

# Reliever Availability Model Workflow & Analysis

## ***Defining Availability***

The following report will cover the process of creating the reliever availability table, including the workflow to acquire the data, build the model, and create the table. It will also cover how we checked the reliability of the model, in-game performance results given availability %, and possible areas of improvement for the future. We defined “availability” as the historical frequency of using a pitcher given workload, pitcher characteristics, and other things such as run differential and home/away. We’ll first discuss the “features”, or variables, we chose to use to build our model.

## ***Choosing Features***

The features chosen to focus on were as follows:

- **Rest Days** - number of full rest days since last outing
- **Pitch Count Previous Outing**
- **Days Thrown Last 7 Days** - # appearances over last 7 days
- **Pitch Count Last 7 Days** - # pitches thrown in-game over last 7 days
- **Days Thrown Last 14 Days** - # appearances over last 14 days
- **Pitch Count Last 14 Days** - # pitches thrown in-game over last 14 days
- **Days Since IL** - # days since coming off IL
- **Days on IL in Last 14 days**
- **Leverage Index Last 7 Days** – average in-game leverage index over last 7 days
- **Rolling FB Velo** - Rolling fastball velocity last 365 days
- **Rolling SWM Rate** - Rolling swing and miss rate last 365 days
- **Rolling FB Stuff** - Rolling fastball stuff score last 365 days
- **Rolling xwOBA** - Rolling xwOBA against last 365 days
- **Rolling K Rate** - Rolling strikeout rate last 365 days
- **Rolling BB Rate** - Rolling walk rate last 365 days
- **Run Diff** - pitcher team's current run differential
- **Run Diff Opp** - opposing team's current run differential
- **Home/Away** - whether the game is home or away
- **Rehab Stint** – whether they are making a rehab outing or not

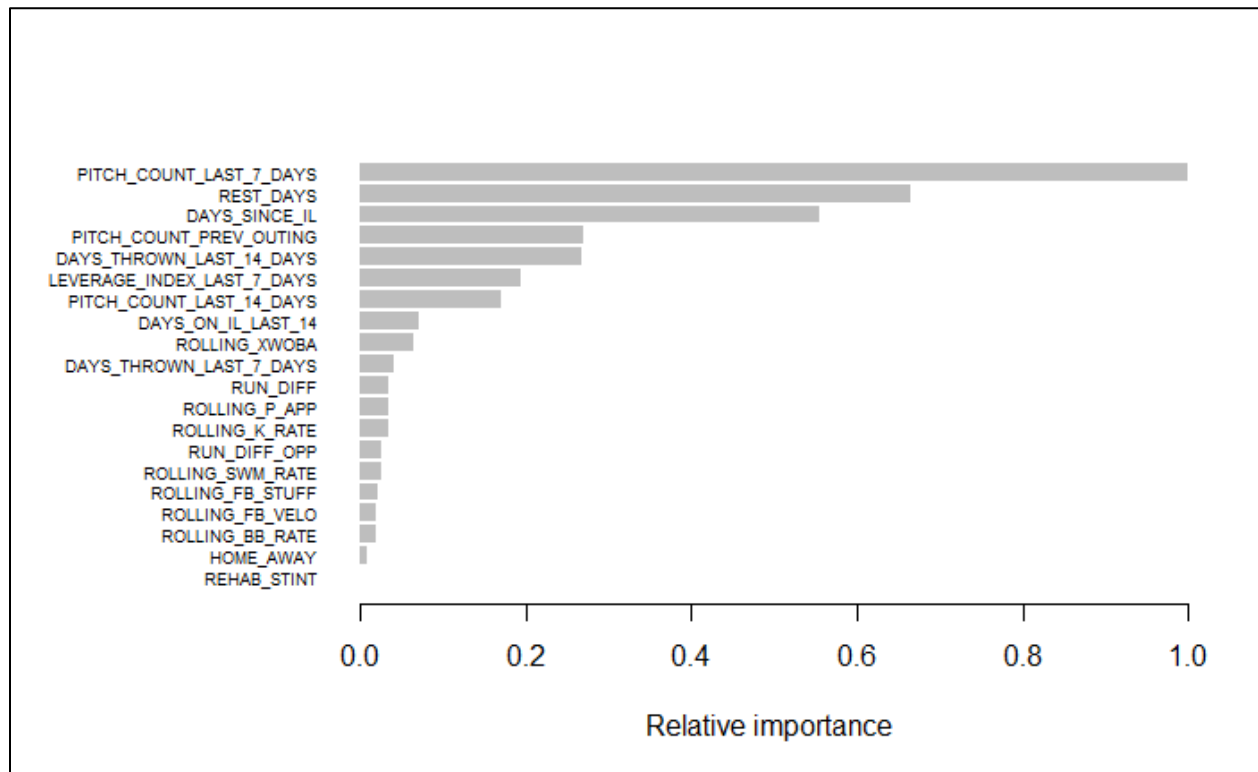
This gave a good combination of workload, performance, injury history, and a few miscellaneous factors that may influence who should be brought into the game.

