Cincinnati Reds Hackathon

Villanova Sports Analytics Club:

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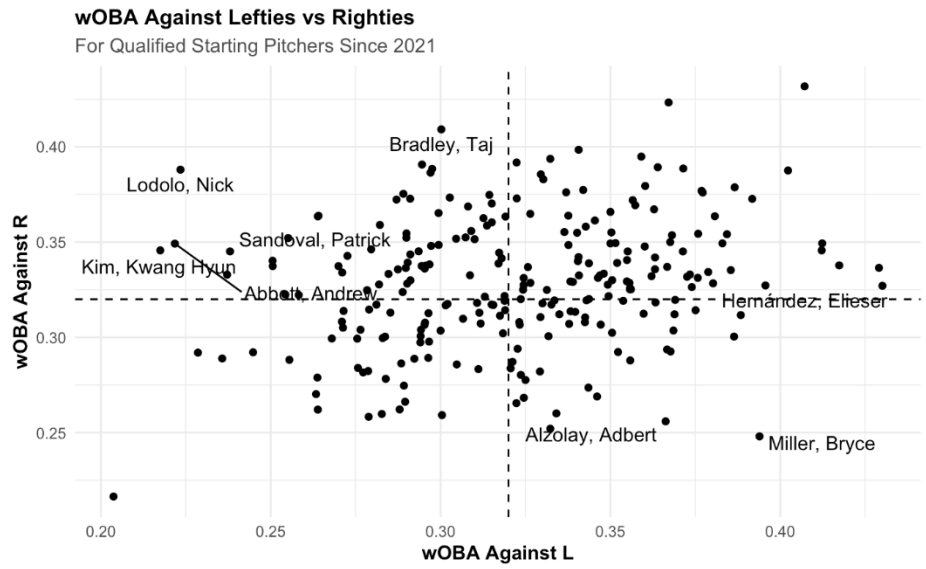
In baseball today, the difference between the conventional roles of starters and relievers has become increasingly blurred. Thus, when identifying characteristics of pitchers that lead to success in specific roles, much research was undergone to help us formulate an analysis that made sense both number-wise and baseball-wise. We began by brainstorming some characteristics specific to starters that relievers probably wouldn't have, and vice versa. The main goal of our analysis was to identify the starting pitchers that would perform better in the bullpen. Approaching this with a baseball mindset, we examined metrics from the `Savant` and `Fangraphs` dataset. In terms of this, our hypothesis was that starters who struggled in key metrics like fatigue, L/R split, RISP, etc. would be better as relievers, and furthermore their performance in these metrics indicate what role would fit them. Specifically, a focus was put on the variables `release_speed` (pitch velocity) and `release_spin_rate` (spin rate). By looking at the average of these two variables in the first half of an outing against the average of these variables in the second half of the respective outing, we could see which pitchers had decreases in the physical metrics of their pitches, otherwise known as fatigue. For example, examine the average spin rate of Gerrit Cole's first 45 pitchers in a game and the average spin rate of his last 45 pitches in the same game. If there was a significant decrease in velocity, that would demonstrate fatigue. Calculating this over the duration of an entire season lets us identify pitchers who are not equipped to sustain the full efficacy of their pitches for an extended period and would likely perform better in a role with less innings.

Another area considered was the pitcher's lefty/righty splits. To do this, we calculated their wOBA allowed for LHB and for RHB to see any large differences. Struggling against one side of the plate would indicate that a reliever role would better fit a pitcher as a team can better control the handedness of the batter faced.

