Analysis of MLB Pitcher Roles

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Introduction

Fluidity within MLB pitcher roles has led teams to work harder to optimize pitcher deployment strategies. Pitchers, both starters and relievers, have undergone usage shifts, limiting some from being utilized to their fullest potential. This write-up aims to identify characteristics of both pitcher types and individual pitchers who may benefit from a different traditional role.

The simplest distinction between starters and relievers is outing duration. To provide length, starters must face each batter multiple times, which decreases pitcher performance. Nonetheless, this decline in effectiveness differs by pitcher. Thus, we approached the prompt by identifying characteristics of pitchers that improve performance when facing a lineup multiple times.

While pitcher performance deteriorates when facing a batter multiple times, examining this phenomenon without context can be misleading. Pitchers frequently face a lineup more than twice if they are performing well, resulting in selection bias. Therefore, pitcher performance is only estimated for the first and second time through the order (TTO).

To project pitcher performance, two models are constructed. The first model estimates pitchers' expected weighted on-base average (xwOBA), a measure of contact quality, the first TTO (first nine batters). This serves as a baseline measure of the pitcher's ability. The second model predicts the difference in pitchers' xwOBA between the first and second TTO (first - second), quantifying a pitcher's ability to maintain performance when facing the lineup again.

Data

Data are on the player season level, with the following variables included as predictors:

For each pitcher, the usage percentage of all pitches, excluding eephus, screwballs, and knuckleballs, are included as independent variables, with values of 0 assigned for pitches not thrown by the pitcher. Similarly, the data contains Stuff+ and Location+, calculated by FanGraphs, of every pitch type for each pitcher, with pitches not thrown by pitchers assigned values of 0. These three measurements accounted for the distribution, quality, and command of a pitcher's pitch repertoire. Logically, pitchers with better stuff, better command, and more pitch types should have less drop-off in performance the second TTO.

Pitches per batter, the average number of pitches a pitcher throws per at-bat, is used as a measure of a pitcher's efficiency. Theoretically, a more efficient pitcher will conserve energy and thus perform better the second TTO.

Velocity slope quantifies how much a pitcher's velocity declines per pitch during an average outing. This is determined by the difference between the first and last three pitches of a specific pitch type in an outing, divided by pitch count. To eliminate small samples, the variable has the following thresholds:

- The pitch must be thrown at least six times in the outing.
- The pitch must be their fastest fastball type, thrown at least 10% during the season.
- The pitcher must have thrown at least twenty pitches in the outing.
- The first three pitches of an outing are excluded to account for warming up.

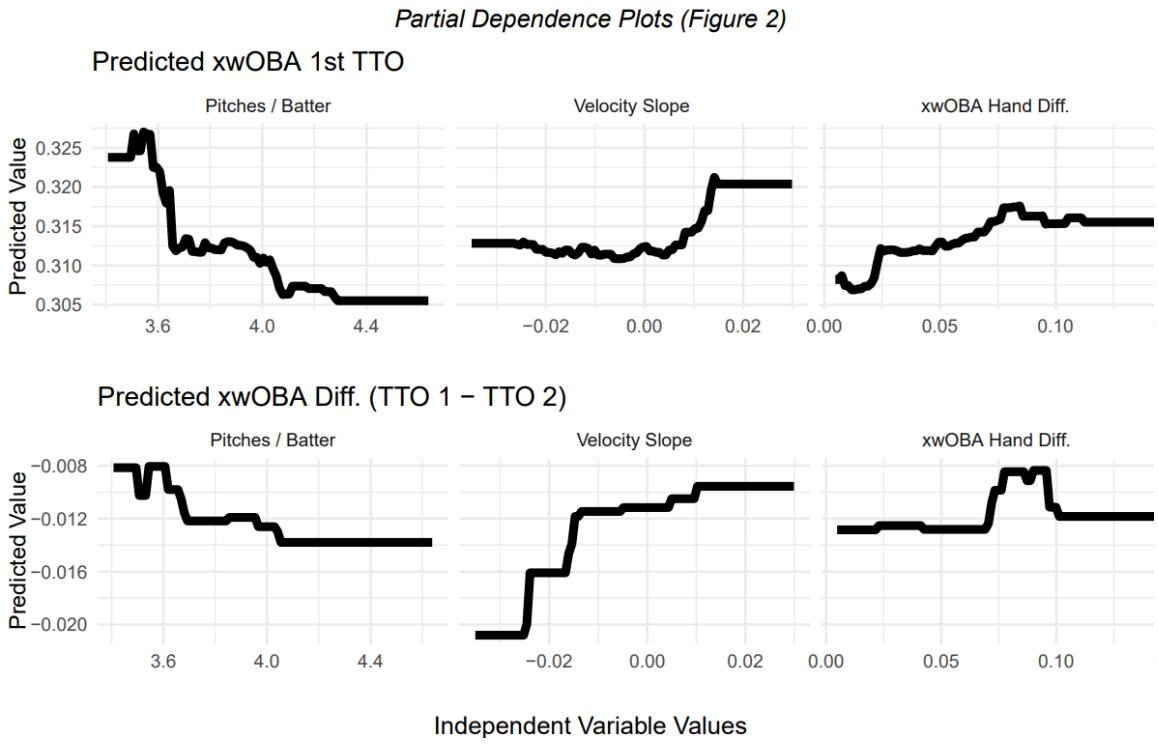
The xwOBA handedness difference captures a pitcher's ability to effectively face both left- and right-handed batters. It is calculated by taking the absolute value of the difference in xwOBA when facing right- and left-handed batters. When teams deploy relievers, pitcher-batter handedness splits are usually an important consideration. However, starting pitchers are known before games, and opposing teams can account for handedness when constructing lineups. If a pitcher performs significantly worse against one side, teams may stack the lineup, disadvantaging starters who cannot effectively face both righties and lefties.

