Determining the Value of a Foul Ball

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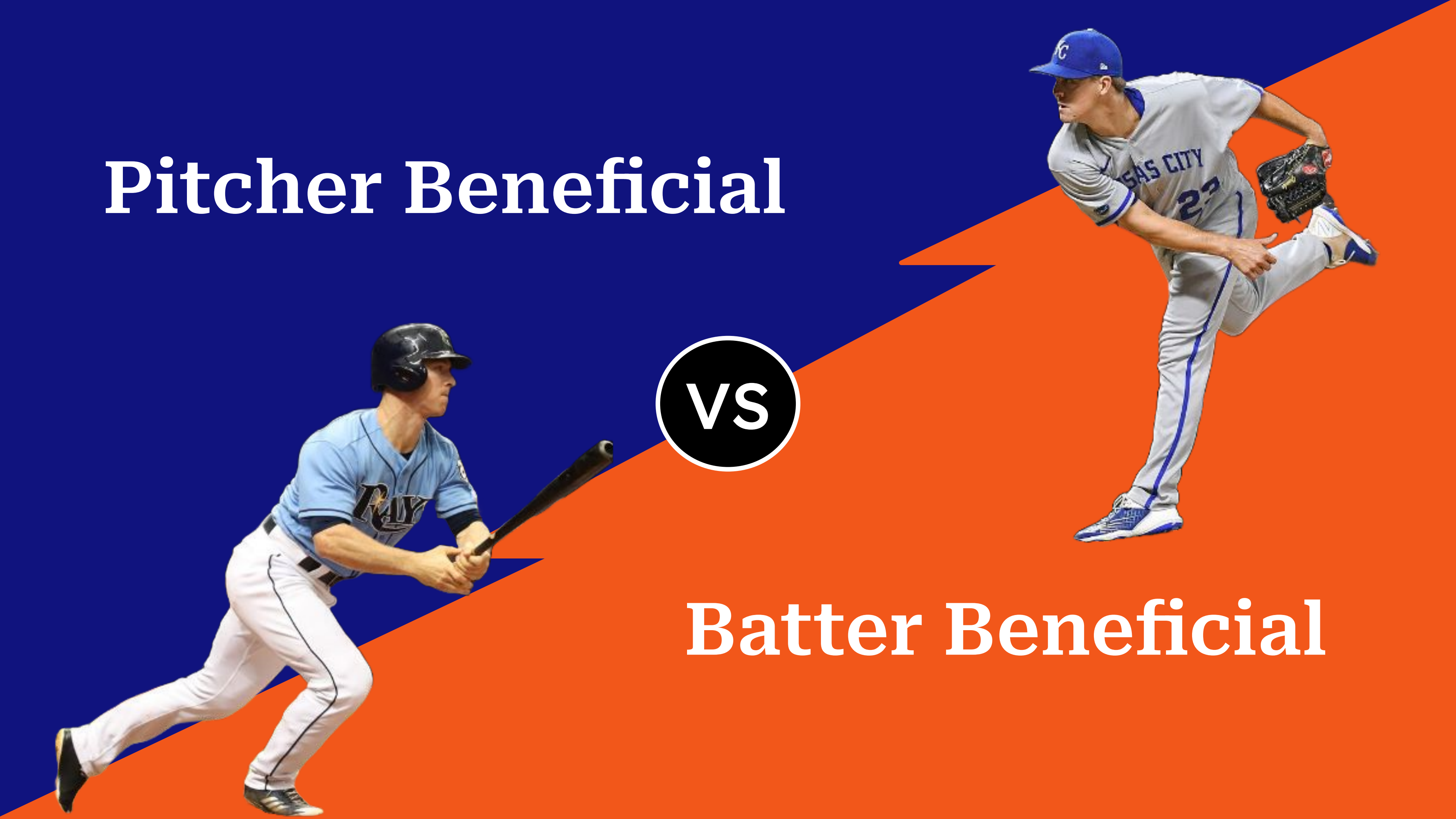

Pitcher Beneficial
VS
Batter Beneficial

Methodology

- Use Out Probabilities by Count
- Determine Out Probability Added on a Foul Ball
- Model Probability on an out Based on Pitch Characteristics
- Model Probability of Pitch Being Fouled Off
- Create Algorithm Using These Components to Determine the Probabilities
- Analyze Metric in Context of Player and Team Offensive Output

