Decoding NBA Greatness

A Data-Driven Journey from Metrics to Mastery

Presented by Wenli

Introduction

Overview

This project analyzes NBA playoff player statistics from 2005 to 2024 using ML techniques. Through PCA for dimensionality reduction, K-Means Clustering for player grouping, and Linear Regression, Random Forest & NN for performance prediction, we aim to uncover patterns and provide actionable insights.

Objective

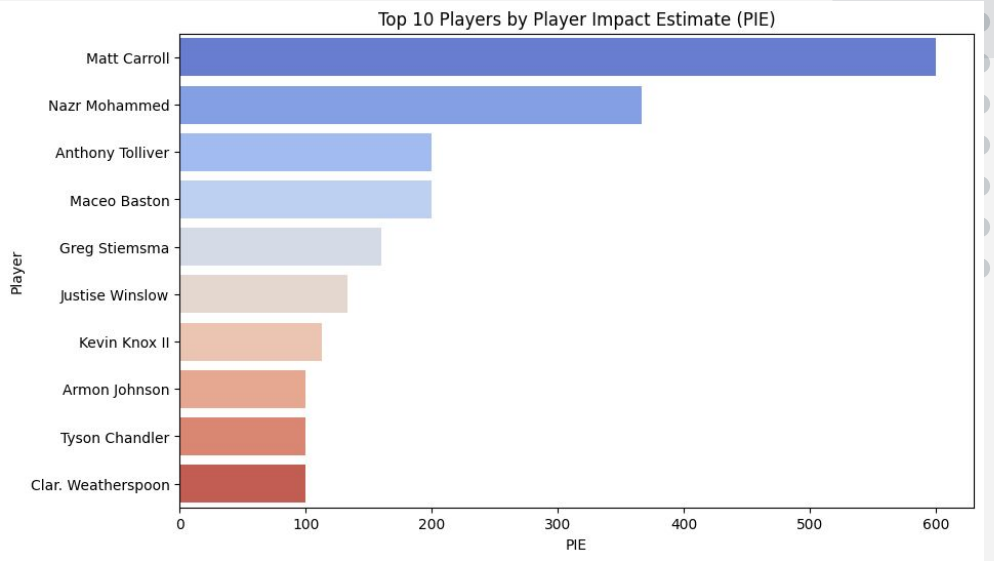
- Identify distinct playing styles.
- Enhance predictions of Player Impact Estimate.
- Support player development, scouting, and strategy decisions.

