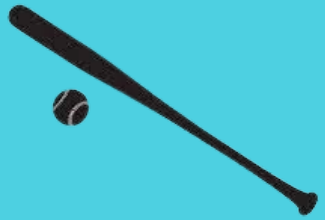
Wharton Moneyball Academy 2023



Optimal Rest Days for Pitchers: Maximizing Performance and Wins

Blake Zilberman
Philip Sherr
Lyev Pitram
Marc Sutton

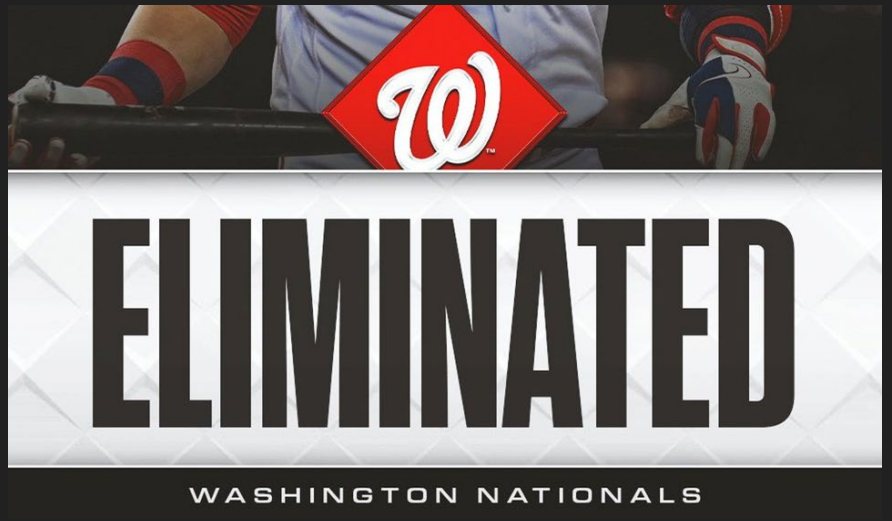
Opening Case: Max Scherzer's short rest playoff woes

During the 2017 NLDS, the Washington Nationals used Max Scherzer **as a starter in game 3**. However, two days later in game 5, **Scherzer was brought in from the bullpen** in the 5th inning of a 4-3 game...

Scherzer proved to be a disaster, allowing 4 runs and costing his team the elimination game, as well as their season.

The Nationals overlooked Scherzer's need for rest days to return to peak performance.

As a result, the Nationals lost the game and were forced to live with the results of their glaring mistake.



Five-man rotations have been the regular season norm for decades. This long-standing standard may lead to a mental bias, similar to the aversion to underhanded free throws in basketball.

Are teams following the norm because it is the norm, or because it is correct?

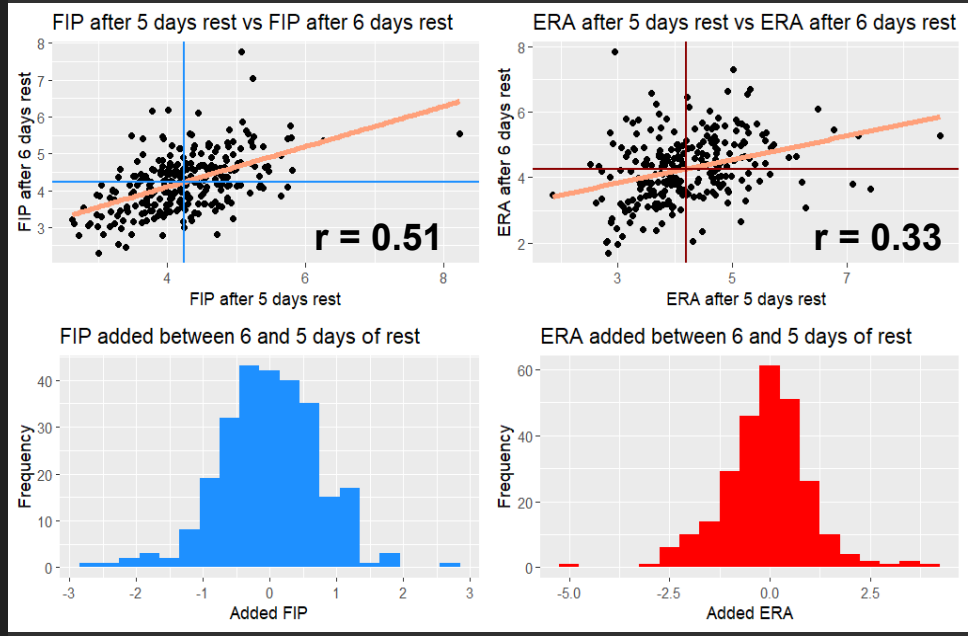
Research Question:

What is the ideal number of rest days between starts for pitchers in order to maximize their performance and win the most games?

