Reclassifying Underutilized Pitchers Using Machine Learning

Cincinnati Reds Hackathon

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Executive Summary

In the last decade, MLB relief pitching appearances have skyrocketed forcing teams to put a significant emphasis on diversifying their bullpen. Due to this phenomenon, we have been tasked with reclassifying pitchers who have been underutilized in their current roles. To accomplish this, using the provided FanGraphs and Savant pitcher data, we trained two machine learning models which evaluated factors indicative of a quality starter and reliever. We then used these models to predict how each pitcher would perform in the opposite role. Throughout this paper, we will provide an in depth justification and overview of our models as well as highlight two players we believe are being misused within their organization.

Methodology

To answer the question of what pitchers should be reclassified we first had to answer, for each role, what are the differentiating factors that produce a quality pitcher. Our first step was to find variables indicative of each role's success using the xgb.importance function. We decided to use ERA as our dependent variable as it is the most widely used measure of a pitcher’s ability to prevent runs. We started this process by selecting statistics from the data set we believed to be predictive of ERA, omitting those used in the ERA calculation. Along with this we created a pitch arsenal entropy statistic to value the variability of their pitch selection. After creating the preliminary model with all variables and running the xgb.importance function, we found RE24 to have an overwhelmingly high gain of .727, gain being the reduction in loss of a variable. Through further research we found that RE24 was highly similar to ERA and in order to reduce overfitting we removed it from the model. We then systematically removed low importance variables until we minimized the model’s root-mean square error. We can see the importance of the final factors that were included in Figures 1 and 2. These steps were originally done using all starting pitchers and then repeated using relievers to create two separate Xgboost models. Our final step was to input all starting pitchers into the reliever model, and vice versa, to predict each pitcher's ERA in the opposite role.

Model Results

The starting pitchers model contained 14 variables that were predictive of ERA. The root mean squared error of this XGBoost model was around 0.38, which indicates that the model was fairly accurate in its predictions. The feature with the highest importance, as determined by the xgb.importance() function, was WPA/LI which exhibited a substantial impact on the predictive accuracy of our model, as indicated by a gain of 0.48. Other features that showed to be important in the model were WHIP and LOB%. When running relieving pitchers through the starter pitcher model, the players who would be predicted to improve the most in a new role are displayed in Figure 3.

The relieving pitchers model, on the other hand, contained 24 variables and had a slightly higher root mean squared error at 0.48. Removal of variables only caused the error to rise. The feature with the highest importance to the predictive power of the model was WPA/LI, followed by WHIP and LOB%. When running starting pitchers through the relieving pitcher model, the players who would be predicted to improve the most in a new role are displayed in Figure 4.

Candidates for Profiling

When inputting our starters into our reliever model and vice versa, we found a myriad of pitchers for each season that performed better under our model when put into the opposite role. However, it was not only this ERA difference that influenced our decisions when profiling specific pitchers. Some pitchers were projected to decrease their ERA from a very high number to a slightly lower, but still high, number. We found these projections to be less valuable as we wanted to identify pitchers that would make a significant difference given the context of their team makeup. Moreover, many starters with good-to-elite ERAs were projected to have miniscule ERAs as a reliever, but we stayed away from profiling these players as they are already able to contribute a higher amount of well above average quality innings in their current roles.

Our choices were also not meant to be single-faceted. We also looked at performance as outings increased for SP in order to see which players got increasingly worse as games went on in tandem with

better projected ERAs in another role. This process led us to feel strongly about two players changing from their current roles: Kutter Crawford and Tony Gonsolin.

Profile One: Kutter Crawford, Boston Red Sox SP

Known as a starter who occasionally comes out of the bullpen, Kutter Crawford has experienced moderate success since debuting with the Red Sox in 2021. He has pitched to an ERA of 4.51 and 5.43 in the past two seasons respectively as a starter, while pitching to ERAs of 5.63 and 1.66 as a reliever in those same two seasons, albeit in a smaller sample size. Crawford did not pitch in enough games to qualify for our model in his 2022 season, but was projected to have a 3.92 ERA as a reliever were he to permanently be in that role (Figure 5).