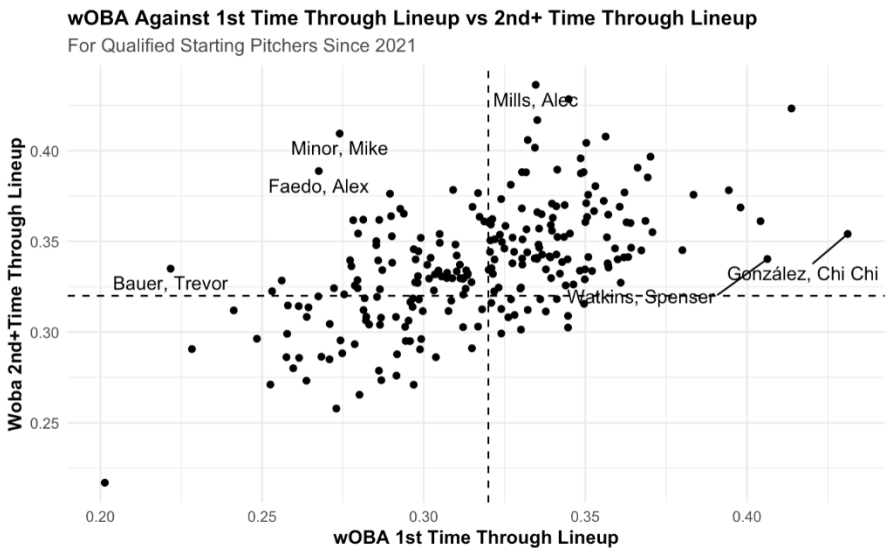
Other splits we looked at were how pitchers performed against a batter the first time in a game versus the subsequent at-bats, and how pitchers performed in their first 15 pitches versus the rest of the game. Pitchers who are better in the first inning or first few innings but drop off in performance after indicate success in shorter outings in a reliever role.

Furthermore, we explored how pitchers fared in spots with RISP versus normal, low-leverage spots in games, since relievers are more often put into games at times where there is RISP. Pitchers with better stats for RISP indicate that they handle high-pressure spots well and are well-suited for a reliever role.

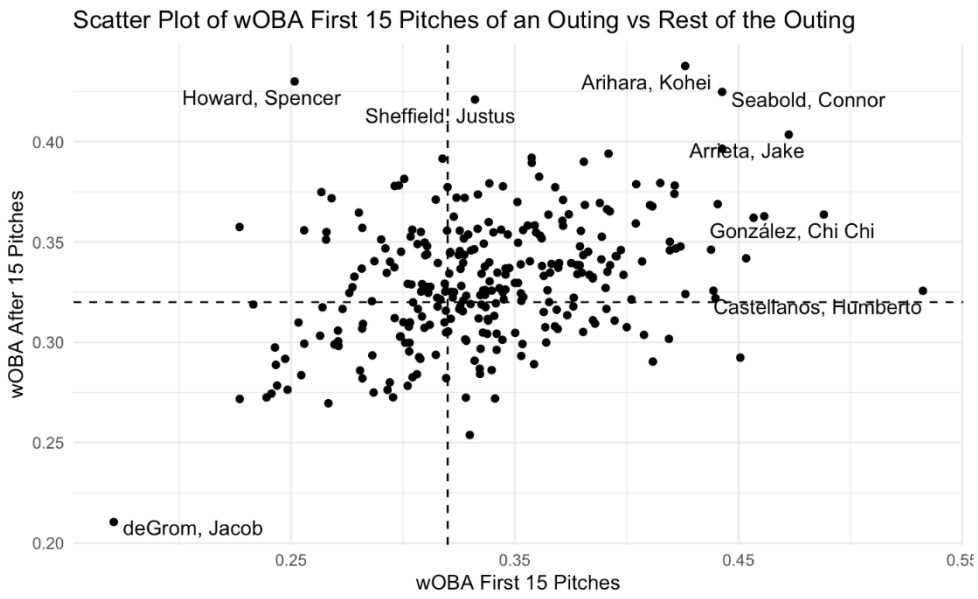
Lastly, a critical statistic for relievers is K-BB%. Relievers are relied upon to limit runners on base and balls in play. High-leverage relievers who are elite at this are incredibly valuable to teams. We created a model to predict K-BB% using `Stuff+`, `Location+`, and their pitch usage breakdown. This predicted value can better indicate how their K-BB% would look independent of the batter faced. We created an xGBoost model with `caret` to predict this value using a high learning rate to tune the hyperparameters as it gave a more accurate result. Our RMSE was 0.032, which is a fair result, and our feature importance plot shows that `Stuff+` was by far the most significant response variable.