01

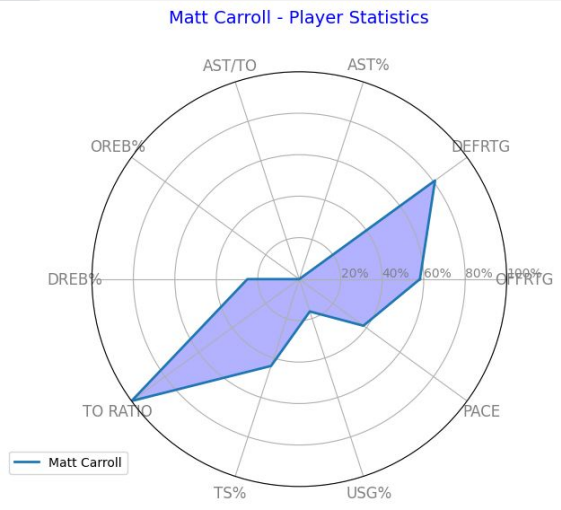
Data Exploration & Diagnostics

Dataset Summary

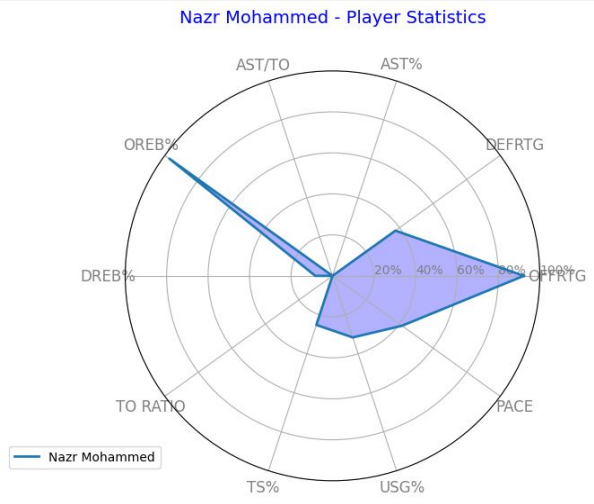
- **Years**
  - 2005–2024 (~210 data points/year)
- **Player Metrics**
  - Minuted Played, Offensive Rating, Defensive Rating, Effective Field Goal Percentage, Shooting Percentage, Usage, Assistant Percentage, Offensive Rebounding, Rebounding, Pace, Age.
- **Target**
  - Player Impact Estimate



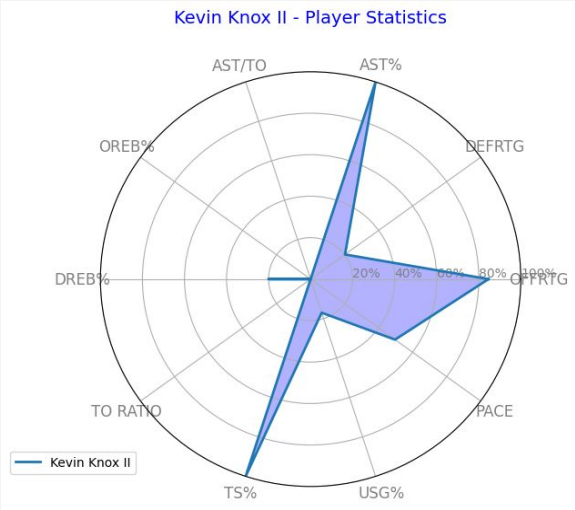
Selected Top Player Profile



Strong performance in Offensive Rating and Usage.

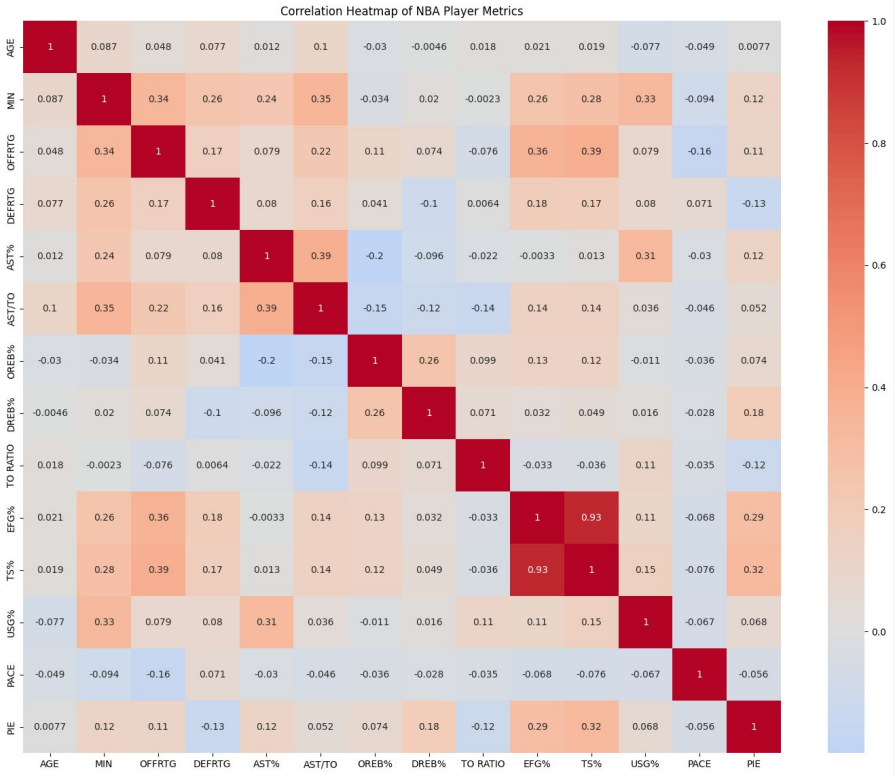


Strong performance in Offensive Rebounding.



