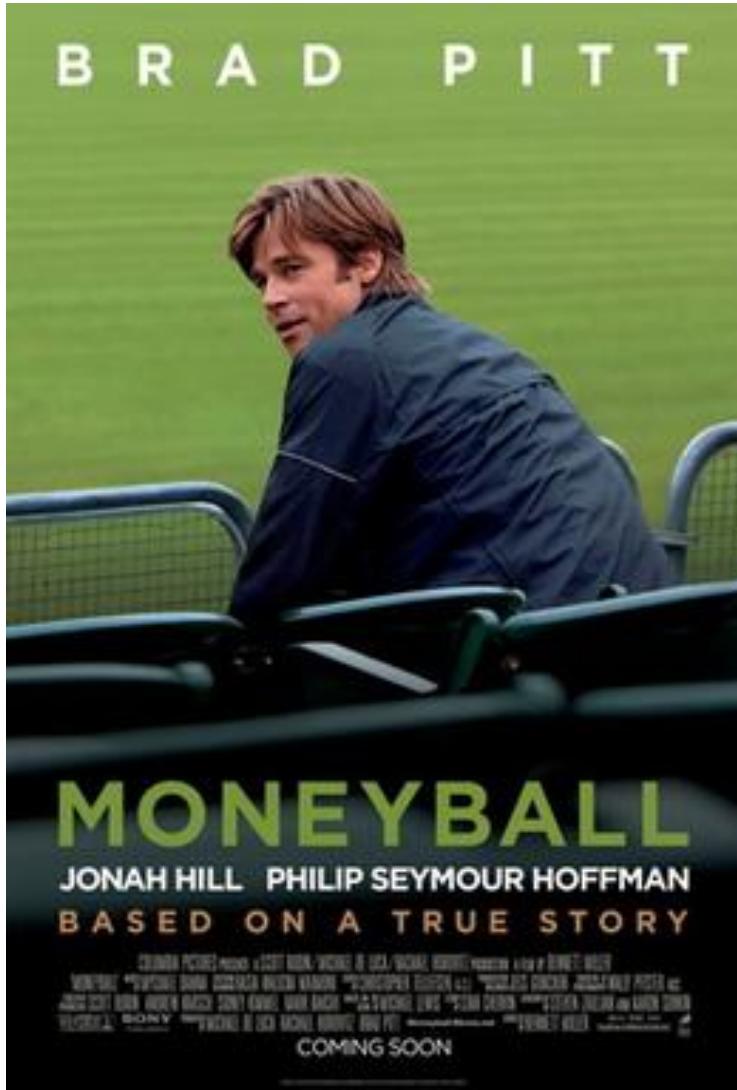


# NFL-Player Evaluation

Jhonsen Djajamuliadi

Project #2 @ METIS Bootcamp

# Why Evaluate NFL Players?



- NFL multibillion-dollar industry

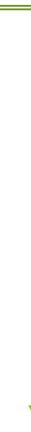
## Team Manager's Goal

*Build a dream team,  
but spend less \$\$\$*

## Challenges in NFL analytics

- Player's performance depends on many factors
- Subjective evaluation

## Limited Methods [1,2,3]

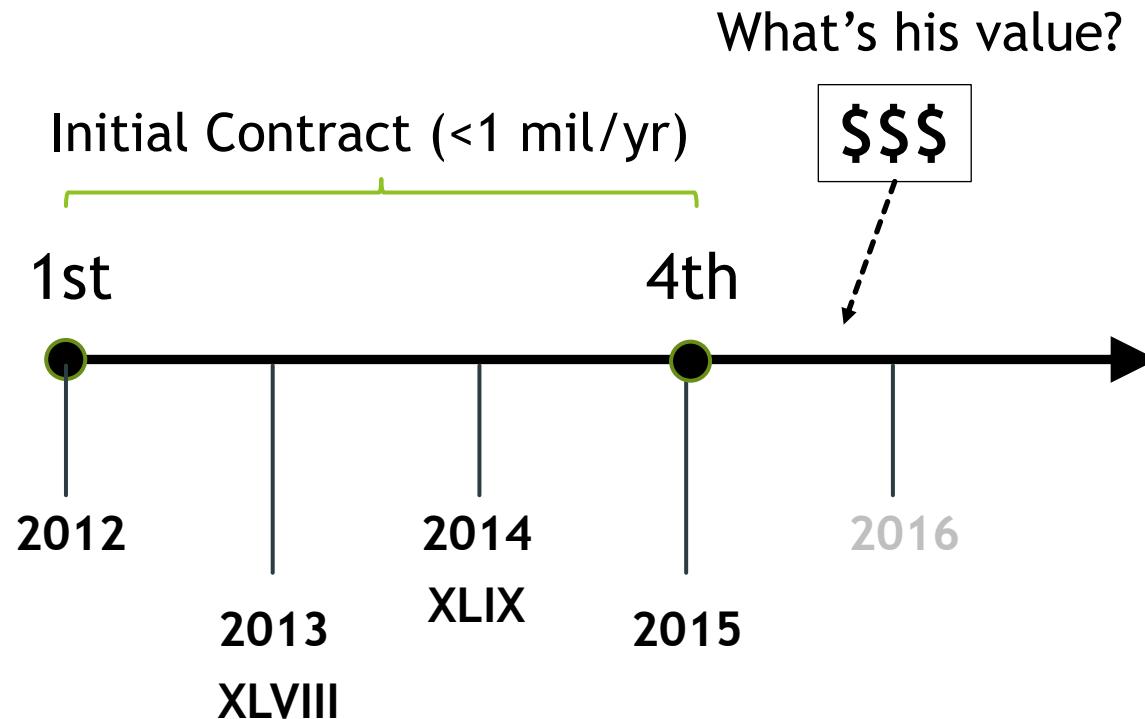


## Machine Learning

[1][https://en.wikipedia.org/wiki/Moneyball\\_\(film\)#/media/File:Moneyball\\_Poster.jpg](https://en.wikipedia.org/wiki/Moneyball_(film)#/media/File:Moneyball_Poster.jpg)

# Project Goal & Methodology

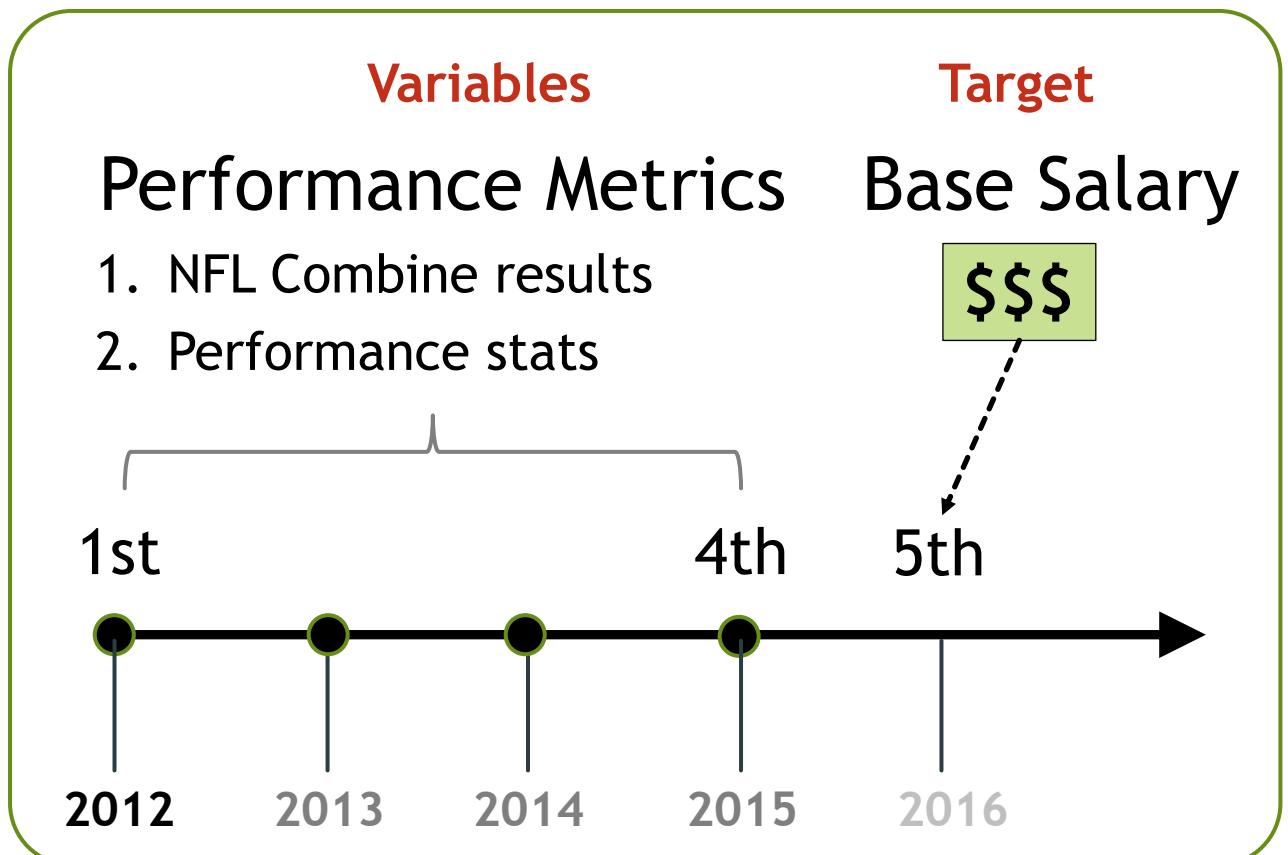
Question:  
- Was Russell Wilson Underpaid?



