A Machine Learning Approach to MLB Catcher Framing

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Introduction

- “Catcher framing is the art of a catcher receiving a pitch in a way that makes it more likely for an umpire to call it a strike – whether that’s turning a borderline ball into a strike, or not losing a strike to a ball due to poor framing.” - MLB.com Glossary

Motivation

- Baseball catchers can influence the call of a ball or strike on how they catch the ball
- Some catchers are better than others at this skill
- Baseball teams are aware of this and are acquiring players good at this skill to win more games
- We want to quantify the best catcher's at framing for the 2021 season
- There are several factors that influence whether a pitch will be a strike or ball
- Catchers getting more strikes translates to more outs, and fewer runs for the opposing team

Data

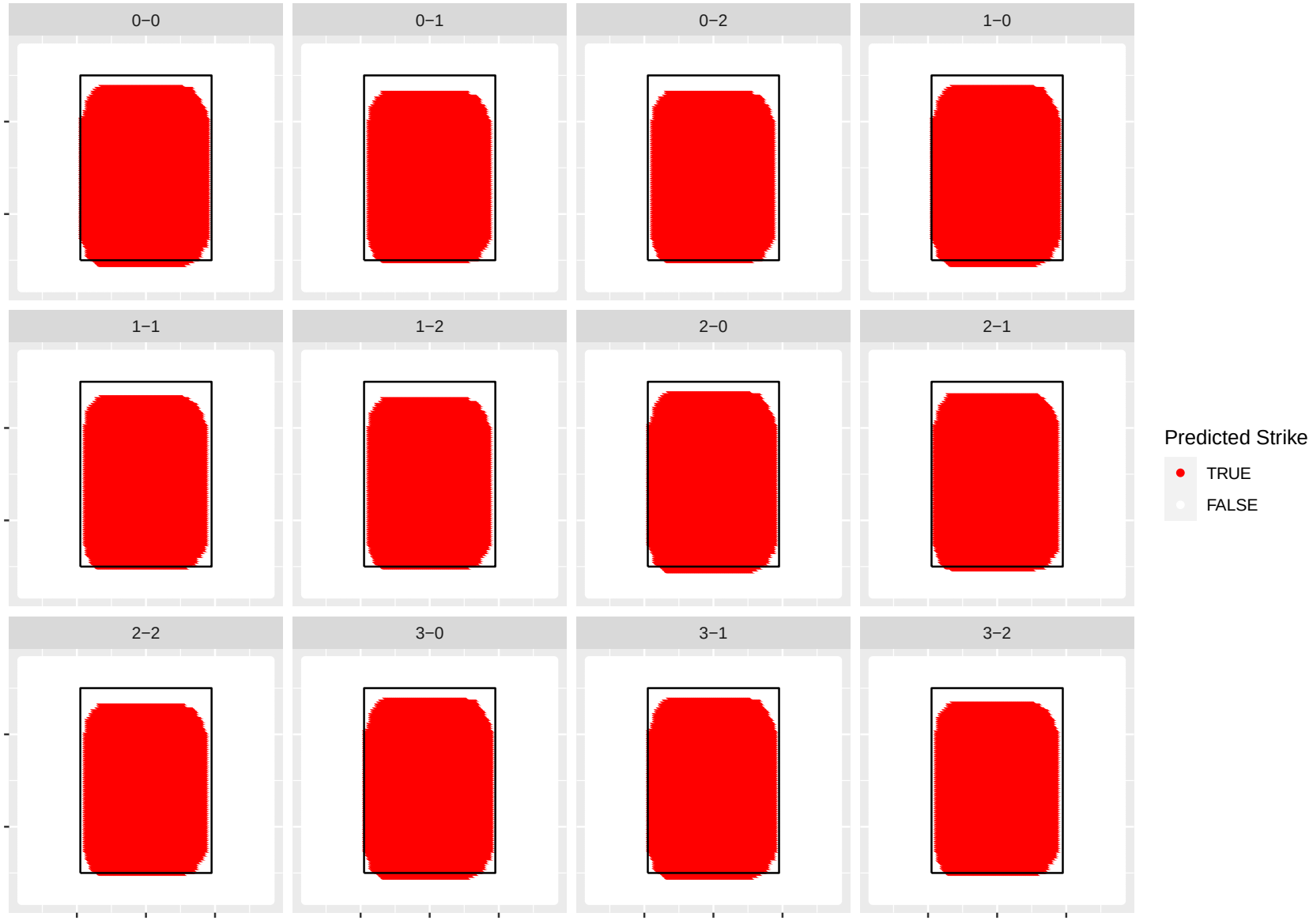
- 2021 pitch data scraped from Baseball Savant through baseballr package
- ~700,000 rows (each for a single pitch)
- Wanted to look at pitches that were not swung at by the batter (called strike or ball)
- ~350,000 rows remain

Variables

- We used:
- Pitch type and pitch release speed, position, and spin rate
- Whether or not the pitcher and batter are right or left handed
- Count, number of outs during the at-bat, and inning number
- Where the pitch landed
- Whether the game was played home or away
- How tall the batter is