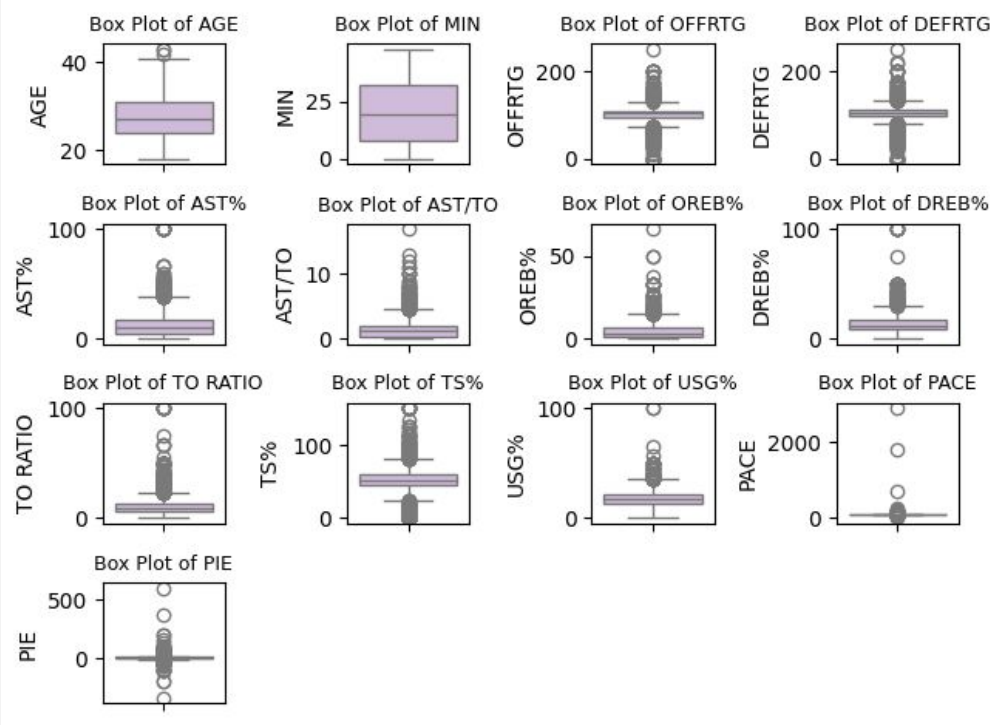
Strong performance Defensive Rating and Usage.