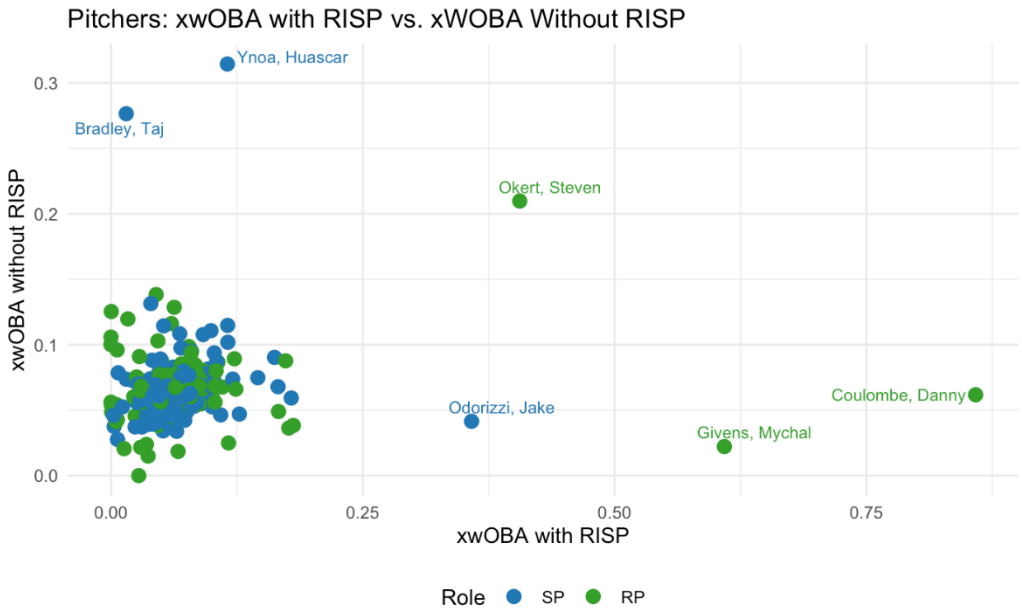
The above graph shows the pitcher's wOBA against lefties versus righties. The data points in Quadrants II and IV show a large disparity in their performance depending on the batter's swing. Thus, these pitchers should be considered for a reliever role because it is easier to control the handedness of the batters a pitcher faces when they come out of the bullpen.



The above graph shows the wOBA against hitters the first time in a game versus 2nd and on in a game. Pitchers that fall in Quadrant IV are successful against hitters the first time, but tend to struggle later in games. This is an indication that being a reliever, who could only see each hitter one time in a game, would be a fitting role for them.

