The Art of Swing

You are a SLUGGER?

Group Member

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To measure the various abilities across different batters?

Power パワー

Slugger

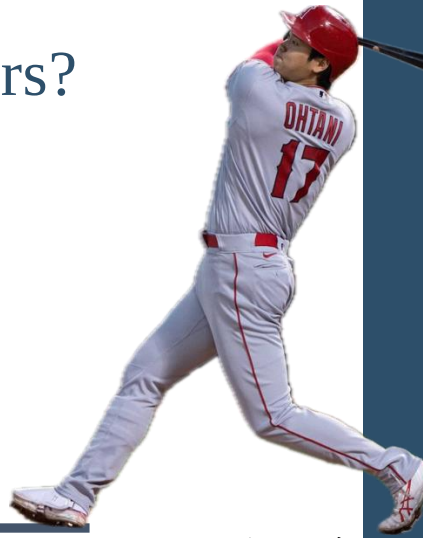
Giancarlo Stanton　中村剛也

kyle schwarber　Brandon Laird

Elite Batter

Mike Trout　近藤健介

Shohei Ohtani (大谷翔平)　柳田悠岐



Contact ミート

Weak Batter

Takuya Nakashima (中島卓也)

Contact Batter

Ichiro Suzuki (鈴木一朗)

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Calling for perfect metrics to measure a batter's batting ability

1. To measure the true batting ability of a player

    - Eliminate the influence of luck
    - Eliminate the influence of the defense ability of the fileders
    - Eliminate the influence of the field

2. To determine a player's salary next year

Major League Baseball | Statcast proposed 6 metrics on May 13

- Bat Speed
- Fast-swing Rate
- Squared-up Rate
- Blast
- Swing Length
- Swords

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Contents

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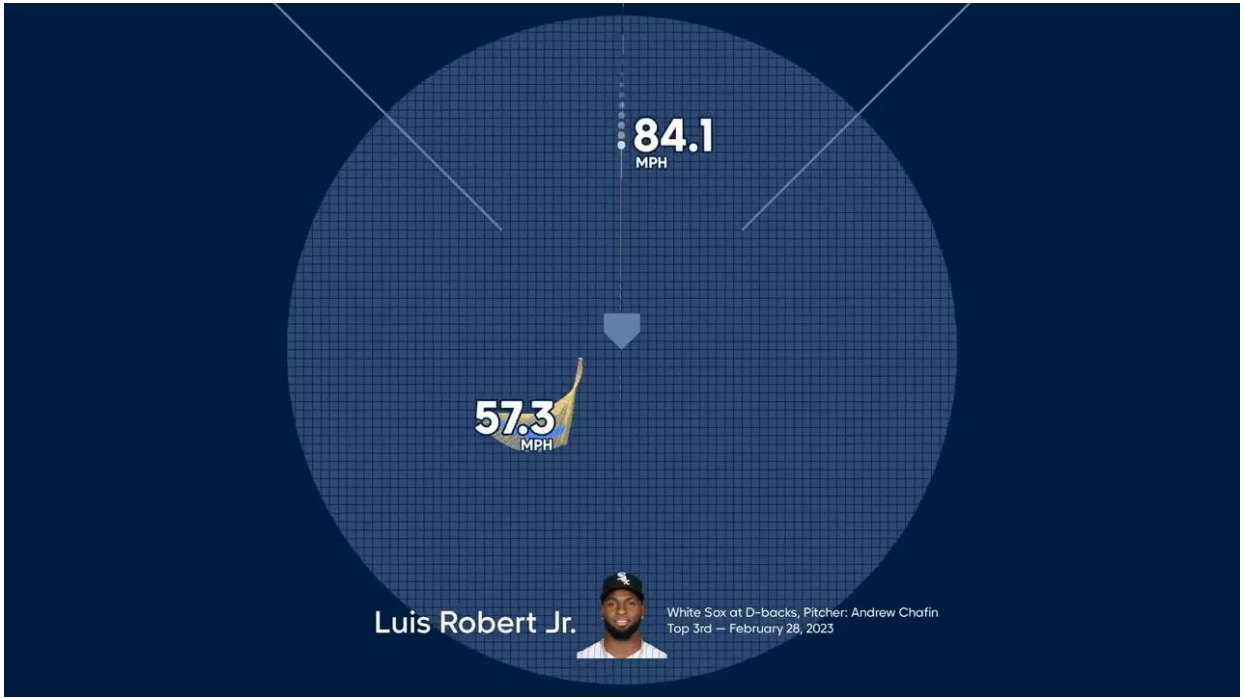
01

Bat Speed & Fast Swing Rate

Bat Speed

- Definition: How fast the sweet spot moves when contact occurs.



Average Bat Speed

- Definition: A player's **average bat speed** is the average of his top 90% of swings.
- Visualization:
  - Average bat speeds range from 62 to 80 mph, with a concentration around 71 mph.
  - The distribution follows approximately a normal distribution.

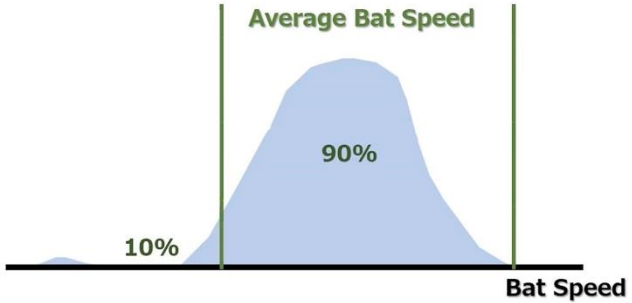


Figure 1: Definition of Average Bat Speed

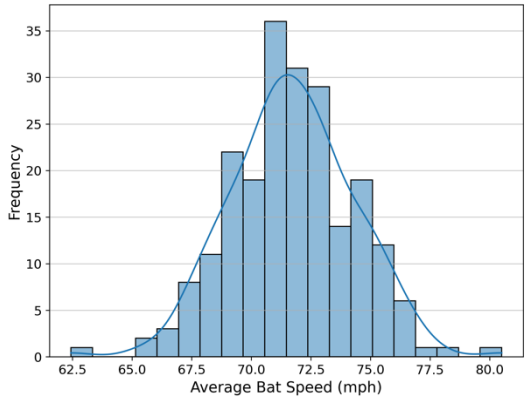


Figure 2: Distribution of Average Bat Speed

Fast Swing Rate

- Definition: The percentage of all of one's swings that did reach 75 MPH.
- Why 75mph: The swing speed is where you see per-swing production reach league-average.
- Analysis: From the table, each indicator Fast Swing is much higher than Not a Fast Swing.

Figure 1: Definition of Fast Swing Rate

	Fast Swing	Not a Fast Swing
BA	0.311	0.219
SLG	0.612	0.374
wOBA	0.392	0.267
hard-hit rate	0.535	0.360
RV/100	0.722	-2.868

Table 1: Fast Swing vs Not a Fast Swing

Correlation Analysis between Avg Bat Speed and Fast Swing Rate

- Positive correlation, R-squared is 0.879..