# Web Scraping and Data-Wrangling

## Sources:

- Pro-football-reference - players stats
- Spotrac - players salary



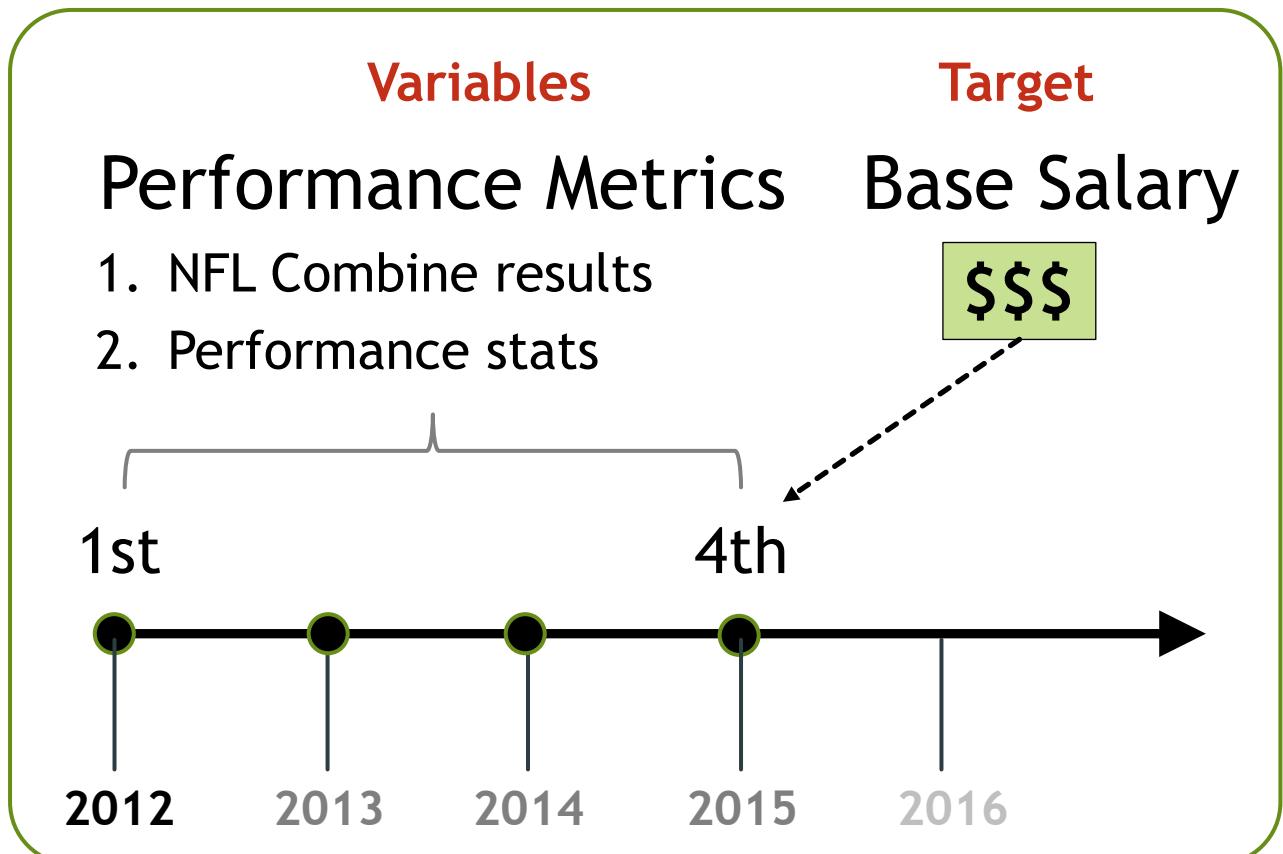
- Iterate over 15 year-span (2000-2014)
  - 3 Positions:
    - Running Backs
    - Receivers
    - Quarterbacks
- (190 rows)

NFL Analytics is complex!

# Web Scraping and Data-Wrangling

## Sources:

- Pro-football-reference - players stats
- Spotrac - players salary



- Iterate over 15 year-span (2000-2014)
  - 3 Positions:
    - Running Backs
    - Receivers
    - Quarterbacks
- (356 rows)

NFL Analytics is complex!