Why use FIP instead of ERA?

The correlation between FIP performances at different rest day intervals is 0.51, which is higher than the correlation for ERA, which is 0.33.

FIP focuses on what the pitcher can control, and removes confounding factors like defensive plays by fielders and ballpark dimensions, providing a better estimate of pitcher performance.



Either way, the general ERAs and FIPs scale the same way, allowing us to use them interchangeably.

Too many or too little days of rest are home to largely negative outliers

-17.88% worse than average

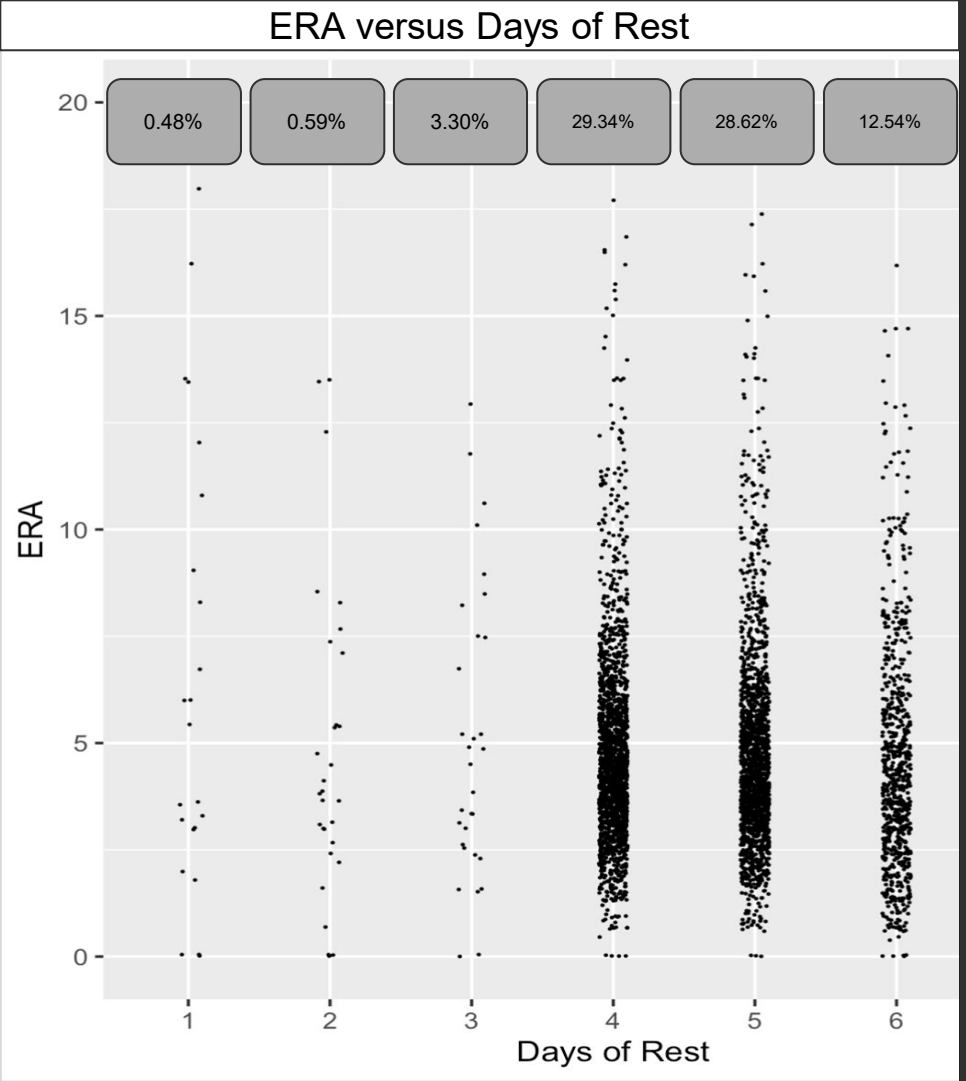
-7.46% worse than average

-6.56% worse than average

-3.51% worse than average

Days of Rest	Combined FIP	FIP % diff. from average
1	5.18	-17.88%
2	4.59	-7.46%
3	4.55	-6.56%
4	4.24	0.27%
5	4.19	1.32%
6	4.22	0.72%
7+	4.40	-3.51%

Giving a starting pitcher 1,2,3 or 7 days of rest between starts diminishes their performance.



