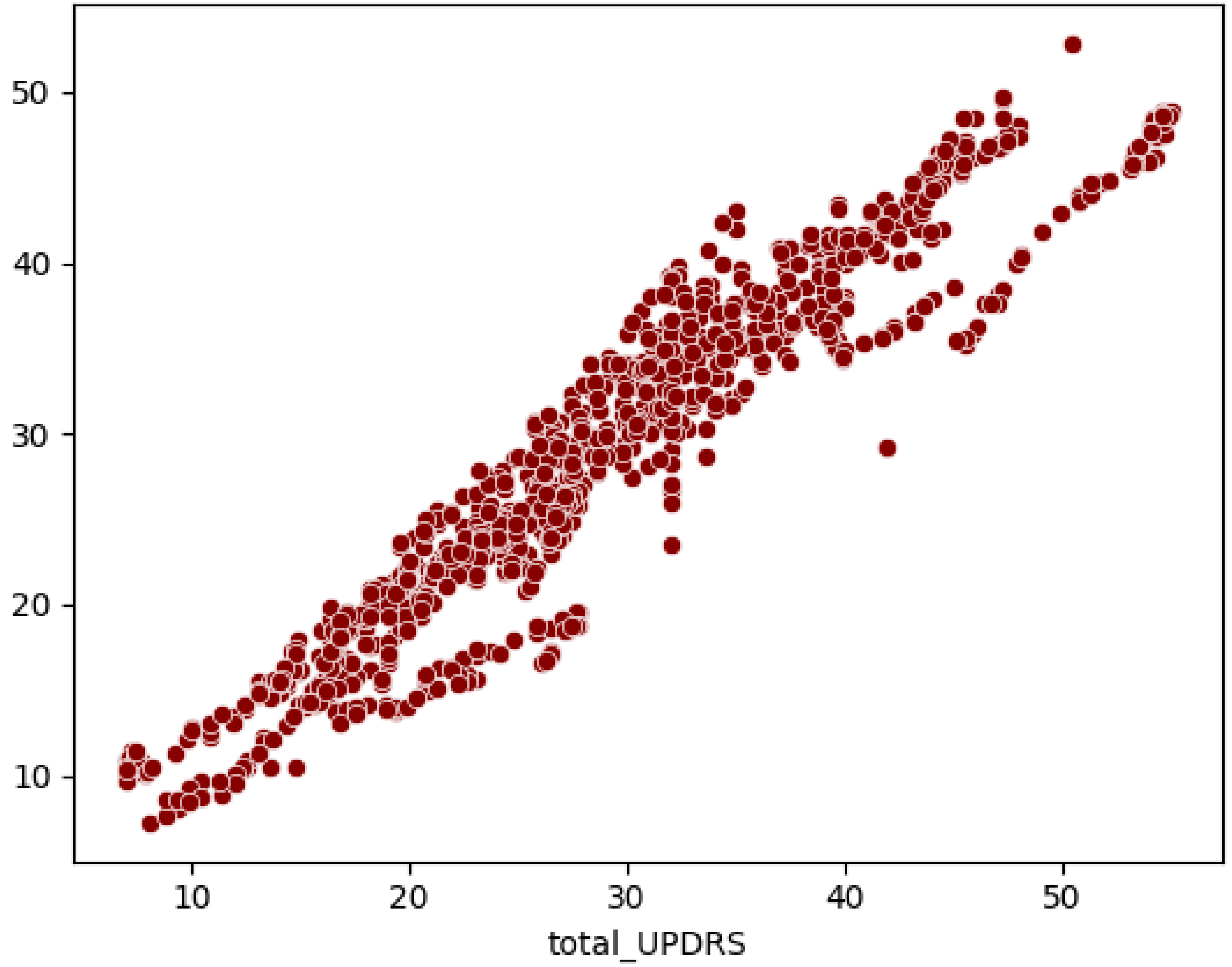
EVALUATION METRICS

MAE (Mean Absolute Error): Average prediction error in UPDRS points

R^2 Score: Measures how well the model explains the variability in the data

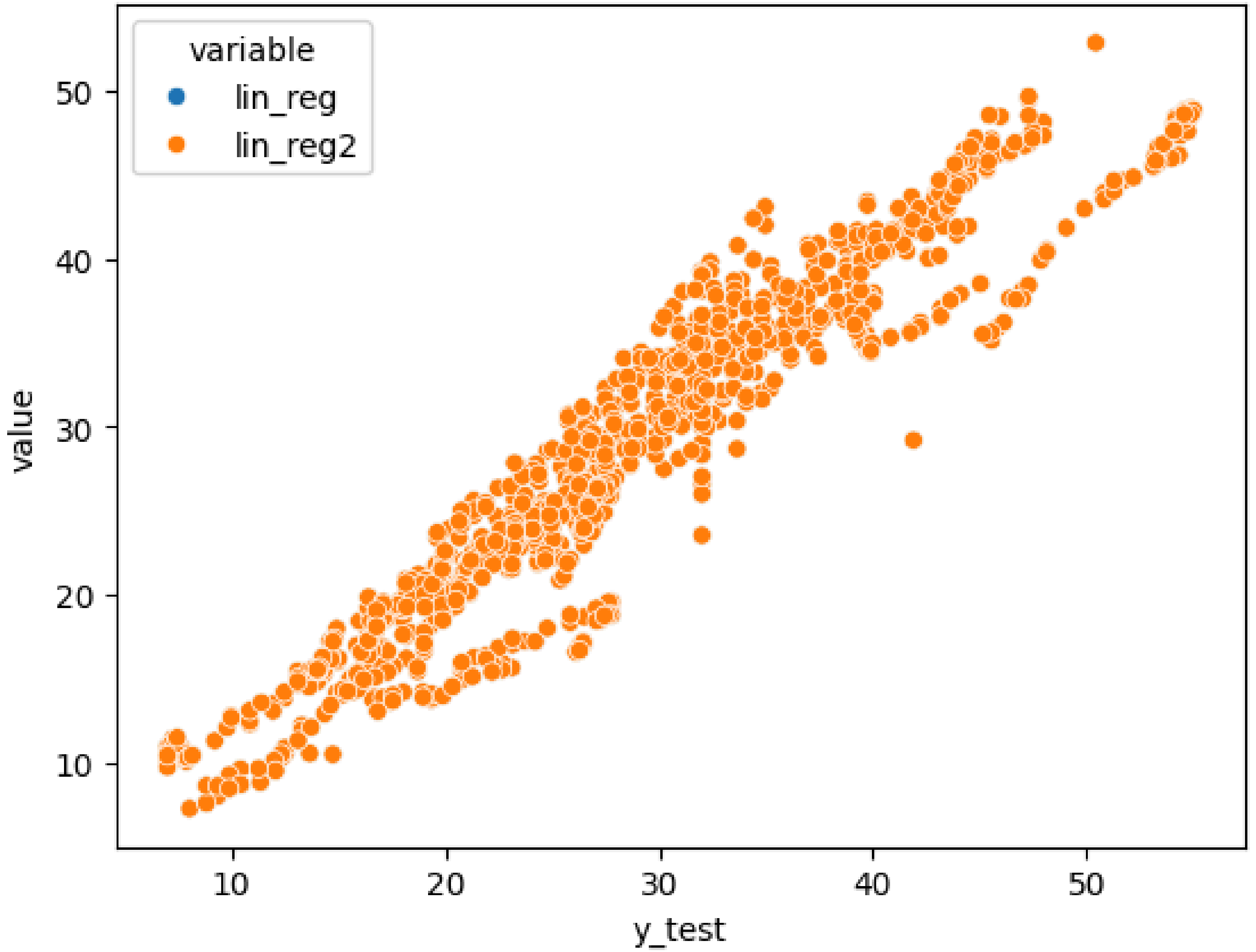
Feature Engineering and Selection

Linear Regression



X, y Predictions

MAE	2.42
MSE	10.69
RMSE	3.27
R2	0.90



Our model predicts that a patient with minimal voice pathology would have a relatively low total UPDRS score of approximately **8.78**.

Hyperparameter Tuning and Model Optimization

Cross-Validation

Model K Fold

R2 scores for each fold
0.91381079
0.90167049
0.91176976
0.91351376
0.90381669

Mean R2
0.909

Standard deviation
0.005

Advanced Model: Random Forest

Results:

- MAE ≈ 0.13
- R^2 ≈ 0.999

Interpretation:

Our model performed extremely well
We achieved:
Very low error
R^2 score close to 1

Challenges and Learnings

Challenges

Complex, multifactorial disease → voice explains only part

Small number of patients (42) → limited variability

Learnings

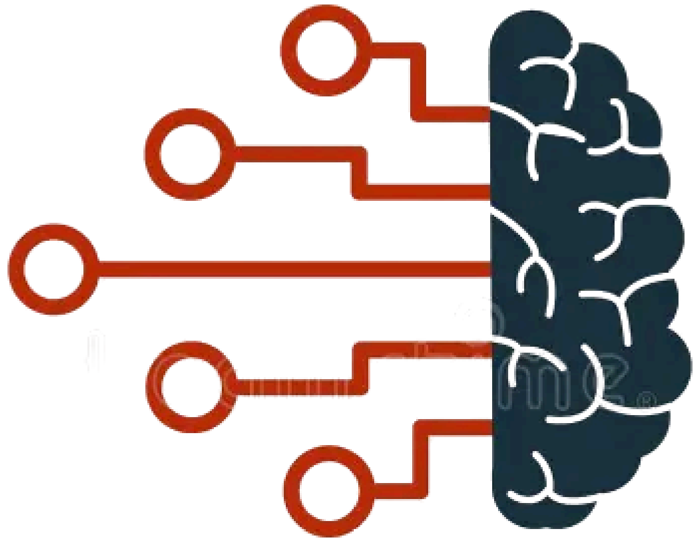
Simple models are a good baseline

Ensemble models can improve performance

Conclusion

Voice data can help predict Parkinson’s severity but is not sufficient alone.

Random Forest improved predictions over Linear Regression, confirming non-linear patterns exist in the data.



Real-World Application and Impact

Practical Applications:

Accessible pre-screening tool
Telemedicine / remote diagnosis
Disease progression monitoring

Potential Impact:

Early detection enables better treatment
Cost reduction in healthcare
Increased accessibility for patients

Ethical Considerations & Limitations:

Limited dataset size (197 samples)
Requires clinical validation
Complements, not replaces, medical diagnosis

Future Work and Improvements

Areas for Expansion:

- Collect larger, more diverse dataset
- Experiment with Deep Learning models (Neural Networks)
- Integrate additional biomarkers (gait analysis, handwriting)

Potential Improvements:

- Mobile application for regular screening
- Longitudinal patient tracking system
- Multi-modal diagnostic approach

THANK YOU!

TEAM ELEVEN - 011