

## Group 3: Predicting WAR

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## Overview

- ▶ Goal: build a model to predict WAR (Wins Above Replacement)
- ▶ WAR measures a player's total contribution compared to a replacement-level player
  - ▶ It combines multiple aspects of performance: hitting, baserunning, defensive value, positional difficulty, and their playing time, and puts it into a single number.
  - ▶ Interpreted as the number of additional wins a player adds to a team
  - ▶ Since it provides a single encompassing measure of a player's value, WAR is greatly relied on by MLB front offices

## Motivation

- ▶ Can a player's current-season performance statistics be used to predict their next season Wins Above Replacement (WAR)?
- ▶ Major League Baseball teams rely heavily on WAR to evaluate a players value, make contract decisions, and project roster needs.
- ▶ It provide a competitive advantage for a team by:
  - ▶ Helps identify declining players
  - ▶ Allows for budgeting and contract planning
  - ▶ Encourages player development and roster optimization
- ▶ Our goal is, by using statistical and machine learning models, we will:
  - ▶ Identify which player statistics best predict future WAR
  - ▶ Compare the performance of three different statistical learning models: OLS, LASSO, and BOOSTING
  - ▶ Build a model that maintains high predictive accuracy

## Data used

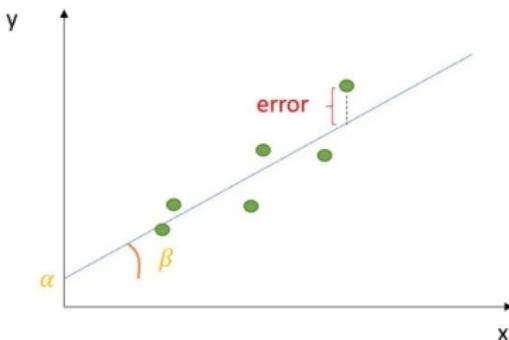
- ▶ Our data came from baseball-reference.com
- ▶ We used standard batting data from 2020-2025 to build our models (500 obs each year)
  - ▶ 2020-2024 was used for training
  - ▶ 2025 was our test data set
- ▶ Variables:
  - ▶ WAR, age, **games played**, plate appearances, at bats, runs scored, **hits**, doubles, triples, **home runs**, RBIs, stolen bases, caught stealing, walks, strikeouts, **batting average**, on base percentage, slugging percentage, OPS percentage, OPS+, rOBA, Rbat+, total bases, double plays grounded into, hit by pitch, sacrifice hits, sacrifice flies, intentional walks

# Models Used



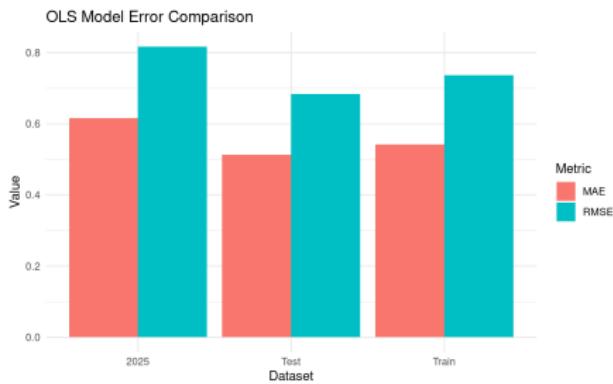
## OLS Models

- ▶ An Ordinary Least Squares (OLS) model identifies and measures the relationship between a response variable and predictor variables
  - ▶ It finds the best-fitting linear trend that minimizes squared error.
- ▶ Pros:
  - ▶ Convenient,
  - ▶ Has accurate regression results for linearly related data
- ▶ Cons:
  - ▶ May be too simplistic for real world examples
  - ▶ Assumptions of Linear Regression



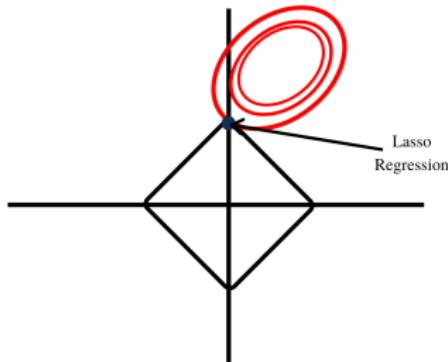
# OLS Metrics Plot

- ▶ Error metrics for both final testing data set (2025) and the training data split into training and testing sets
- ▶ Significant terms:
  - ▶ age, games played, plate appearances, at bats, runs, hits, doubles, triples, home runs, stolen bases, caught stealing, walks, strikeouts, OPS+



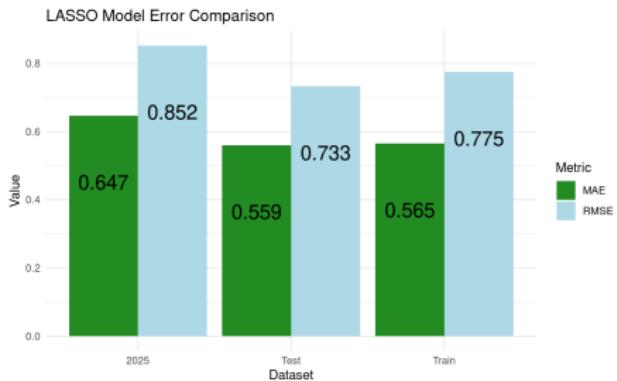
## LASSO Models

- ▶ LASSO models perform regularization (L1), which shrinks some coefficients to exactly zero
  - ▶ Essentially feature selection
- ▶ Pros: Produces a more interpretative model, prevents over fitting
- ▶ Cons: LASSO performs poorly when predictors are highly correlated



