Predicting Pitcher Fatigue

MLB Winter Meetings 2023

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The Goal: effective pitch selection in light of pitcher fatigue

Types of Pitches

Fastball - fastest, least movement

Cutter - fastball variant, more horizontal movement

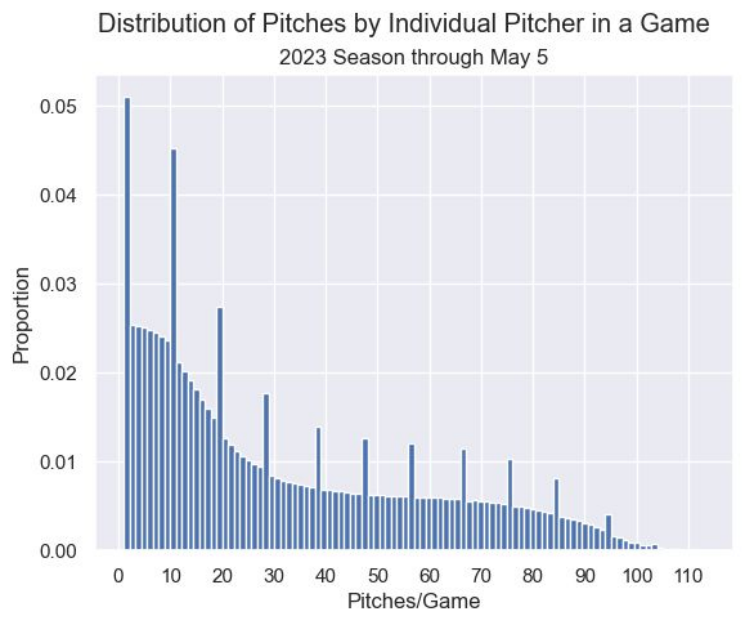
Sinker - fastball variant, more vertical movement

Slider - offspeed, faster than curveball, often moves to pitcher’s arm side

Curveball - slow, more vertical movement than slider

Changeup - designed to look like fastball, but slower

Pitch Count Management



Managers are careful to limit the number of pitches thrown during an outing.

These limits are often fixed numbers (divisible by 10) rather than dictated by the game situation.