Example

- Strike Probability by Location and Count

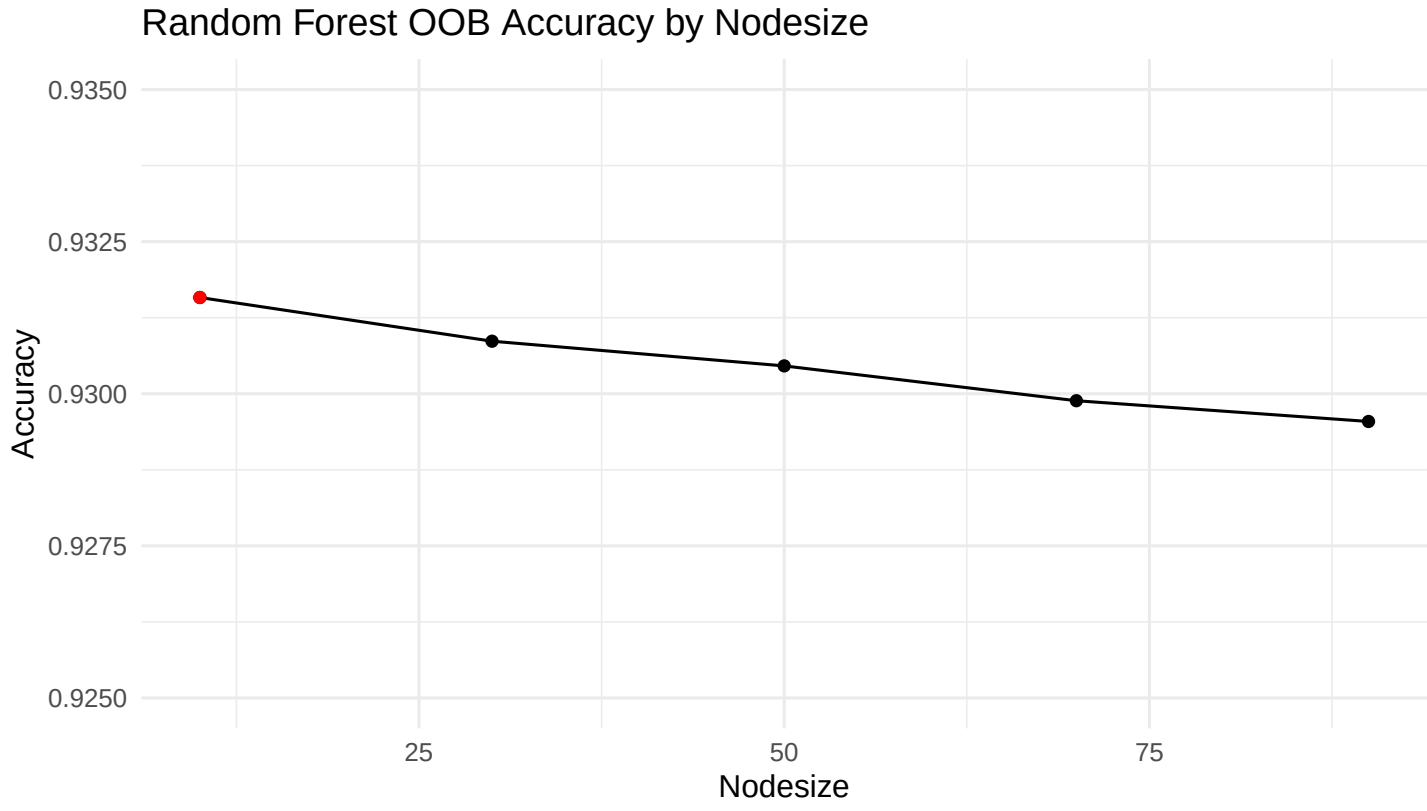


Logistic Regression Model

```
##
## Call:
## glm(formula = strike ~ ., family = "binomial", data = data_no_catchers[train,
##     ])
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6191  -0.9878  -0.6111   1.2276   2.4930
##
## Coefficients:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept)          1.698e+00  6.906e-01   2.459 0.013931 *
## pitch_typeCurveball  4.183e-01  3.844e-02  10.881  < 2e-16 ***
## pitch_typeCutter     2.955e-01  3.189e-02   9.266  < 2e-16 ***
## pitch_typeFastball   4.516e-01  2.885e-02  15.654  < 2e-16 ***
## pitch_typeSinker     6.161e-01  2.719e-02  22.658  < 2e-16 ***
## pitch_typeSlider     3.748e-01  2.810e-02  13.338  < 2e-16 ***
## release_speed       -1.049e-02  1.789e-03  -5.863 4.53e-09 ***
## release_pos_x        3.145e-03  7.481e-03   0.420 0.674232
## release_pos_z       -4.714e-02  1.077e-02  -4.378 1.20e-05 ***
## standR               7.872e-02  1.151e-02   6.840 7.89e-12 ***
## p_throwsR           -7.410e-03  3.137e-02  -0.236 0.813241
## count0-1            -1.020e+00  1.844e-02 -55.307  < 2e-16 ***
## count0-2            -2.027e+00  3.482e-02 -58.230  < 2e-16 ***
## count1-0            -1.363e-01  1.684e-02  -8.093 5.83e-16 ***
## count1-1            -7.867e-01  2.004e-02 -39.252  < 2e-16 ***
## count1-2            -1.857e+00  2.927e-02 -63.427  < 2e-16 ***
## count2-0             3.026e-02  2.594e-02   1.166 0.243454
## count2-1            -5.445e-01  2.631e-02 -20.694  < 2e-16 ***
## count2-2            -1.446e+00  2.971e-02 -48.682  < 2e-16 ***
## count3-0             7.629e-01  3.751e-02  20.341  < 2e-16 ***
## count3-1            -2.723e-01  3.654e-02  -7.453 9.09e-14 ***
## count3-2            -1.019e+00  3.705e-02 -27.503  < 2e-16 ***
## pfx_x               -5.689e-03  7.340e-03  -0.775 0.438287
## pfx_z                9.248e-03  1.539e-02   0.601 0.547869
```