Methodology

Pitchers who threw fewer than 200 pitches in a season were removed from the dataset. Additionally, all variables other than pitch percentages, Location+, and Stuff+, were regressed toward the mean to more heavily weight pitchers who pitched more. Both models were constructed using decision tree gradient boosting, which was chosen due to its ability to model nonlinear relationships that exist between the independent variables. To generate more accurate predictions, hyperparameters were tuned using a grid search. This iterated through each combination of hyperparameters and, for each iteration, trained the model and performed 5-fold cross-validation to evaluate model performance using RMSE. The model was trained on pitchers with at least 20 observations of facing a batter twice in a game and tested on relief pitchers.

Results

Figure 1 displays the importance of each variable in both models. In this plot, the importance of stuff, location, and usage are aggregated for each pitch type. Unsurprisingly, stuff and location are essential both TTO, while the importance of maintaining velocity and effectively facing both right- and left-handers increased the second TTO. The partial dependence plots in *Figure 2* provide important context.



While fairly level the first TTO, velocity slope appears to have a significant, positive impact on xwOBA the second TTO, suggesting that maintaining velocity increases a pitcher's effectiveness the second TTO. Interestingly, throwing more pitches per batter decreased xwOBA the first TTO, although it increased xwOBA the second TTO. This indicates that efficient pitchers are more capable of maintaining success the second TTO. The effect of the xwOBA handedness difference is stronger the first TTO, with larger discrepancies correlating to higher xwOBA values.

In particular, a diverse pitch mix is more important for starters than relievers. While a limited set of pitches may retire a batter once, the ability to vary pitches and keep batters surprised becomes crucial when facing a lineup repeatedly. Additionally, starters must be able to sustain velocity throughout a long outing, and they must be effective against both right- and left-handed batters. Starters also benefit from retiring batters using fewer pitches, allowing them to face more batters.

While these traits are less important for relievers, relievers must still have high-quality pitches and effective command, the most important factors in the first TTO model.

Player Spotlights

Based on the model results and 2023 statistics, we identified two pitchers who could benefit from switching roles. For uniqueness, we did not highlight any pitcher who has served in both roles.

Robert Suarez could move from reliever to starter based on model results. Suarez boasts a four-pitch mix featuring a four-seam fastball, changeup, sinker, and a sparsely used slider. As seen in *Table 1*, Suarez differentiates himself with above-average Stuff+ and Location+ on all four pitches. Suarez's changeup ranks 3rd among relievers in Stuff+ and top twenty in Location+. With four excellent pitches and great command, Suarez is an ideal candidate to become a starter.

Figure 3: Robert Suarez SP Percentiles

Percentiles are amongst 2021–23 Starting Pitchers

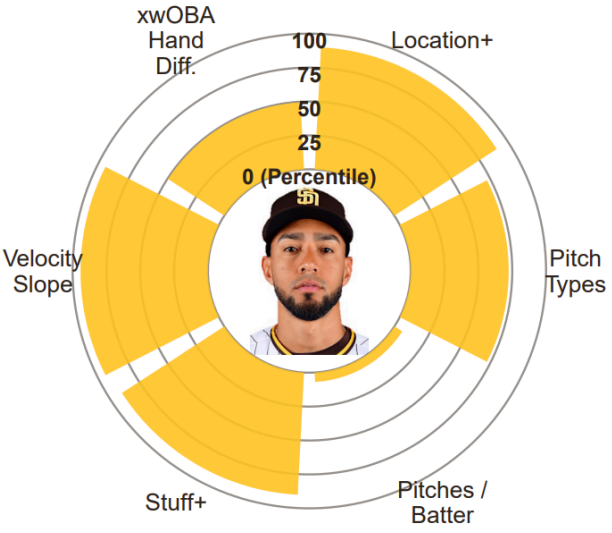


Table 1: Robert Suarez Pitch Summary Statistics

Robert Suarez

Pitch	Usage%	Location+	Stuff+
Fastball	0.365	109.1	128.4
Change-Up	0.336	102	111.9
Sinker	0.243	107.2	119.1
Slider	0.045	112.6	108.7

Based on xwOBA, Suarez is one of three relievers projected to be better the second TTO (0.268) than the first (0.276), ranking 5th and 1st in projected xwOBA, respectively, in his first and second TTO. Suarez's fastest pitch, his sinker, actually gained velocity during appearances, and he effectively limited pitches per batter.