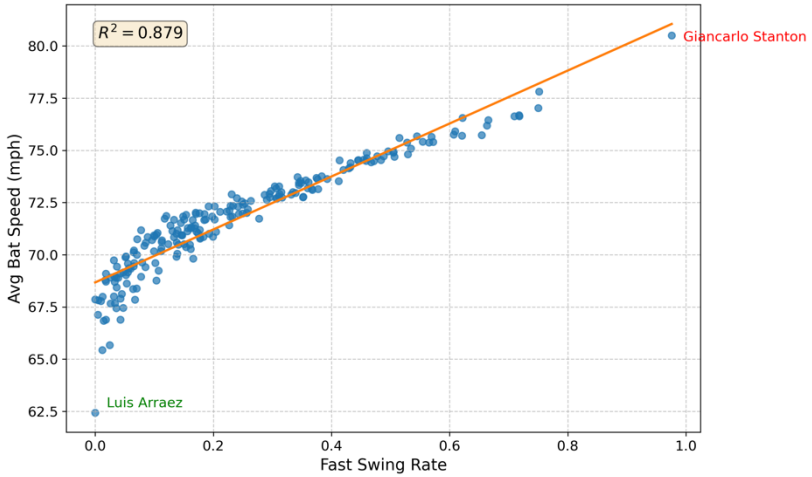


Figure 1: Correlation between Avg Bat Speed and Fast Swing Rate

Rk.	Player	Team	mph Avg. Bat Speed	>= 75mph Fast Swing Rate[?]
1	Stanton, Giancarlo	NYY	80.6	96.9%
2	Cruz, Oneil	PIT	77.7	72.9%
3	Schwarber, Kyle	PHI	76.9	72.8%

Rk.	Player	Team	mph Avg. Bat Speed	>= 75mph Fast Swing Rate[?]
1	Arraez, Luis	MIA	62.5	0.0%
2	Turner, Justin	TOR	65.2	1.0%
3	Schanuel, Nolan	LAA	65.4	2.5%

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Correlation Analysis between Avg Bat Speed and Fast Swing Rate

- Positive correlation, R-squared is 0.879.
- **Giancarlo Stanton** (a power hitter): Average bat speed of 80.6 mph, fast swing rate of 0.972.
- **Luis Arraez** (lacking in strength, but skilled): Average bat speed of 62.5 mph, fast swing rate of 0.

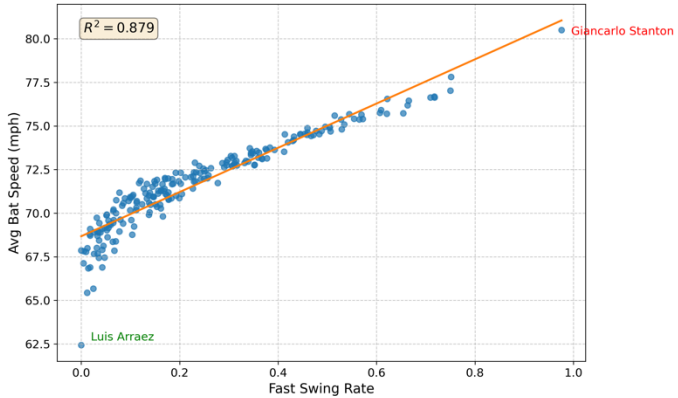


Figure 1: Correlation between Avg Bat Speed and Fast Swing Rate

	Giancarlo Stanton	Luis Arraez
Bat Speed	80.6	62.5
Fast Swing Rate	97.2	0.0
xBA	0.250	0.326
xSLG	0.512	0.409
xwOBA	0.342	0.340

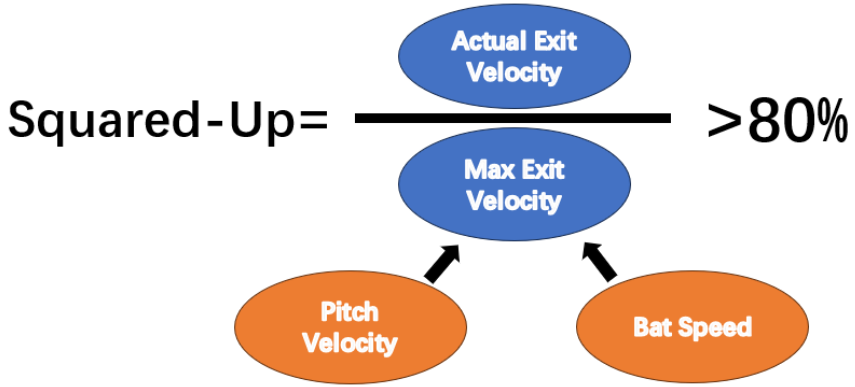
Table 1: Fast Swing vs Not a Fast Swing

02

Squared-Up Rate

Definition

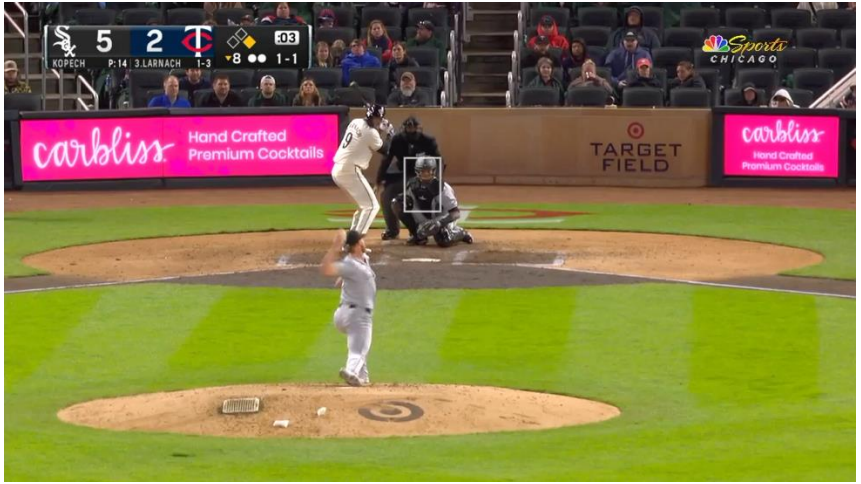
- **Squared-Up**



- **Squared-Up Rate**

$$\text{Squared-Up Rate (Swing)} = \frac{\text{Squared-Up Qty}}{\text{Total Swing Qty}}$$

Video Cases



Trevor Larnach (Squared-Up)

- Pitch speed: 98.8mph
- Swing speed: 75.6mph
- Exit velocity: 110mph
- Theoretical maximum exit velocity: 113.4mph
- **Swing speed conversion rate: 97%**

Ronald Acuna Jr. (Not Squared-Up)

- Pitch speed: 98.4mph
- Swing speed: 78.6mph
- Exit velocity: 90.3mph
- Theoretical maximum exit velocity: 117.4mph
- **Swing speed conversion rate: 77%**

Squared-Up vs. Not Squared-Up

Based on the data of each ball, the statistics of each indicator of Squared Up and Not Squared Up are calculated

- The various indicators under Squared-Up is much higher than that under Not Squared-Up

- Based on the ANOVA results, Squared Up scored significantly higher than Not Squared Up

	Squared-Up	Not Squared-Up
BA	0.3708	0.1261
SLG	0.6602	0.1430
wOBA	0.4382	0.1197
hard-hit rate	0.5976	0.0133
RV/100	11.1873	-6.6557

Table 1: Squared-up vs Not Squared-up

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Factor: Pitch Type

- Pitch type with maximum hard hit rate:
  - 4-Seam Fastball
  - Sinker
- The faster the pitch, the faster the hit.

