Ensemble Methods for NBA Salary Prediction

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PROBLEM STATEMENT

Predicting the Salary of an NBA player given their intrinsic information and in game statistics through the season.

DATA QUERYING & PROGRAMMING

- R v(4.1.2)
- nbastatR (maintained by Abe Resler)
- BasketballReference

R PACKAGES USED

- tidyr v(1.2.0) & dplyr v(1.0.8)
- caret v(6.0-92)
- ranger v(0.13.1)
- Boruta v(7.0.0)
- xgboost v(1.6.0.1)
- glmnet v(4.1-4)

DATA PREPROCESSING

- Rookies from 1985-86 to 2020-21
- Salary normalised by yearly salary cap
- Pertinent Features:-
  - Usage %
  - Player Efficiency Rating
  - VORP
  - Win Shares
  - Age
  - Position
  - Team(s)
  - Count of Games
- 80-20 stratified train-test split
- 5 fold CV for hyperparameter tuning

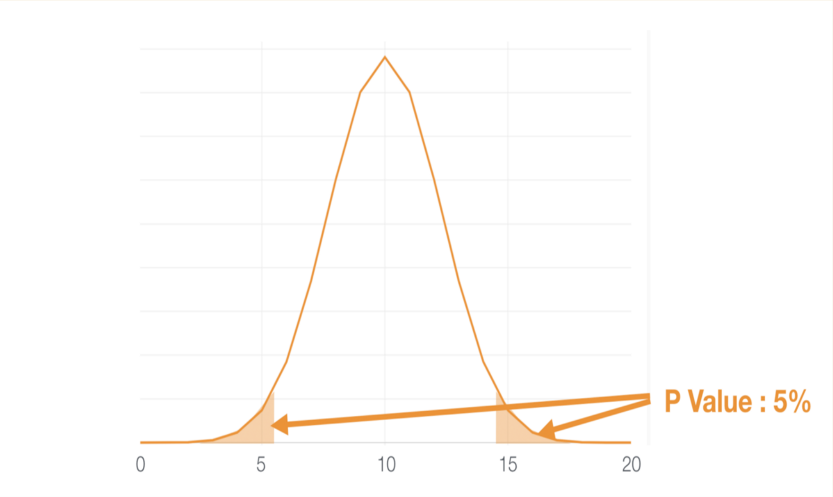
WHAT IS AN ENSEMBLE MODEL?

- A Model that “aggregates” estimates from a (large) number of other models (weak learners) to provide a final estimate for the supervised learning problem.
- Training sets are bagged or pasted

BORUTA ALGORITHM

Central Idea:-

Feature is useful *iff* it performs better than the best randomised feature



[1]

[1] (Nishida, *Finding variable importance with Random Forest & Boruta*, 2019)