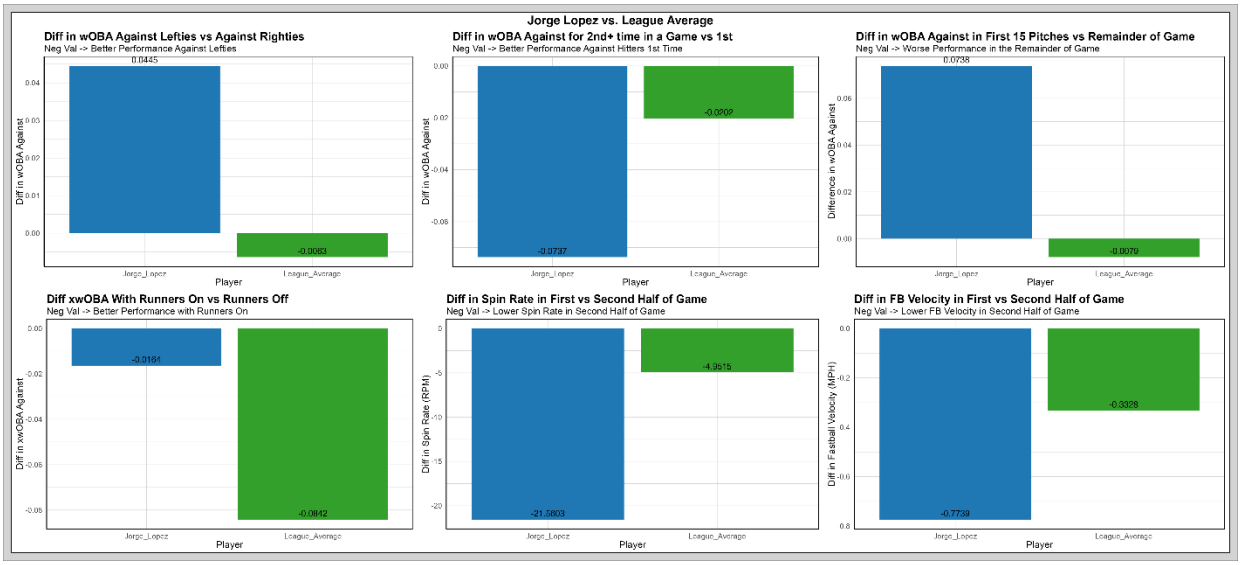


This graph shows the difference in wOBA for starting pitchers in their first 15 pitches of an appearance compared to the rest of that appearance. Pitchers who perform well in the first 15 pitches of an outing but struggle afterward might be better suited for the bullpen as players who start off pitching well would be ready to come out of the bullpen to pitch well immediately.