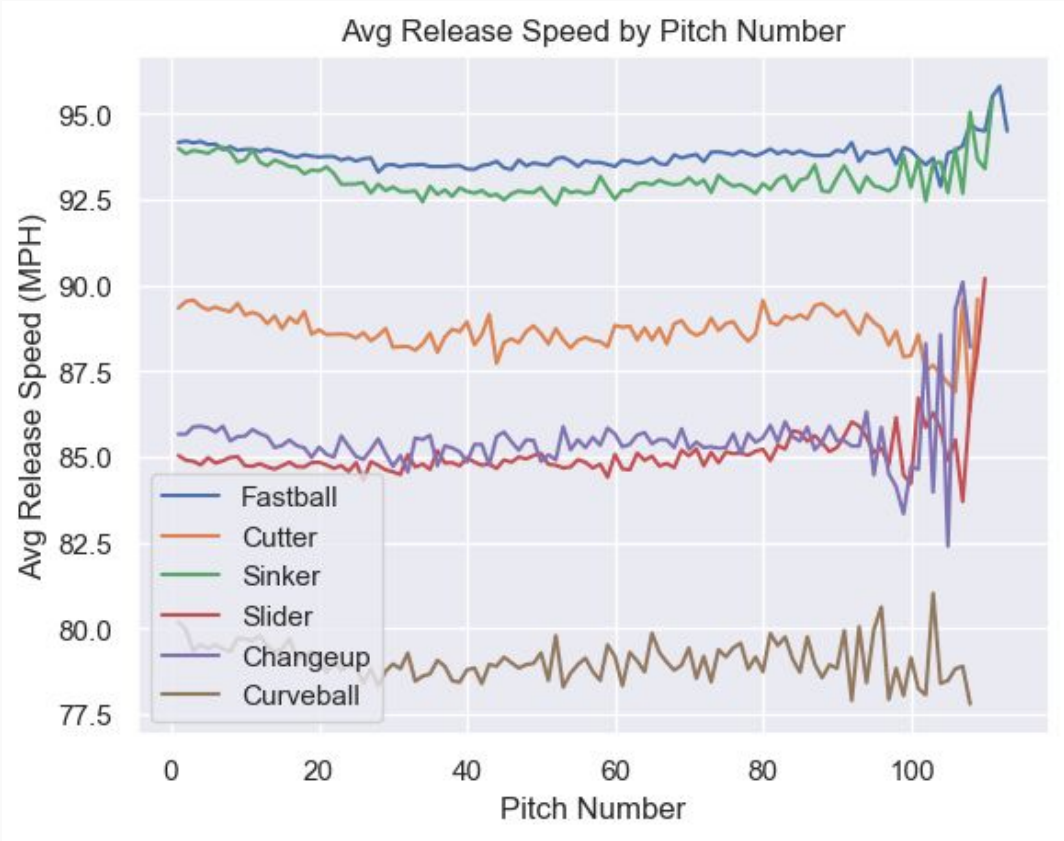
Pitch Variability - Release Speed

Average speed by pitch remains relatively stable throughout a pitcher's outing until around pitch number 100.

Fastballs and fastball variants (cutter and sinker) decline slightly in release speed around pitch 40-60, increasing again around pitch 80.

One potential explanation is that as pitchers become more fatigued, they attempt to throw high speed pitches faster, creating greater risk of injury.

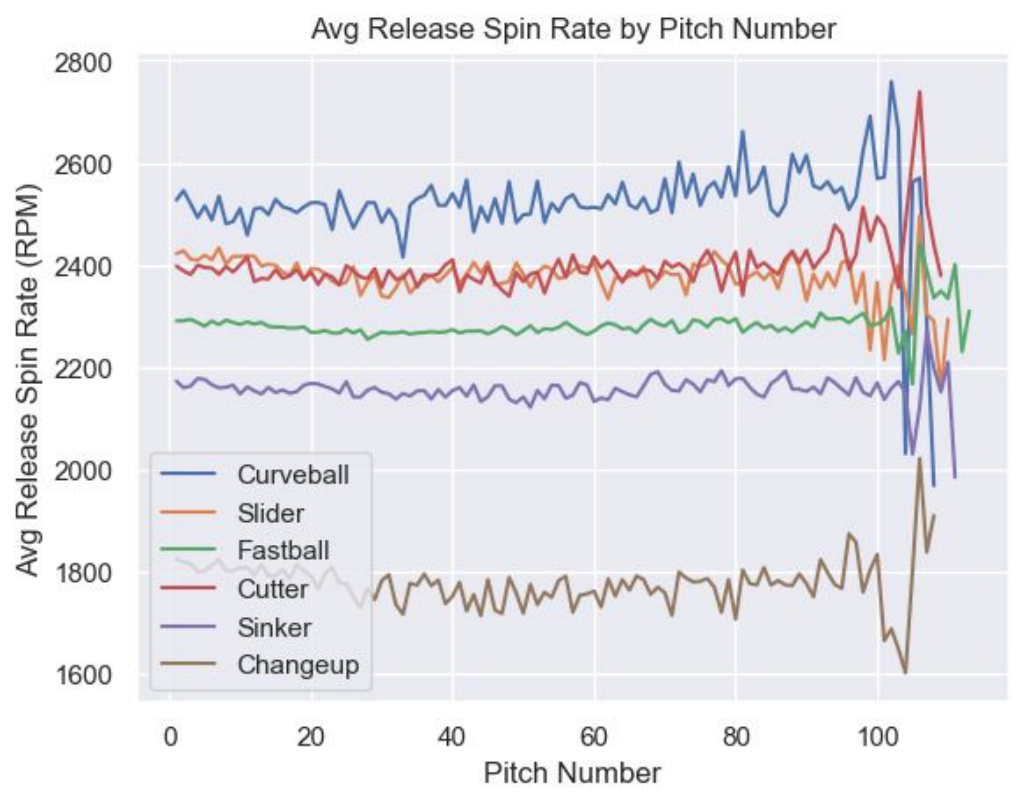
Alternatively, it may simply represent that high-velocity pitchers are removed from a game before they reach 80 pitches.