Data

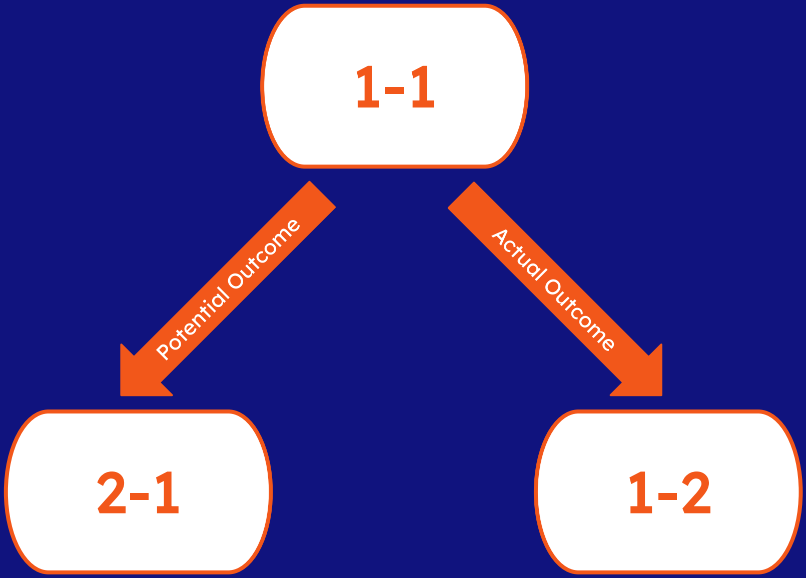
savant

2020 - 2023
Pitch Level

2023 Foul Balls

Creating Out Probabilities

Out Probabilities by Count

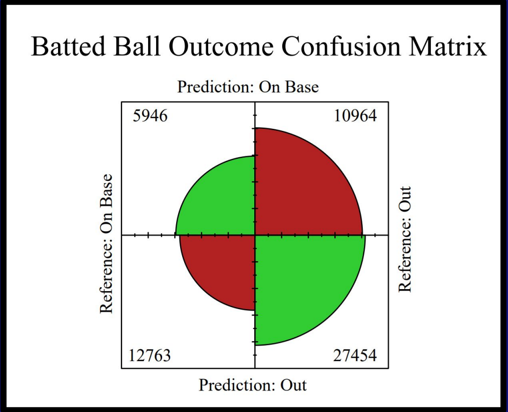


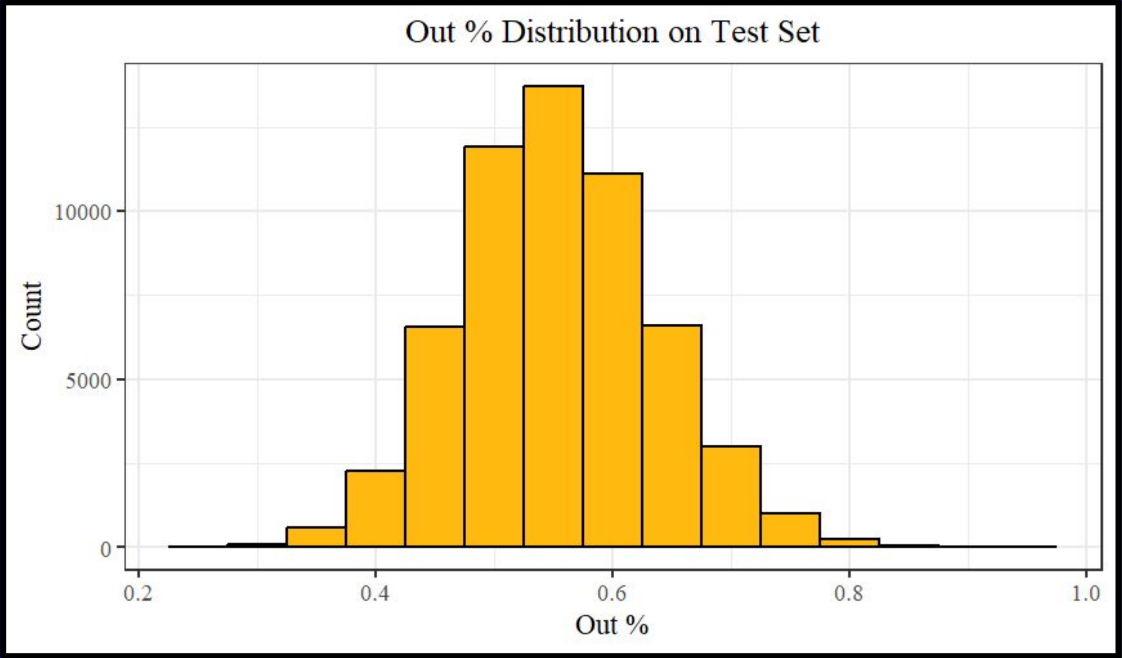
Foul Ball Out Probability Added:
77.32% - 61.02% = 16.30%