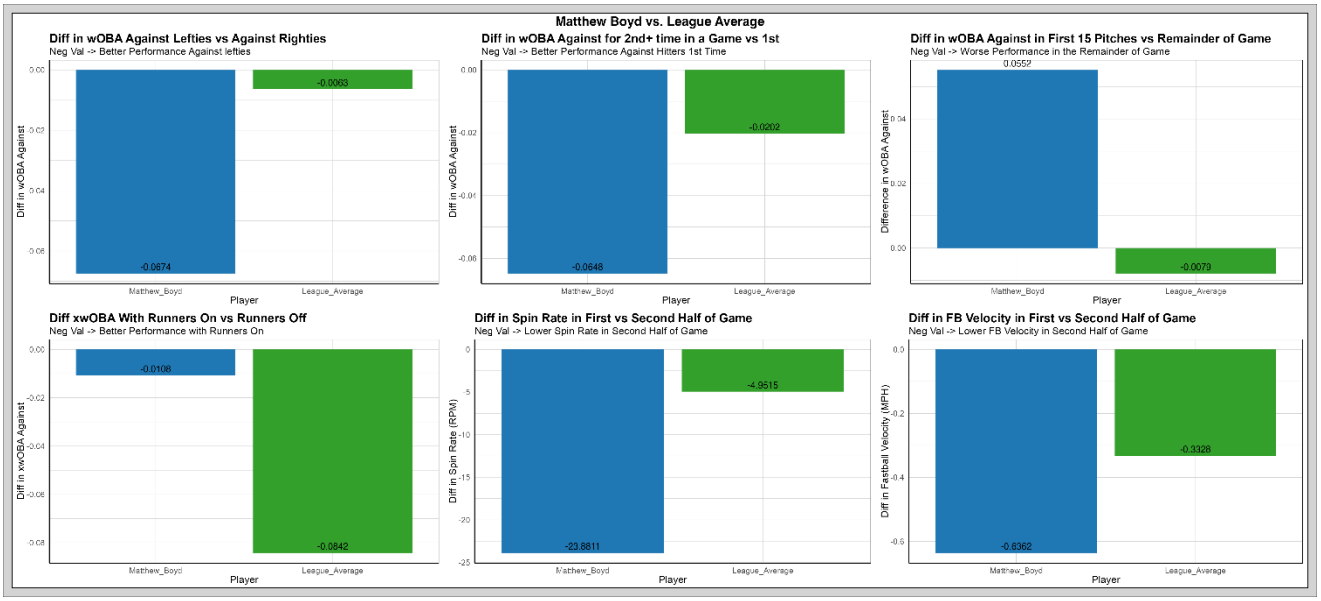


The graph here shows the difference in xwOBA allowed for pitchers with runners in scoring position (RISP) versus pitchers without RISP. Starting pitchers are delineated by blue dots and relief pitchers by green dots. If there are starters with low xwOBAs for RISP, but high xwOBAs without RISP, this would show that they may be better suited and more valuable in a reliever-type role where they could successfully perform in high-leverage situations.

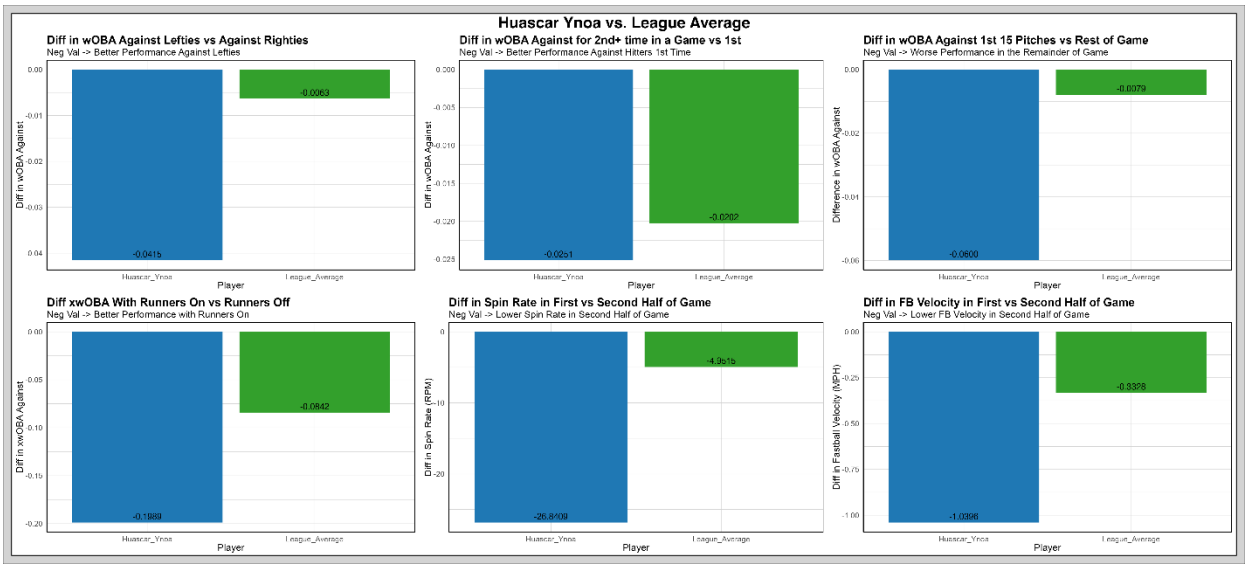
The players we chose to look closer at were Jorge Lopez, Huascar Ynoa, and Matthew Boyd. When we found stats that we believed to best capture pitchers who were better suited to being a reliever, a prime candidate was Jorge Lopez. This is no surprise because Jorge Lopez was a starter in 2021, but in 2022 he switched roles and became a relief pitcher, where he was much more successful. This shows that the statistics that we examined are meaningful and accurate because they support real-world examples. Other names that showed up alongside Jorge Lopez were Huascar Ynoa and Matthew Boyd. These are the players that we think would most benefit from a role switch.