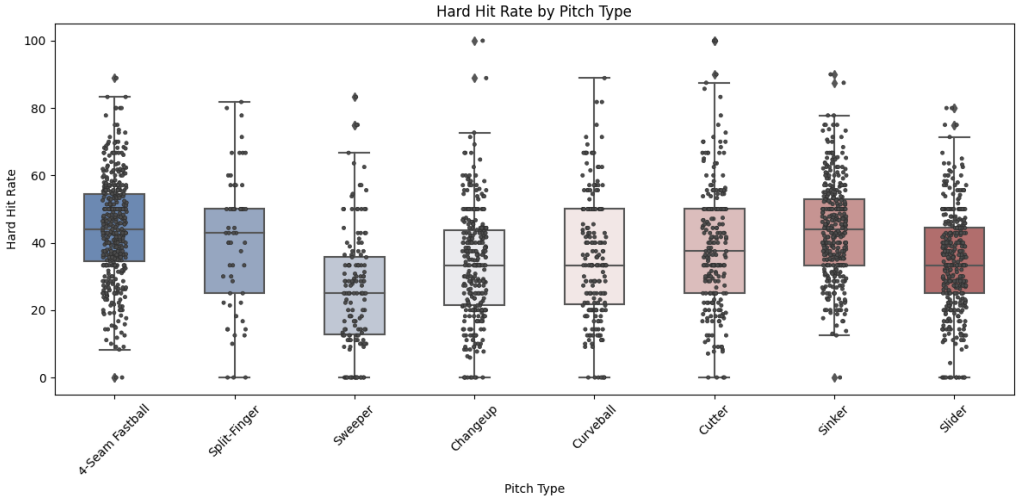

Figure 1: Hard Hit Rate by Pitch Type

Batter Case

- Giancarlo Stanton:

  High Bat Speed, Low Squared-Up Rate

- Luis Arraez:

  Low Bat Speed, High Squared-Up Rate

	Giancarlo Stanton	Luis Arraez
Bat Speed	**80.6**	**62.5**
Fast Swing Rate	97.2	0.0
xBA	0.250	0.326
xSLG	0.512	0.409
xwOBA	0.342	0.340
Squared-Up Rate	**0.213**	**0.436**

Table 1: Squared-up vs Not Squared-up

Luiz Arraez’s Beutiful Hits

Luiz Arraez (Squared-Up)

- Pitch speed: 88.2mph
- Swing speed: 57.0mph
- Exit velocity: 89.9mph
- Theoretical maximum exit velocity: 90.5mph
- Swing speed conversion rate: 99%

Luiz Arraez (Squared-Up)

- Swing speed: 55.8mph
- Swing speed conversion rate: 98%

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Fast-Swing vs. Squared-Up | xBA

- Compared with fast swing rate, Squared-Up has a greater impact on xBA

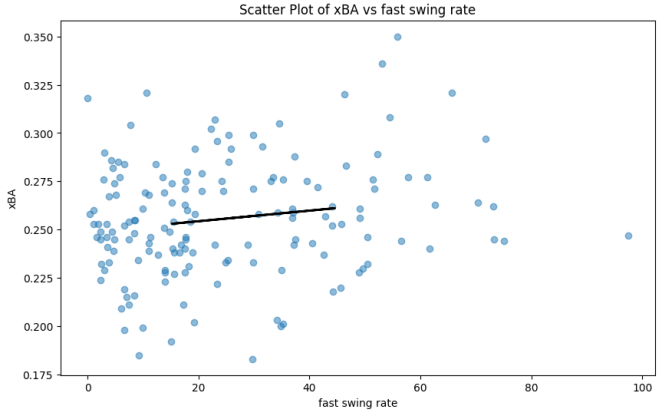

Figure 1: xBA vs Fast Swing Rate

Figure 2: xBA vs Squared-Up per Swing

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Fast-Swing vs. Squared-Up | xSLG

- Cases are opposite for SLG, Fast Swing Rate has a greater impact on xSLG

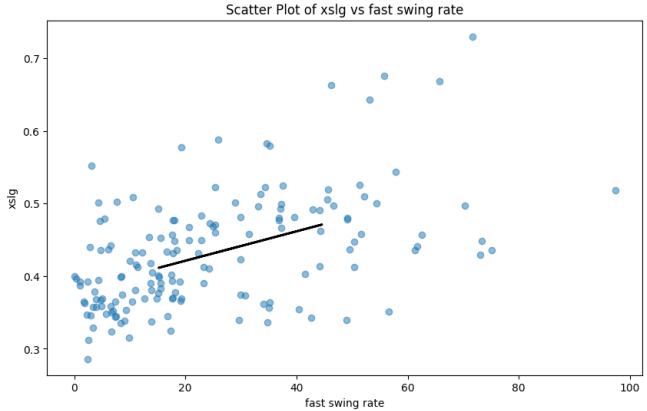

Figure 1: xSLG vs Fast Swing Rate

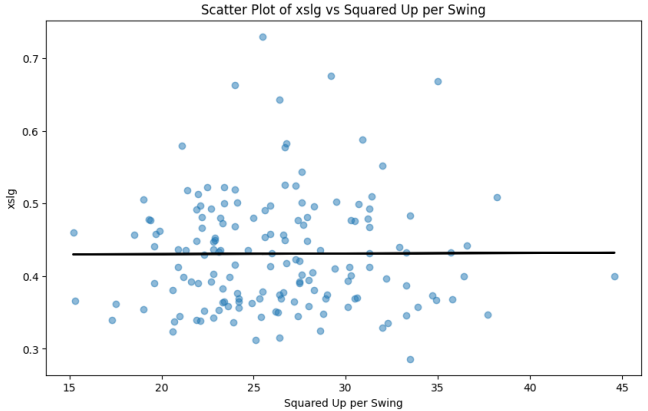

Figure 2: xSLG vs Squared-Up per Swing

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Fast-Swing vs. Squared-Up | xwOBA

- There is little difference between the impacts of Fast Swing Rate and Squared-Up Rate.