Pitch Variability - Release Spin Rate

Release spin shows similar tendencies to release speed. Here, the curveball relies most on high spin rate.

At the end of an outing, pitchers either are either extending themselves beyond their capabilities, or low-spin pitchers have been removed.

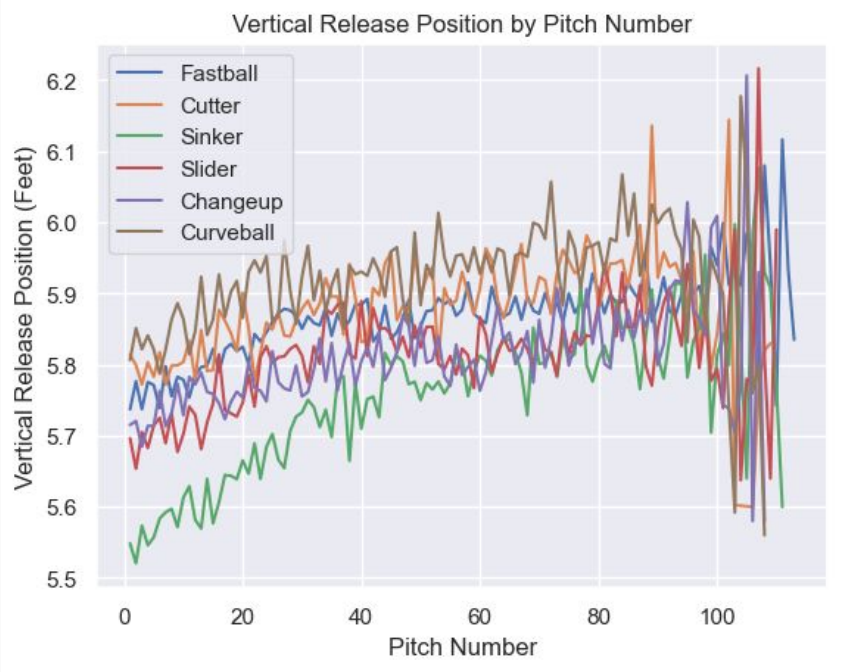


Increase in Vertical Release Postion

Vertical release position, unlike release speed or spin rate, increases gradually and consistently throughout a pitcher's outing.

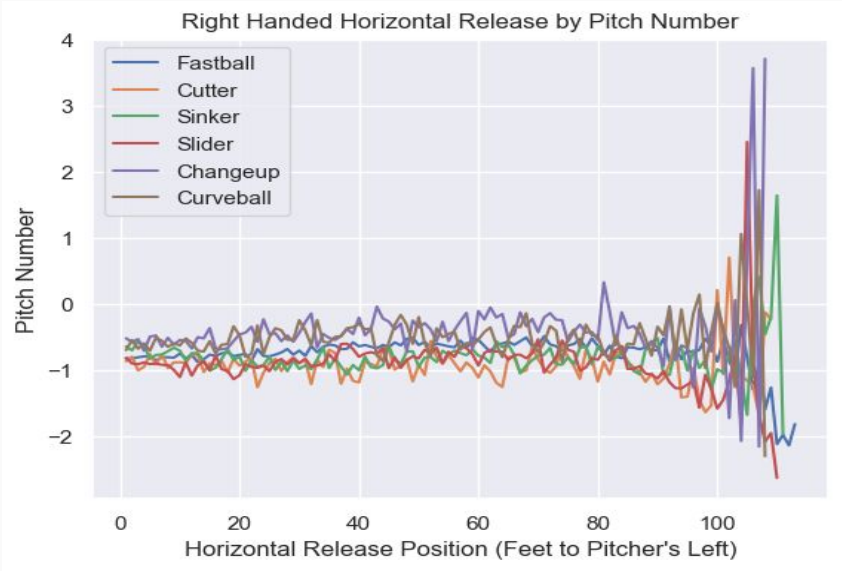
This increase is more likely due to fatigue rather than removal of low-quality pitchers.