% of total data

There is not enough data to make proper assumptions about pitcher starts with less than 4 days of rest.

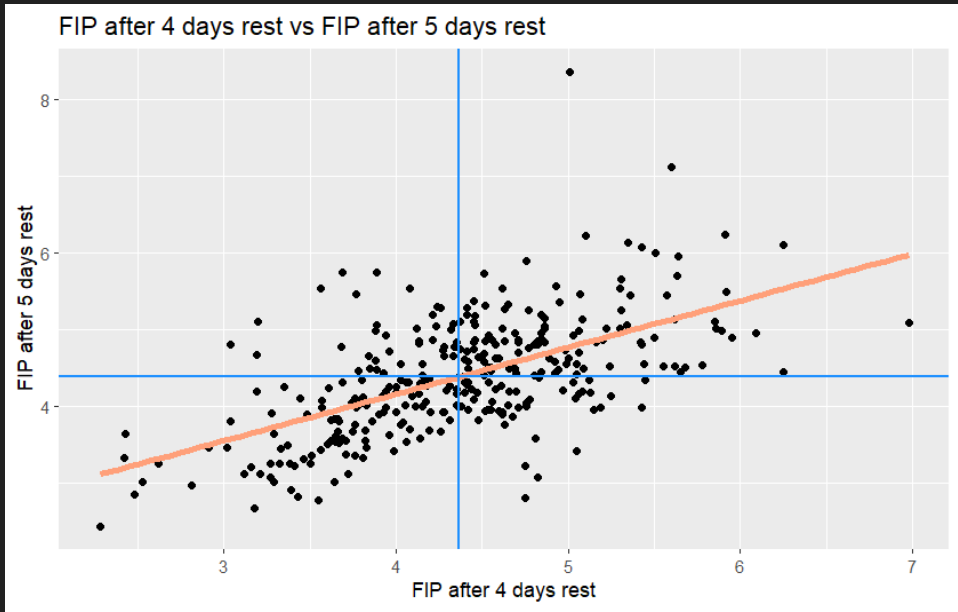
This creates higher variability, making it unreliable to use as a predictor.