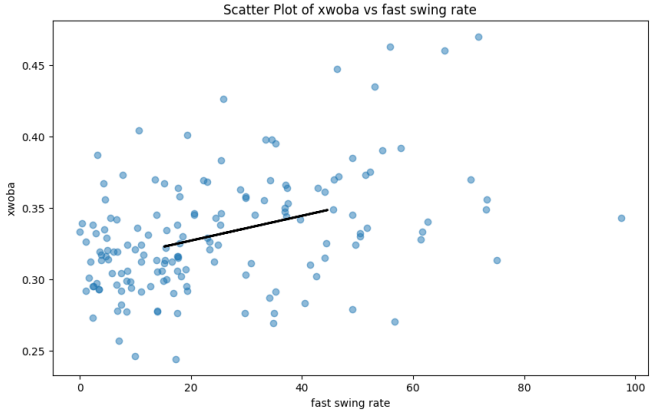

Figure 1: xwOBA vs Fast Swing Rate

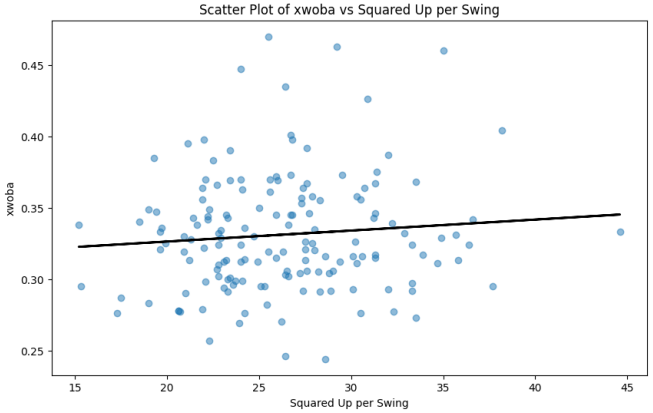

Figure 2: xwOBA vs Squared-Up per Swing

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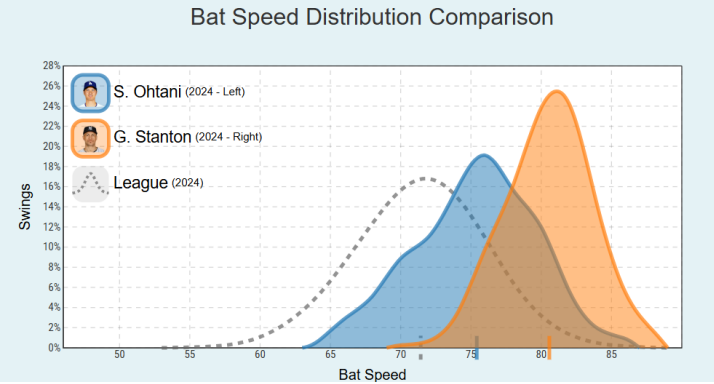
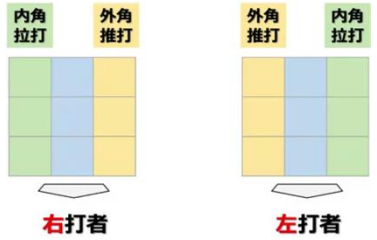
Bat Speed

The faster, the better?

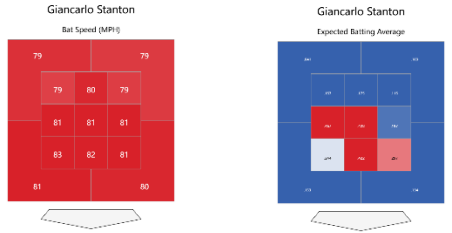


- A good batter will adjust the bat speed to the pitch
  - Stanton: Bat speed is evenly distributed, **low BA**, and outside corner lower than the inside corner.
  - Otani: Adjusted BS(outside corner lower than inside corner), **high BA**(outside corner hits are even higher)

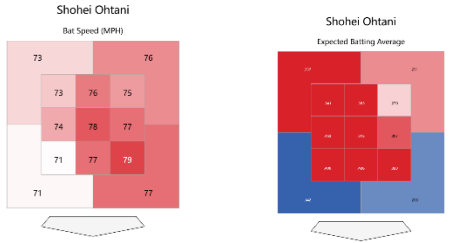
Pull or Push:



G. Stanton:



S. Ohtani:



Batter Types

- The faster you swing, the harder it is to master the contact point of the bat.

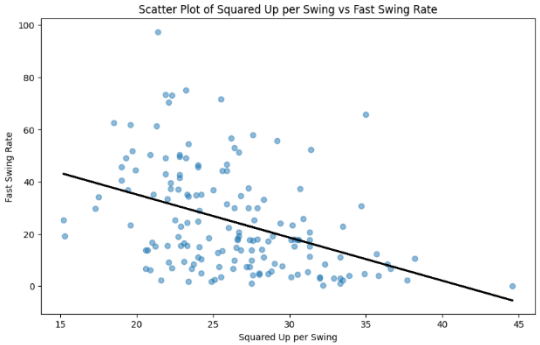


Figure 1: Squared-Up per Swing vs Swing Rate

- Both fast swing rate and squared up rate promote various indicators.

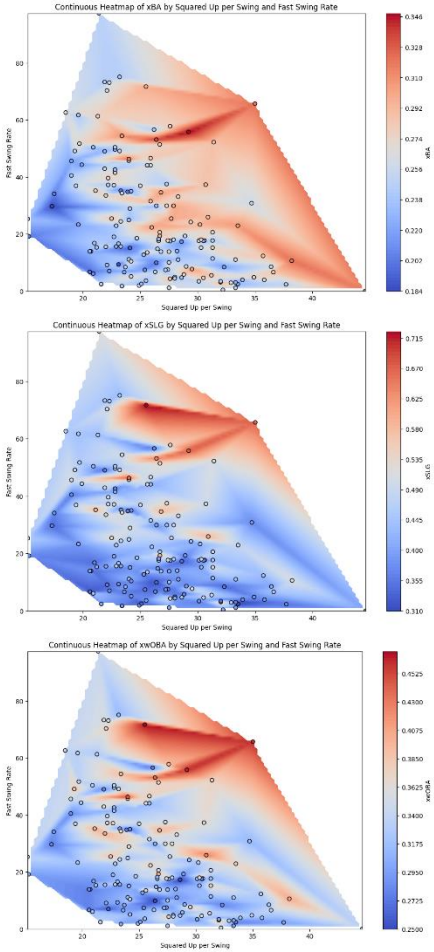


Figure 2: Heat Map of Different Indicators

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Batter Types

Four Types:

- **Slugger**:

  Low Squared-Up Rate& High Fast Swing Rate

- **Contact hitter**:

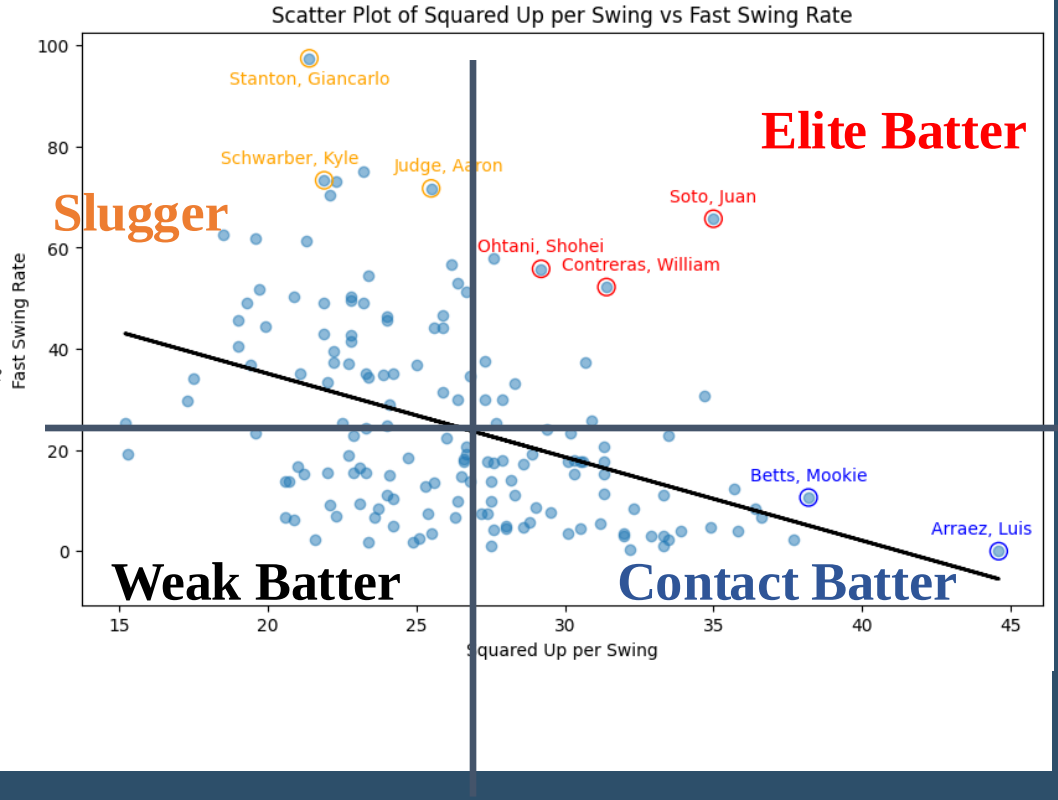
  High Squared-Up Rate& Low Fast Swing Rate