	STRIKES		
BALLS	0	1	2
0	68.47%	73.78%	80.46%
1	62.69%	69.53%	77.32%
2	51.30%	61.02%	71.11%
3	28.46%	41.17%	54.35%

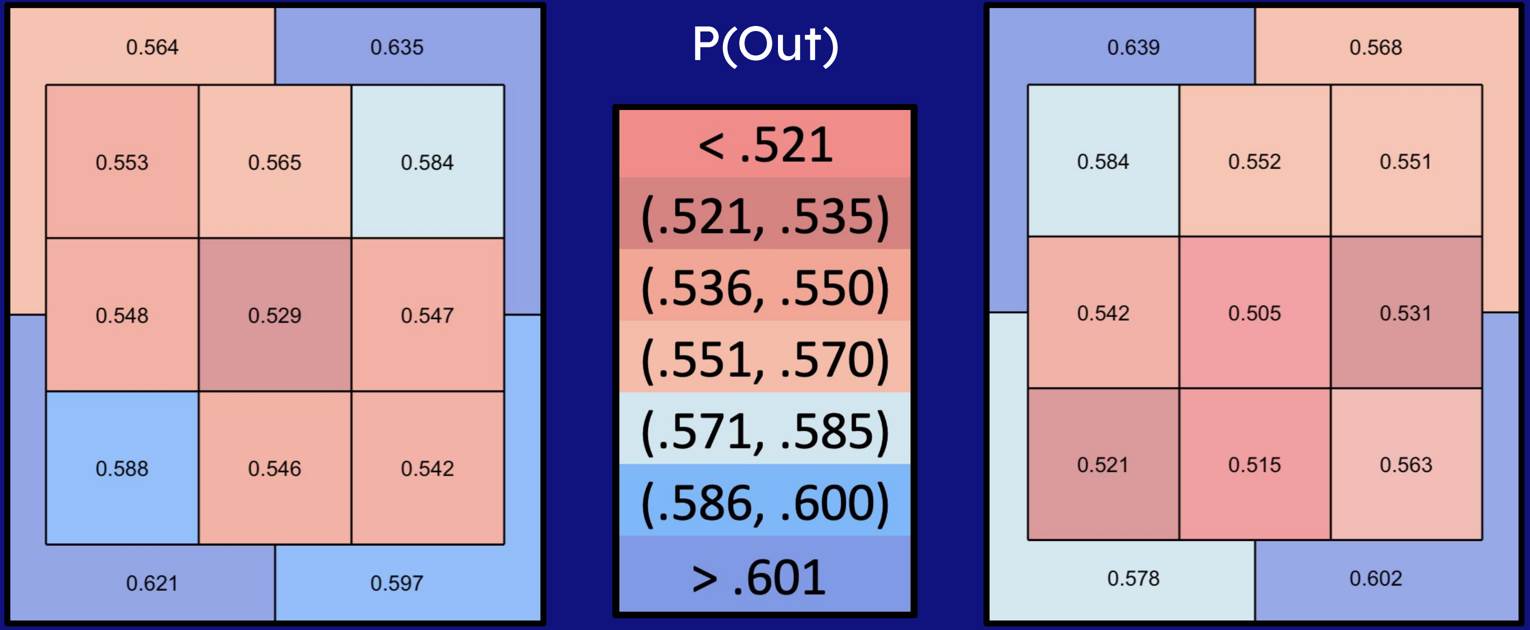
Batted Ball Out Model

- Random Forest
- On Base/Out
- Predictors Used:
  - Pitch Characteristics*
  - Statcast Zone
  - Batter Handedness