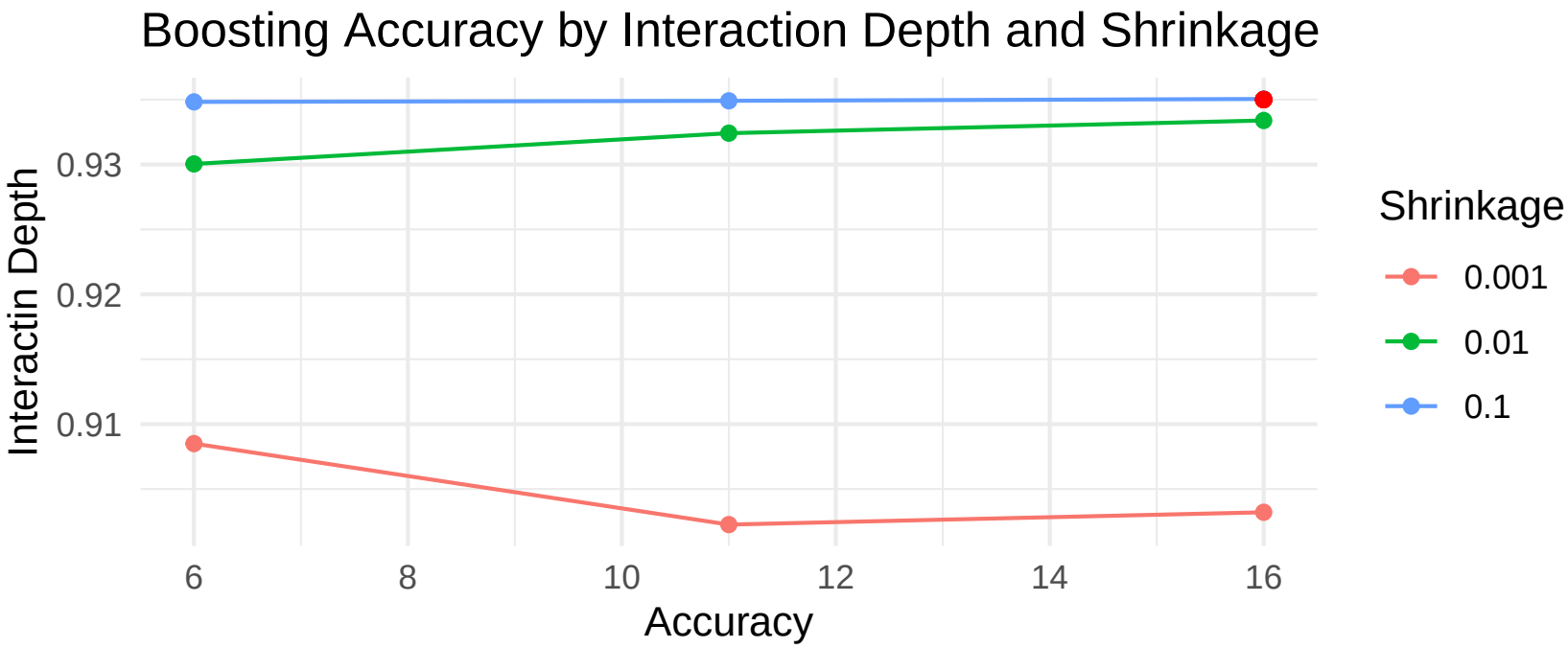
Random Forest

- Tested several Random Forest models
  - Nodesize: 10, 30, 50, 70, 90 | # of Trees: 500
  - Compared Out-Of-Bag Error



Boosting

- 3 Fold Cross Validation on Boosting
  - Interaction depth: 6, 11, 16
  - Shrinkage: 0.1, 0.01, 0.001
  - Number of Trees: 500
  - Compared CV accuracy
- 27 models took over 5 hours to run



Boosting Part 2

- Only tuned shrinkage and interaction depth
- Now tune trees with interaction depth of 16 and shrinkage of 0.1
- Trees: 300, 500, 600, 900, 1200