San Diego's recent loss of star pitching has left them with a shortage of quality options in both roles. Based on our analysis, we believe that Suarez would have high upside as a 4th starter.

Graham Ashcraft was identified as a starting pitcher who could benefit from transitioning to a relief role. In 2023, his xwOBA rose from .310 in the first time TTO to .334 in the second, and

model results project similar values of .314 and .333, respectively. Ashcraft predominantly utilized his cutter and slider, mixing in an occasional sinker. As seen in *Table 2*, his cutter and slider were highly effective, while his sinker was extremely poor. As a three-pitch pitcher with two standout pitches, Ashcraft's pitch arsenal falls short of the breadth typical of a starter. Transitioning to the bullpen could allow him to reduce his sinker usage and primarily throw his cutter and slider, a combination that has proven effective for several elite relievers.

Figure 4: Graham Ashcraft SP Percentiles

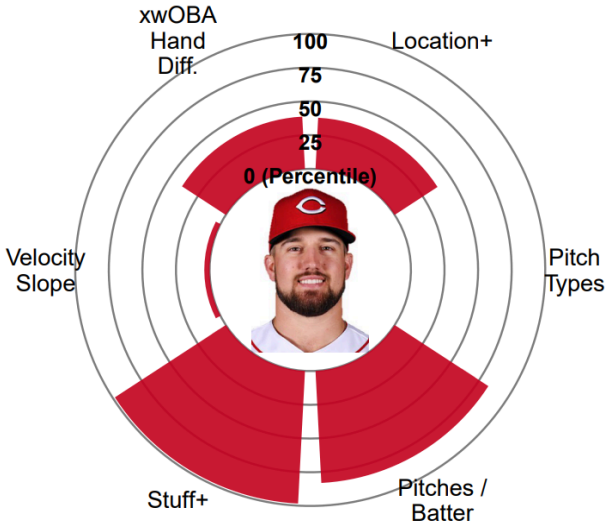
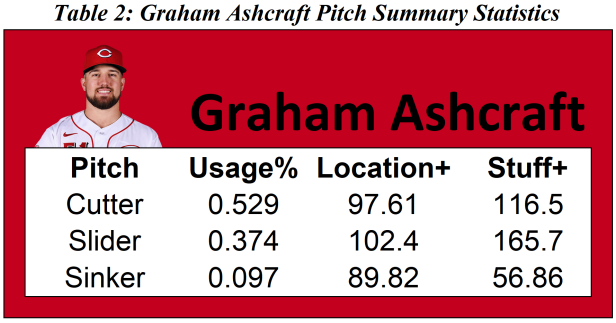


Table 2: Graham Ashcraft Pitch Summary Statistics



Graham Ashcraft

Pitch	Usage%	Location+	Stuff+
Cutter	0.529	97.61	116.5
Slider	0.374	102.4	165.7
Sinker	0.097	89.82	56.86

Additionally, Ashcraft struggles to maintain consistent cutter velocity throughout his starts, ranking third worst among starting pitchers in 2023 with an adjusted velocity slope of -0.021. While this large drop is problematic as a starter, its impact would decrease as a reliever. Furthermore, Ashcraft's xwOBA was approximately .047 higher against righties compared to lefties. While these splits are strange for a right-handed pitcher, moving to the bullpen would allow the team to deploy him primarily against lefties, potentially maximizing his effectiveness.

Despite injury concerns that have plagued the Reds' rotation, recent acquisitions and abundant young talent provide the starting pitching depth to make a transition to the bullpen feasible. Allowing Ashcraft to hone his electric stuff and function as a high-leverage setup man with the potential for longer outings would improve an already strengthened bullpen.

Conclusion

Our analysis identified key factors including maintaining velocity, pitch efficiency, effectiveness against right- and left-handed batters, and the depth and quality of a pitcher's arsenal as crucial for effectiveness when facing a lineup multiple times, a critical aspect of starting pitching. Using this approach, Robert Suarez was identified as a reliever who could become a starter, and Graham Ashcraft was identified as a starter who could thrive in a relief role. In this way, teams could seek to further optimize their usage of pitchers.