Out Probability by Zone



Left-Handed Batters

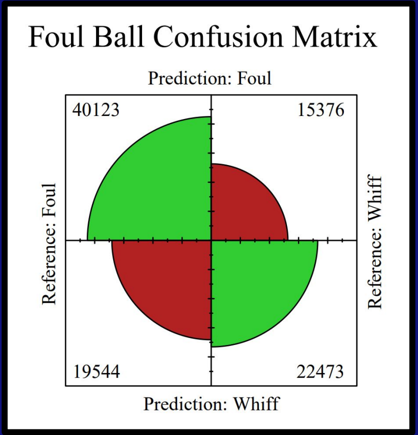
Right-Handed Batters

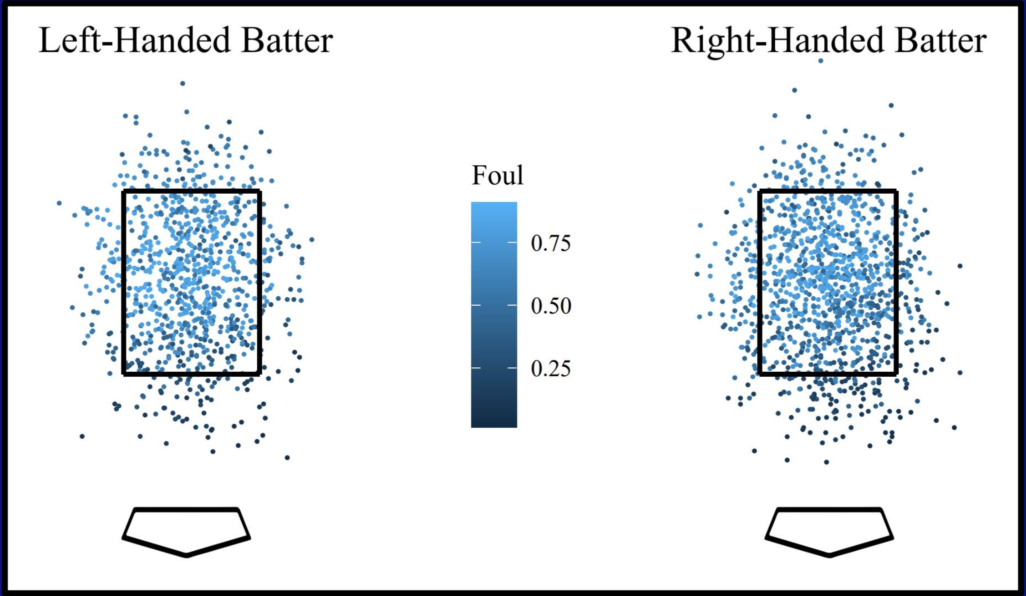
Foul Ball Model

- Naive Bayes

$$P(foul\ or\ whiff \mid feature) = \frac{P(feature \mid foul\ or\ whiff) \cdot P(foul\ or\ whiff)}{P(feature)}$$