The research will focus on pitching with 4, 5, or 6 days of rest between starts

Additional day of rest graphed

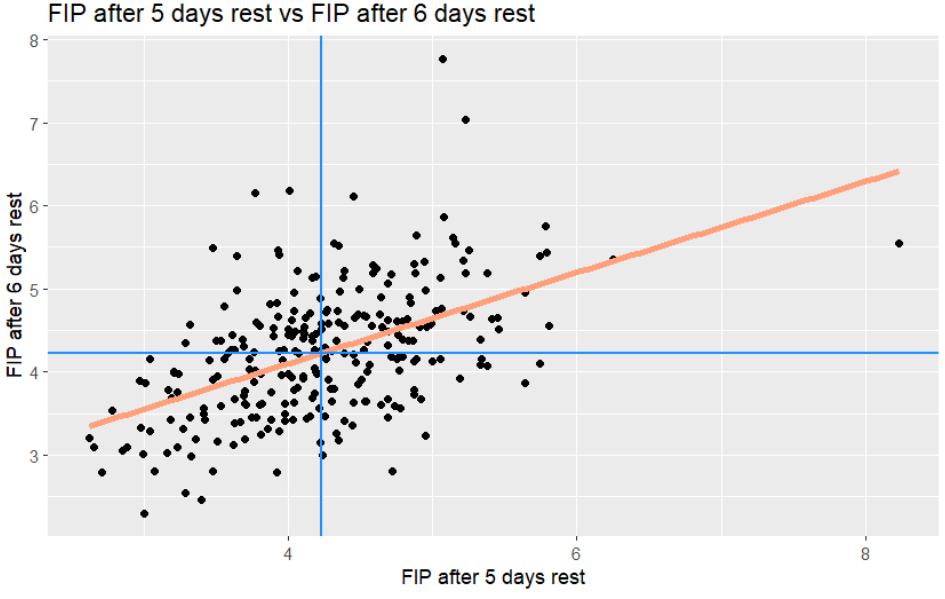
Predicted FIP5 = 1.7274 + 0.6083 * FIP4

Benchmark of 4.36

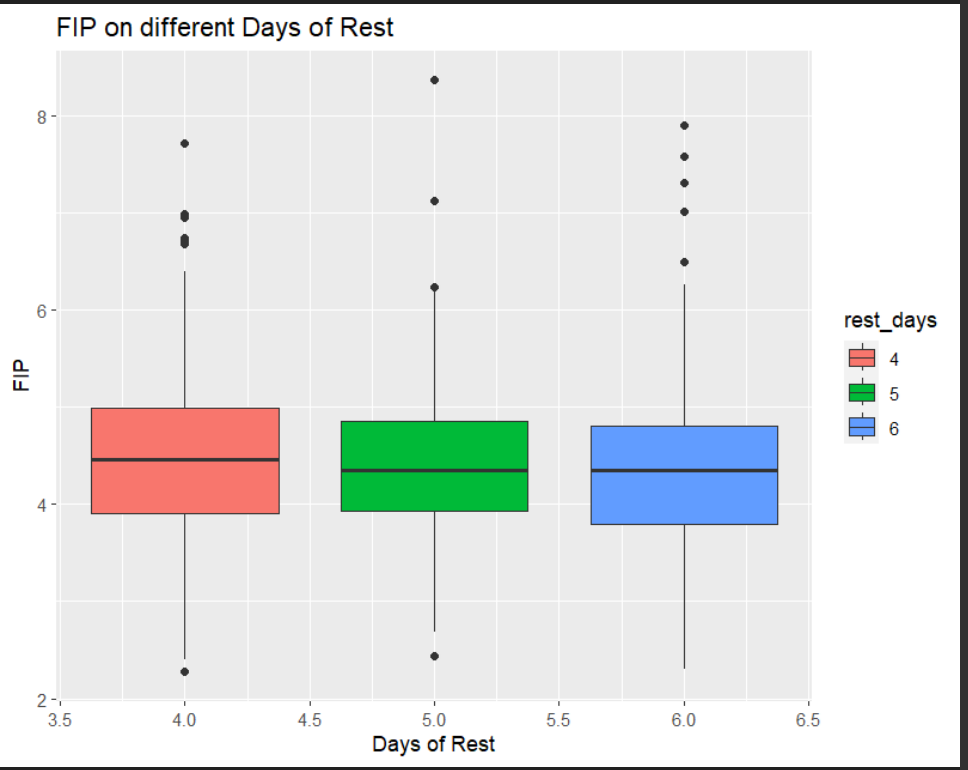


Predicted FIP6 = 1.9094 + 0.5474 * FIP5

Benchmark of 4.23



Break the graphs down into numbers



Days of Rest	4	5	6
Median FIP	4.46	4.35	4.35

- **Better FIP = Lower FIP**

- Without adjustments, pitcher performance with 4, 5, and 6 days of rest appear fairly similar

Adjusting FIP

1. Subtract FIP_{DoR} from career average FIP
   a. Derive the excess FIP produced at each level of rest

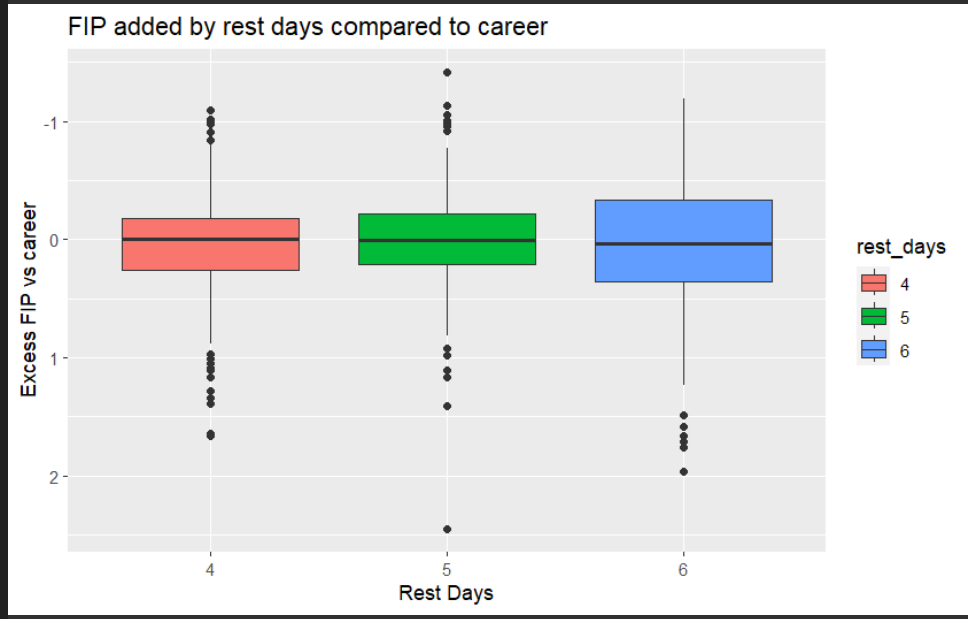
1. Categorize players into three groups based on percentiles and adjust for career performance.
   a. Given that teams tend to provide more rest to poorer players and play better players more frequently.