Correlation Heatmap of Player Metrics



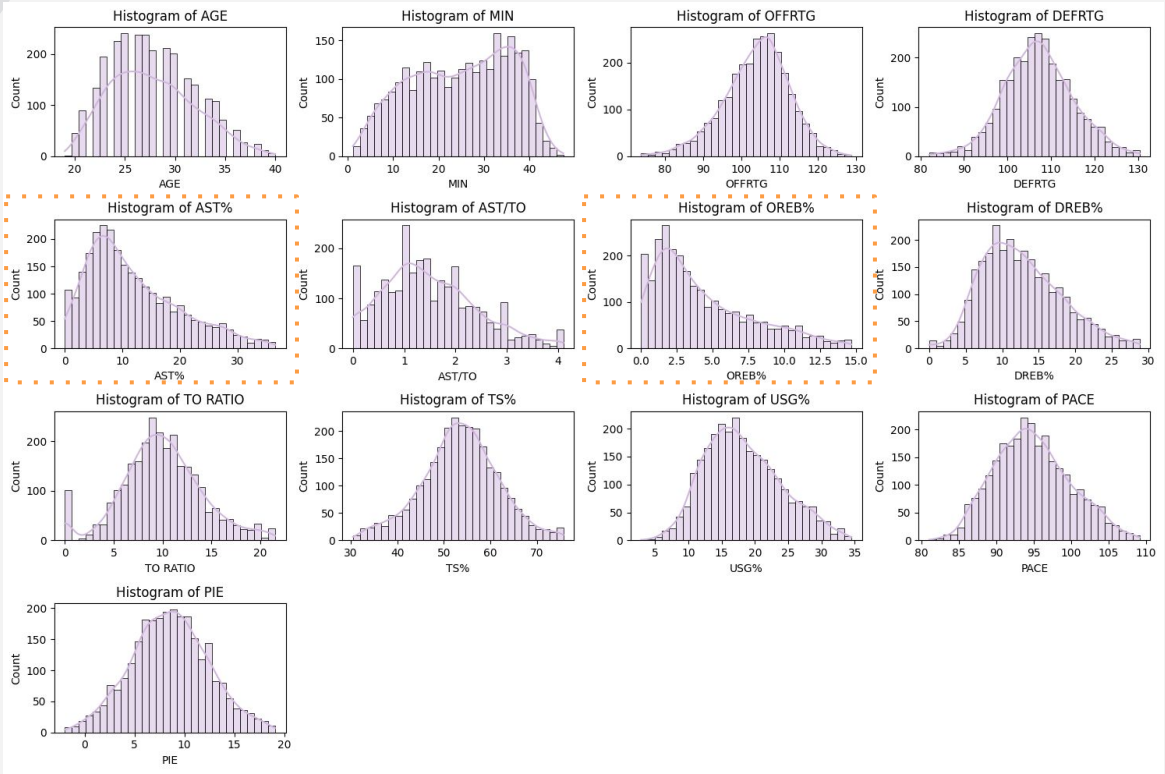
High correlation between EFG% and TS%.

Outlier Analysis



Significant variability in most Player Metrics, especially for offensive/defensive ratings, assist percentages, and rebounding metrics.

Skewness Analysis

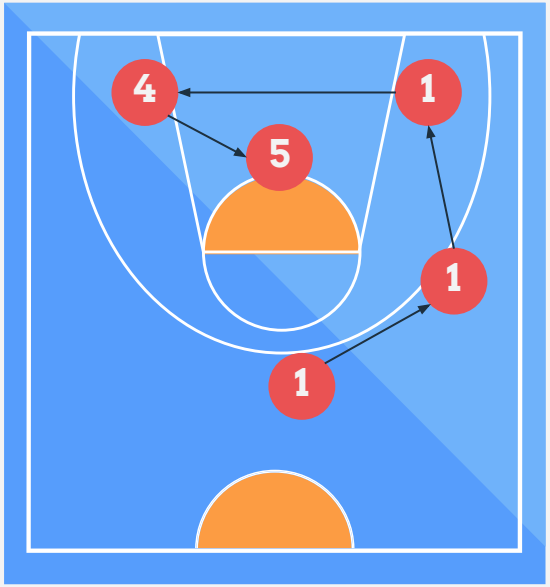


Variables	Skewness Value
OREB%	0.95
AST%	0.84
AST/TO	0.52
DREB%	0.52
USG%	0.41
AGE	0.38
PACE	0.28
DEFRTG	0.08
TO RATIO	0.07
PIE	0.06
TS%	-0.08
MIN	-0.2
OFFRTG	-0.37

OREB% and AST% show moderate skewness.

