Called Strikes Analysis: Measuring the strike calls MLB hitters receive

Samuel Brown, James Carney, Tyler Gorecki

Introduction

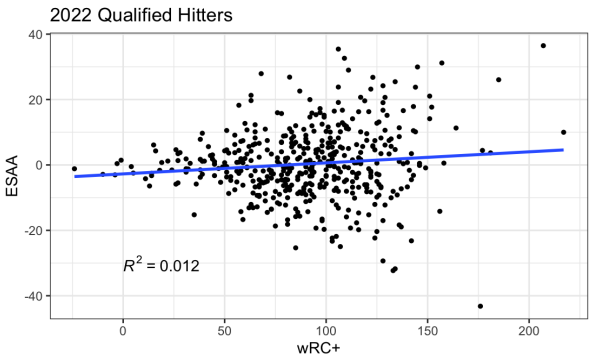
There is a claim in the baseball world that better players get better treatment from umpires. For example, if a borderline pitch to Mike Trout is called a ball, the first instinct is not to contemplate whether the pitcher missed his spot or the catcher poorly framed the pitch. Instead, opposing fans might react and say Trout only got that call because he is one of the top hitters in the game and the league wants him to do well. While this seems crazy for the umpire to be able to decide in a split second decision, we decided to investigate further. The goal of our analysis was to find insight into how MLB players receive more favorable strike calls. This would include the previously mentioned 'better hitters,' but also players on better teams and even those who are just popular with fans. With this analysis, a model was created that assigns a probability of being a called strike to every taken pitch in the 2018-2022 MLB seasons. This allowed us to create a statistic that compares the strike calls each hitter got to what they were expected to get, in order to analyze whether there is a trend over time or whether missed calls are more due to random umpire mistakes (fooled by catcher framing, missing a call, etc.).

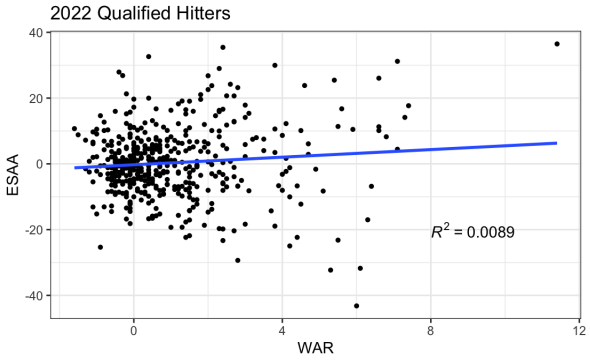
Modeling

To determine the probability that each pitch in our dataset was called a strike, we used a generalized additive model (GAM) that smoothed by a pitch's horizontal location and standardized vertical location, running separate models on each season and batter-pitcher handedness matchup combinations. The width of the strike zone is obviously consistent for each hitter, but we wanted to standardize the height of the zone to create consistency between tall players like Aaron Judge and shorter players such as Jose Altuvé. To do this, we divided the distance between the pitch height and the bottom of the zone by the overall height of the zone (as defined by Baseball Savant data[1]) to find the proportionate height of the pitch within the strike zone itself. We also allowed the parameters to shift from count to count to adjust for how the size of the strike zone changes based on balls and strikes. Once we had the probability that a given pitch was a strike, we found the number of strikes that a batter would have been expected to receive in a given season, and subtracted this total from the number of strikes that were actually called on the batter to give us a batter's Expected Strikes Above Average, or ESAA. A higher ESAA would show that a hitter got more favorable calls.