## ***Building the Model***

The model was trained on all data from all pitchers during the 2023 MLB season that made at least 70% of their appearances out of the pen. The target variable we were trying to predict was whether they pitched or not. A "pitched flag" column was created which contained a 1 if they pitched that day and a 0 if they did not. We accounted for all 162 games for each pitcher,

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updating each of the features regardless of whether they pitched or not to generate valid records for the model to predict on. These feature importance results are visualized in the figure below.



*Feature Importances for Reliever Availability Model*

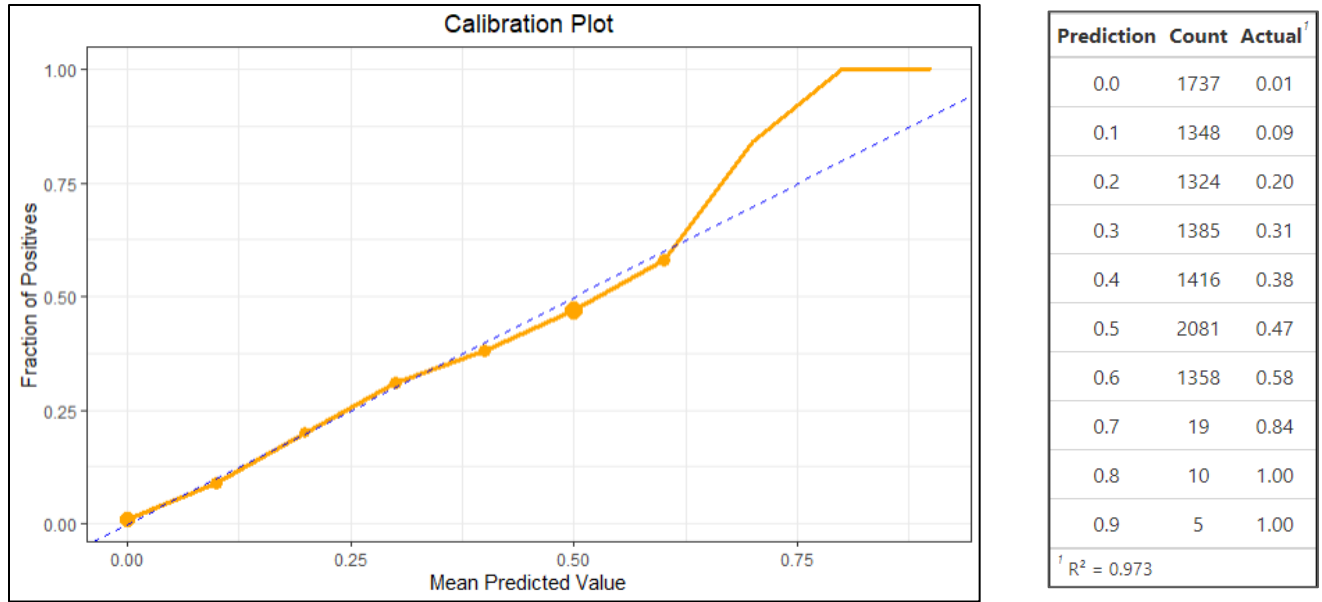
Unsurprisingly, the model found a **combination of workload and injury history** to be far and away the most significant factors in determining when a guy should be used, with leverage index also being a significant factor. The most significant pitcher performance metric determined by the model was **xwOBA**.

Instead of producing a binary should pitch/should not pitch for the prediction, we returned a probability between 0 and 1 that the pitcher entered the game given that day's features. This helped rank the availability of the arms in the pen by this value.

### **Model Calibration**

To ensure the model properly classified each pitcher availability % into what should naturally occur, a calibration plot was created. In our calibration plot, each predicted availability % is rounded to the nearest 10<sup>th</sup> percent, and the “fraction of positives”, or the proportion of records where the pitcher did indeed pitch, were calculated for each of these ntiles. The fraction of positives are plotted against the percentages in the calibration plot below.

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*Calibration Plot & Table for Reliever Availability Model*

The goal is for each fraction and percentage to be as close in value to each other as possible (e.g. at 30% (0.3) the fraction of positives should be 0.3). If the model is good, the plot should follow a linear function. Outside of a handful of predictions at the top of the range (which it correctly predicts as days they should pitch) our plot in orange appears to follow the dotted blue line closely, indicating the model is displaying good behavior and is reliable.

### **Creating the Table**

The table updates daily with the newest data and checks if any roster changes have been made since the previous game. Their name, average leverage index, workload numbers entering that game, and availability % were included. The availability % is also colored by ntile to help interpret the value and who should be hot or not that day. Pitchers are often overworked, underworked, or otherwise utilized at inappropriate times because the game situation calls for it. Because of this, a pitcher will not be used 100% of the time they are at their best, nor will they always get a day off when they need it. As a result, the highest probability the model finds for availability is (generally) somewhere around 65%. If Jose Leclerc's availability is 50%, this means, historically, pitchers with similar workload/performance were used about half the time. This is actually relatively on the higher end of probabilities (indicated by more green), meaning he could be a good option to use that day.