02

Base Model

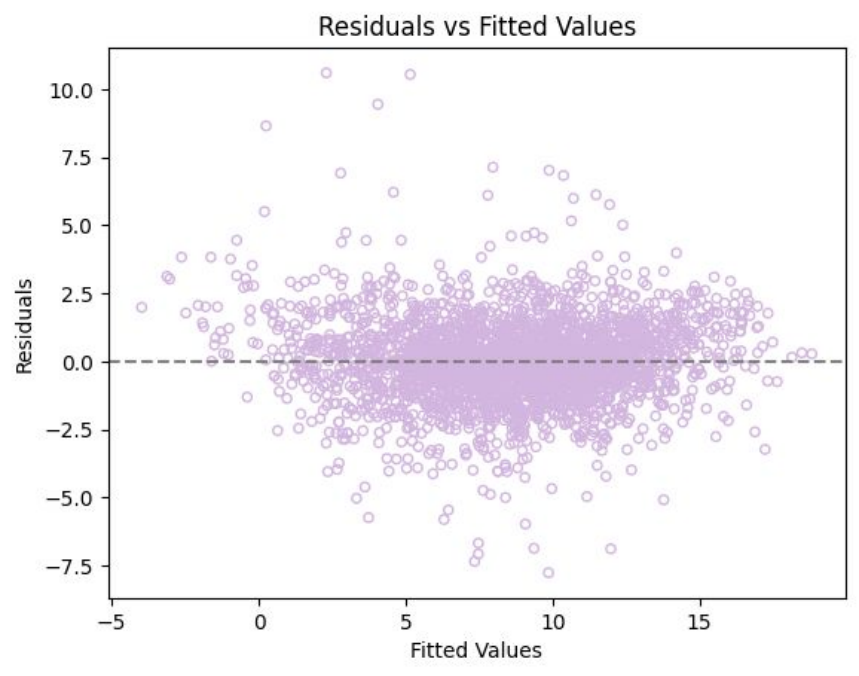


Linear Regression Summary

Variable	Coefficient	Std Error	t-Statistic	P-Value
const	5.27	0.77	6.80	0.00
AGE	-0.02	0.01	-3.27	0.00
MIN	0.06	0.00	16.69	0.00
OFFRTG	-0.04	0.00	-10.01	0.00
DEFRTG	-0.09	0.00	-23.86	0.00
AST%	1.28	0.04	34.94	0.00
OREB%	0.48	0.04	13.28	0.00
DREB%	0.26	0.01	41.38	0.00
TO RATIO	-0.22	0.01	-29.59	0.00
TS%	0.26	0.00	64.73	0.00
USG%	0.22	0.01	34.81	0.00
PACE	-0.02	0.01	-3.91	0.00
R-squared				**84%**

Note: AST/TO is removed from the regression model with a p-value of 0.18.

Model Diagnostics



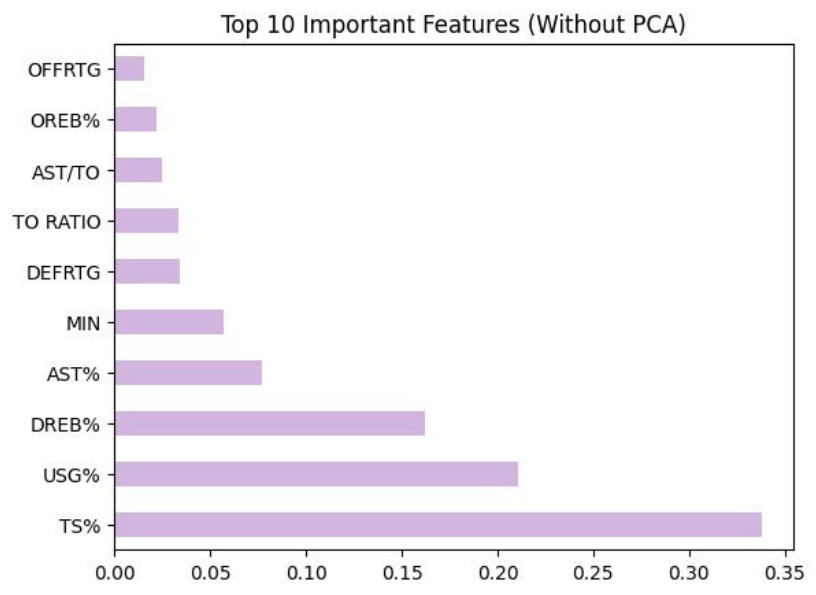
Residual has constant variance.

