STATS 601 Project Proposal:

Caught Looking: Analyzing Variation in Umpire Strike Zones

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1. Introduction

As technology advances, Major League Baseball (MLB) has faced increased pressure from fans, coaches, and players to use video technologies to aid umpires in making calls on the field. In particular, ball and strike calls are notoriously subjective and challenging for a human to make.[1] With this project, we will assess the ability of umpires to make ball and strike calls that match the rulebook and that are consistent across different game situations. To conduct our analysis, will access preprocessed PITCHf/x data for the entire 2018 MLB season from Kaggle (Schale, 2019). PITCHf/x is a system that uses cameras mounted in every MLB stadium to track the speed and location of every pitched baseball. The most important part of the PITCHf/x data for our purposes is the set of coordinates that gives the location of every ball that crosses the plate, but it has many other details about the game and players involved that will enable us to assess the ability of umpires to stay consistent across a variety of situations.

2. Research questions

The first question we are looking to answer is whether umpires' realized strike zones match the requirements prescribed by the official rules of baseball. Once we have estimated strike zones for each umpire, we can use simulation to assess their "error rate"—the percentage of pitches they would classify as a ball or strike that, according to the rules of baseball, should have the opposite classification. As time and space permit, we also are looking to answer secondary questions such as:

- Do umpires' strike zones change when there are 2 strikes in the count? What about 3 balls?

[1] https://www.youtube.com/watch?v=Akx2kBavZ9Y

- Do umpires have different strike zones for star pitchers and batters than they do for mediocre players?
- Do umpires change their strike zone when a game goes into extra innings?

The general theme of each all of these questions is how good are umpires at (consistently) making the correct ball and strike calls? The worse the umpires perform in different game situations, the louder will be the calls for technology-aided officiating.

3. Methodology

Estimating strike zones from pitch location data is fundamentally a nonlinear classification problem. Given pitches that have an x and y coordinate, we want to classify the pitches in a rectangle in the middle of the grid as strikes, and anything too far away from the middle (outside the rectangle) as balls. Some methods that we think would succeed in drawing a realistic decision boundary are kernel logistic regression, additive logistic regression, support vector machines, tree-based methods, and neural networks. Upon selecting a technique that gives representation of the umpires' strike zones based solely on the pitch location, we can train models that take into account game-level and player-level information (such as game situation or player skill). Upon selecting the best method modeling the umpires' strike zones, we will construct low-dimensional encodings (using, e.g., kernel PCA or a neural network approach) that will be used in the main analysis. To study the effect of game- and player-level information as well as the effect of the particular umpire on the strike zone, we will consider a multivariate regression approach where the response will be taken as the estimated strike zone. Finally, we can compare the list of "best" umpires according to our analysis with the umpires who were selected by MLB to officiate in the playoffs to see if our rankings match those of the league's executives.

References

Schale, P. (2019). MLB Pitch Data 2015-2018. Kaggle Dataset (https://www.kaggle.com/pschale/mlb-pitch-data-20152018).