# Wrangling & Feature Engineering

# Data structure

# @ 1-Hot Encoding

# # Transformations

# Log1p

Box-cox

Yeo-Johnson

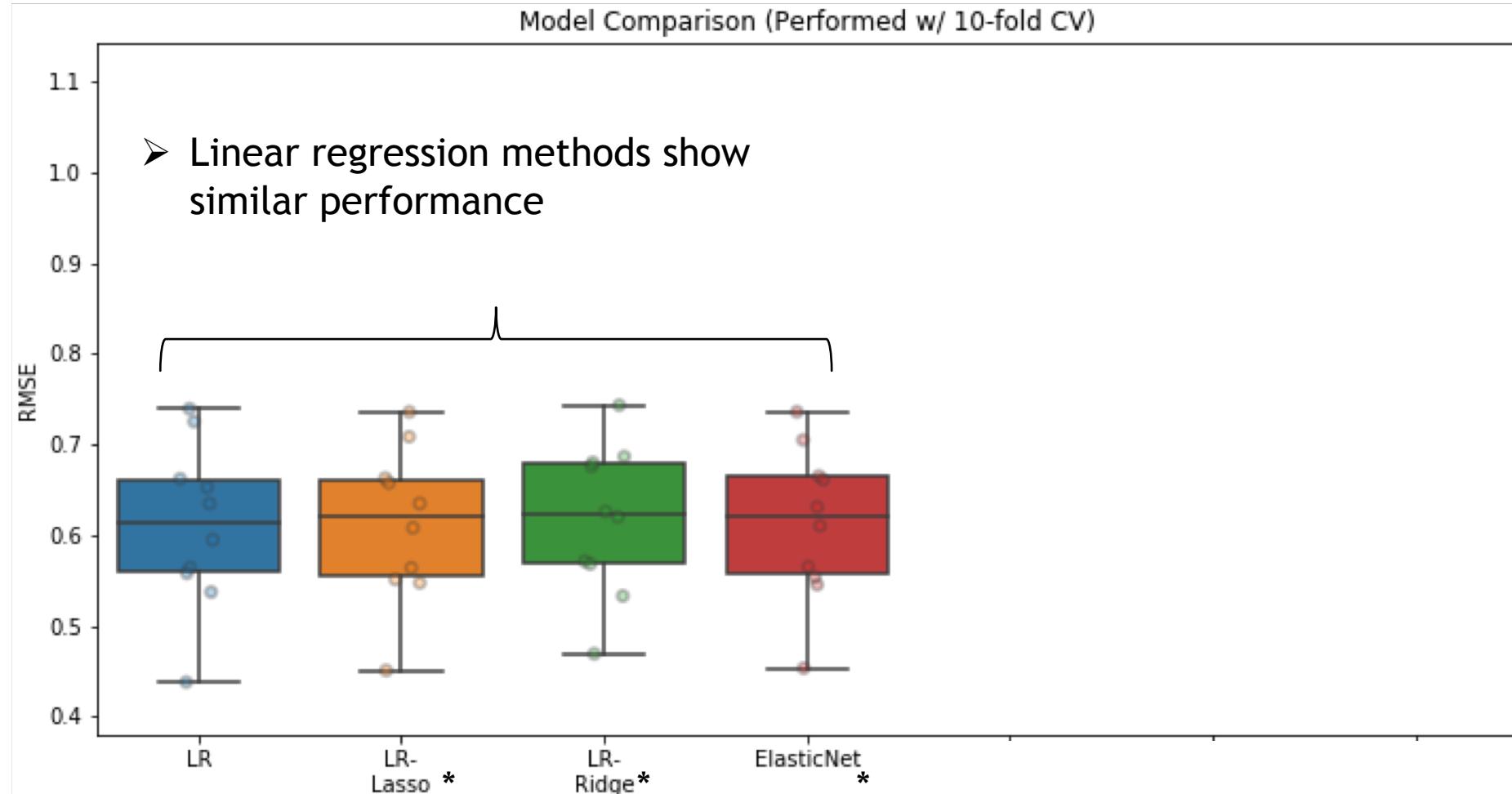
# + Engineering

## USD inflation rate applied

## Weighted average of Yards & Touchdowns

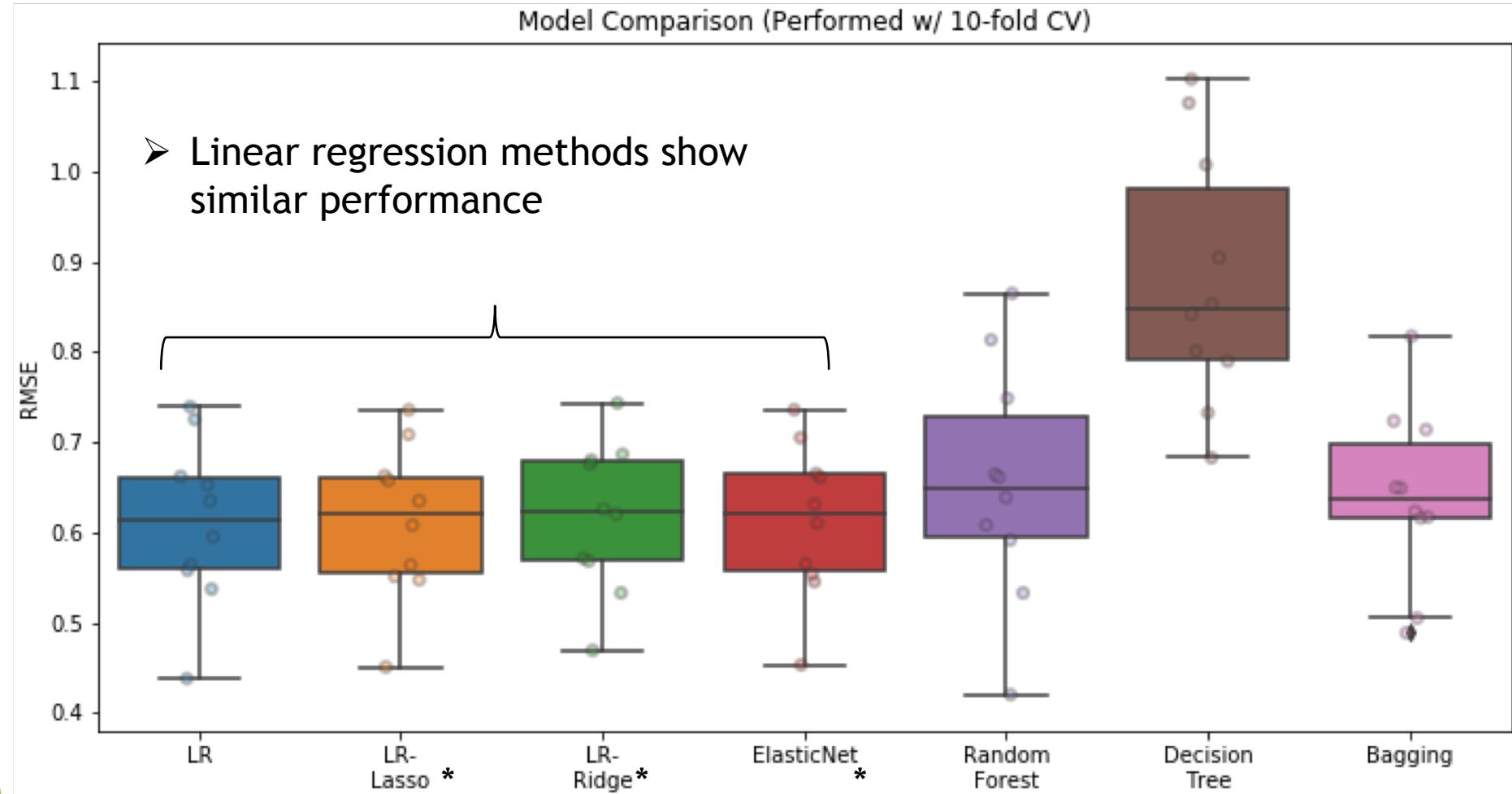
Dimension: (356 rows, 11 features)

# Best Model for Player Evaluation?



\* $\lambda$ : 0.03, 246, 0.07

# Best Model for Player Evaluation?

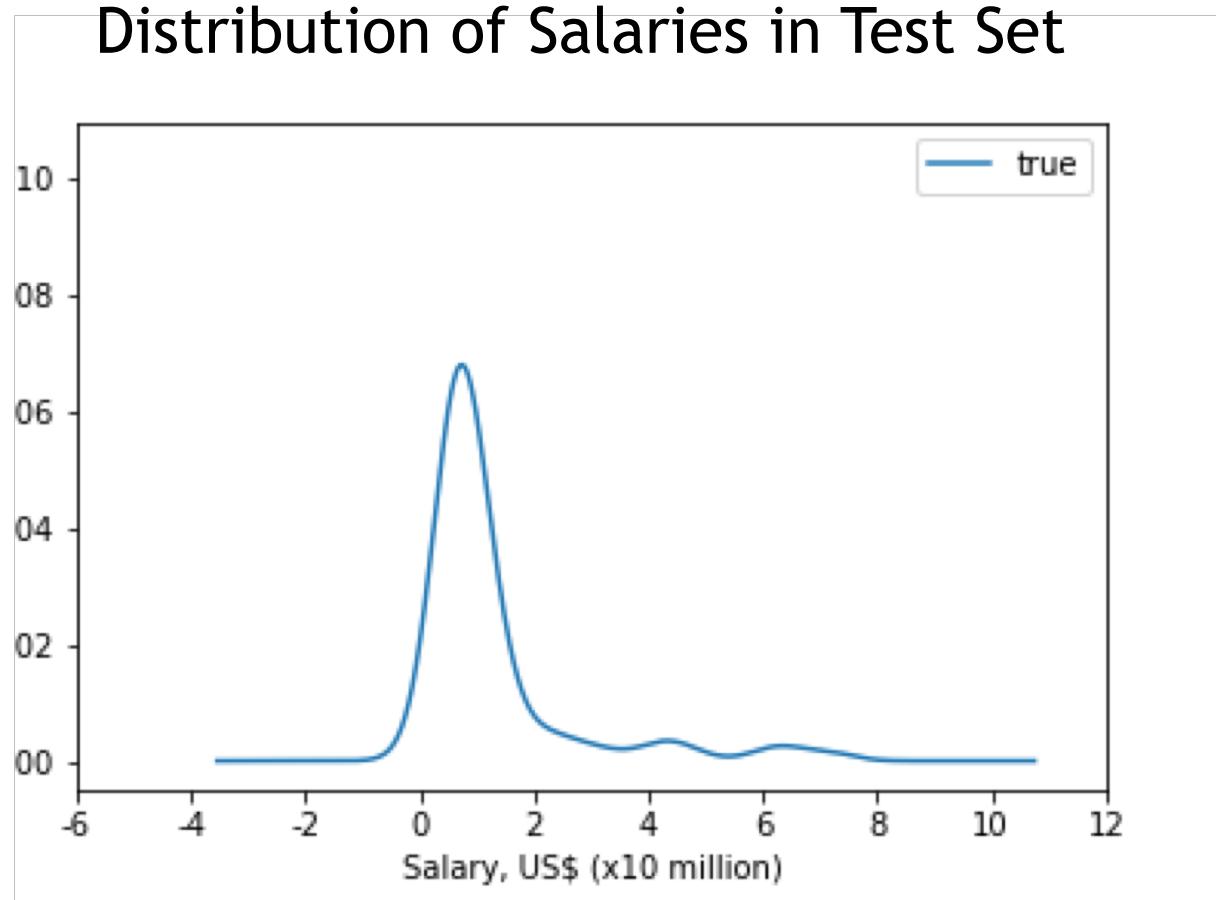


\* $\lambda$ : 0.03, 246, 0.07

➤ Tree-based regressors  
(out-of-the-box) perform worse

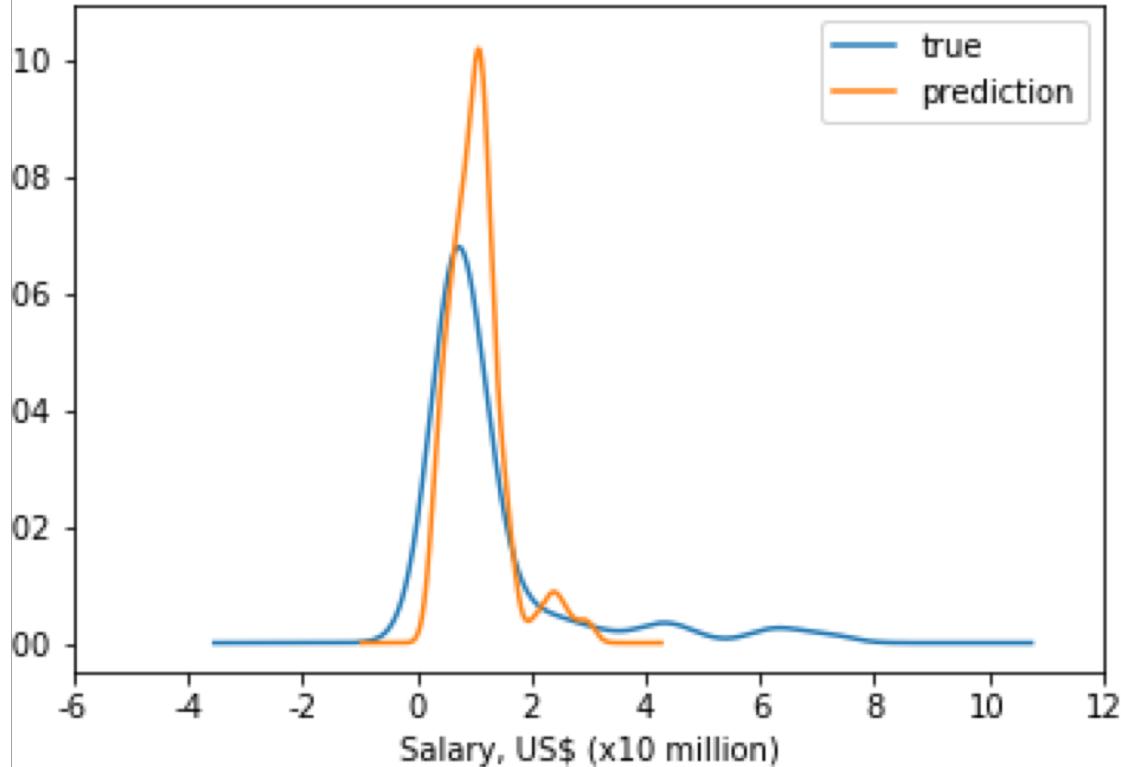
*Keep It Simple  
data-Scientist!*

# Model Performance of Simple LR



# Model Performance of Simple LR

Distribution of Salaries in Test Set



- Similar distributions and comparable lineshapes
- Some discrepancies
  - *Pretty good model!*
- Error ~USD 1.1 million (RMSE)