Feature	VIF
const	680.59
AGE	1.04
MIN	1.56
AST%	1.53
DEFRTG	1.09
OFFRTG	1.37
DREB%	1.36
OREB%	1.46
TS%	1.24
TO RATIO	1.09
USG%	1.49
PACE	1.16

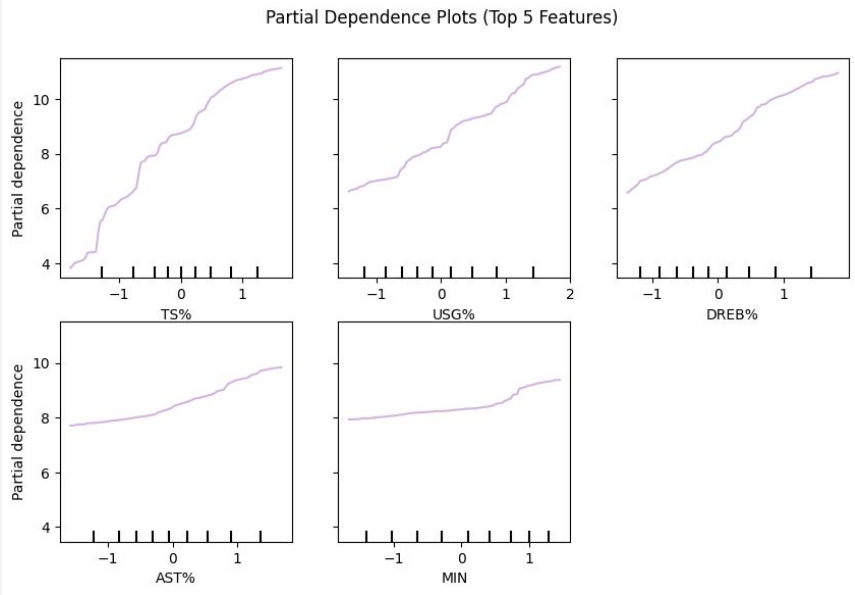
No alarming multicollinearity violation.

03
Alternative Model 1

Random Forest Model Summary

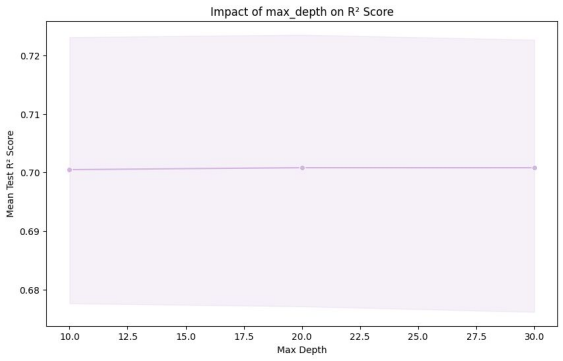


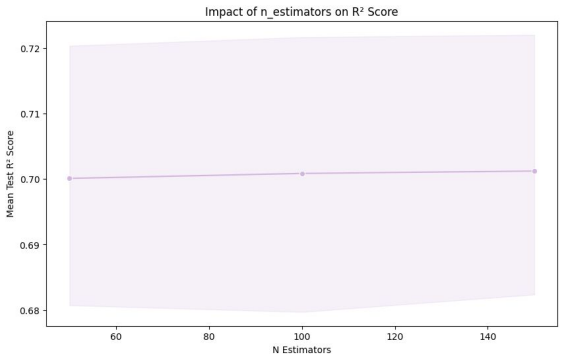
True shooting contributes the most to the model's predictive power.