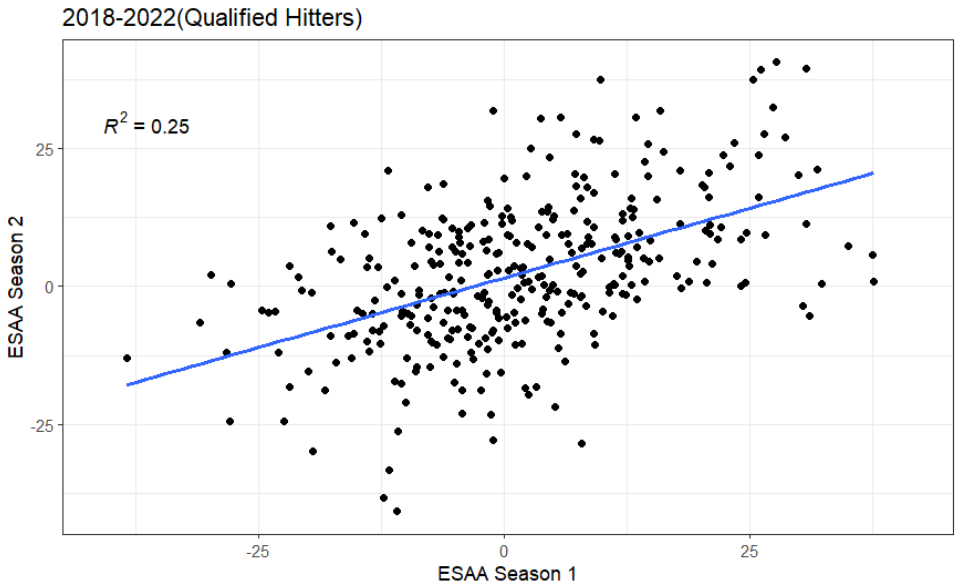
Results

As can be seen from the plots, there is not a relationship between a hitter's ESAA and wRC+, nor between a hitter's ESAA and WAR:

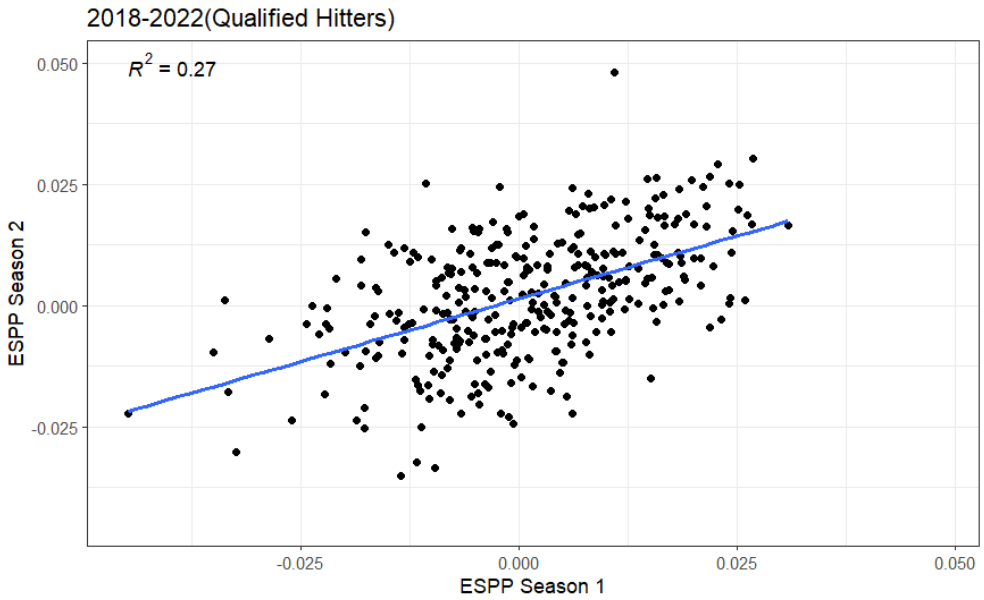




However, we did discover that ESAA showed some stickiness over the course of consecutive seasons, with an R^2 of .23 between seasons (previous on x-axis, next on y-axis):



And the relationship remained similar once adjusted for the number of pitches taken (ESPP):



We re-adjusted the statistic, Expected Strikes Above Average (ESAA), to a per-pitch value, Expected Strikes per Pitch (ESPP) above, that is more effective in showing the true called strike value of hitters over the last five seasons. This is necessary because the 2020 MLB season consisted of only 60 regular season games instead of the normal 162 games, affecting the aggregation of pitches a hitter saw in that season compared to others. Also, players who have more at-bats or see more pitches in a typical season could also cause the statistic to be inconsistent. Therefore, adding a per-pitch value allows ESPP to be well-rounded. The range of ESPP for MLB hitters from about -0.06 to 0.06 may seem insignificant, but if a hitter sees 1500 pitches, a .01 difference in ESPP is 15 calls throughout the year, which can be worth millions of dollars to players and teams during contract negotiations and end of season results.