- Predictors Used:
  - Count
  - Pitch Characteristics

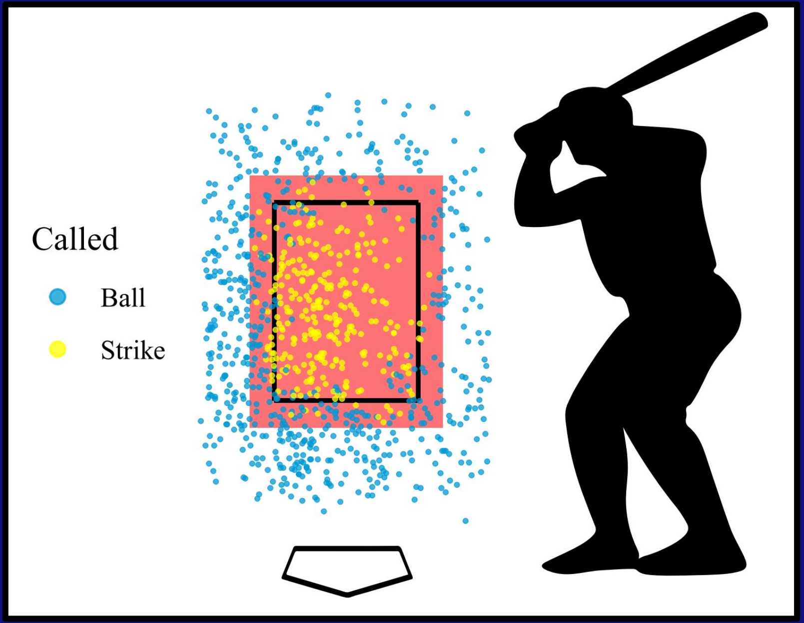




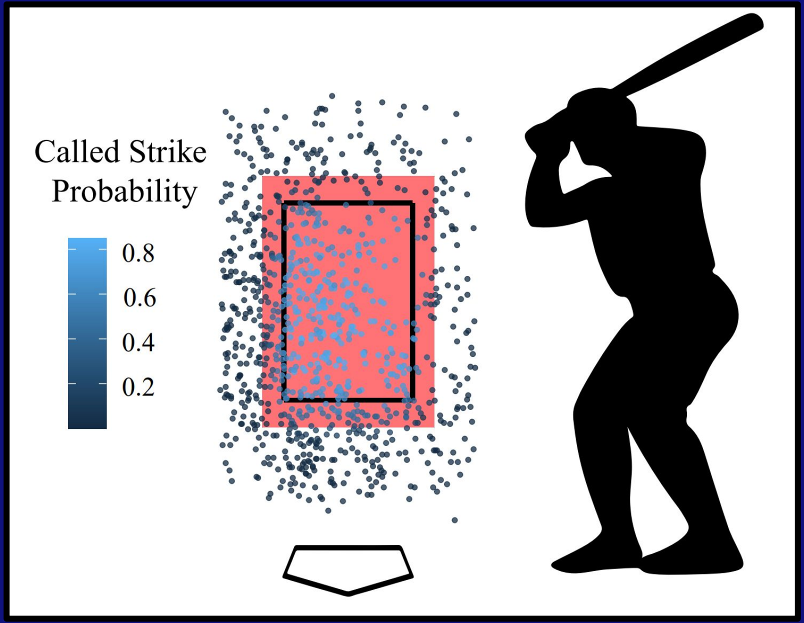
“Hittable” Pitches

Shohei Ohtani 2023

Called Balls and Strikes



Called Strike Probability



Building an Algorithm

Batter Conditions

Foul Ball Out Probability Added

Batter FOPA =

P(Count) - P(Count | No Swing) ,	Not Hittable
P(Count) - P(Out | Ball in Play) ,	Hittable, <2 Strikes
P(Foul) - P(K) ,	Hittable, 2 Strikes

Pitcher Conditions

Foul Ball Out Probability Added

Pitcher FOPA =

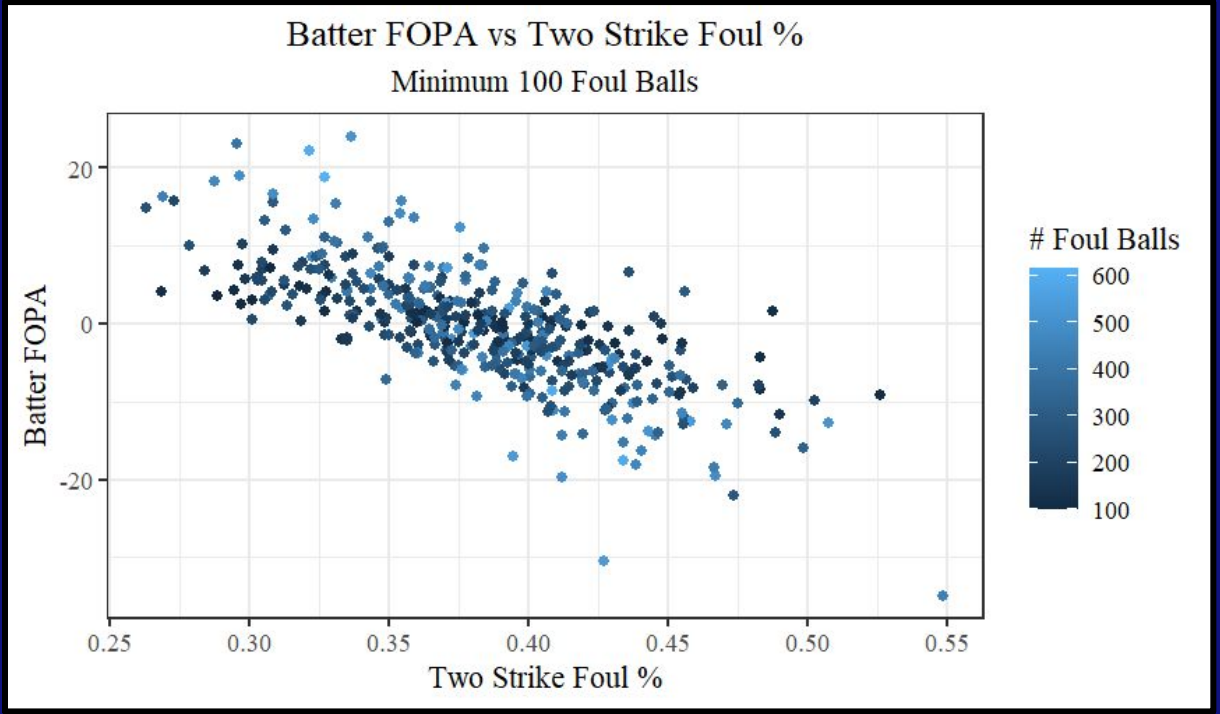
- P(Count) - P(Count | No Swing) , — Not Hittable, <2 Strikes
- P(Count) - P(Count | No Swing) P(Whiff) - P(K),* — Not Hittable, 2 Strikes
- P(Count) - P(Out | Ball in Play) , — Hittable, <2 Strikes
- P(Count) - P(Out | Ball in Play) P(Whiff) - P(K),** — Hittable, 2 Strikes