# Model Performance of Simple LR

## Distribution of Salaries in Test Set



# Model Improvement & Future Work

## 1. Obtain more data

- NFL.com's API to collect missing data, < year 2000

## 2. Explore other ways of feature engineering

- Opportunity Factor : **minutes played /game, injury in depth chart, etc.**
- Interaction terms : **coach's strategy  $\propto$  offensive lines  $\propto$  QB**
- Nurture vs Nature : **motivation? neighborhood of origin?**

✓ Progress towards bigger breakthroughs  
in NFL analytics using ML

# Answering the $\$10^6$ Question!

Question:  
- Was Russell Wilson underpaid?



Answer:  
- YES!

- Given his performance stats:

	yr1_l1p	yr2_l1p	yr3_l1p	yr4_l1p	dash_bc
0	6.032606	6.088364	6.060291	6.290457	0.0

	Wt	ht_inch	draftRnd_yj	pos_RB	pos_WR	draftStat_Yes
0	203.0	70.0	0.0	0	0	1

Our LR model:  
\$2.6 mil

Actual Salary:  
< \$1 mil

\$\$\$



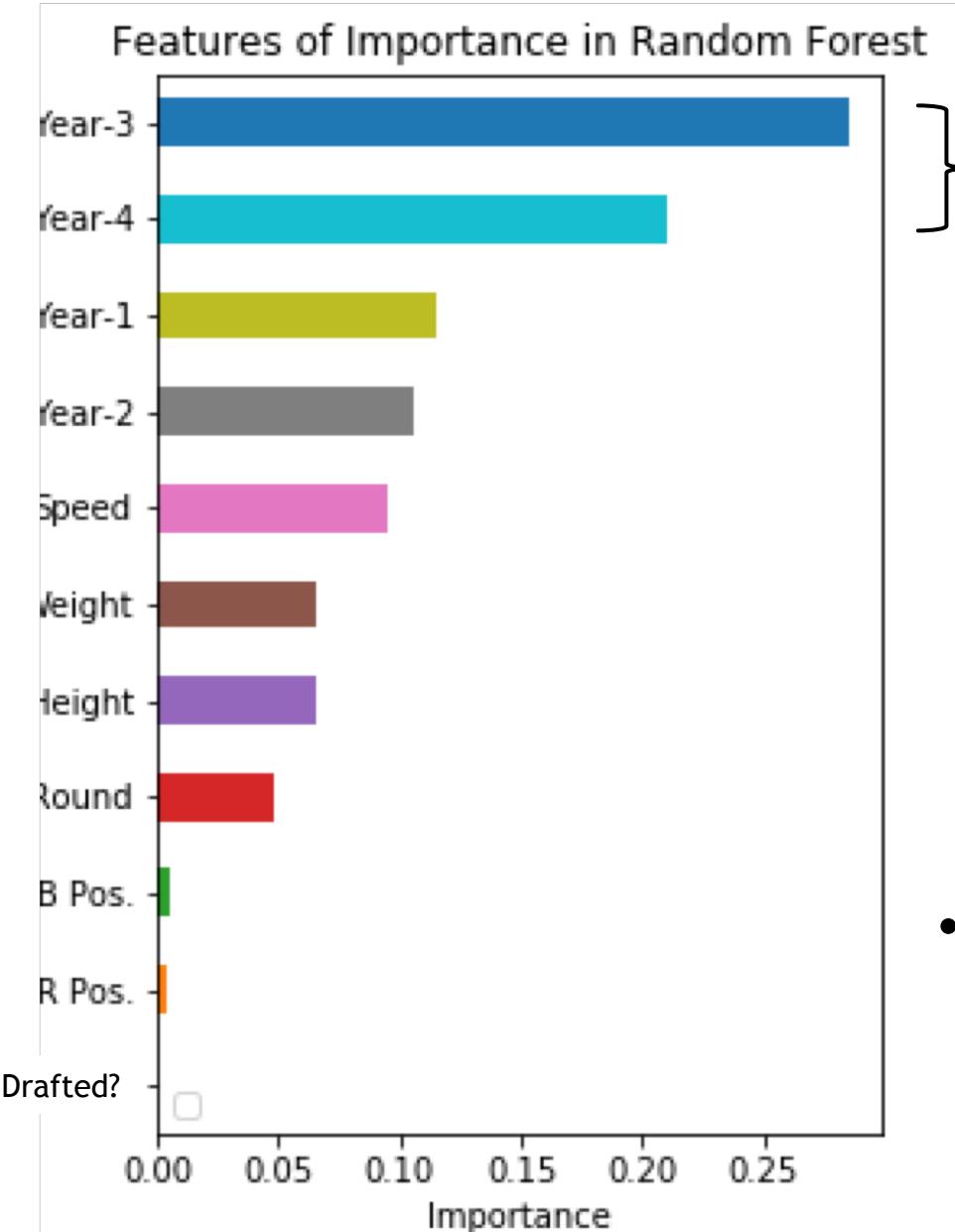
Thank You...

## Fun Facts from EDA:

- Quarterbacks make 2x as much \$\$\$ than other positions
- Roughly 60-70% players drop out within 5 years.
- Tom Brady made < 0.5 mil USD/year in his first 5 years of NFL career

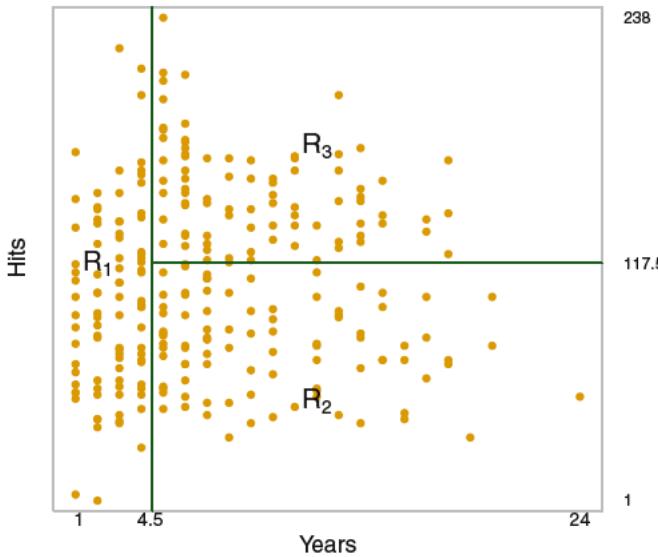
# Appendix

# Features of Importance in RF Model



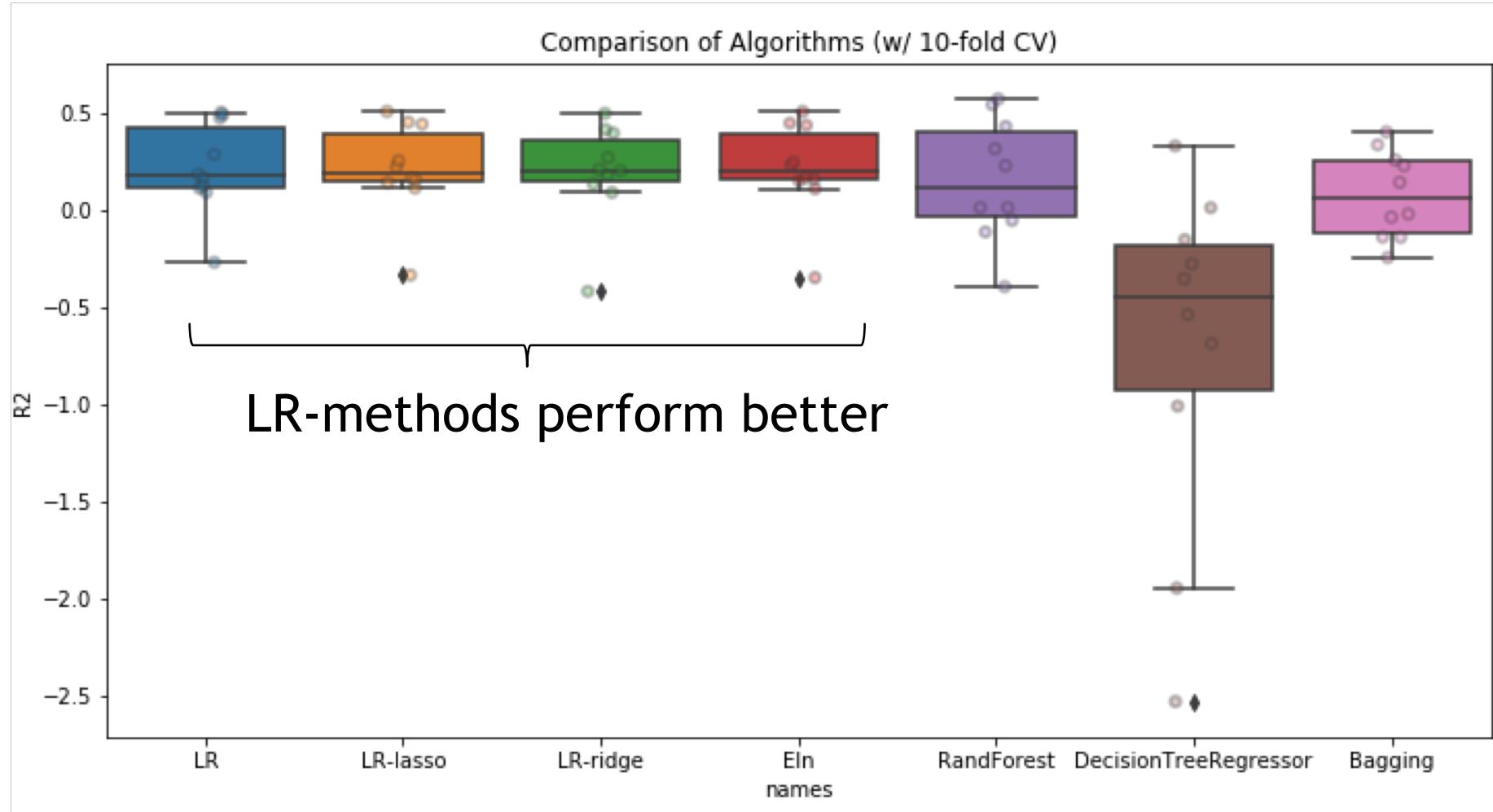
- Players performance in *Year-3 & Year-4* play a huge role in the model
- Players don't need to get drafted, *to get paid!*