- **Elite hitter**:

  High Squared-Up Rate& High Fast Swing Rate

- **Weak hitter:**

  Low Squared-Up Rate& Low Fast Swing Rate



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03

Blast & Swing Length

Definition of Blasts

An easier understanding:

- Squared-up Rate ≥ **82%**
- Bat Speed ≥ **82 mph**

Distribution of Blasts

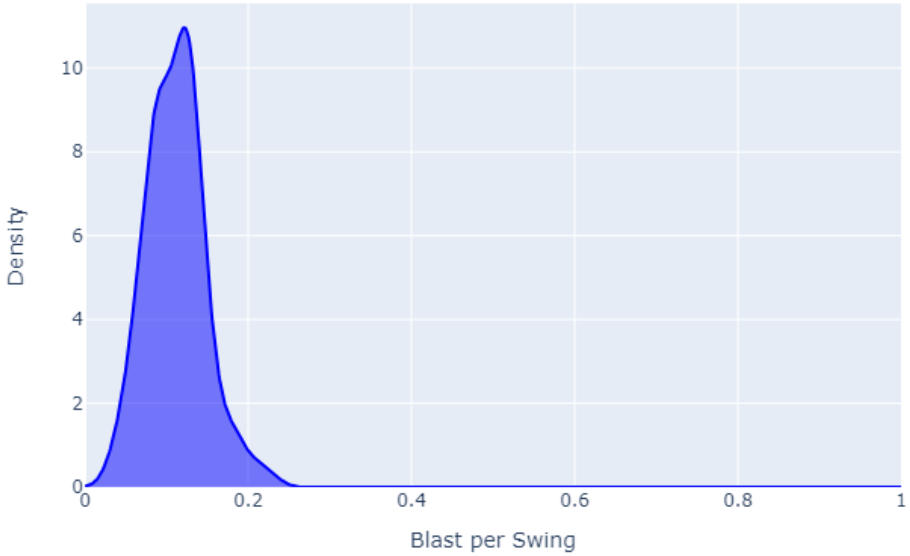

Figure 1: Density of Blasts

Rk.	Player	% Swing
1	Soto, Juan	22.6%
2	Contreras, William	22.4%
3	Ohtani, Shohei	20.9%
4	Judge, Aaron	19.9%
5	Díaz, Yandy	19.5%
6	Stanton, Giancarlo	19.4%

Figure 2: Swing of Top Players

Comparison between Blasts and Non-Blasts

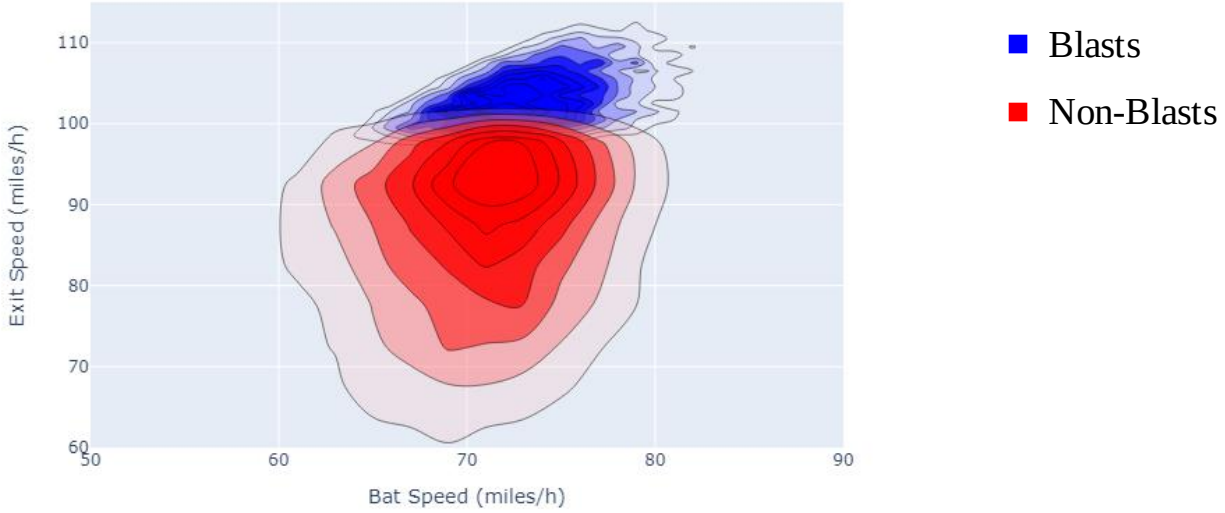

Figure 1: Exit Speed vs Bat Speed

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Comparison between Blasts and Non-Blasts