One issue ran into was once a pitcher fell out of the 7-day pitched window, his availability dropped precipitously. This could be because historically if someone hasn't pitched in a while, it means they are either injured or not a regular option out of the pen. This was addressed by removing the % and highlighting these pitchers in yellow, which means they can generally be considered "available". Below are a few examples from Rangers games in 2024.

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Reliever Availability						
Texas Rangers vs. Los Angeles Angels (2024-09-28)						
Pitcher	LI Last 7 Days	# Days Rest	# Pitches Last Outing	# Outings Last 7 Days	# Pitches Last 7 Days	% Availability
 Gerson Garabito	0.34	6	10	1	10	49.9
 Josh Sborz	2.87	3	11	1	11	46.9
 Marc Church	3.00	5	24	1	24	44.8
 Dane Dunning	0.89	6	81	1	81	34.3
 Daniel Robert	1.04	0	21	1	21	28.2
 Kirby Yates	1.07	0	20	2	37	25.7
 Matt Festa	0.99	0	17	3	68	21.4
 Andrew Chafin	1.28	0	14	3	72	20.3
 Jose Leclerc	1.00	0	6	3	78	19.8
 David Robertson	1.45	0	18	4	55	18.0

Leverage Index can be binned into 3 categories: Low = 0-0.85, Medium = 0.85-2, High = 2+, where 1 is average

## Availability Table from 9/28/24

Reliever Availability						
Texas Rangers vs. Los Angeles Angels (2024-09-29)						
Pitcher	LI Last 7 Days	# Days Rest	# Pitches Last Outing	# Outings Last 7 Days	# Pitches Last 7 Days	% Availability
 Jose Leclerc	0.45	1	6	2	31	50.6
 Daniel Robert	1.04	1	21	1	21	49.2
 Andrew Chafin	1.08	1	14	2	38	48.2
 David Robertson	1.72	1	18	3	40	46.2
 Matt Festa	0.99	1	17	3	68	40.6
 Marc Church	1.93	0	15	2	39	29.9
 Kirby Yates	1.54	0	9	3	46	29.9
 Dane Dunning	0.08	0	15	1	15	15.6
 Gerson Garabito	0.23	0	35	1	35	6.5
 Walter Pennington	1.00	7	27	0	0	—

Leverage Index can be binned into 3 categories: Low = 0-0.85, Medium = 0.85-2, High = 2+, where 1 is average

\*Players highlighted in light yellow have exceeded 7 day window but should generally be considered available to pitch

## Availability Table from 9/29/24

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## ***Pitcher Performance Expectations by Availability***

To determine how availability affects pitcher performance, we grouped availability % into low, medium, and high levels of availability on the days guys threw. Low availability accounted for the bottom 25% of outings in terms of availability. High availability accounted for the top 25% of outings in terms of availability. And medium availability accounted for everything in between (25-75%). The performance measures calculated were SWM Rate, K Rate, BB Rate, and xwOBA. The test data used included all MLB data from 2024. These are the in-game performance results on the days in which pitchers entered while falling into one of the three respective availability buckets.

<i>Availability</i>	<i>Count</i>	<i>IP</i>	<i>SWM%</i>	<i>K%</i>	<i>BB%</i>	<i>xwOBA</i>	<i>% Avail (Low)</i>	<i>% Avail (High)</i>	<i>% Avail (Mean)</i>
<b>Low</b>	2527	2662.1	25	24.1	8.5	.298	2.1	37.3	26.9
<b>Medium</b>	5054	2794	25.2	24.8	8.7	.292	37.3	55.2	47.5
<b>High</b>	2526	2629	26.5	26.8	9.2	.288	55.2	91.3	59.5

*Pitcher In-Game Performance by Availability % in MLB (2024)*

Each metric, besides BB rate, improves at each subsequent availability bucket. The “% Avail” columns indicate the min, max, and mean of each bucket. Some reasonable cutoffs for these buckets would appear to be <35%, 35-55%, and 55+%, if we wanted to classify a reliever into available, emergency, unavailable, etc.

## ***Application of the Table***

The key things to interpret from the table are who the top available guys are and how taxed the bullpen is as a whole. This could prove incredibly helpful in bullpen management, injury prevention, and roster decisions as the season moves along.

## ***\*Message to Code Manager\****

The scripts for the reliever availability model, predictions, and table can be found in Databricks in `databricks_analytics/Lance/Reliever_Availability`. During the season you will need to set up a job to run the predictions and table each day around 9:30 am so the major league staff can have the report ready for their advanced scouting meeting prior to each game. You will only need to run the model once prior to each season and copy the new experiment artifact into the predictions script.

This is something you will have to monitor quite closely as oftentimes situations like late additions can be made which might require some hardcoding of players into the table. Effective communication with the advanced scouting staff is absolutely necessary to ensure that everything is properly addressed.