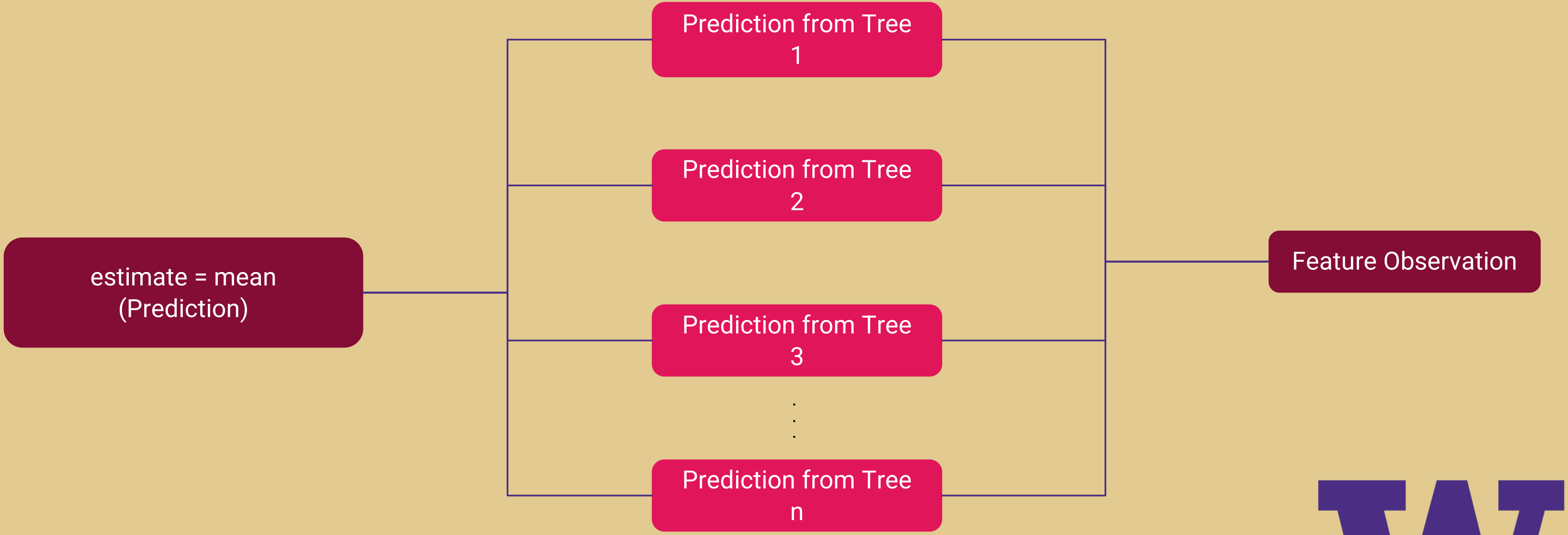
BASELINE MODEL

- Elastic Net
- Optimal Hyperparameters
  - α = 0.1
  - λ = 0.0003342206

RESULTS

MODEL	OUT OF SAMPLE RMSE	ERROR VALUATION IN 2021 SALARY ($)
Random Forest	0.05375	6,041,710
XGBoost-Linear	0.05485	6,165,897
Stochastic XGBoost - Tree	0.05486	6,167,435
XGBoost - Tree	0.05491	6,172,589
Elastic Net	0.05945	6,683,473

RANDOM FOREST



estimate = mean (Prediction)

Prediction from Tree 1

Prediction from Tree 2

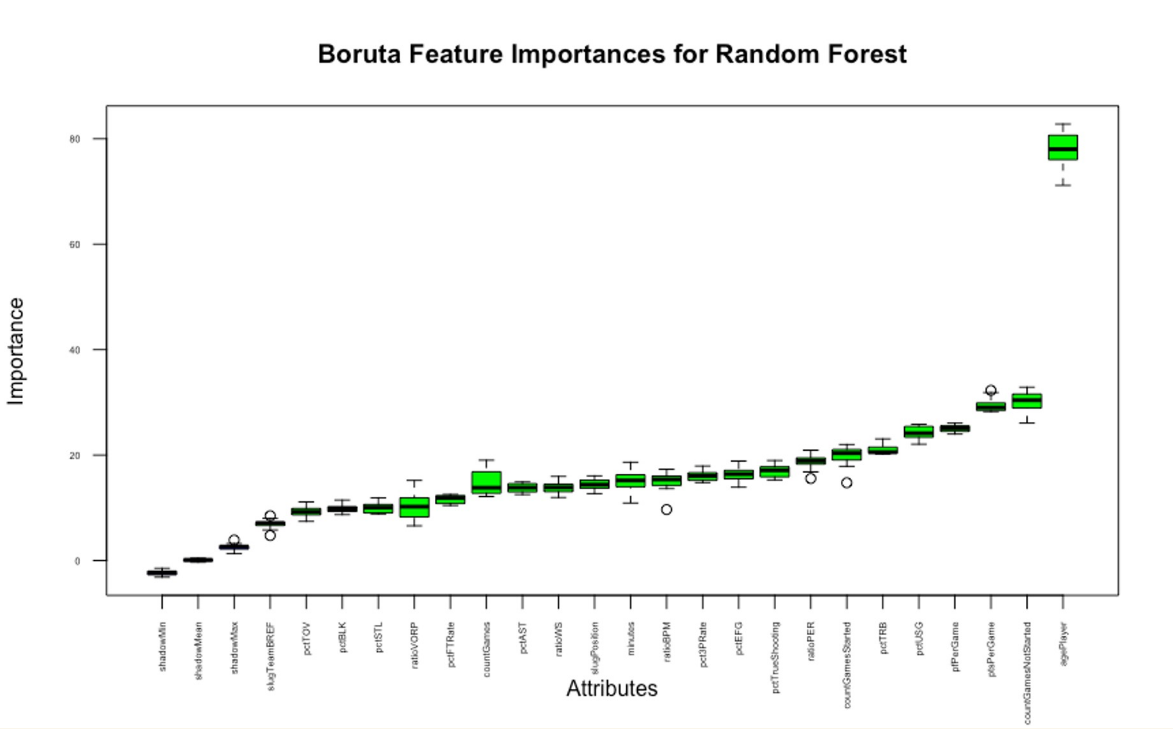
Prediction from Tree 3

. . .