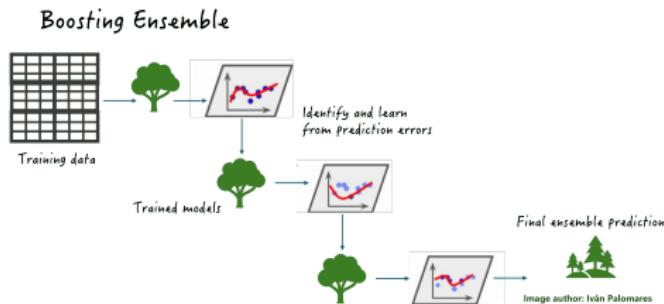
# LASSO Metrics Plot

- ▶ Error metrics for both final testing data set (2025) and the training data split into training and testing sets
- ▶ Shrunk terms:
  - ▶ Plate appearances, home runs, RBIs, batting average, on base percentage, OPS+, rOBA



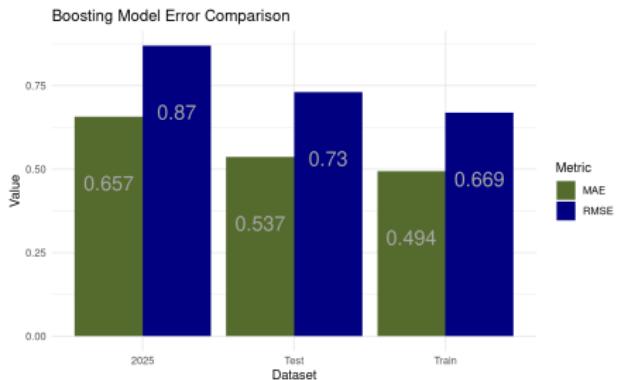
# Boosting Models

- ▶ Boosting grows trees sequentially using information from previously grown trees
  - ▶ Each tree fit on a modified version of the original data set
  - ▶ Good at capturing non-linear patterns
- ▶ Pros: High predictive accuracy and captures complex, nonlinear relationships automatically.
- ▶ Cons: Prone to over fitting and requires careful tuning of hyper parameters to perform well.

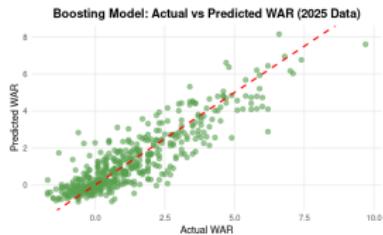
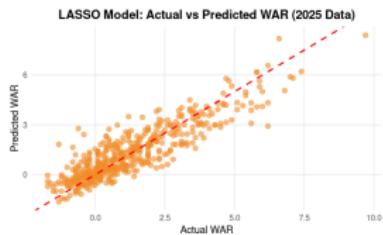
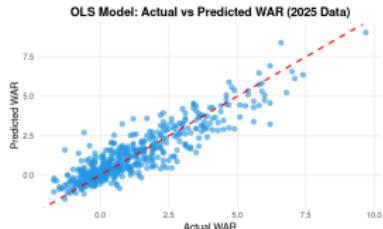


# Boosting Metrics Plot

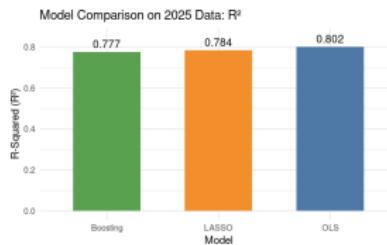
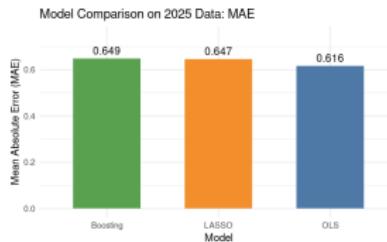
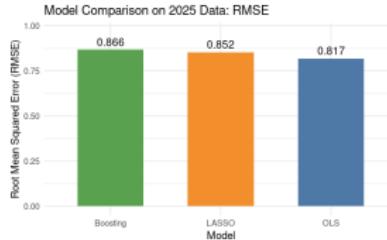
- ▶ Error metrics for both final testing data set (2025) and the training data split into training and testing sets



# Model Comparison: OLS, LASSO, and Boosting



# Model Comparison: RMSE, MAE, and R<sup>2</sup>



## Player Examples Using OLS model

<b>Player</b>	<b>Prediction</b>	<b>Actual</b>
Aaron Judge	9.1	9.7
Hunter Goodman	3.2	3.7
Michael Toglia	-1.0	-1.7
Bobby Witt Jr.	6.1	7.1
Shohei Ohtani	8.4	6.6

## Key Findings

- ▶ OLS performed the best overall
  - ▶ Lowest prediction error
  - ▶ Highest explained variance
- ▶ LASSO selected a subset of meaningful predictors, making it easier to understand which player stats drive WAR
- ▶ Variables with a strong predictive value: plate appearances, home runs, hits, OPS+, walks, and strikeouts
- ▶ WAR prediction is challenging
  - ▶ some components are hard to obtain from batting-only statistics
  - ▶ player injuries, playing time, or other external factors produce noise

Questions?