* = mean
** = weighted mean

Leaderboards

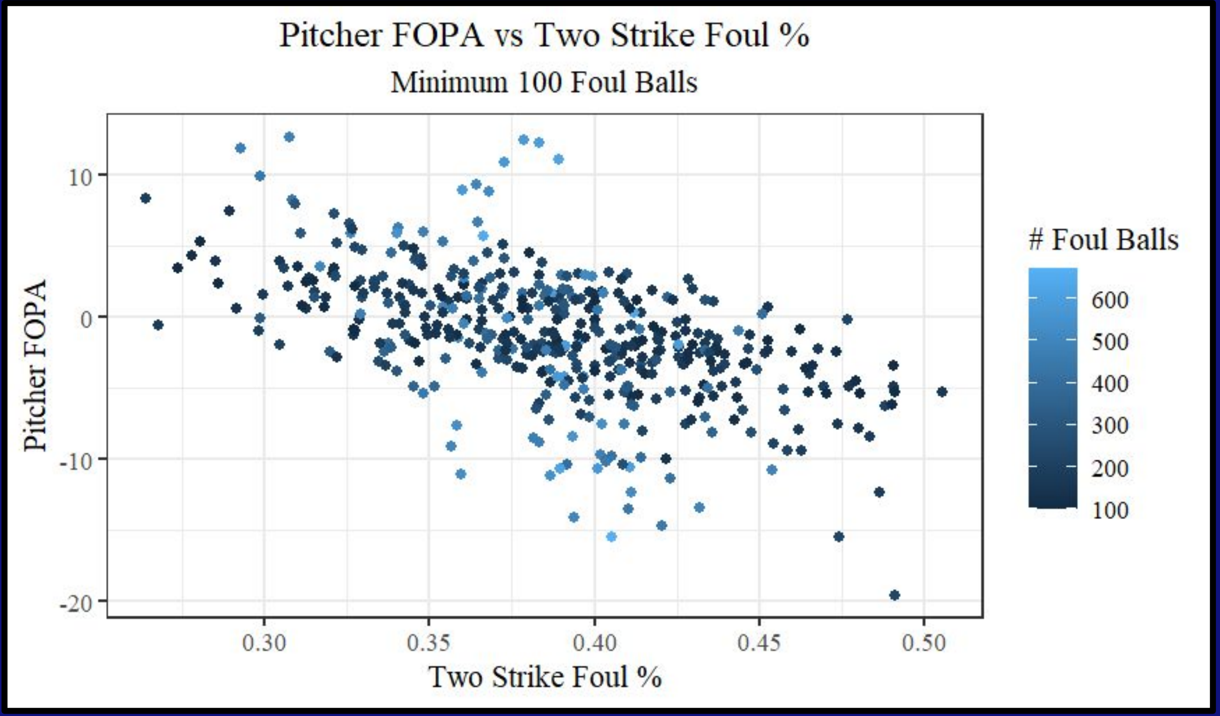
Shiny App

Hitter Metric Analysis



Player	FOPA
Ha-Seong Kim	-34.90
Spencer Torkelson	-30.53
Alex Call	-22.08
Willy Adames	-19.74
Brandon Nimmo	-19.56
Cody Bellinger	-18.54
Daulton Varsho	-18.12
Anthony Santander	-17.57
Ty France	-17.01
Spencer Steer	-16.34

Pitcher Metric Analysis



	Player	FOPA
	Framber Valdez	12.71
	Justin Steele	12.51
	Mitch Keller	12.29
	Kyle Freeland	11.89
	George Kirby	11.07
	Pablo Lopez	10.93
	Kyle Gibson	9.92
	Johan Oviedo	9.37
	Logan Gilbert	8.98
	Yusei Kikuchi	8.90

Shortcomings

- Interpretation of “good” and “bad” foul balls
- Model performance
- Different model types
- Modeling on a league level
- Explanatory variables

Questions?