Shohei Ohtani | Blast - Homerun

- Bat Speed: 82.8mph
- Squared-Up Rate: 93.8%

Shohei Ohtani | No Blast - Fly ball

- Bat Speed: 80mph
- Squared-Up Rate: 90%

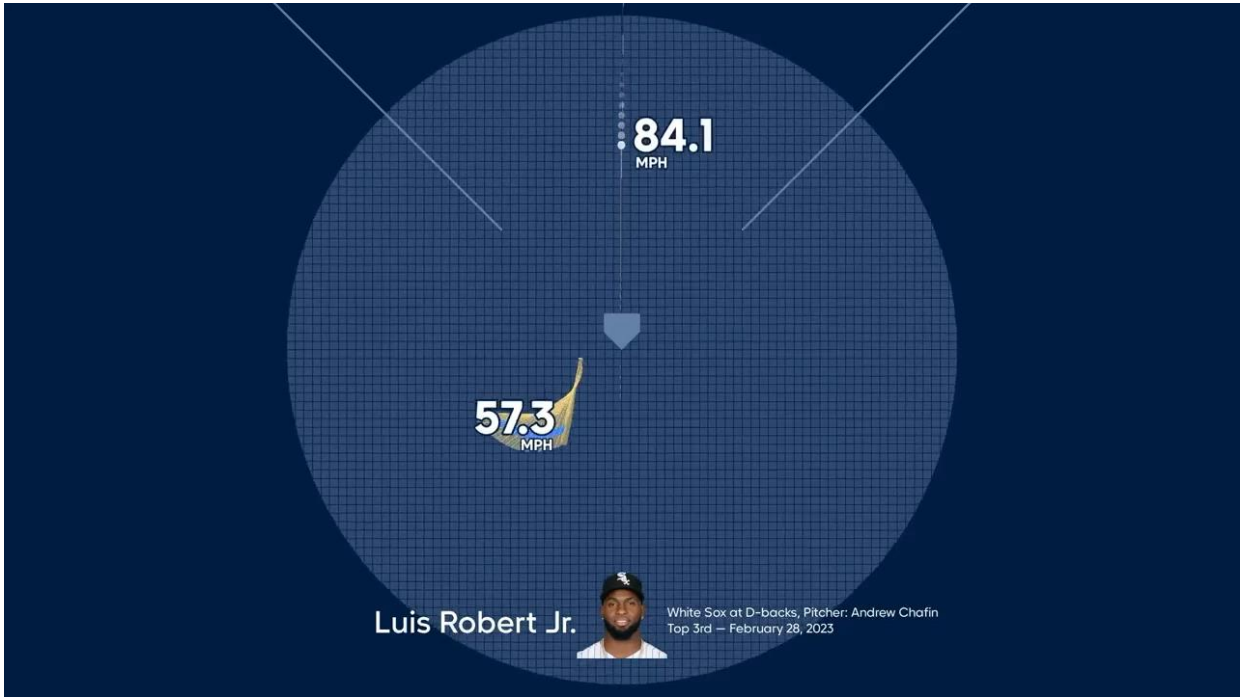
Comparison between Blasts and Non-Blasts

	Blasts	Non-Blasts
wOBA	0.705	0.177
BA	0.547	0.174
SLG	1.120	0.221
Expected Run Value	31.720	-5.820

Table 1:Blasts vs Non-Blasts

Definition of Swing Length

The length that the 「Sweet-Spot」 passed through.



Effect of Swing Length

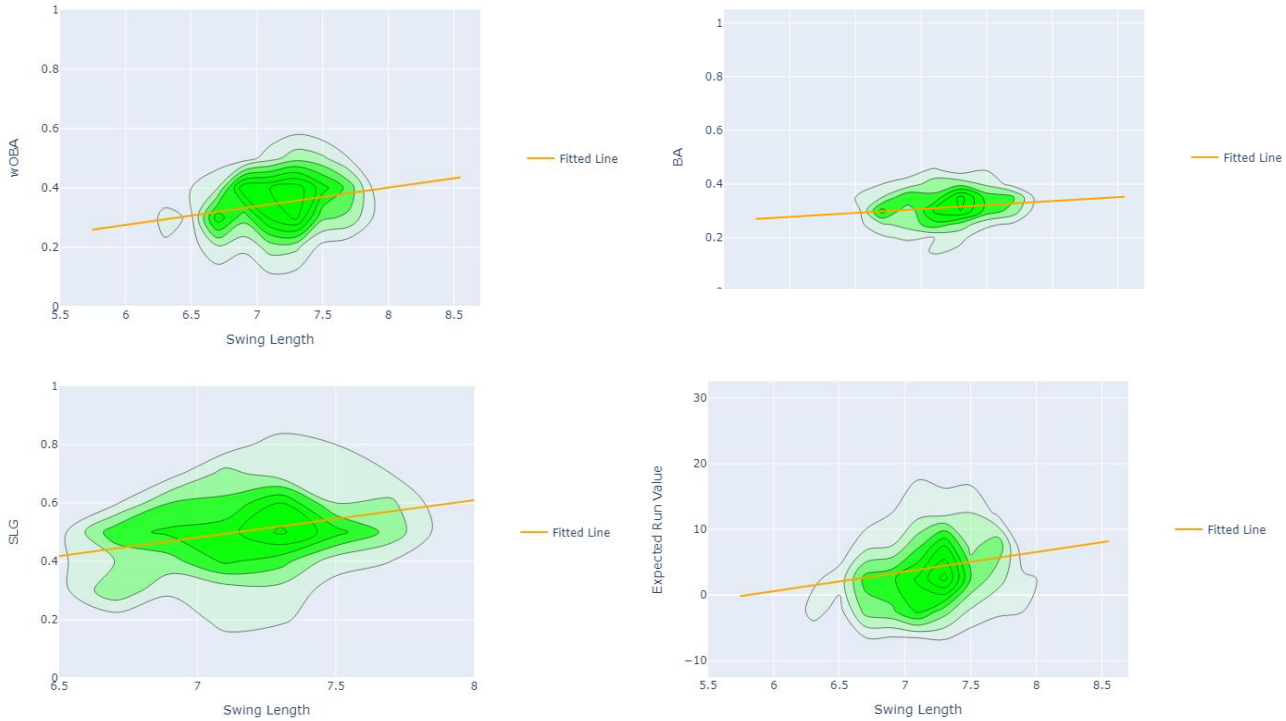


Figure 1: Different Indicators vs Swing Length

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Effect of Swing Length

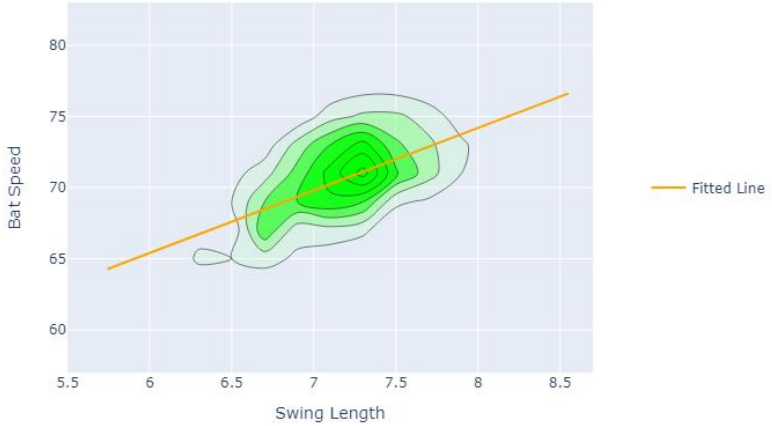


Figure 1: Bat Speed vs Swing Length

	Giancarlo Stanton	Luis Arraez
Swing Length	8.4	5.9
Bat Speed	80.6	62.5
xBA	0.250	0.326
SLG	0.512	0.409
Hard Hit%	53.4%	21.4%
K%	30.8%	5.7%