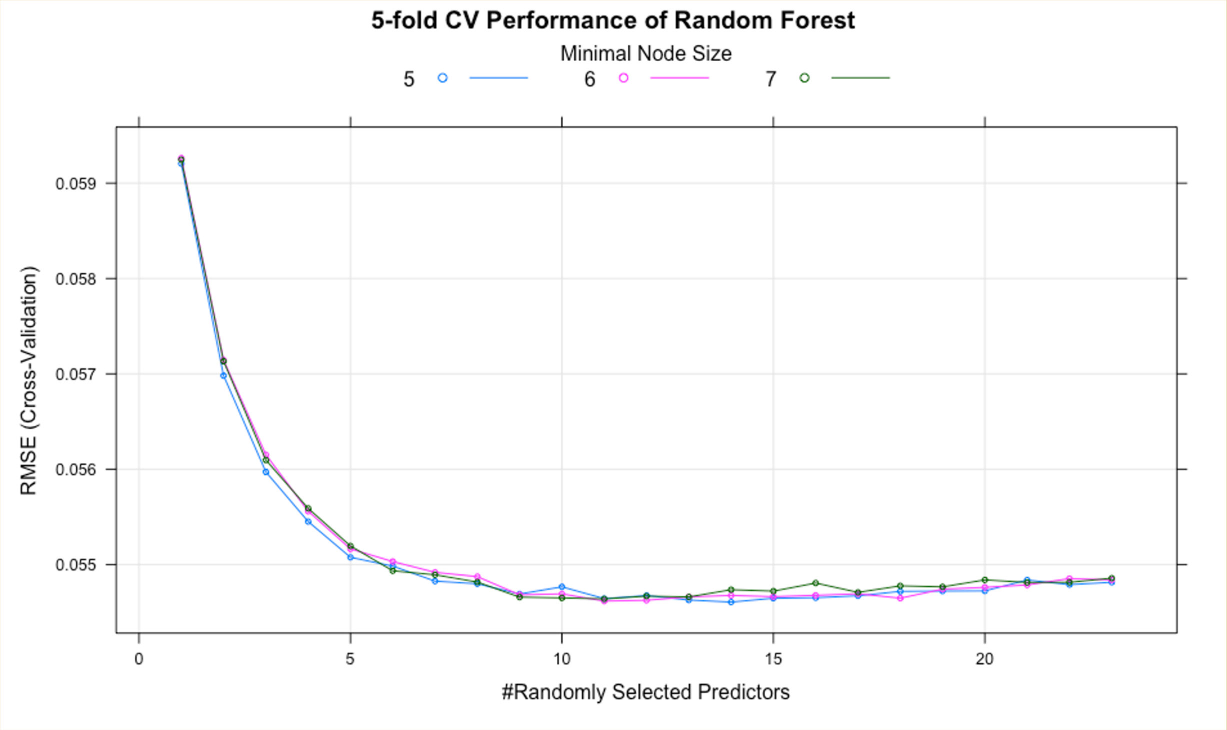
Prediction from Tree n

Feature Observation

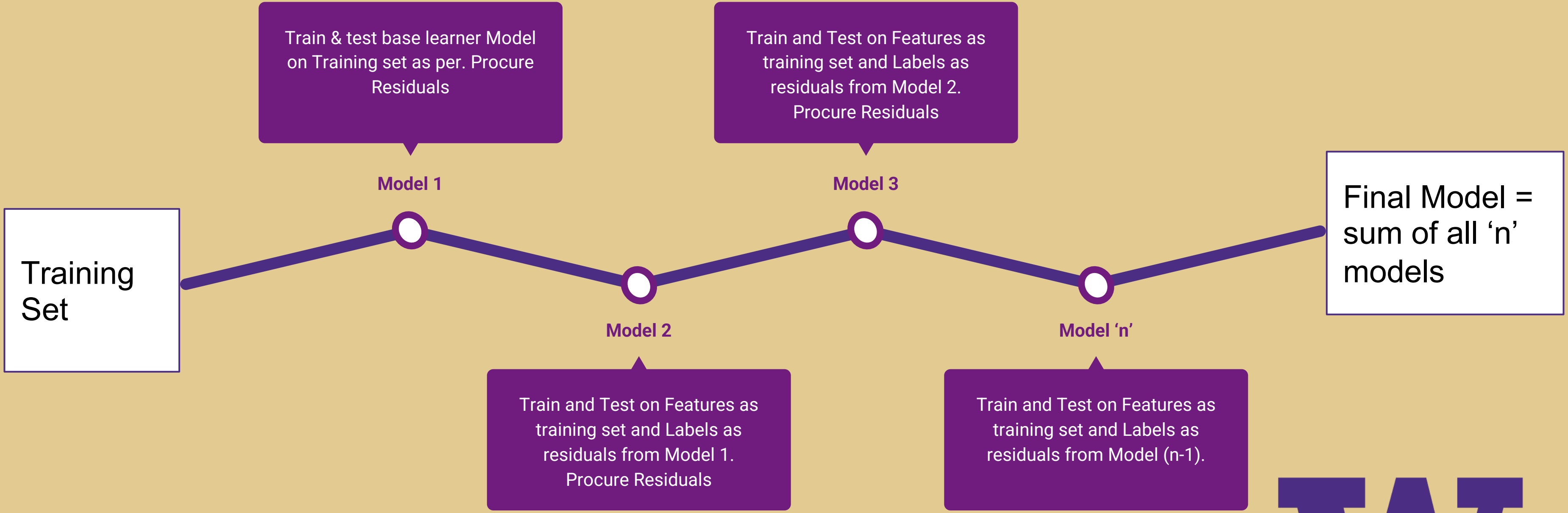
RANDOM FOREST FEATURE SELECTION



RANDOM FOREST HYPERPARAMETER TUNING



GRADIENT BOOSTING & XGBOOST



Training Set

Model 1

Train & test base learner Model on Training set as per. Procure Residuals

Model 2