1

Now let's adjust FIP for the career average performance

Days of Rest	4	5	6
Median Excess FIP	0	0.01	0.04

- Better FIP = lower FIP
  - Once adjusted for career average performance, 4 days of rest stands out as the lowest



Career average FIP - $FIP_{DoR4,5,6}$ = Excess FIP vs career

2

$\hat{FIP}$ = Multiply the beta (regression coefficients) for each value of rest days by the corresponding subset (number of days of rest and quality of pitcher).

After adjusting for the quality of pitcher, we can see that 5 days of rest produces the best results….

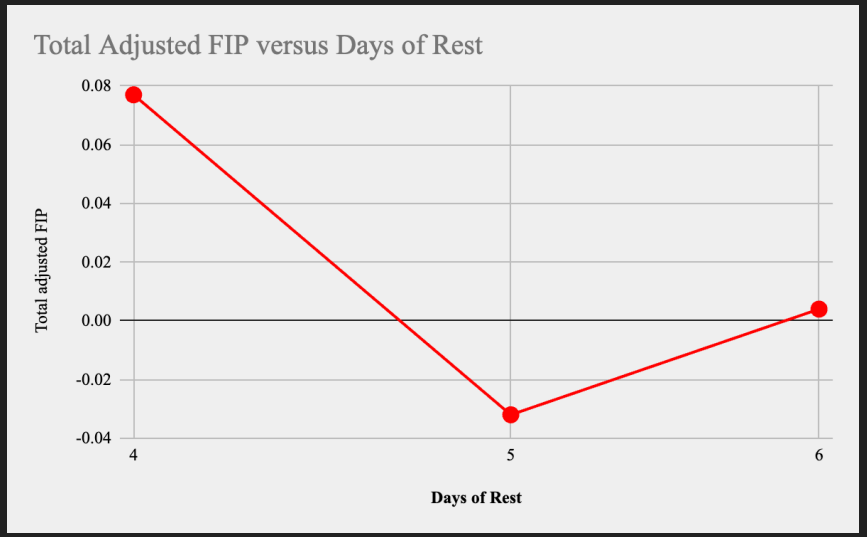
Subtract $\hat{FIP}$ for the specific DoR and quality categories by the average for each quality category…

Finds the excess FIP after adjusting for pitcher quality

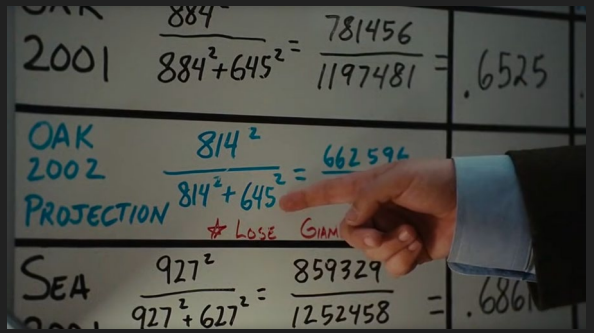
Days of Rest	Good	Average	Bad	avg. excess FIP adjusted for pitcher quality
4	0.00	0.05	0.19	**0.077**
5	-0.03	0.01	-0.11	**-0.042**
6	0.03	-0.06	-0.08	**-0.036**

After adjusting for quality, 5 DoR is strongest

Total Adjusted FIP



Days of Rest	4	5	6
Career Avg. Excess FIP	0	0.01	0.04
Quality Adjusted Excess FIP	0.077	-0.042	-0.036
Total Adjusted Excess FIP	0.077	-0.032	0.004



Days of rest	Earned runs Adjustment * 5/9 innings pitched	MLB Average Runs scored (2015-2022)	Runs against after adjusted	Win Percentage	Multiplied by 162 Games
4	0.042778	4.5	4.560	0.4934	79.9292
5	-0.017778	4.5	4.475	0.5028	81.4492
6	0.002222	4.5	4.503	0.4997	80.9440

Excess FIP x average MLB starter innings pitched

Derived using Bill James' Pythagorean Win Formula

$$\frac{RS^2}{RS^2 + RA^2}$$

Teams that have their pitchers pitch with 5 days of rest between starts should gain an average of….