Table 1: Comparison between Giancarlo Stanton and Luis Arraez

Effect of Swing Length

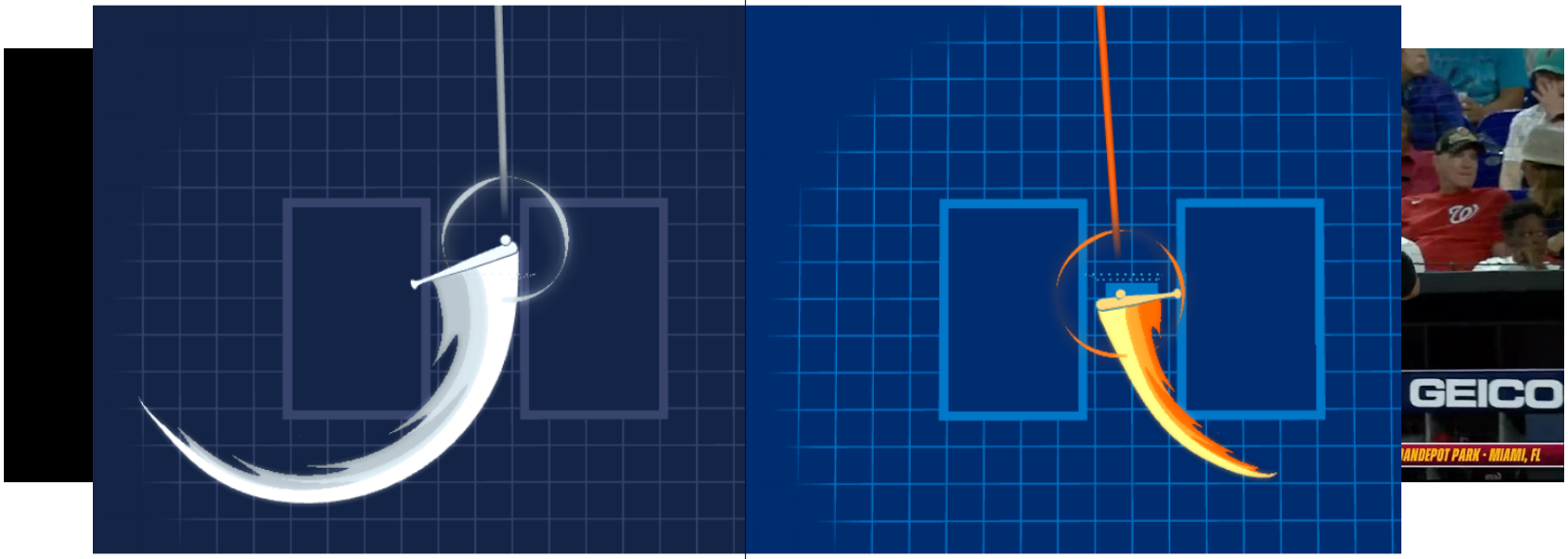
Giancarlo Stanton | Fly Ball

- Swing Length: 9.7 feet

Luis Arraez | Ground Ball

- Swing Length: 4.4 feet

Effect of Swing Length



Gi

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An Example of Short Swing Length (Choking Up)

角中勝也
Kakunaka Katsuya

An Example of Choking Up

角中勝也
Kakunaka Katsuya

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04

Swords

Sword (a swing-and-miss)

Big Swing

A "sword" refers to a batter's reaction when they swing at a pitch as if wielding a sword, but fail to make contact with the ball. This often occurs when the pitch's movement is unexpectedly dynamic, catching the batter off guard.

Sword Frequency for Different Pitch Type

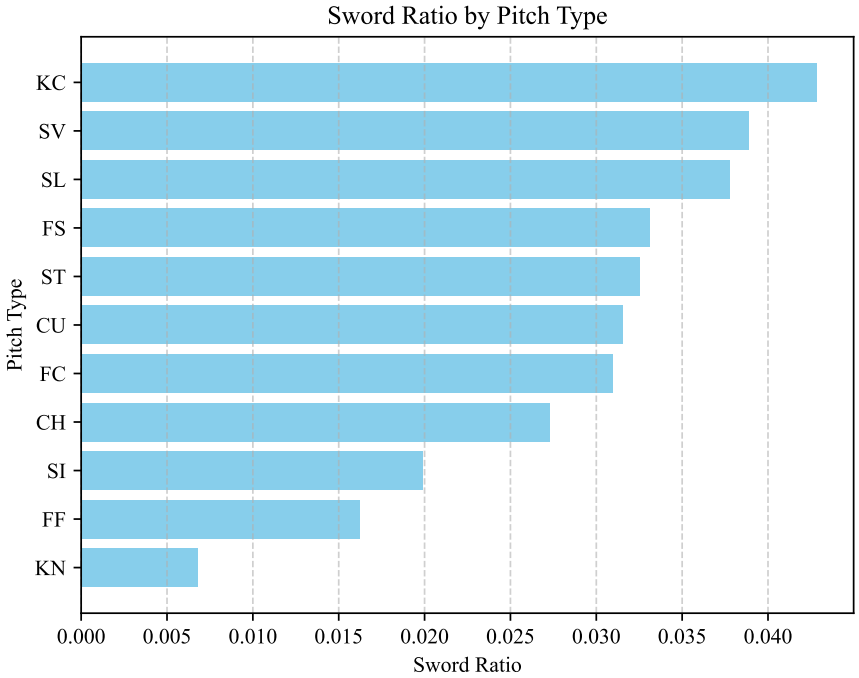


Figure 1: Sword Ratio vs Pitch Type

Knuckle **C**urve: This pitch can be very effective because the unique grip and release create a deceptive and difficult-to-hit pitch for the batter.

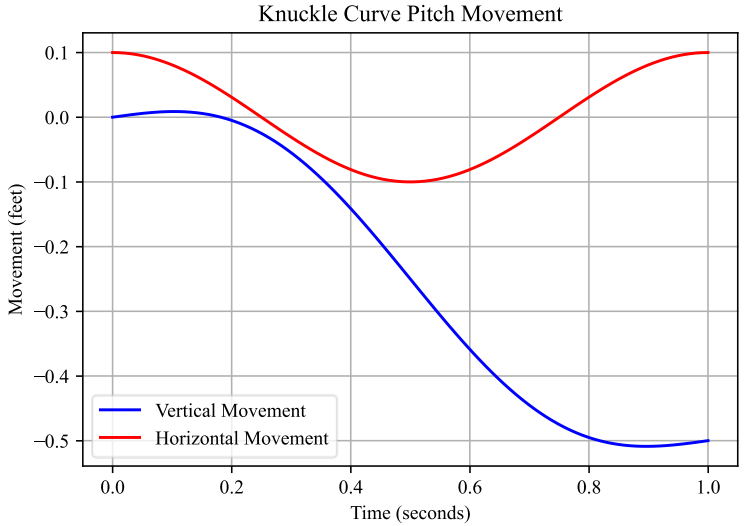


Figure 2: Knuckle Curve Pitch Movement

Sword Frequency for Different Pitch Type

Knuckle **C**urve: This pitch can be very effective because the unique grip and release create a deceptive and difficult-to-hit pitch for the batter.