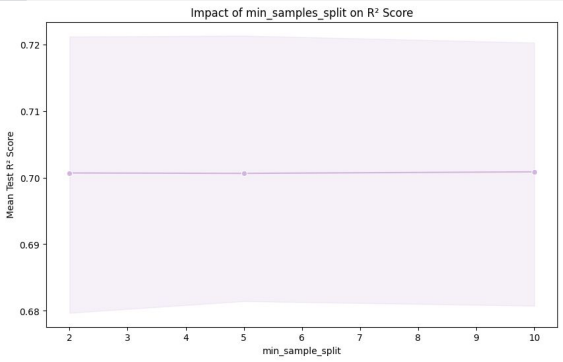


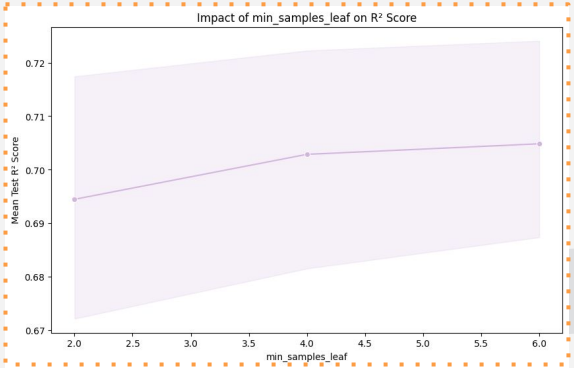
Key player metrics significantly contribute to higher player performance.

Hyperparameter Tuning





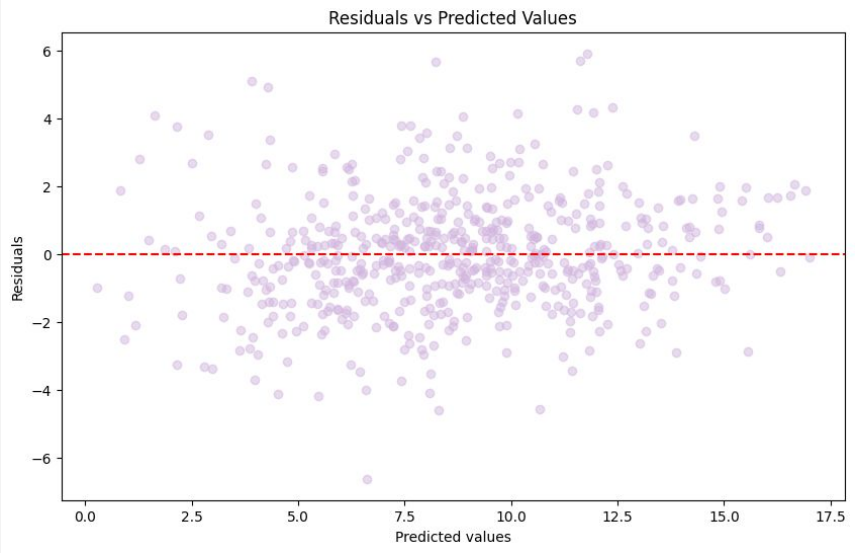




Best Model

- Bootstrap with 0 max depth, 2 leaf node, 2 minimal sample split and 200 number of trees in forest
- R^2 Scores: 80%
- Mean Squared Error: 2.8

Model Diagnostics



Residual has constant variance.

5 Fold Cross Validation

- R^2 Scores range from 77% to 84%
- Mean R^2: 80%
- Standard deviation of R^2: 0.028

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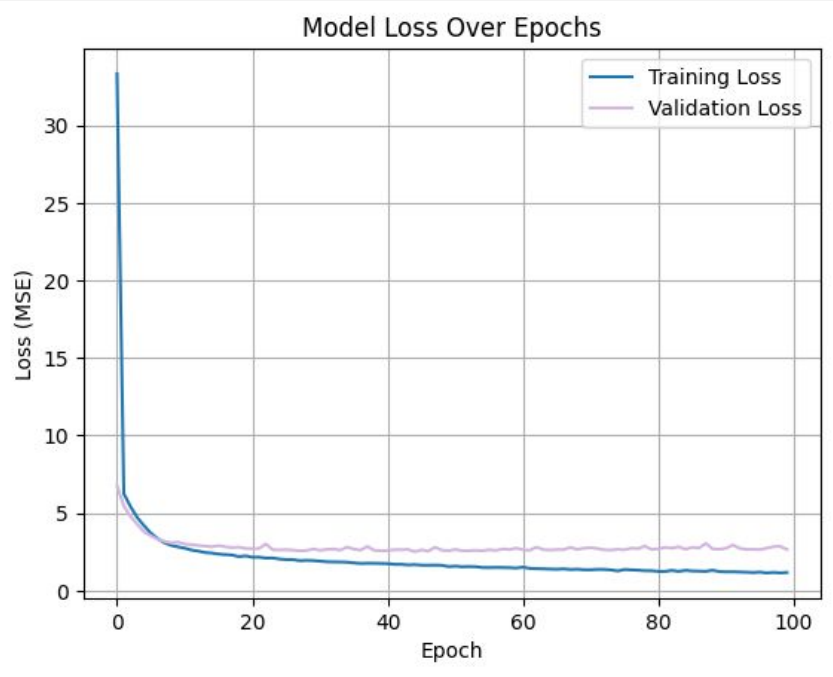
Alternative Model 2