Train and Test on Features as training set and Labels as residuals from Model 1. Procure Residuals

Model 3

Train and Test on Features as training set and Labels as residuals from Model 2. Procure Residuals

Model 'n'

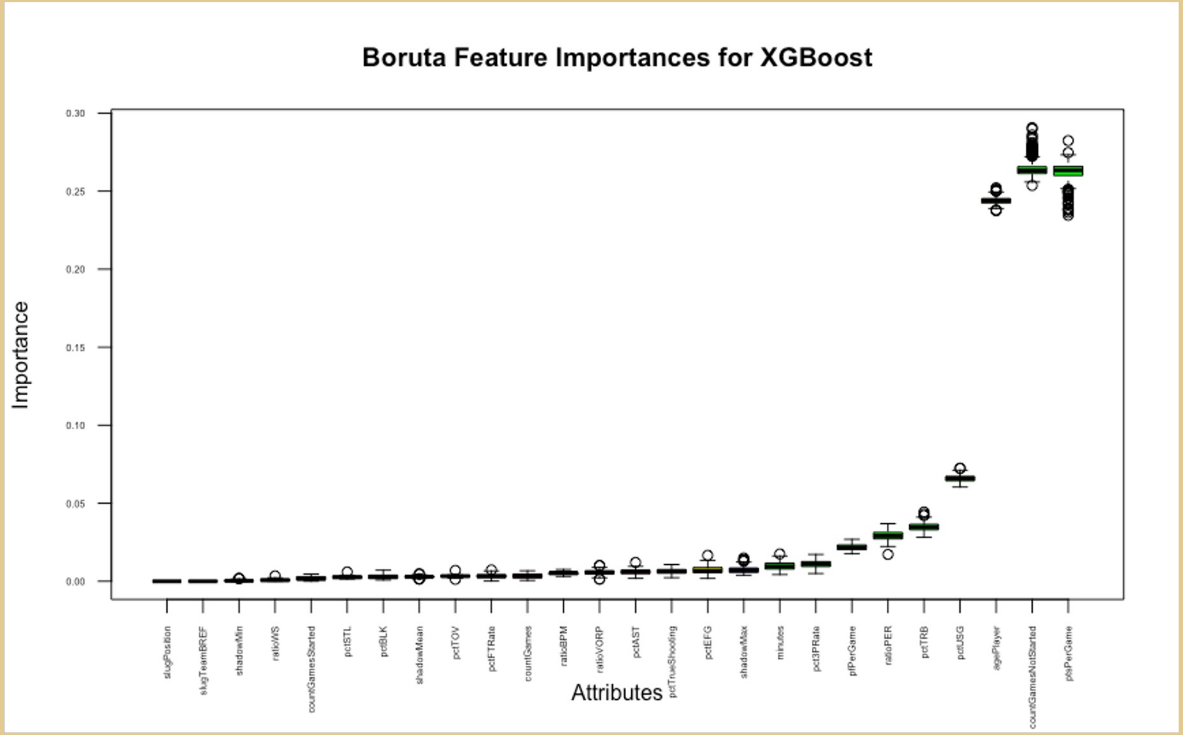
Train and Test on Features as training set and Labels as residuals from Model (n-1).