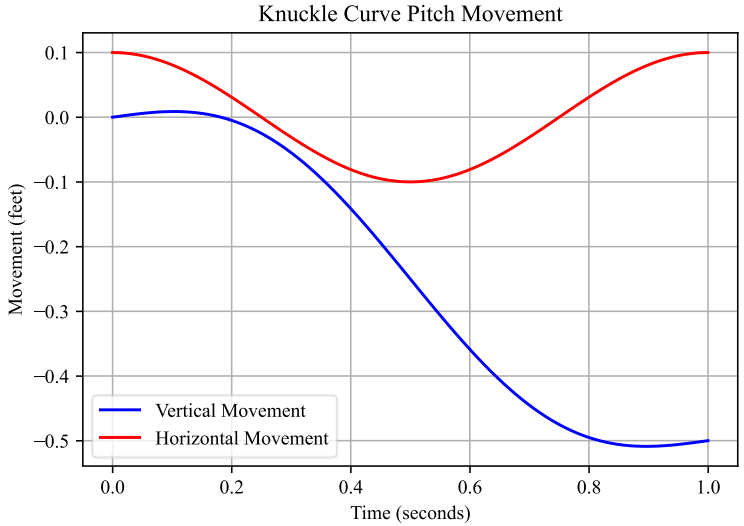


Figure 2: Knuckle Curve Pitch Movement

KDE Plots of Pitcher Attributes

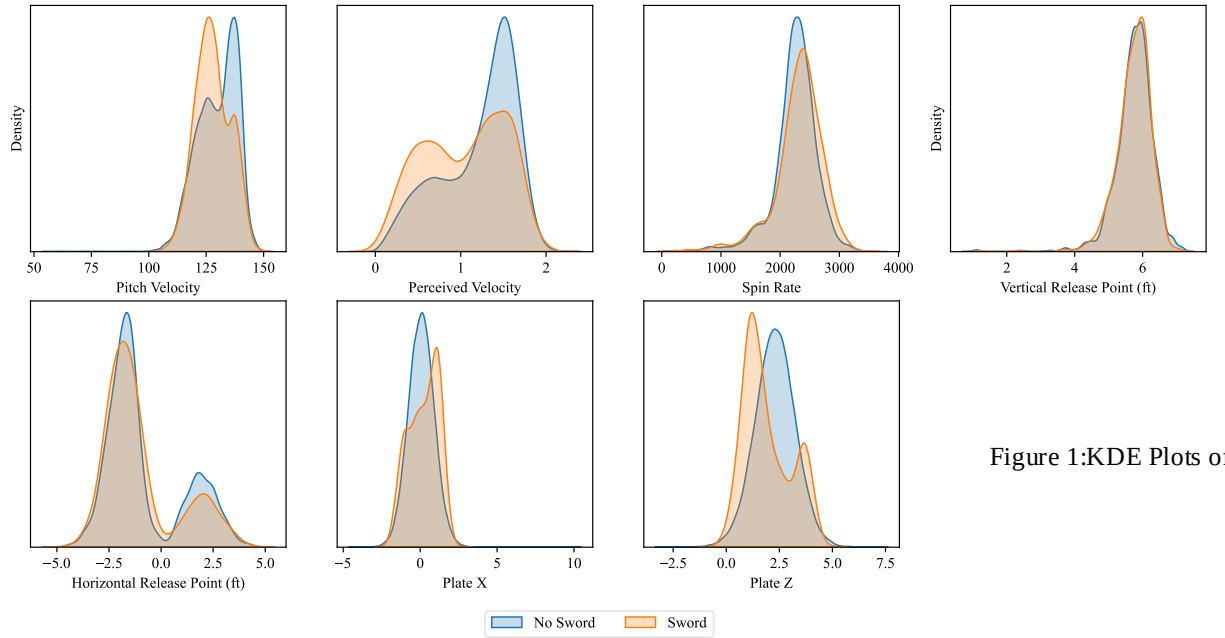


Figure 1:KDE Plots of Pitcher Attributes

- This shows that making a pitch that leads to a sword usually has a lower velocity and a lower plate point.

KDE Plots of Pitcher Attributes

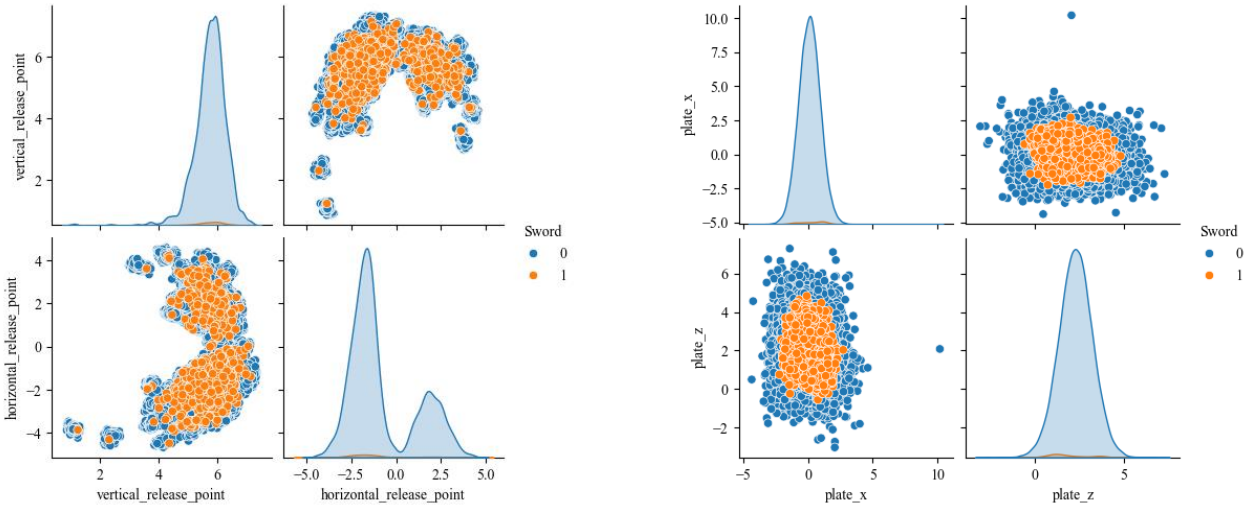


Figure 1:KDE Plots of Pitcher Attributes

➢ The release position of a pitch that results in a “sword” does not significantly differ from that of a common pitch. However, the perceived final position of such pitches tends to be more centered. Inducing a pitch leads to a “sword” requires significant skill.

Recap

Power パワー

Contact ミート

Scatter Plot of Squared Up per Swing vs Fast Swing Rate

Fast Swing Rate

Squared Up per Swing

Stanton, Giancarlo

Schwarber, Kyle

Judge, Aaron

Soto, Juan

Ohtani, Shohei

Contreras, William

Betts, Mookie

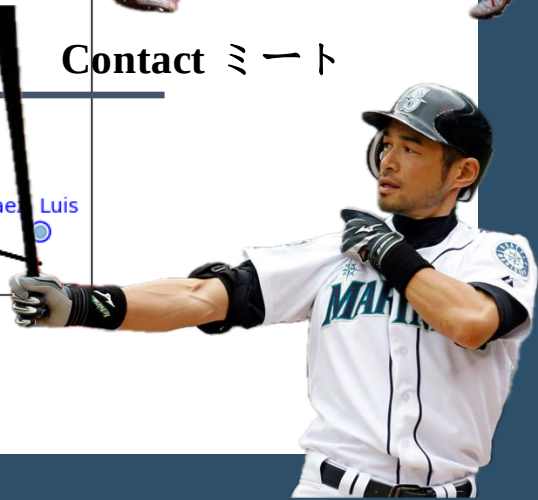
Arraez, Luis

Slugger

Elite Batter

Weak Batter

Contact Batter



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Thanks for Listening

Q & A

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