# Tree-Based Regressors



$$\sum_{j=1}^J \sum_{i \in R_j} (y_i - \hat{y}_{R_j})^2,$$

# $R^2$ Values in Training Set (w/ 10-fold CV)

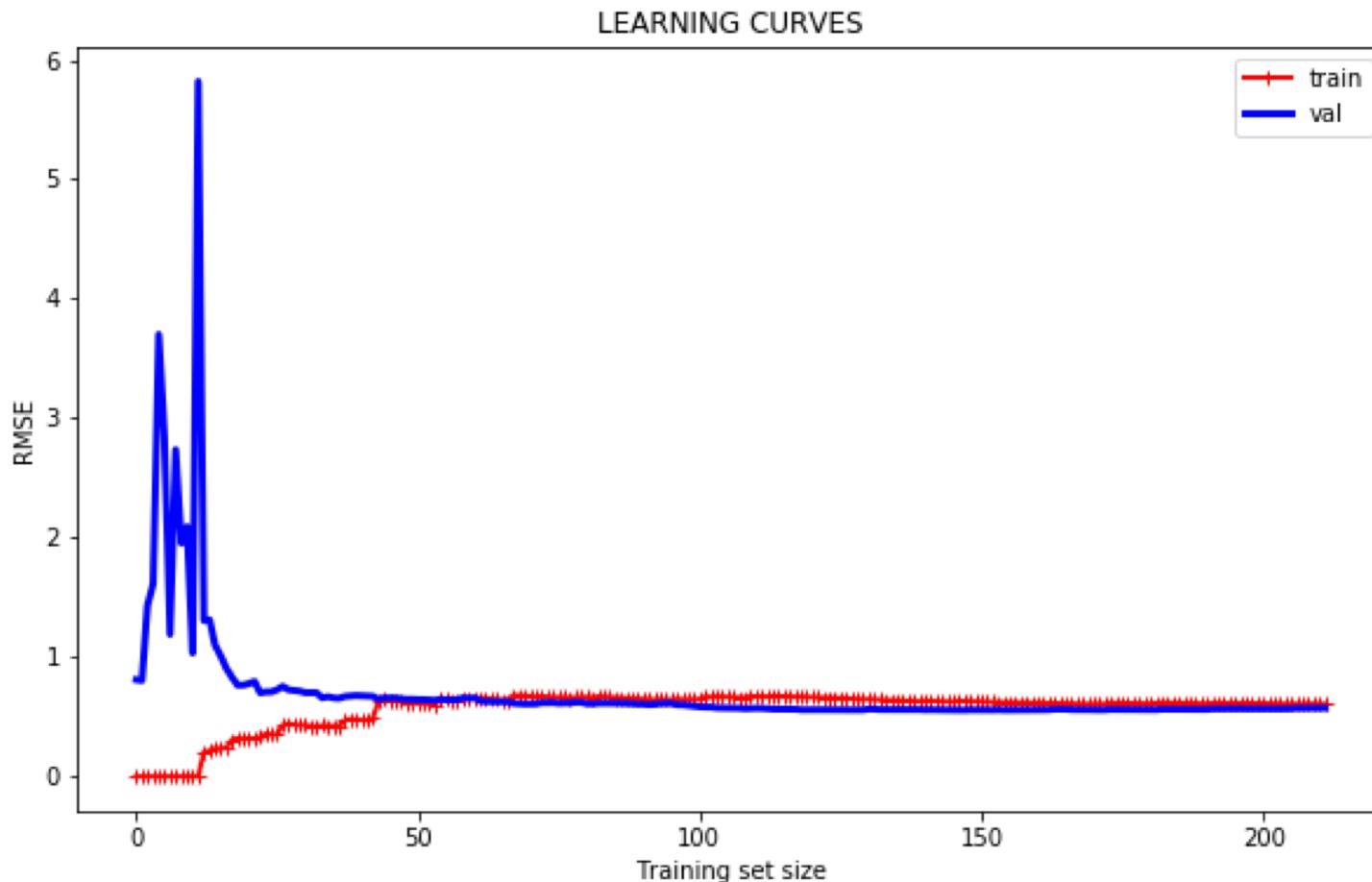


Note:

- Lambdas in Ridge, Lasso & ElasticNet were tuned, but tree-based hyperparameters were not tuned

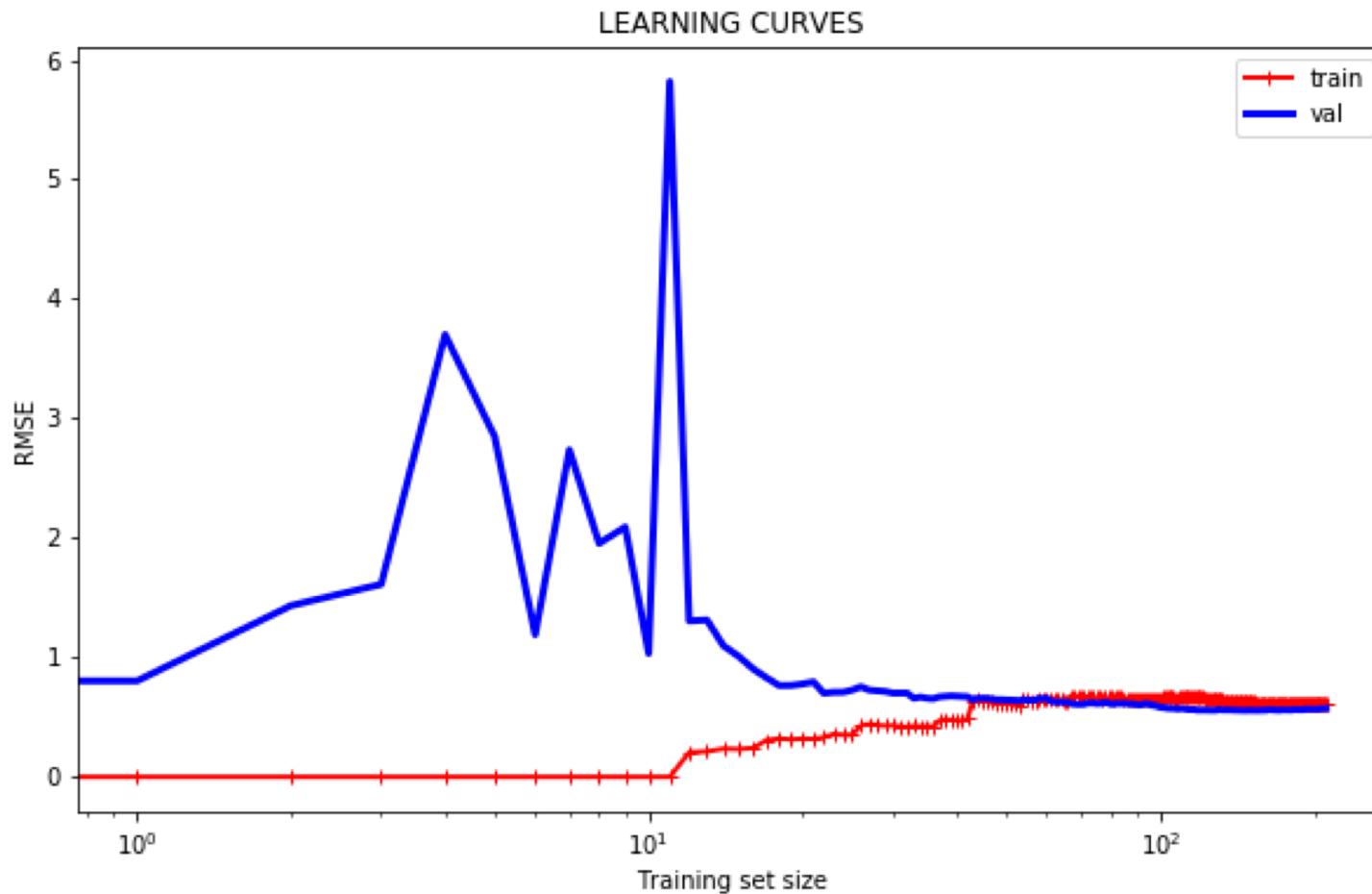
# Do We Have Sufficient Training Set?