Final Model = sum of all 'n' models

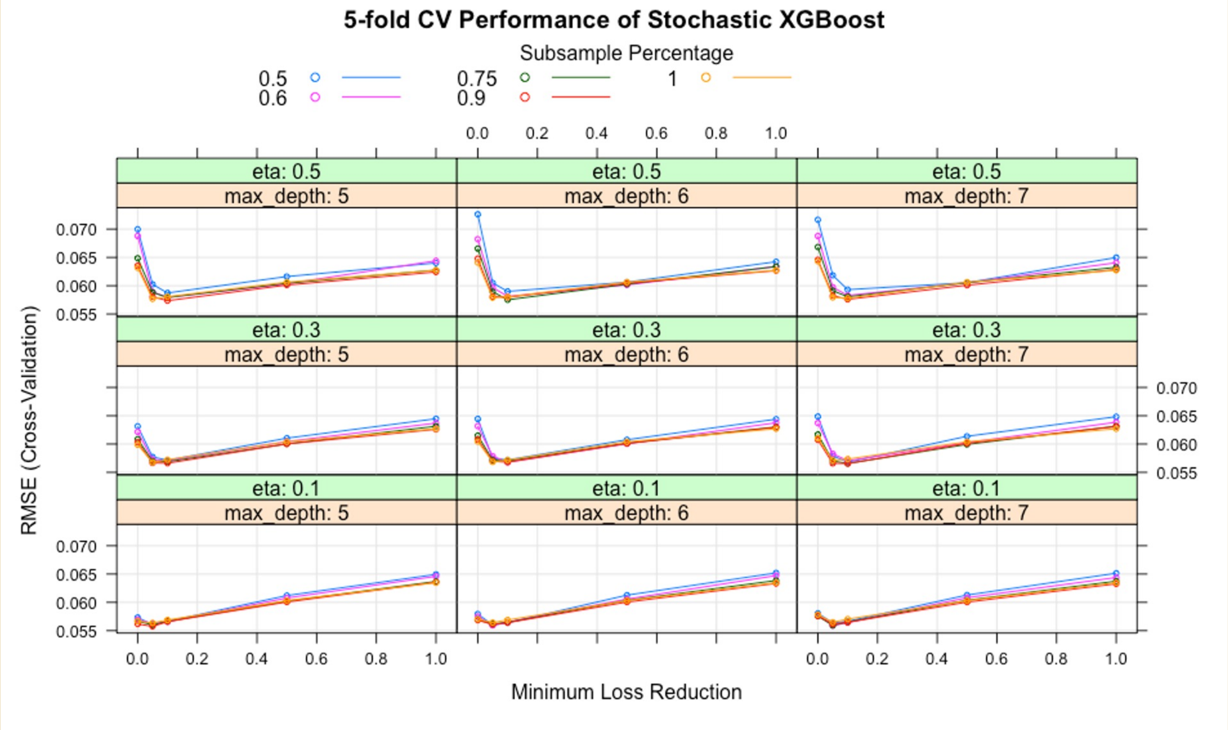
STOCHASTIC GRADIENT DESCENT

- Random Subsampling (without replacement) of Training set
- Evades plateaus and local minima in cost function
- Faster execution with minimal tradeoff

XGBOOST FEATURE SELECTION



STOCHASTIC XGBOOST TREE HYPERPARAMETER TUNING



CONCLUSIONS & SCOPE FOR FURTHER RESEARCH

- Ensemble methods better for the supervised learning problem
- Best Model:- Random Forest
- Further hyperparameter tuning

- 2021 Salary Cap = $ 109,140,000

MODEL	OUT OF SAMPLE RMSE	ERROR VALUATION IN 2021 SALARY ($)
Random Forest	0.05375	6,041,710
XGBoost-Linear	0.05485	6,165,897
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Thank You

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