In other words, as a pitcher gets tired, he releases the ball from a higher position.

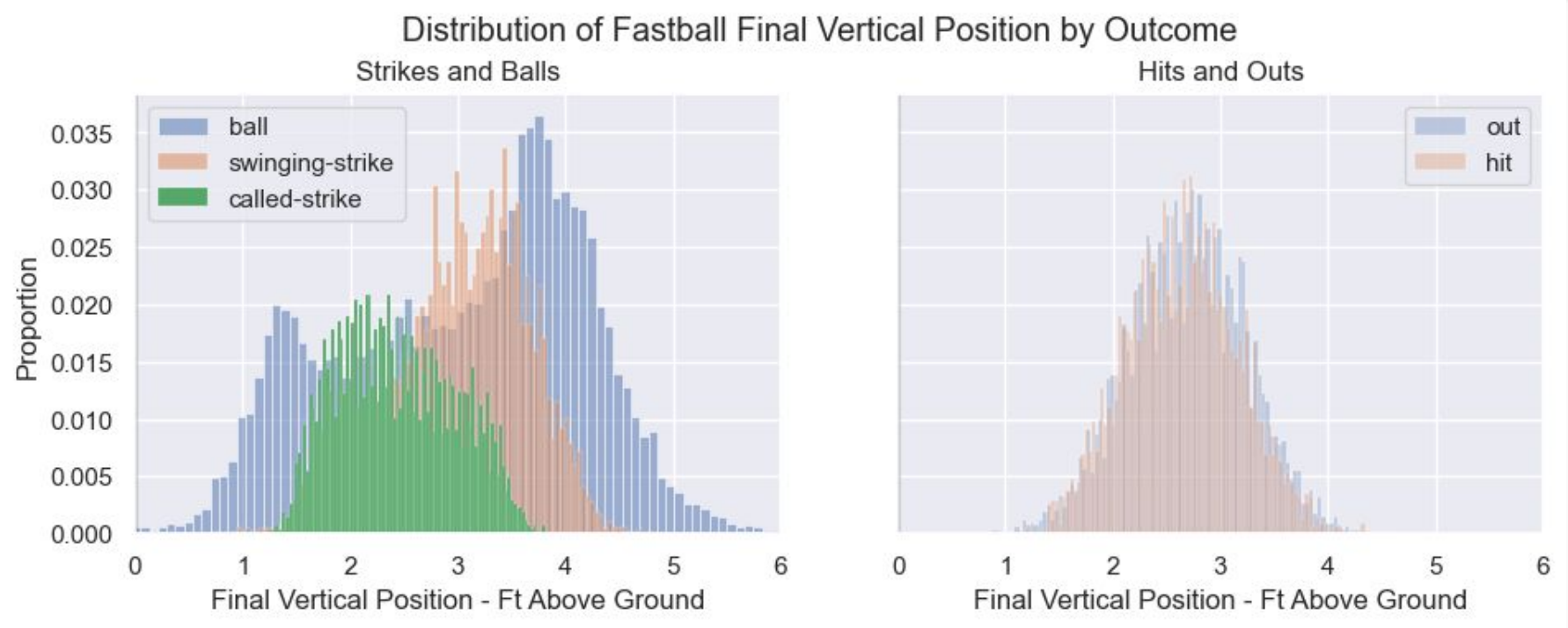


Changes in Horizontal Release Point

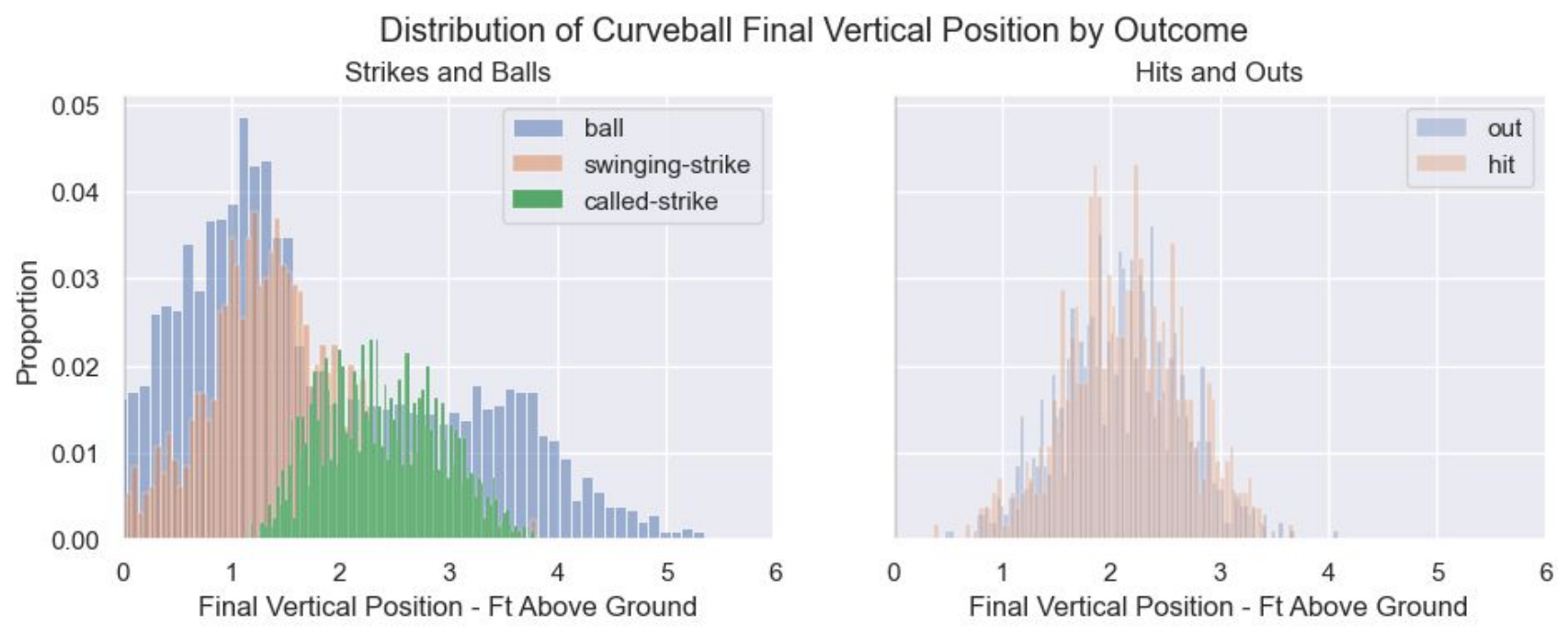
We see a similar change in horizontal release point for right-handed pitchers. Negative numbers reflect that right-handed pitchers are extending their arms farther to the right (away from their bodies) as the outing continues.



Effective Fastballs



Effective Curveballs



What happens as pitchers get tired?

Release position is higher

Velocity is higher

Good for pitches relying on velocity (e.g. fastballs)

Bad for pitches relying on vertical movement (e.g. curveballs)

Next Steps

Working app, reasonable speed (especially for live data)

Data selection - quantity, recency

Better model training

Improving model accuracy for one-vs-rest (AUC ranging 0.55 to 0.65)

Measuring accuracy for multi-label output (currently around 0.4)