- Training- and Validation errors achieve convergence



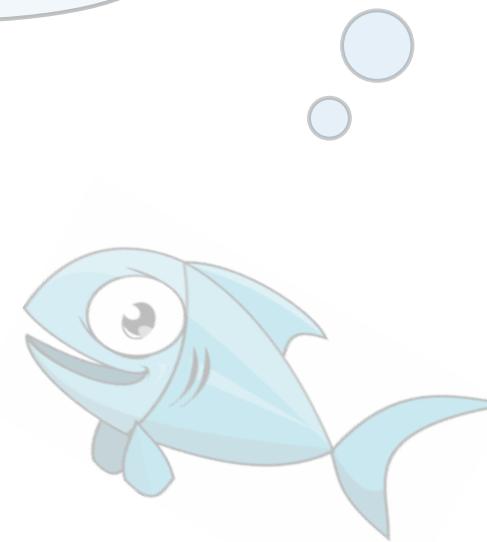
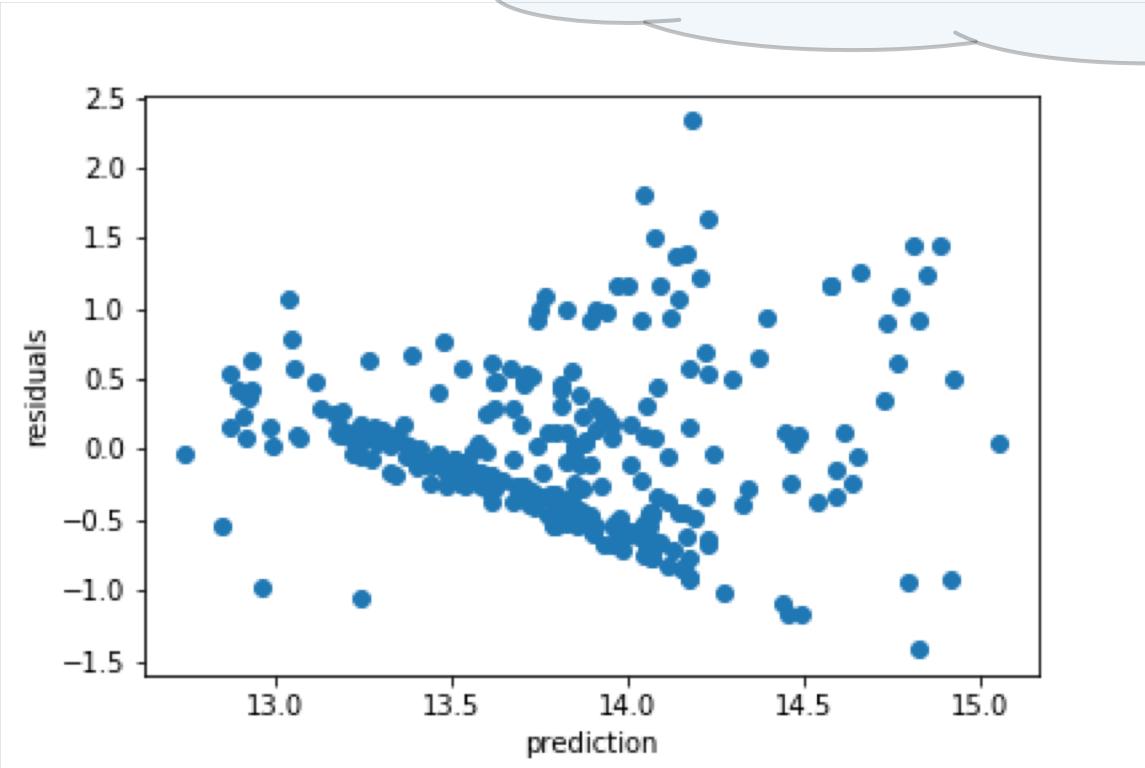
# Do We Have Sufficient Training Set?