- **1.52** more wins per season than teams playing their pitchers with 4 days of rest.
- **0.51** more wins per season than teams playing their pitchers with 6 days of rest between starts.

Keep in mind: In 2021 the Mariners and Blue Jays each missed the playoffs by ONE game

What was the process?

- Examined the FIP of 6,000 starting pitching performances and grouped them by days of rest.

- Created Adjusted Excess FIP by adjusting for the pitchers' individual averages and for grouped pitcher quality.
  - The Adjusted Excess FIP value showed that five days is the optimal rest period between starts.

- Adjusted Excess FIP value was used to calculate the number of wins above/below average teams could achieve by adjusting the days of rest for their pitchers.
  - Used Bill James' Pythagorean Win Formula to calculate wins.

A solution which MLB teams can implement to increase their average wins per season.

Final Conclusion

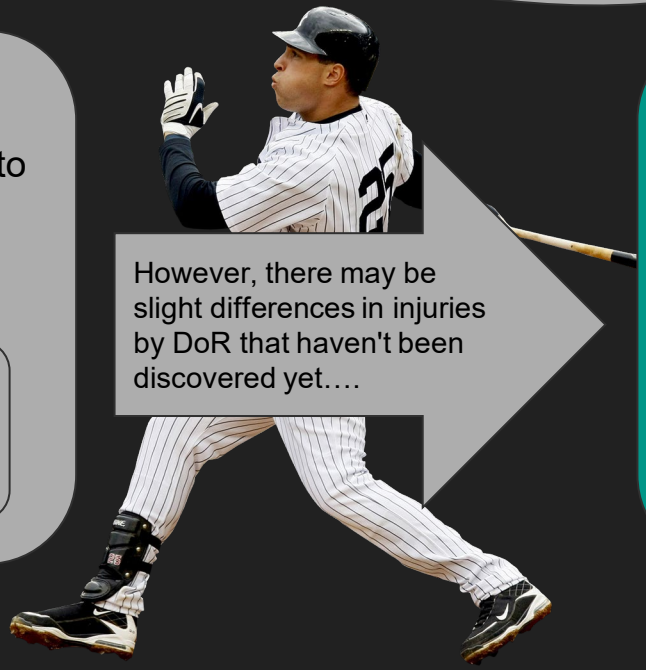
- The four day rest rotation (five man) and the six day rest rotation (seven man) produce an inferior number of wins compared to a five day rest rotation (six man).

By switching from the traditional four to a five day rest rotation, teams can add an average of 1.52 wins per season.

The potential limitation of injuries

JC Bradbury, a sabermetrician, wrote, “there exists little evidence to show that the days of rest affect future injury among adults [athletes].”

Therefore, for the purposes of this experiment, we viewed injuries as a null factor.



However, there may be slight differences in injuries by DoR that haven't been discovered yet….

We are not barring the potential for there to be varying injury levels as a result of differing numbers of rest days.

As a result, this may influence how teams may apply the data discovered.

Further Limitations

- Data only includes the Statcast era (using 2015 -2022)
- Does not consider the possible decrease in pitcher quality when adding additional pitchers to the rotation.

Questions for Further Research

- How do pitchers' pitch counts vary when they are on different amounts of rest and does it affect their performance?
- Should different strategies be employed in the playoffs?

Sources

- “Player Pitching Game Stats Finder.” Edited by Stathead, ***Stathead.Com***, stathead.com/baseball/player-pitching-game-finder.cgi Accessed 26 July 2023.

- Rymer, Zachary D. “Do Innings Limits, Pitch Counts Actually Prevent Serious Injuries in MLB?” *Bleacher Report*, 2 Oct. 2017, bleacherreport.com/articles/1622573-do-innings-limits-pitch-counts-actually-prevent-serious-injuries.

Questions?