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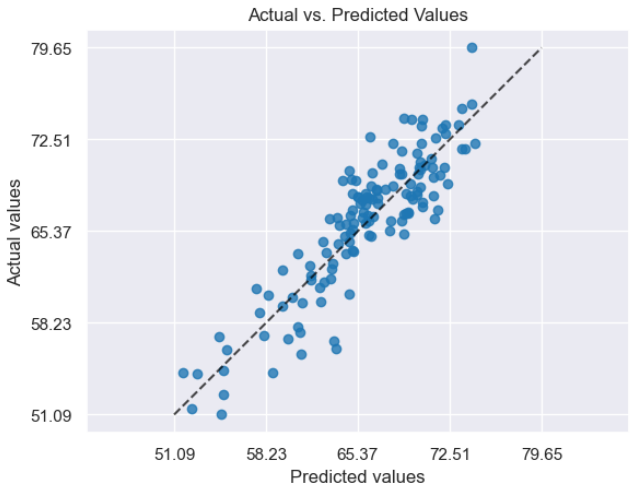
Predicting Bat Speed Using Biomechanical Data

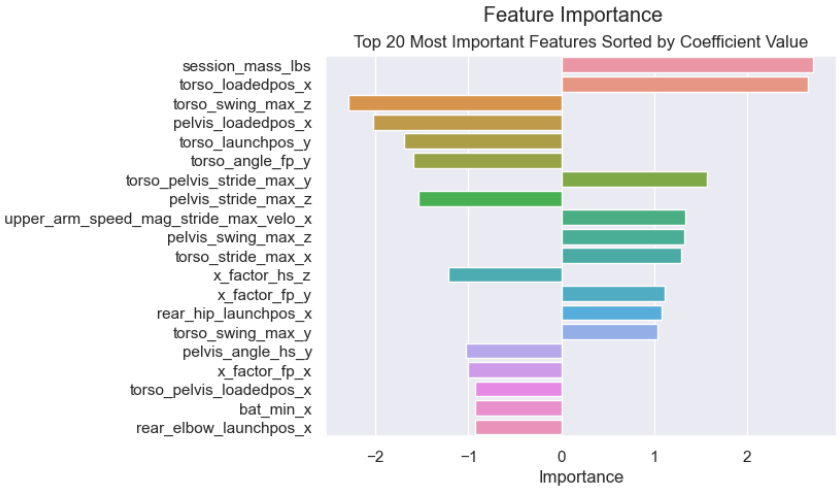
Executive Summary

Objective: The goal of this project is to analyze biomechanical data to predict bat speed – a key quality of elite hitters. Bat speed correlates positively with exit velocity, reduces time to contact, and raises the floor for productive mishits, providing a competitive edge for players and valuable insights for scouts.

Overview: The project entailed a comprehensive dataset provided by Driveline Baseball in which motion capture technology was used to collect biomechanical data from hitters, aiming to pinpoint the factors contributing to bat speed. The dataset examined 98 athletes' data from varying playing levels, resulting in a dataset of 677 observations across 129 variables. Multiple variable selection processes were utilized to mitigate multicollinearity while maintaining interpretability.

Results: An initial multiple linear regression model, assessed via Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and R-Squared (R^2), suggested a model with moderate predictive power (R^2 = 0.31). Refinement steps included outlier removal based on interquartile ranges, which decreased performance (R^2 = 0.10), however the implementation of an elastic net regularization model significantly improved predictive accuracy (R^2 = 0.78).





Conclusions: The elastic net model yielded encouraging results, with the athlete's body mass and torso angle at load position identified as significant factors influencing bat speed. Despite this model's performance, exploring alternative variable selection methods, enlarging the scope of the dataset, and incorporating advanced machine learning techniques could further enhance the accuracy and predictive power. Nevertheless, the results underscore the complex interactions between biomechanics and bat speed, offering potential implications for player training and evaluation.