- Training and Validation errors achieve convergence



# Predictions vs. Residuals

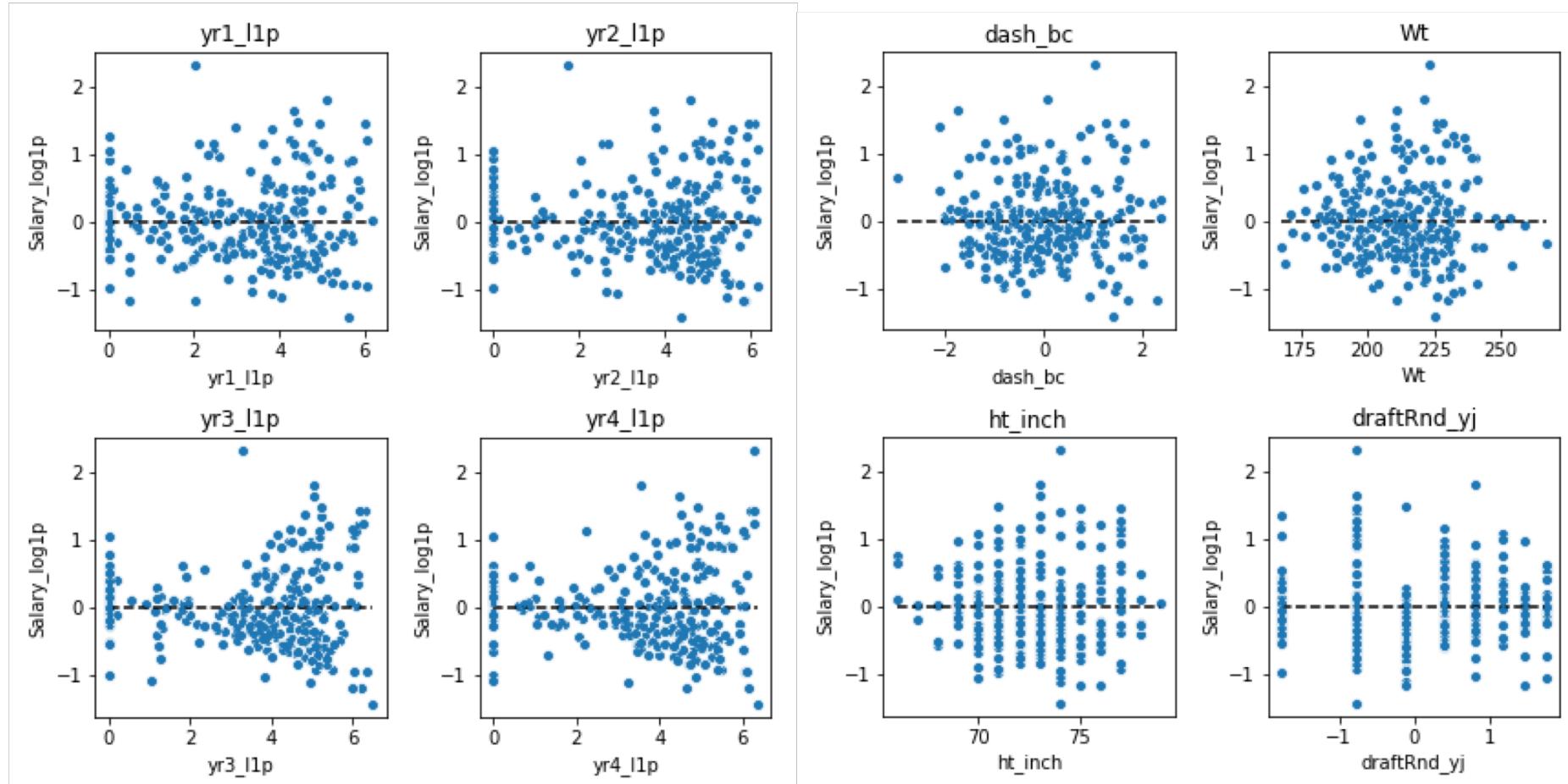
*Something looks fishy here!*



- Target and/or variables require transformations

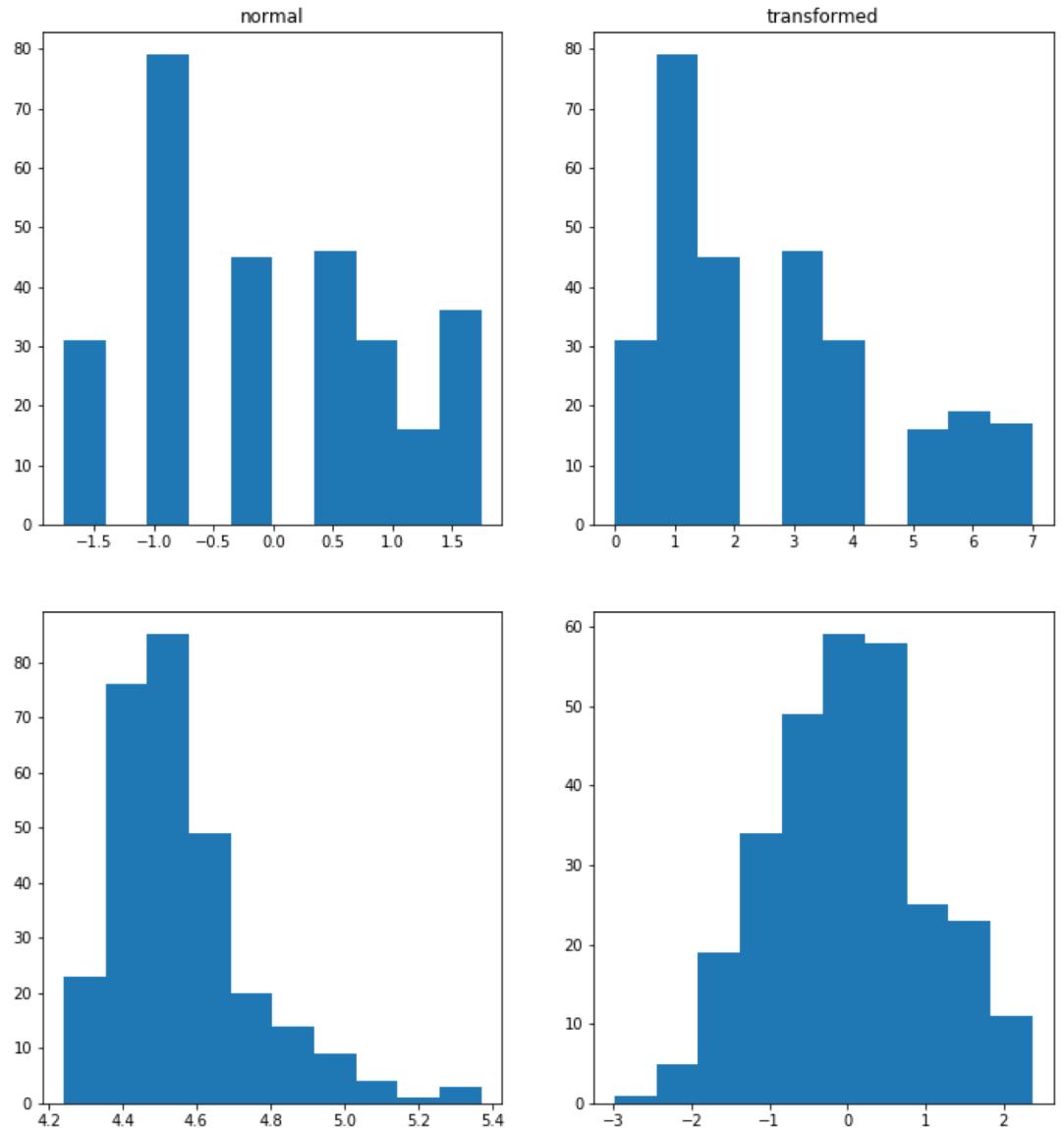
# Residuals vs. Numerical Features

## Training Set



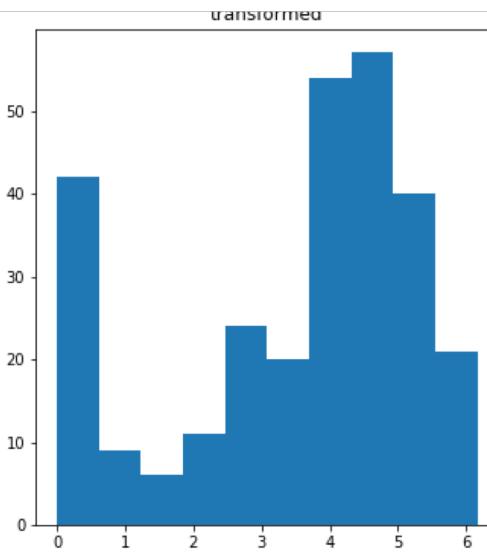
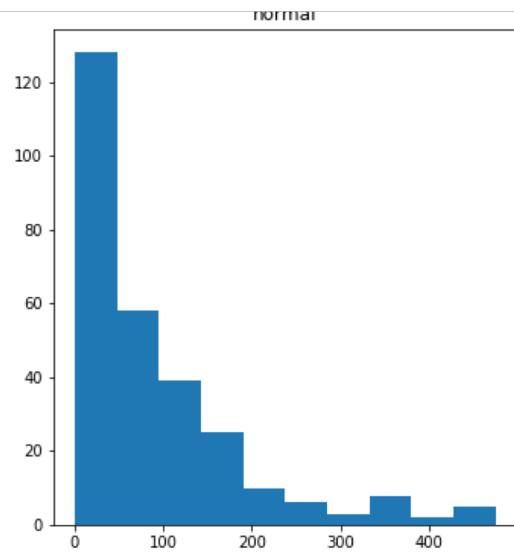
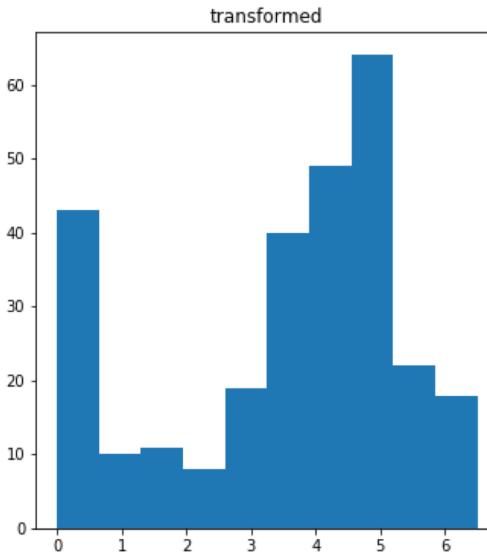
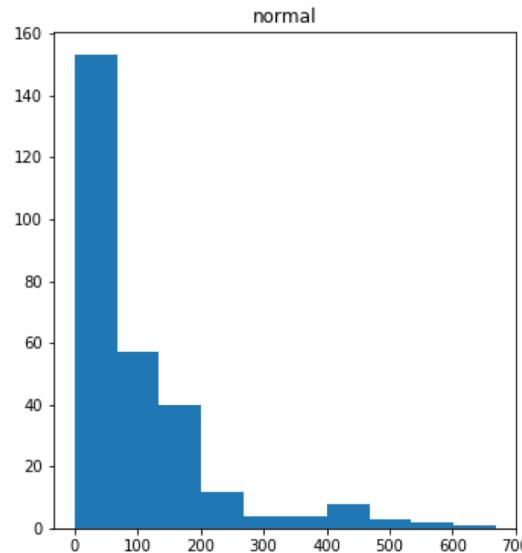
- A few variables still reflect odd-looking residuals, despite transformations

# Histograms of Weight and Draft-Round



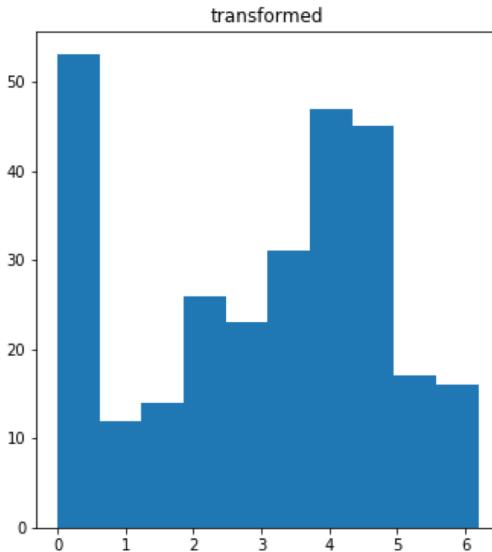
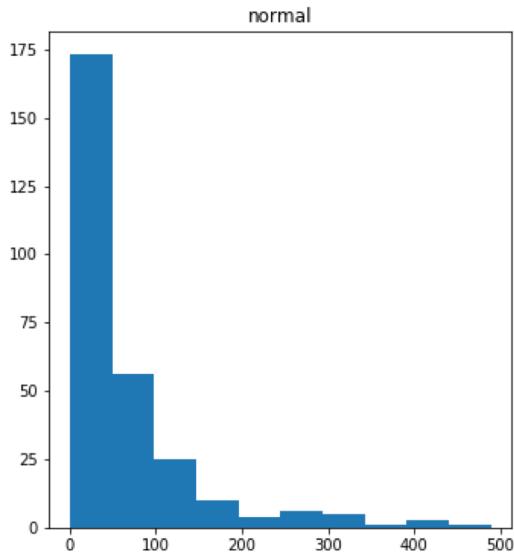
- **Box-cox** transformation on *dash*
- **Yeo-Johnson** transformation on draft-Round