Neural Network Model



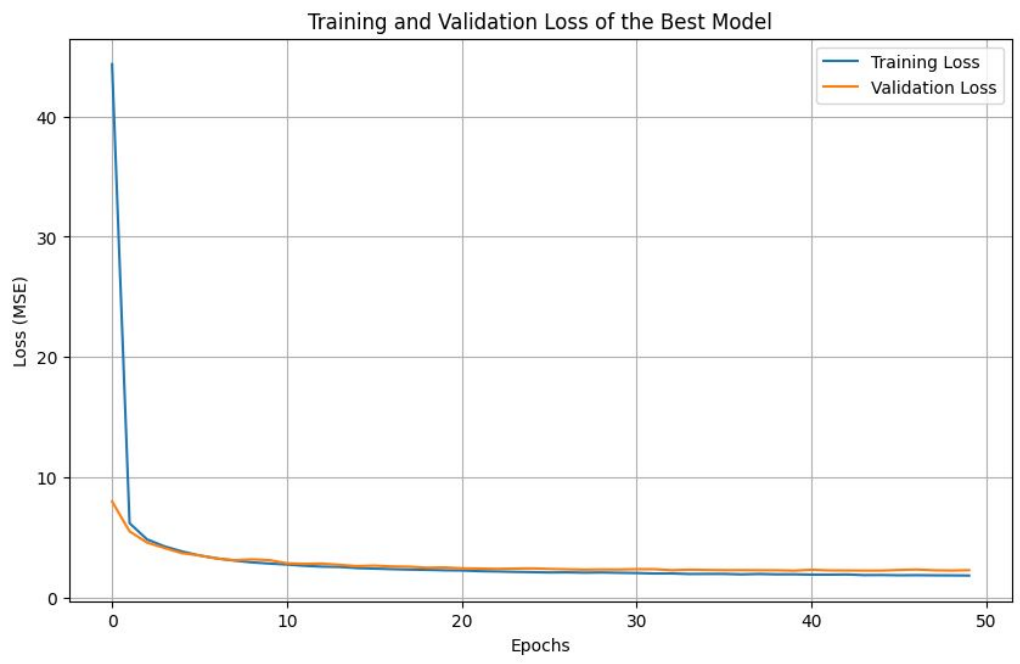
Architecture

- 1 input layer: 128 neuros, L2 reg and relu activation
- 2 hidden layers: 64 & 32 neurons with L2 reg
- 1 output layer: 1 neuron and linear activation

Training and Evaluation

- 100 epochs & 32 batch size
- Mean Squared Error: 2.2
- R^2 Score: .84.7%

Hyperparameter Tuning



Best Model

- R^2 Scores: 86.4%
- MSE: 1.96

Conclusions

Models	Pro	Con
Linear Regression	• High R^2 • Interpretable	• May not capture non-linear relationships as effectively • Sensitive to multicollinearity
Random Forest	• Interpretable • Robust to multicollinearity • Capture complex, non-linear relationships	• Lowest R^2
Neural Network	• Highest R^2 • Capture complex, non-linear relationships • Robust to multicollinearity	• Challenge to interpret

Thank you!

Thanks!

Do you have any questions?

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