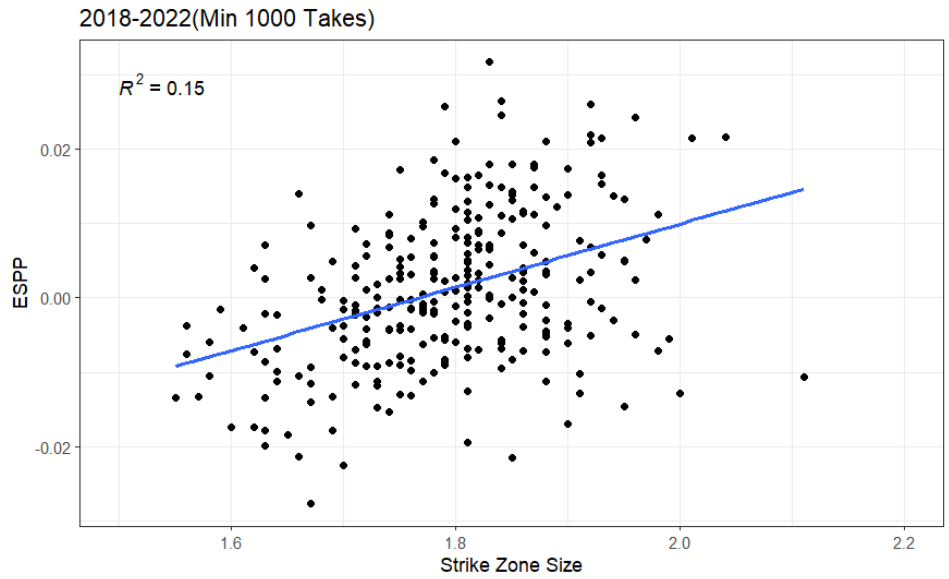
Analysis

The more important implications of this analysis can be seen for extreme values in which hitters get better or worse calls year after year. A majority of the hitters have dots contained within the center of the above plot, which appears to be essentially random, but several hitters have results that would suggest they have some ability to affect umpire calls. For example, over the last five seasons, Rhys Hoskins has received the most beneficial calls in the league, with an ESAA near or at the top of the league in each of those years. However, we don't know exactly why Hoskins, out of all the batters in the MLB, gets the benefit of the doubt from umpires while other batters don't.

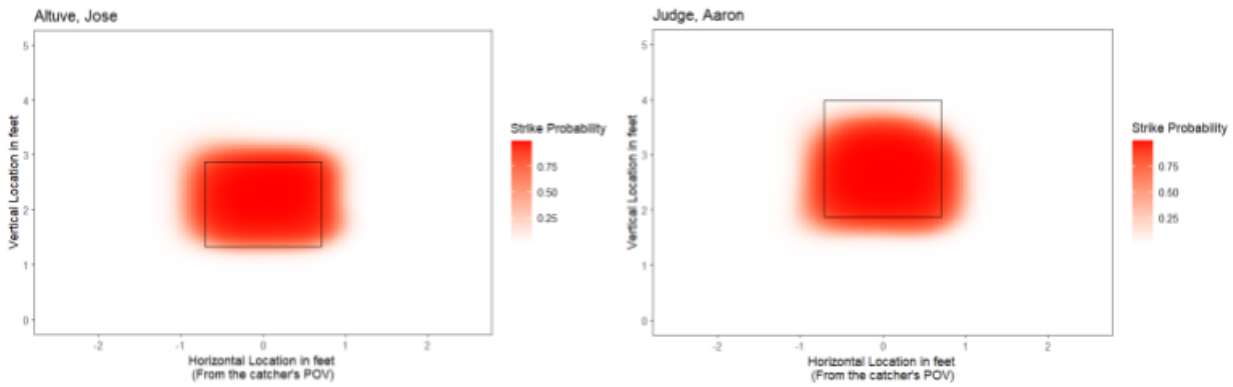
Strike zone size

To try to explain how some hitters could post high or low ESPPs year after year, we looked at the statistic's relationship with the size of a batter's strike zone, thinking that perhaps umpires were systematically favoring short or tall hitters. To test this, we plotted overall ESPP from hitters

with at least 1000 takes from 2018-2022 vs a hitters median strike zone size from that same period:



While there was a slight relationship with taller hitters getting better calls, the number of exceptions to this rule(that's Aaron Judge in the bottom right of the plot) made us doubt that height has too much to do with an umpire's judgment, at least on its own. After all, Altuve and Judge both ended up with similar ESPPs and ESAAs over the five seasons, while their called strikes zones looked like this:



Even if height alone doesn't affect hitter framing, maybe the giants of the league had zones that go lower on their body than your average hitter (see Judge's called zone above). When we separated hitters into quadrants for strike zone height and percentage of pitches near the top of the zone, this is exactly what we see:

ESPP by Zone Height and High Pitch Percentage				
	Volume of Pitches Near the Top of the Zone			
Height of Zone	Least	Fewer	More	Most
Lowest	-0.011	-0.002	-0.003	-0.006
Low	-0.001	-0.003	0.002	0.002
High	-0.003	0.003	0.006	0.012
Highest	-0.007	0.004	0.011	0.018

Tall hitters (at the bottom of the chart with the 'highest' strike zones) who saw a higher proportion of pitches up in the zone (towards the right) had higher ESPPs as a group. However, strangely enough, short hitters saw little difference in results based off of high pitches. The reverse is also true for shorter players and low pitches:

ESPP by Zone Height and Low Pitch Percentage				
	Volume of Pitches Near the Bottom of the Zone			
Height of Zone	Least	Fewer	More	Most
Lowest	-0.007	-0.001	0.004	0.015
Low	-0.004	0.002	0.003	0.011
High	0.007	0.003	0.000	0.002
Highest	0.001	0.006	0.003	-0.002

The players with the shortest zones who see most of their pitches near the bottom of the zone, tend to receive better calls than the average (and taller) hitters. Therefore, there does seem to be some relation between a batter's height and how good their calls are depending on where they see the most pitches. This is intuitive; if Aaron Judge sees a fastball at the letters, it's much more likely to be called a ball than if Altuve gets the same pitch relative to his height. Umpires can only mentally adjust their zones so much before reflexes take over.

Moving Forward

Issues with the statcast-defined zone

One issue that may come into play would have to do with the definition of the top and bottom of the zone for the statcast data we are using states that an operator manually sets reference points for the zone when the hitter "settles into the hitting position." We wonder if this could be a cause for "missed" calls. If an umpire really judges a hitter's zone before or after when the statcast operator sets the zone, then the zone given by statcast would be misleading of what an umpire sees. For example, Cody Bellinger is well-known for his very upright stance before getting really into his legs during his swing. The top of his strike zone in his stance is not what would be called by umpires because that would end up being near his shoulders mid-swing. Therefore, this would be a possible uncertainty that we would definitely like to investigate further.

Questions to answer

The next questions we'd like to explore all revolve around the factors that contribute to hitter framing. Why do certain players receive better calls? What factors are able to influence their strike zones? Is this a skill that players can work on and improve? Even with robo-umps on the horizon, unlocking the secret to hitter framing could be a huge revelation in plate discipline in the meantime.

In addition, we would like to improve the model where possible. Due to computing constraints, our GAM simply involved what we thought were the most important factors in making a ball-strike call, and we were forced to leave out important factors such as vertical approach angle and ball movement of the pitch. Although these factors likely wouldn't make a huge difference in the overall numbers of a hitter, a more accurate model is always better, and it could possibly help us look deeper into hitter framing as a skill.

References

1:

- **sz_top**: the distance in feet from the ground to the top of the current batter's rulebook strike zone as measured from the video by the PITCHf/x operator. The operator sets a line at the batter's belt as he settles into the hitting position, and the PITCHf/x software adds four inches up for the top of the zone.
- **sz_bot**: the distance in feet from the ground to the bottom of the current batter's rulebook strike zone. The PITCHf/x operator sets a line at the hollow of the knee for the bottom of the zone.