# Histograms of Player Performance

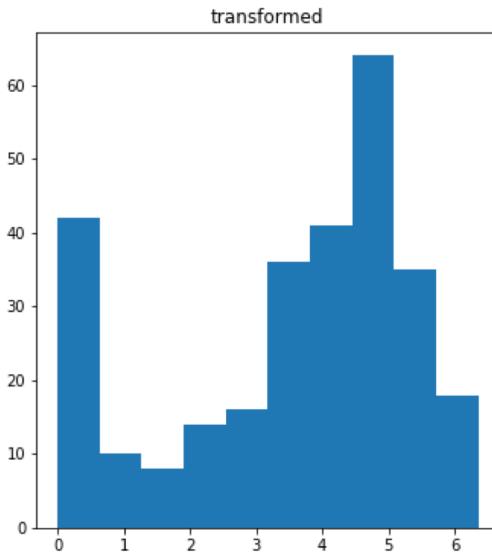
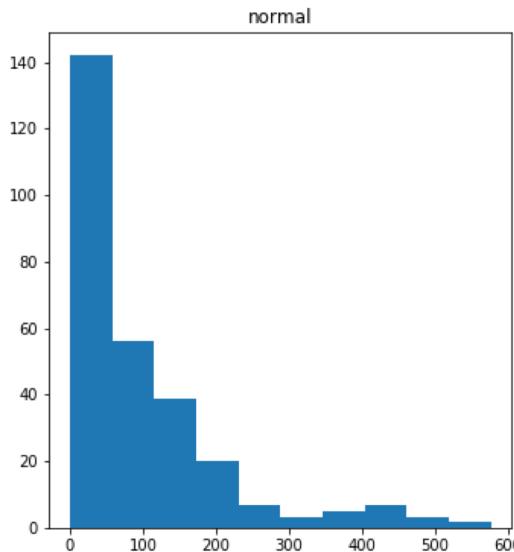


- **Log1p**  
transformations on  
*year-1 & year-2*

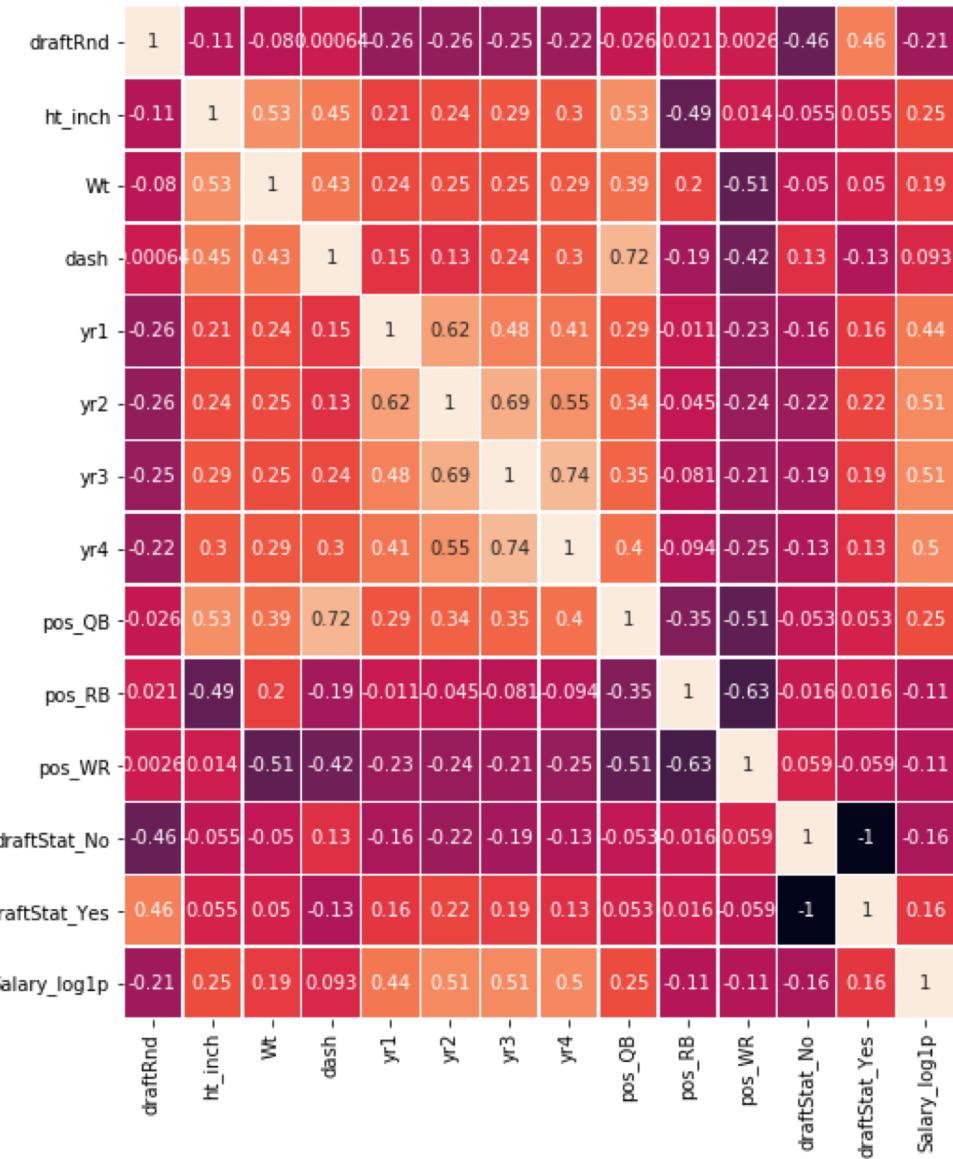
# Histograms of Player Performance



- **Log1p**  
transformations on  
*year-3 & year-4*



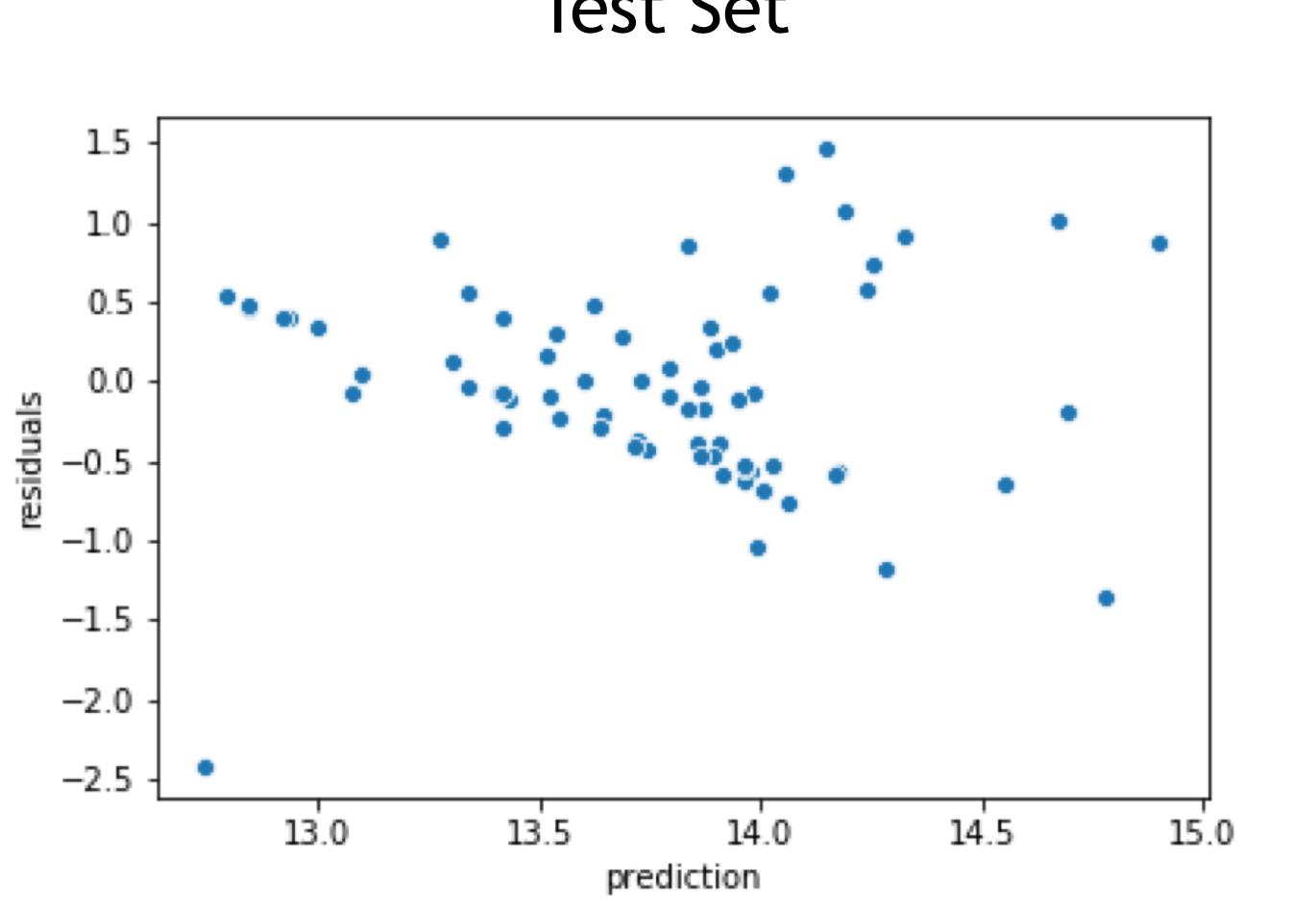
# Correlations: Variables & Target



- Player performance: *Year-1 thru Year-4* show Pearson's correlation of **0.4-0.5**
- Other variables: **<0.25**

# Predictions vs. Residuals

Test Set



# Residuals vs. Numerical Features

Test (hold-out) Set