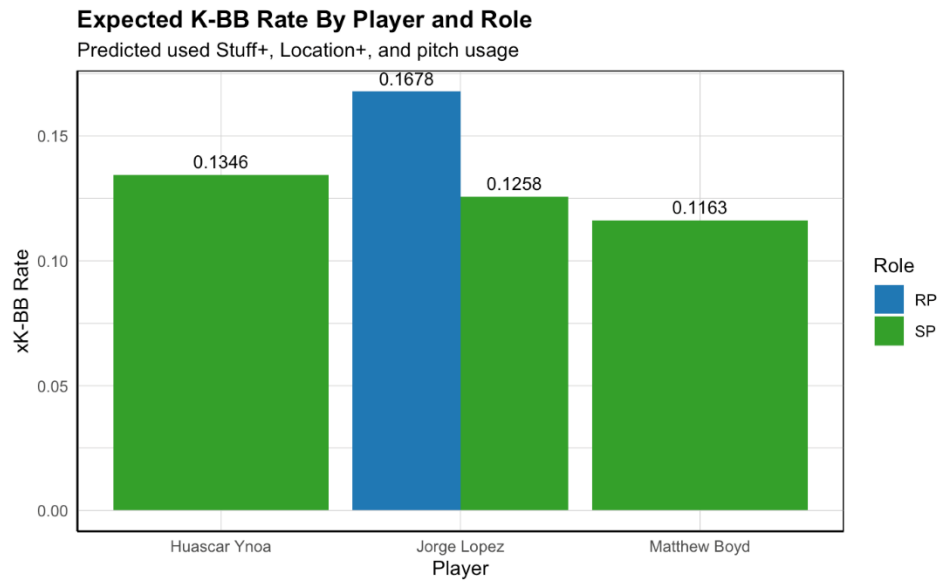
When looking at the above graphic, we can see why the transition from starter to relief pitcher was a success for Jorge Lopez. The top left graph shows Lopez performing far better against RHB, which is beneficial to a team's bullpen. The top middle graph shows Lopez is worse than league average in the second time through the order. The top right graph shows that Lopez is outperforming the league average in the first 15 pitches of an outing, so he performs well immediately when he steps on the mound. Although he is below league average with runners on base, the bottom left graph displays his value is still negative, showing he is still good in high-leverage spots. Lopez experiences a drop in velocity and spin rate far greater than league average in the second half of his starts, which demonstrates fatigue and would be better suited for a reliever role.



The above graphic, Matthew Boyd would also be better suited in a relief role. The top left displays that he is much better at pitching against LHB, meaning that he should be deployed situationally against lefties. The fact that Boyd performs far worse than league average in terms of wOBA allowed against his second time through the order, but far better in the rest of the game compared to his first 15 pitches, according to the top middle and right graphs, supports our claim that Boyd could improve out of the pen against weaker hitters. The bottom middle and right graphs show both spin rate and velocity take a dip as the game progresses, which suggests that he is not suited to longevity in a single game like a starter should be. Although the bottom left graph shows he is well below league average, Boyd is marginally better with runners on, as evidenced by his slightly negative xwOBA difference value which indicates he is better pitching with runners on.



Another pitcher that should make the move from starter to bullpen is Huascar Ynoa. Looking at the top right and middle, he struggles after the first 15 pitches and is worse than league average when dealing with batters for the second time compared to the first time. Ynoa is also above league average in terms of pitching with runners on, according to the bottom left meaning that he can be successful when employed in high-stakes situations. Moreover, as his time in the game increases, his spin rate and velocity in the second half of games pitched decreases, using the bottom middle and right. Ynoa pitches better against lefties than righties, meaning that he could be utilized in spots with LHB at the plate. Ynoa should be a reliever that must have his pitch count closely monitored due to in-game longevity concerns.



This shows the xK-BB% from the model we built for our 3 players. Using their raw pitch profile, it gave a better picture of how their K-BB% should look based on their pitches. As starters, all 3 of these pitchers struggle with below average K-BB%. Jorge Lopez shows how his xK-BB% increased as he switched roles, so we should expect that from the other players if they transition.