Although he did outperform our model as a reliever in 2023, his FIP/xFIP values were 3.95 and 4.36 respectively, indicating regression from that level of success. Through further analysis, Crawford was found to perform consistently worse as his outings went on, as indicated in Figure 6. Moreover, for the 2023 season, his fastball velocity peaked around 25 pitches, then decreased significantly over the course of his outings as indicated in Figure 7. Both of these findings, coupled with a projected lower ERA, influenced our decision to recommend that Crawford come exclusively out of the bullpen.

In all, Kutter Crawford as a starting pitcher is consistently mediocre in terms of ERA, gets worse as the game goes on in terms of run expectancy and decreases significantly in terms of fastball velocity. Having Crawford pitch for only 2-3 innings allows him to maximize the velocity of his fastball while simultaneously preventing the struggles he experiences deeper into games. With Crawford being the sixth man in the Red Sox rotation after the acquisition of Lucas Giolito, we believe him to be best suited for coming out of the bullpen and bridge the gap between the ever-shortening outings of starting pitchers and the ever-increasing electric stuff of late inning relievers.

Profile Two: Tony Gonsolin, Los Angeles Dodgers SP

Although oft-injured, Tony Gonsolin has experienced extensive success in the Dodgers' rotation since debuting in 2019. Pitching to a 2.14 ERA over 130.1 innings in 2022 (albeit with peripheral values at least a full run above that ERA), Gonsolin fell off significantly in 2023, with Tommy John Surgery ending his season in August as he finished with a 4.98 ERA over 103 innings and even uglier peripherals. Our model, however, projected Gonsolin to have a 4.20 ERA as a reliever this past season, 0.78 runs below his starter ERA. Further looking into his performance throughout outings, we found that his performance significantly decreased as his pitch count exceeded 60, as seen in Figure 8.

Were Gonsolin to have a longer track record of success as a starter, we may not make the recommendation to move him to the bullpen. However, his injury history, shaky peripherals, improved RP ERA within our model, and finding of his decrease in performance later in outings all led to our recommendation for Tony Gonsolin to exclusively act as a reliever when he comes back from injury in 2025. In fact, with the Dodgers' acquisition of Shohei Ohtani, who is also projected to come back to the mound in 2025, we recommend that the Dodgers should roll out Ohtani and Gonsolin in tandem. Not only do they get to keep Ohtani's outings shorter (and protect the health and longevity as a pitcher of their $700M investment) with Gonsolin able to pitch multiple innings in relief after him, Ohtani and Gonsolin's repertoires are highly different, which may disrupt the timing of opposing hitters when facing such different velocities from back-to-back pitchers.

Figures

Figure 1:

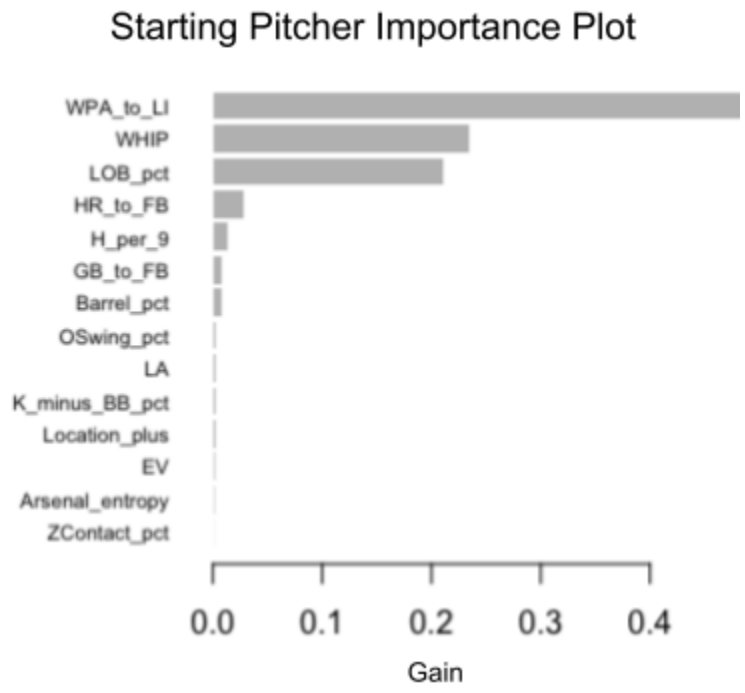

Figure 2:

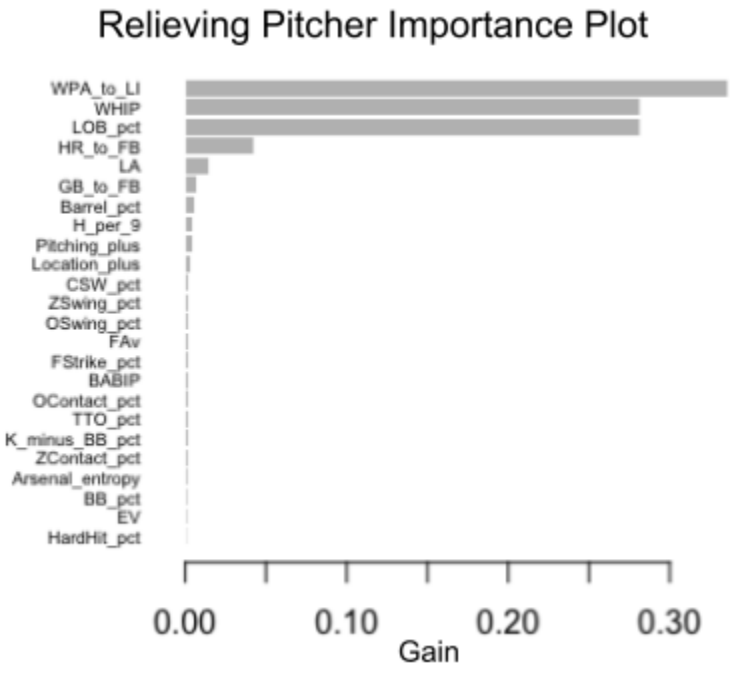

Figure 3:

Name	Season	RP ERA	Predicted SP ERA	% Change
Gregory Soto	2023	4.62	3.51	24.17
Tony Watson	2021	3.92	3.02	23.09
Tyler Kinley	2021	4.73	3.72	21.41
Heath Hembree	2021	5.59	4.56	18.43
Will Smith	2023	4.40	3.65	16.91

Figure 4:

Name	Season	SP ERA	Predicted RP ERA	Percent Change
Zack Greinke	2021	4.11	3.69	41.98%
Adam Wainwright	2021	3.05	2.54	51.76%
Lance Lynn	2021	2.69	2.50	19.47%
Max Scherzer	2021	2.46	2.29	17.37%
Jake Arrieta	2021	7.39	6.64	74.39%

Figure 5:

Kutter Crawford ERA by Role		
Year	ERA as SP	ERA as RP
2022	5.43	5.63
2023	4.51	1.66
Projected 2023 (full season)	N/A	3.92

Figure 6:

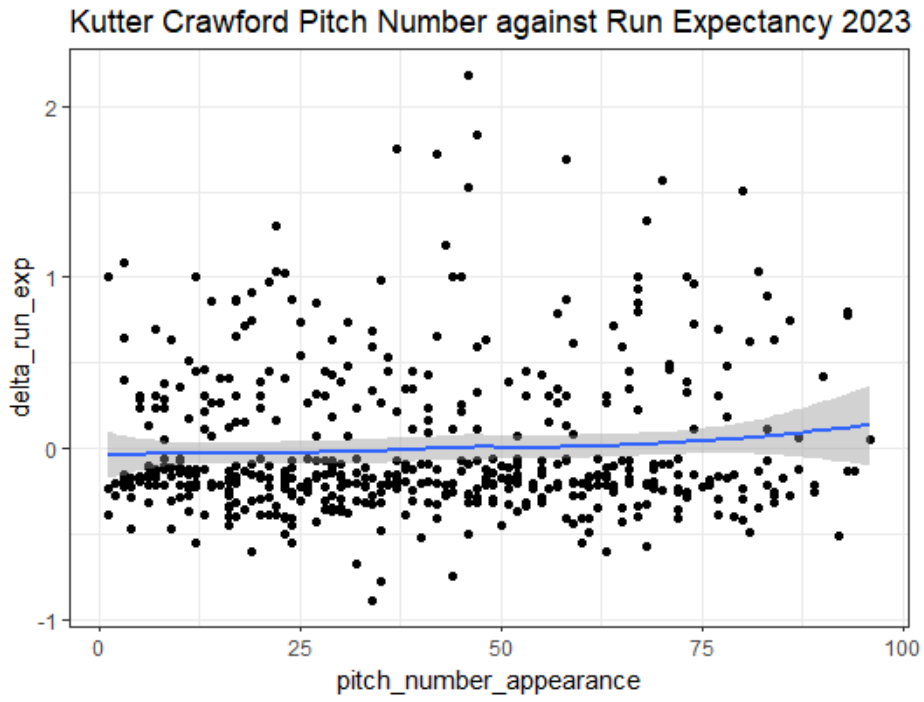

Figure 7:

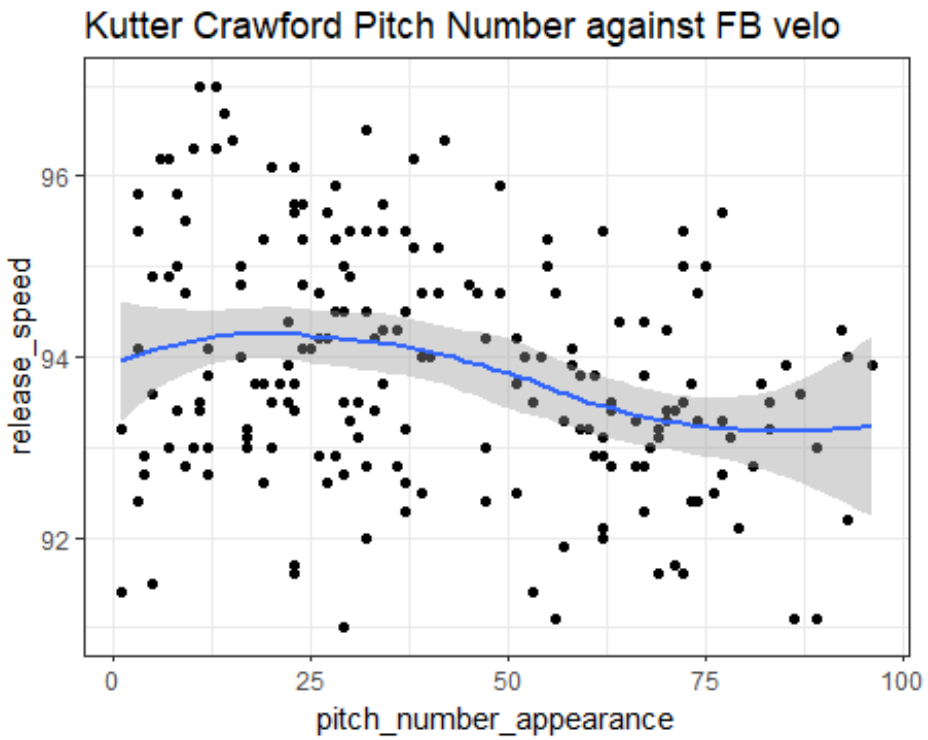

Figure 8: