

How MLB Players Use Real-Time Data to Enhance Their Game

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Friday, April 19th, 2024

9:00 – 9:50 AM

CA 233

Inspiration for this Presentation



- 2022 AMATYC Conference In Toronto
- Passions: Family, Baseball, Math, & Music
- Baseball is the best sport EVER!!!
- Baseball's unique
 - An individual sport within a team sport
 - Defense controls the ball



“HOW CAN YOU NOT BE ROMANTIC ABOUT BASEBALL?”

-MONEYBALL

Inspiration for this Presentation

- Baseball will surely break your heart

**“YOU EVER GOT YOUR HEART
BROKEN? YEAH. WHEN WE LOST
THE PENNANT IN '87.”**

-FOR LOVE OF THE GAME



Hollywood movies by sport according to Wikipedia as of 11/22/22...I know, I know. I excluded biographical and documentaries.

Sport	# of Hollywood Movies
Baseball	126
Football	125
Basketball	87
Soccer	71
Ice Hockey	62
Golf	49
Tennis	36

Why This Particular Topic?

“You say, well, how does a guy take this right down the middle after he’s seen so many pitches? Well, one explanation, he wasn’t lookin’ for it. He was sittin’ on the curve ball. This is a generation of player that guesses more on two strike counts than any other generation in the history of the game. And why is that? Cause they have data. They know what a guy’s tendencies are. They’ll get, if they get a 75% percentage on a pitch in a count, they’ll sit on it.”

– Mike Krukow



Goal for this Session

**“YOU KNOW WHAT WE GET
TO DO TODAY, BROOKS?
WE GET TO PLAY BASEBALL!”**

-THE ROOKIE



- Introduce MLB Statcast technology
- Introduce Baseball Savant
- Discuss how MLB players and managers are likely using the data
- Discuss my findings since Statcast was introduced in MLB
- Provide information that you may use to connect with your students
- Sprinkle in a little math at a basic level

Baseball Quiz

- 1) Can you determine what fielding position each glove is most likely designed for?
- 2) Which MLB team hat am I wearing right now? How about the jersey?
- 3) The Modern Era of baseball has, to date, eight distinct sub-eras. These sub-eras are defined by the perception of how games were won during that particular era. Can you name three of these sub-eras?



“I’M CRASH DAVIS; I’M YOUR NEW CATCHER, AND YOU JUST GOT LESSON NUMBER ONE; DON’T THINK. YOU CAN ONLY HURT THE BALL CLUB.”

-BULL DURHAM

Baseball Quiz

- 1) Can you determine what position each glove that I hold up is most likely designed for?
Catcher; First Base; Outfield (or Pitcher); Third Base (or SS); Infield (or P)
- 2) What MLB team belongs to the hat that I'm wearing right now? How about the jersey?
New York Giants; New York Knights (from The Natural)
- 3) The Modern Era of baseball has, to date, eight distinct sub-eras. These sub-eras are defined by the perception of how games were won during that particular era. Can you name three of these sub-eras?

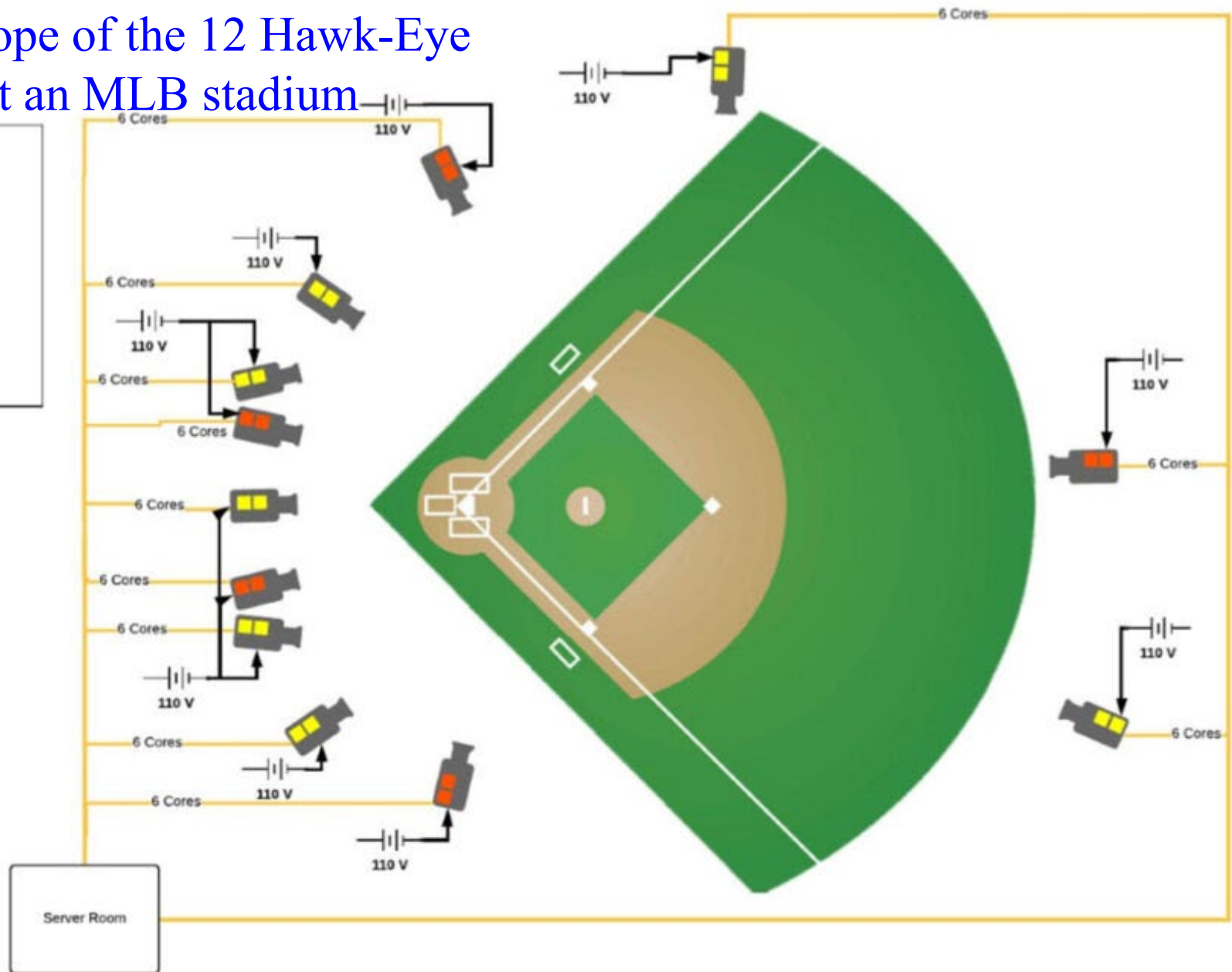
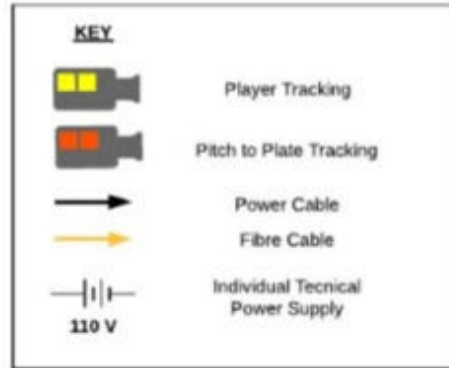
According to Baseball-Reference

- The Dead Ball Era (1901-1919)
- The Live Ball Era (1920-1941)
- The Integration Era (1942-1960)
- The Expansion Era (1961-1976)
- The Free Agency Era (1977-1993)
- The Steroid Era (1994-2005)
- The Post Steroid Era (2006-2014)
- The Statcast Era (2015-Present)



What is Statcast?

Position and scope of the 12 Hawk-Eye cameras at an MLB stadium



What is Statcast?



- Implemented in 2015
- In 2020, Hawk-Eye was introduced
- 7 TB of data generated during a single game
- Data is organized for immediate public use
- Data-based decisions can be made pitch by pitch by anyone

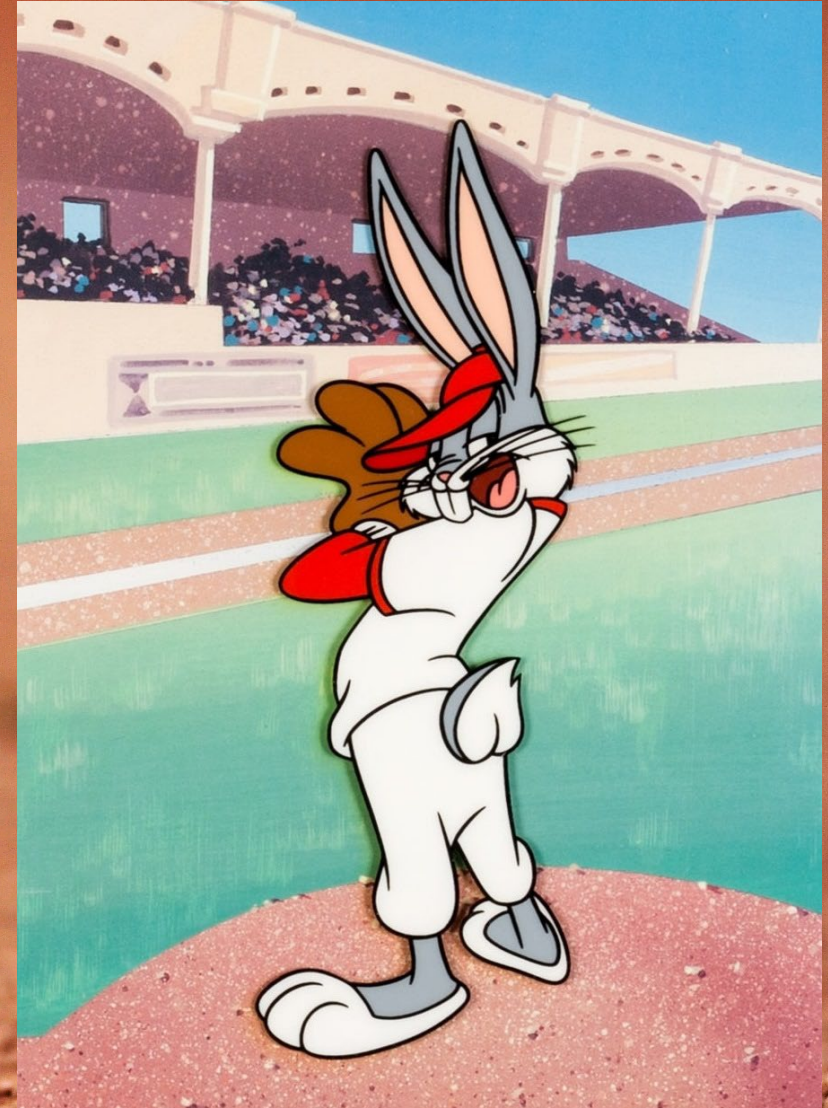


Basically, Statcast helps to turn a couple of maroons into...



“WATCH ME PASTE
THIS PATHETIC
PALOOKA WITH A
POWERFUL
PARALYZING PERFECT
PACHYDERMAS
PERCUSSION PITCH!”

-BUGS BUNNY



The Kid



AND

The Professor

“TED WILLIAMS COULD HIT BETTER WITH A BROKEN ARM THAN WE COULD WITH TWO GOOD ARMS.”

-JERRY COLEMAN

“RALPH MEDAR (MLB SCOUT) TAUGHT ME AT A YOUNG AGE IT WAS MOVEMENT, LOCATION, THE ABILITY TO CHANGE SPEEDS — *AND THEN* VELOCITY, IN THAT ORDER, WHICH I THINK STILL HOLDS TRUE TODAY.”

-GREG MADDUX

“GREG MADDUX HAD THE 100-MILE-AN-HOUR MIND.”

-SCOTT BORAS (MADDUX’S AGENT)



Where to house the data?

- Baseball Savant
- Created by Daren Willman in 2013
- Easy to use website where Statcast Data is kept
- MLB game files downloaded nightly



JANE: “DO YOU LOSE VERY MUCH?”

BILLY: “I LOSE. I’VE LOST 134 TIMES.”

JANE: “YOU COUNT THEM?”

BILLY: “WE COUNT EVERYTHING.”

-FOR LOVE OF THE GAME

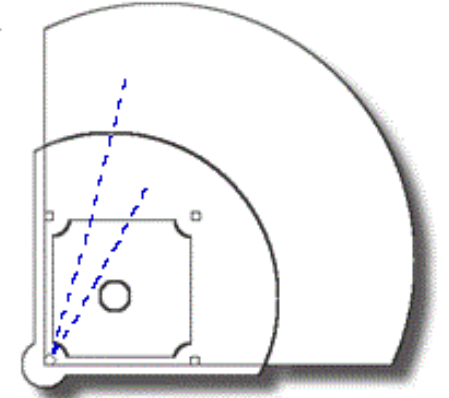
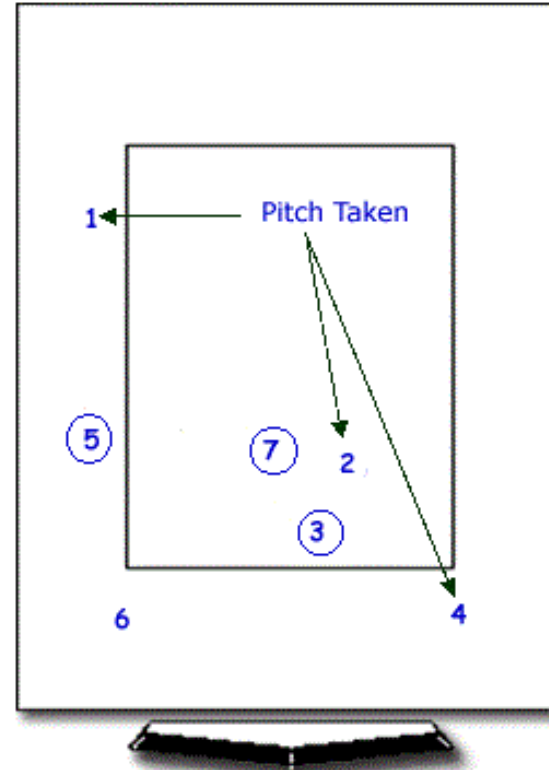
Baseball Savant revolutionizes baseball charts



Player: Seager Opponent: Rangers Date: 10-15

Pitcher: Verlander #: 5 (L/R)

○ = swing



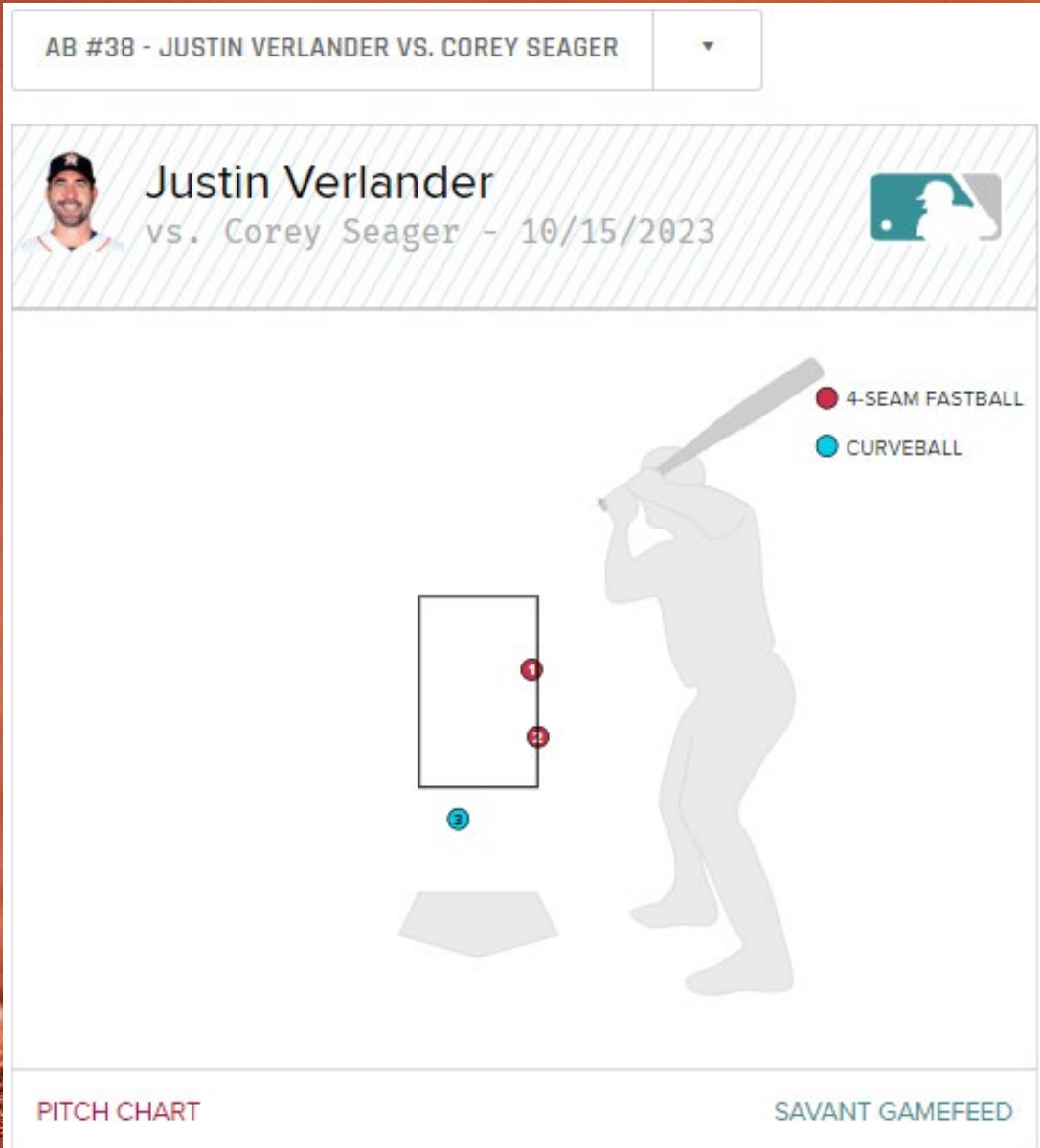
Field Legend
 Ground Ball: - - - - -
 Line Drive: ————
 Fly Ball: ⤴

Pitch Location Legend
 Strike: [hatched box]
 Ball: [white box]

Pitch	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Hard	x				x															
Off-Speed		x	x	x		x	x													
Result																				

6-3 1b

Baseball Savant revolutionizes baseball charts



#	Pitch Type	Result	Pitch Vel (MPH)	Spin	VBreak (In.)	HBreak (In.)
1	Curveball	In play, no out	77.6	2696	60 ↓	7 ←

Result	EV (MPH)	LA (Deg.)	Dist (ft.)	xBA
Single	92.4	-1	45	.300

Corey Seager singles on a ground ball to right fielder Kyle Tucker.

#	Pitch Type	Result	Pitch Vel (MPH)	Spin	VBreak (In.)	HBreak (In.)
1	4-Seam Fastball	Foul	93.7	2495	8 ↓	8 →
2	Slider	In play, out(s)	85.9	2474	33 ↓	6 ←

Result	EV (MPH)	LA (Deg.)	Dist (ft.)	xBA
Pop Out	80.8	73	124	.000

Corey Seager pops out to third baseman Alex Bregman in foul territory.

#	Pitch Type	Result	Pitch Vel (MPH)	Spin	VBreak (In.)	HBreak (In.)
1	4-Seam Fastball	Called Strike	94.8	2422	11 ↓	12 →
2	4-Seam Fastball	Foul	94.5	2467	13 ↓	13 →
3	Curveball	Swinging Strike	79.0	2703	58 ↓	5 ←

Corey Seager strikes out swinging.

Some of the little bit of math in this presentation...

- 1) How many different possible pitch counts are there on a hitter?
- 2) Name this formula: $W = \frac{x^2}{(x^2 + y^2)}$. What does each variable represent?
- 3) Assume that there is only one way to achieve a “ball” (ignore illegal pitches and pitch clock violations) AND there are three ways to achieve a “strike”. A called strike; a swing and a miss; or a foul ball (ignore the strike that is called for a clock violation). How many different ways can a batter get to:
 - a) An 0 – 0 count?
 - b) A 1 – 0 count?
 - c) An 0 – 1 count?
 - d) A 2 – 2 count?



“YOU’RE KILLING ME SMALLS!”

-THE SANDLOT

Technically, there is an infinite number of ways a batter can get to a 2 – 2 count

“PICK ME OUT A WINNER, BOBBY.”

-THE NATURAL



- There are $\frac{4!}{2!2!} = 6$ different ways to arrange 2 balls and 2 strikes (BBSS, BSBS, BSSB, SSBB, SBSB, SBBS)
- There is one way to achieve a ball and three ways to achieve a strike, so BBSS = $1 \times 1 \times 3 \times 3 = 9$ and BSBS = $1 \times 3 \times 1 \times 3 = 9$, etc. Do this six times and you get $9 \times 6 = 54$ ways.
- But wait, for the options BSSB, SSBB, and SBSB, there could've been foul balls after the second strike (S). Each foul ball (F) counts as another unique way to get to a 2 – 2 count, and since you are allowed unlimited foul balls after two strikes without penalty, you could conceivably bat until you (or the pitcher) die.

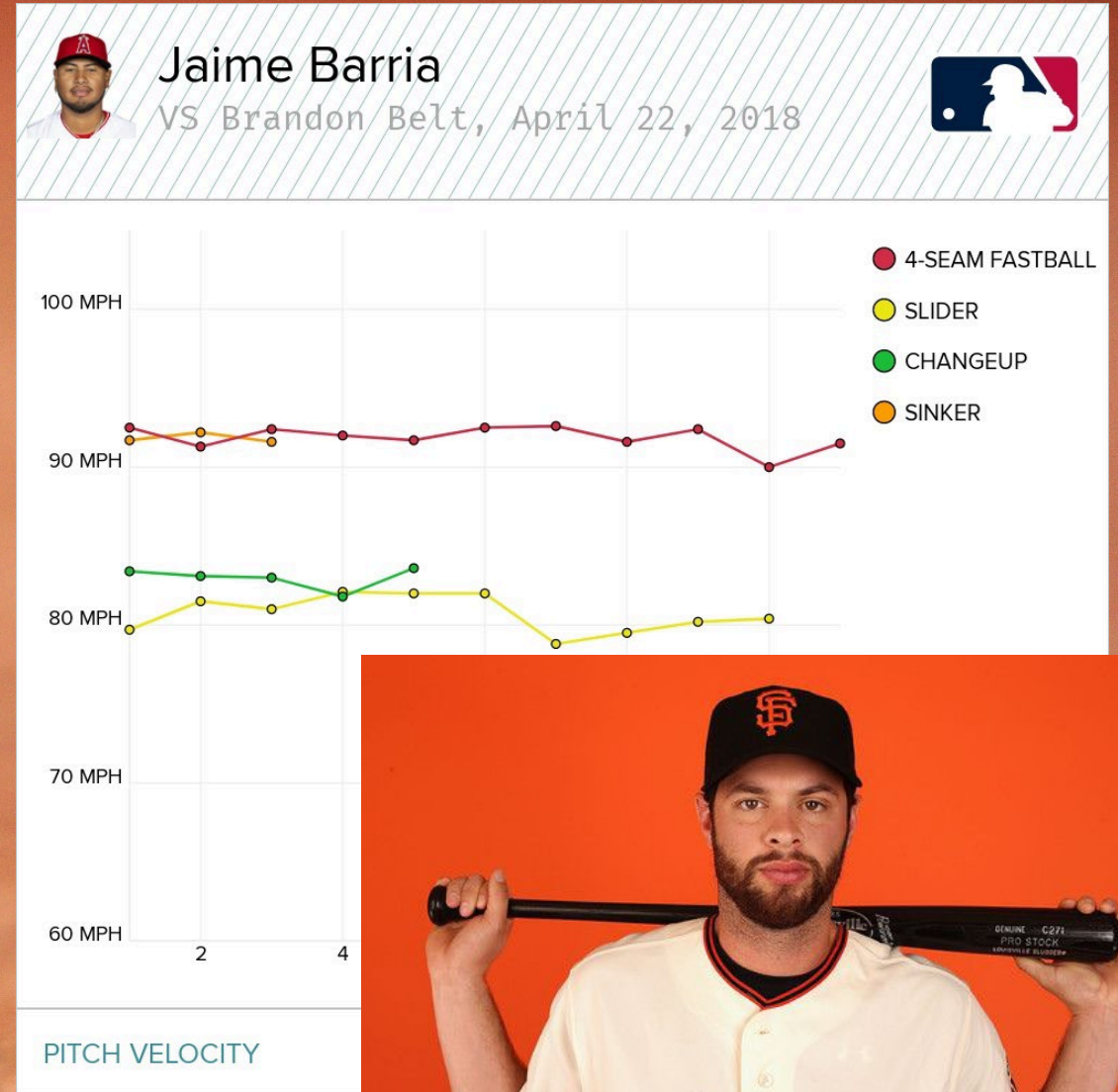
Brandon Belt's 21 Pitch Record

SBSFFB to get to 2 - 2

First Six Pitches	Result	Count
Sinker	Foul (S)	0-1
Four Seam FB	Ball (B)	1-1
Slider	Swinging Strike (S)	1-2
Four Seam FB	Foul (F)	1-2
Slider	Foul (F)	1-2
Change Up	Ball (B)	2-2
...



Three more pitches to get to a 3 - 2 count (9 total)!



https://www.mlb.com/video/must-c-record-21-pitch-at-bat-c1966388883?partnerId=web_video-playback-page_video-share

Brandon Belt's 21 Pitch Record

17

PITCH CHART

PITCH TYPES

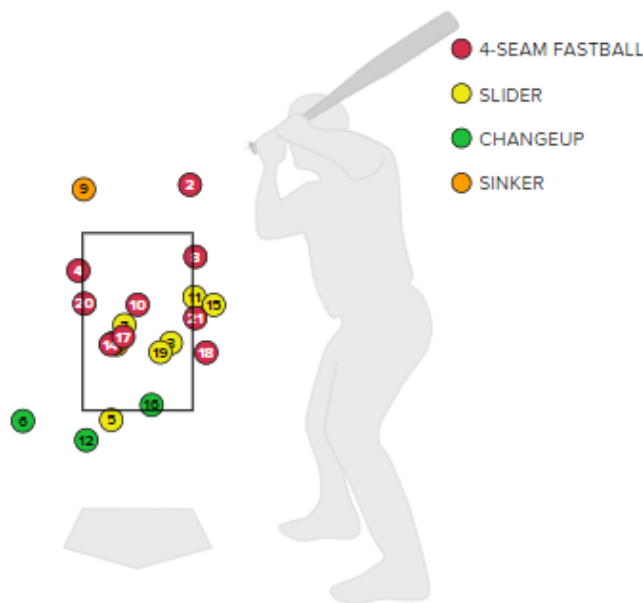
PITCHERS

Chart Options



Jaime Barria

vs. Brandon Belt - 4/22/2018



PITCH CHART

SAVANT GAMEFEED

#	Pitch Type	Result	Pitch Vel (MPH)	Spin	VBreak (In.)	HBreak (In.)
1	Sinker	Foul	91.7	2129	19 ↓	14 →
2	4-Seam Fastball	Ball	92.5	2206	15 ↓	7 →
3	Slider	Swinging Strike	79.7	2309	44 ↓	3 ←
4	4-Seam Fastball	Foul	91.3	2218	17 ↓	7 →
5	Slider	Foul	81.5	2375	40 ↓	3 ←
6	Changeup	Ball	83.4	1878	28 ↓	14 →
7	Slider	Foul	81.0	2364	41 ↓	2 ←
8	4-Seam Fastball	Foul	92.4	2273	13 ↓	3 →
9	Sinker	Ball	92.2	2064	17 ↓	11 →
10	4-Seam Fastball	Foul	92.0	2211	14 ↓	5 →
11	Slider	Foul	82.1	2354	37 ↓	4 ←
12	Changeup	Foul	83.1	1680	27 ↓	10 →
13	Changeup	Foul	83.0	1749	27 ↓	11 →
14	4-Seam Fastball	Foul	91.7	2149	12 ↓	3 →
15	Slider	Foul	82.0	2190	38 ↓	4 ←
16	Changeup	Foul	81.8	1603	31 ↓	14 →
17	4-Seam Fastball	Foul	92.5	2284	12 ↓	8 →
18	4-Seam Fastball	Foul	92.6	2223	12 ↓	2 →
19	Slider	Foul	82.0	2238	36 ↓	1 ←
20	4-Seam Fastball	Foul	91.6	2241	14 ↓	6 →
21	4-Seam Fastball	In play, out(s)	92.4	2134	14 ↓	7 →

Result	EV (MPH)	LA (Deg.)	Dist (ft.)	xBA
Lineout	83.1	25	280	.210

What information can we access in Baseball Savant?

<https://baseballsavant.mlb.com/>

- **Game Feed**

- “Watch” an entire game online with all stats being recorded in real time (Next 5 slides are examples of data obtained in Game Feed)

- **Illustrator**



- Analyze any player AND how they performed against other players

- **Visuals**

- For Defense Analysis: **Outs Above Average**
- For Pitcher Analysis: **Visual Pitcher Report and Pitch Arsenal**
- For Hitter Analysis: **Swing Take Visuals**
- For Player Comparisons: **Player Similarity**





Game Feed Stats from the box score of Texas Rangers vs Houston Astros – ALCS Game 1 October 15th, 2023

	1	2	3	4	5	6	7	8	9	R	H	xBA	HH%
	0	1	0	0	1	0	0	0	0	2	6	.230	33.3
	0	0	0	0	0	0	0	0	0	0	5	.287	16.7

Rangers	Pos	AB	R	H	2B	3B	HR	RBI	BB	SO	AVG	OPS	Hard Hit
1 Marcus Semien	2B	4	0	0	0	0	0	0	0	0	.148	.429	
2 Corey Seager	SS	4	0	1	0	0	0	0	0	2	.389	1.343	
3 Mitch Garver	DH	4	0	0	0	0	0	0	0	1	.286	.857	
4 Adolis Garcia	RF	4	0	0	0	0	0	0	0	0	.250	.750	
5 Evan Carter	LF	4	1	1	1	0	0	0	0	1	.389	1.338	🔥🔥
6 Jonah Heim	C	3	0	1	0	0	0	1	1	0	.250	.558	
7 Nathaniel Lowe	1B	4	0	0	0	0	0	0	0	2	.154	.454	🔥
8 Josh Jung	3B	3	0	1	0	0	0	0	0	2	.391	1.139	
9 Leody Taveras	CF	2	1	2	0	0	1	1	1	0	.333	.964	🔥

Astros	Pos	AB	R	H	2B	3B	HR	RBI	BB	SO	AVG	OPS	Hard Hit
1 Jose Altuve	2B	3	0	0	0	0	0	0	1	0	.200	.588	🔥
2 Alex Bregman	3B	4	0	1	0	0	0	0	0	0	.211	.654	🔥🔥
3 Yordan Alvarez	DH	4	0	0	0	0	0	0	0	3	.350	1.431	
4 Jose Abreu	1B	4	0	1	0	0	0	0	0	2	.300	1.083	🔥
5 Kyle Tucker	RF	4	0	0	0	0	0	0	0	0	.111	.405	🔥
6 Chas McCormick	LF	4	0	1	0	0	0	0	0	1	.333	.666	
7 Mauricio Dubon	CF	3	0	1	0	0	0	0	0	0	.375	.750	🔥🔥
8 Jeremy Pena	SS	3	0	1	0	0	0	0	0	0	.278	.649	🔥
9 Martin Maldonado	C	1	0	0	0	0	0	0	1	1	.154	.421	
👉 Yainer Diaz	C	1	0	0	0	0	0	0	0	0	.000	.000	

Rangers	IP	H	R	ER	BB	SO	HR	NP	ERA	Pitch Types	Hard Hit
Jordan Montgomery	6.1	5	0	0	1	6	0	90	2.08		🔥🔥🔥🔥🔥

Astros	IP	H	R	ER	BB	SO	HR	NP	ERA	Pitch Types	Hard Hit
Justin Verlander	6.2	6	2	2	2	5	1	101	1.42		🔥🔥🔥

Game Feed "Scoreboard" Stats



PITCH CHART

PITCH TYPES

PITCHERS

Chart Options



LIVE - END 3

Texas Rangers 1 @ 0 Houston Astros

Direct Link | Gameday | Game Preview | Click to Hide ↑

SCOREBOARD

ILLUSTRATOR

BOX SCORE

EXIT VELOCITY

PITCH VELOCITY

PLAYER BREAKDOWNS

PITCH 3D

LIVE AT BAT

WIN PROBABILITY

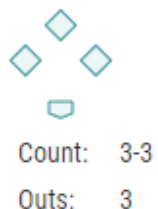
Statcast Metrics

End 3rd

R H xBA

T Rangers (0-0)

1 4 .288

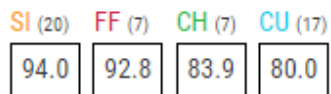


H Astros (0-0)

0 2 .222

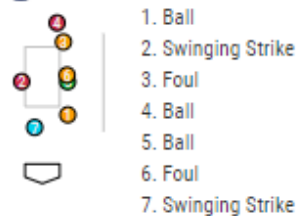
Current Pitcher

T Jordan Montgomery



Current Batter

H Yordan Alvarez



Game Win Probability

Batter

PA In. Result

H Yordan Alvarez	25	3	Strikeout
H Alex Bregman	24	3	Single
H Jose Altuve	23	3	Pop Out
H Martin Maldonado	22	3	Walk
H Jeremy Pena	21	3	Groundout
T Adolis Garcia	20	3	Pop Out
T Mitch Garver	19	3	Flyout
T Corey Seager	18	3	Pop Out
H Mauricio Dubon	17	2	Flyout
H Chas McCormick	16	2	Flyout
H Kyle Tucker	15	2	Forceout
H Jose Abreu	14	2	Single

Exit Velo

LA

Hit Dist.

Velocity





































xBA

HR / Park

				81.4				
	92.5	17	230	94.0	.640			
	82.4	56	205	94.9	.020			
				94.2				
	85.7	-22	7	93.9	.120			
	89.3	78	42	94.5	.010			
	93.7	38	327	85.7	.060	0/30		
	80.8	73	124	85.9	.000			
	93.5	29	323	92.3	.170	0/30		
	90.3	27	328	94.7	.120	0/30		
	99.0	-8	16	93.9	.260			
	80.9	21	245	83.7	.810			

Taveras' HR off of Verlander on "Scoreboard"

<https://www.mlb.com/video/leody-taveras-homers-1-on-a-fly-ball-to-right-center-field-7thehk>

		Evan Carter	44	6	Lineout	84.4	26	309	94.5	.130	0/30
		Adolis Garcia	43	6	Pop Out	89.1	76	78	95.4	.010	
		Mitch Garver	42	6	Strikeout				95.1		
		Yordan Alvarez	41	5	Strikeout				79.8		
		Alex Bregman	40	5	Groundout	91.9	-3	30	79.3	.260	
		Jose Altuve	39	5	Lineout	85.1	28	274	79.5	.080	
		Corey Seager	38	5	Strikeout				79.0		
		Marcus Semien	37	5	Lineout	85.3	21	288	86.3	.500	
		Leody Taveras	36	5	Home Run	105.4	26	398	86.9	.940	30/30
		Josh Jung	35	5	Strikeout				94.0		
		Martin Maldonado	34	4	Strikeout				93.9		
		Jeremy Pena	33	4	Single	99.9	13	213	78.9	.900	
		Mauricio Dubon	32	4	Single	101.8	14	207	91.1	.820	
		Chas McCormick	31	4	Single	83.6	23	259	83.4	.320	
		Kyle Tucker	30	4	Flyout	94.1	48	274	92.9	.000	
		Jose Abreu	29	4	Strikeout				94.4		
		Nathaniel Lowe	28	4	Flyout	88.2	32	310	86.3	.030	0/30
		Jonah Heim	27	4	Pop Out	72.1	65	141	93.7	.000	

Verlander's Pitching Stats on "Player Breakdown"



Data taken from the game through the 4th inning

Max EV	Max Velo
103.8	95.6

Pitch Type	Pitches		Pitch Velocity					Spin					Vertical Break					Horizontal Break				
	Count	%	Max	Min	Avg	Yr-Avg	+/-	Max	Min	Avg	Yr-Avg	+/-	Max	Min	Avg	Yr-Avg	+/-	Max	Min	Avg	Yr-Avg	+/-
Slider	19	50	89.5	84.8	87.4	86.9	0.5 ↑	2591	2399	2505	2511	-6 ↓	36	25	30	32	-2	9	2	5	4	1
4-Seam Fastball	12	32	95.6	93.4	94.3	94.3	0.0	2527	2366	2447	2428	19 ↑	13	8	10	12	-2	12	2	8	8	0
Curveball	7	18	80.3	76.0	78.4	78.2	0.2 ↑	2918	2598	2681	2716	-35 ↓	62	55	58	58	0	7	2	5	7	-2
ALL	38		95.6	76.0	87.9			2918	2366	2519			62	8	29			12	2	6		

Pitch Type	Pitches		Exit Velocity			Swings			Plate Discipline									
	Count	%	Avg	Min	Max	Swings	Whiffs	%	CS	CS+Whiffs	CSW%	Fouls	BIP	Zone%	zSwing%	oSwing%	zContact%	oContact%
Slider	19	50	74.0	51.5	93.7	9	0	0	1	1	5	3	6	42	88	18	100	100
4-Seam Fastball	12	32	91.5	78.5	103.3	10	0	0	0	0	0	6	4	58	100	60	100	100
Curveball	7	18	98.1	92.4	103.8	2	0	0	1	1	14	0	2	43	67	0	100	--
ALL	38		83.8			21	0	0	2	2	5	9	12	47	89	25	100	100

Pitch Velocity Tab: Justin Verlander & Jordan Montgomery

- SCOREBOARD
- ILLUSTRATOR
- BOX SCORE
- EXIT VELOCITY
- PITCH VELOCITY**
- PLAYER BREAKDOWNS
- PITCH 3D
- LIVE AT BAT
- WIN PROBABILITY

FILTER TABLE BY BATTER/PITCHER

Rk.	Pitcher	Batter	Game Pitch #	Pitch	PA	Inning	Result	Pitch Type	Statcast Metrics				
									Pitch Vel (MPH)	Spin (RPM)	VBreak (In.)	HBreak (In.)	
1	Justin Verlander	Nathaniel Lowe	106	45	28	4	Ball	Curveball	78.3				
2	Justin Verlander	Jonah Heim	105	44	27	4	In play, out(s)	4-Seam Fastball	93.7	2439	12	↓	4 →
3	Justin Verlander	Jonah Heim	104	43	27	4	Ball	4-Seam Fastball	93.1	2381	11	↓	1 →
4	Justin Verlander	Jonah Heim	103	42	27	4	Ball	4-Seam Fastball	93.2	2417	11	↓	4 →
5	Justin Verlander	Jonah Heim	102	41	27	4	Foul	4-Seam Fastball	92.8	2413	13	↓	6 →
6	Justin Verlander	Evan Carter	101	40	26	4	In play, out(s)	Curveball	76.8	2665	65	↓	8 ←
7	Justin Verlander	Evan Carter	100	39	26	4	Called Strike	Curveball	76.0	2639	64	↓	6 ←
8	Jordan Montgomery	Yordan Alvarez	99	51	25	3	Swinging Strike	Curveball	81.4	2357	48	↓	4 →
9	Jordan Montgomery	Yordan Alvarez	98	50	25	3	Foul	Sinker	94.1	2219	20	↓	15 ←
10	Jordan Montgomery	Yordan Alvarez	96	49	25	3	Ball	Changeup	84.3	1619	24	↓	8 ←
11	Jordan Montgomery	Yordan Alvarez	95	48	25	3	Ball	4-Seam Fastball	93.1	2292	14	↓	4 ←
12	Jordan Montgomery	Yordan Alvarez	94	47	25	3	Foul	Sinker	94.2	2137	18	↓	15 ←
13	Jordan Montgomery	Yordan Alvarez	93	46	25	3	Swinging Strike	4-Seam Fastball	93.0	2308	17	↓	5 ←

Questions that transpired...

**“ANYBODY WHO USES
COMPUTERS DOESN’T
KNOW A DAMN THING
ABOUT THIS GAME.”**

-TROUBLE WITH THE CURVE



- What are MLB managers doing with this extraordinary set of baseball data and visuals?
- Is this helping the players? That is, is there a significant difference in player performance during Post Steroid Era and Statcast Era?
- Who’s benefiting more from the data? The pitcher or the hitter?

The Analytics Managers Likely Want To Know

SKIP: "YOU GUYS, YOU LOLLYGAG THE BALL AROUND THE INFIELD. YOU LOLLYGAG YOUR WAY DOWN TO FIRST. YOU LOLLYGAG IN AND OUT OF THE DUGOUT. YOU KNOW WHAT THAT MAKES YOU? LARRY?"
LARRY: "LOLLYGAGGERS!"
SKIP: "LOLLYGAGGERS."

-BULL DURHAM



- Pitcher/hitter matchups
- Opposing pitchers' pitch profile (velocity/movement/spin rate/release point)
- Spray charts and best non-starting fielders
- Pitcher fatigue (losing their "stuff")
- Number of times the pitcher has pitched through the lineup
- Number of pitches thrown
- How hard a pitcher is being hit (HH%)

'Practice dirty, play clean': How the aging (2021, 107-55) Giants revamped their offense

<https://www.thescore.com/mlb/news/2200462>

Managers Making Data Influenced Decisions

'I was booing myself': Diamondbacks win crucial NLCS game after controversial pitching change



<https://www.usatoday.com/story/sports/mlb/columnist/bob-nightengale/2023/10/19/arizona-diamondbacks-torey-lovullo-brandon-pfaadt-nlcs-phillies/71247933007/>

Kevin Cash's decision to pull Blake Snell, explained: How analytics overruled World Series context clues and cost the Rays



<https://www.sportingnews.com/us/mlb/news/blake-snell-kevin-cash-analytics-explained-world-series/15ja52nunza2b1b37untxyltk3>

Joe Maddon on Analytics in Baseball



“I want all this information. I do. I just don’t like the way it’s implemented. It gets to the point where the pregame is a meeting every day. And it’s an elongated meeting. And players don’t need all this information, quite frankly. They need nuggets. They don’t need dissertations.”

“You don’t need all this. People want to tell you how to build a watch. I just need to know what time it is.”

“I want analytical people on my staff. But I don’t want them in the dugout. I don’t want them in the clubhouse. I want them to do their job, give the work to the coaches, let the coaches then teach the players. I don’t need presenters in the dugout, I don’t need presenters in the clubhouse. ... It’s getting to the point where their impact or authority is exceeding that of a coach. And that’s what I think is wrong.”

<https://theathletic.com/3568605/2022/09/06/joe-maddon-analytics-baseball/>



The Analytics Hitters Want To Know

“AND WHEN THE BAT MEETS THAT BALL AND YOU CAN FEEL THE BALL JUST GIVE, YOU KNOW IT’S GOING TO GO A LONG WAY. DAMN, IF YOU DON’T FEEL LIKE YOU’RE GOING TO LIVE FOREVER. I COULDN’T GIVE THAT UP. NOT FOR NOTHING.”

-EIGHT MEN OUT



- Pitch velocity, movement, and rhythm
- Delivery (arm angle & release point)
- Pitch arsenal (1st & 2nd best pitch)
- Frequency of pitches including frequency in different counts
- First pitch tendencies
- Does the pitcher tip his pitches
- How did the pitcher pitch to similar hitters
- Tendencies under duress
- How fast the pitcher tires
- Their own analytics: launch angle, exit velocity and hot/cold zones

The Analytics Pitchers (and Catchers) Want To Know

- Hitter tendencies
- Seam & Zone Reader or Guess Hitter
- Hitters' Hot/Cold Zones

“YOU’RE PERFECT. YOU, AND THE BALL, AND THE DIAMOND, YOU’RE THIS PERFECTLY BEAUTIFUL THING. YOU CAN WIN OR LOSE THE GAME, ALL BY YOURSELF.”

-FOR LOVE OF THE GAME



- Best “out pitch” against each hitter
- Results of previous matchups against hitter
- Hitters results against similar pitchers

My Findings: Study of World Series Starters

<https://www.baseball-reference.com/>

“IT’S SUPPOSED TO BE
HARD. IF IT WASN’T HARD,
EVERYONE WOULD DO IT.
THE HARD IS WHAT
MAKES IT GREAT.”

-A LEAGUE OF THEIR OWN



- To be considered a subject in my study:
1. Player needed to be a World Series starting pitcher from 2010 to 2021 (excluding 2020) that pitched at least 10 MLB seasons
 2. Player must've pitched in both Post Steroid Era and the Statcast Era
 3. The pitcher must've had at least 20 starts in each of their seasons best categories

World Series Starting Pitchers from 2010 – 2021 (Excluding 2020)

**“JUUUUST A BIT
OUTSIDE.”**

-MAJOR LEAGUE

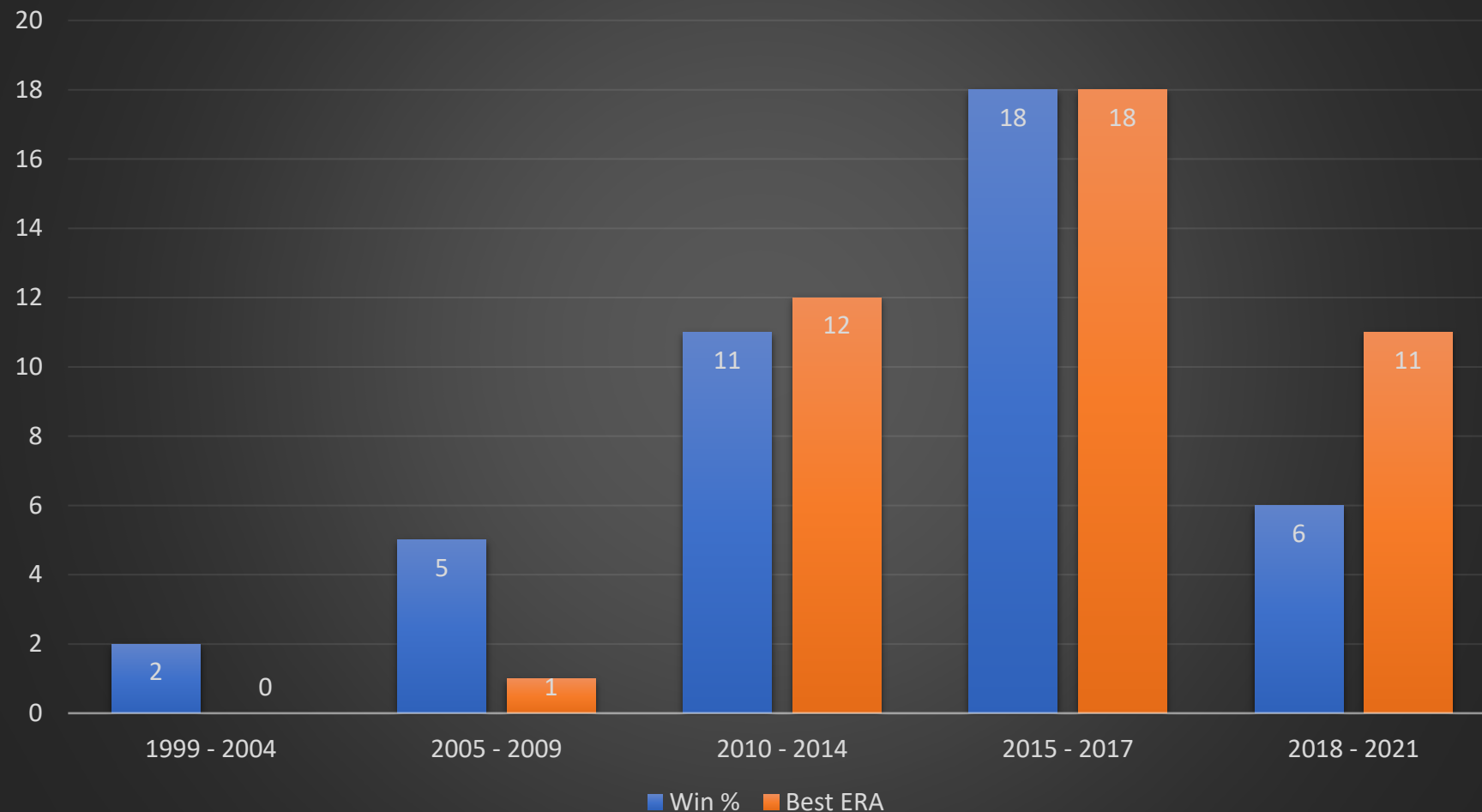


Of the 42 pitchers that met the initial conditions, I was:

1. Looking for the season in which each pitcher had their best ERA and best Winning %
2. Determining if the pitcher was in the early, middle, or end of their career by the 2015 – 2017 seasons

WS pitchers' best ERA and Winning Percentage by Years

2010 - 2021 (Excluding 2020) World Series Starters
Best Win % & Best ERA by Grouped Years



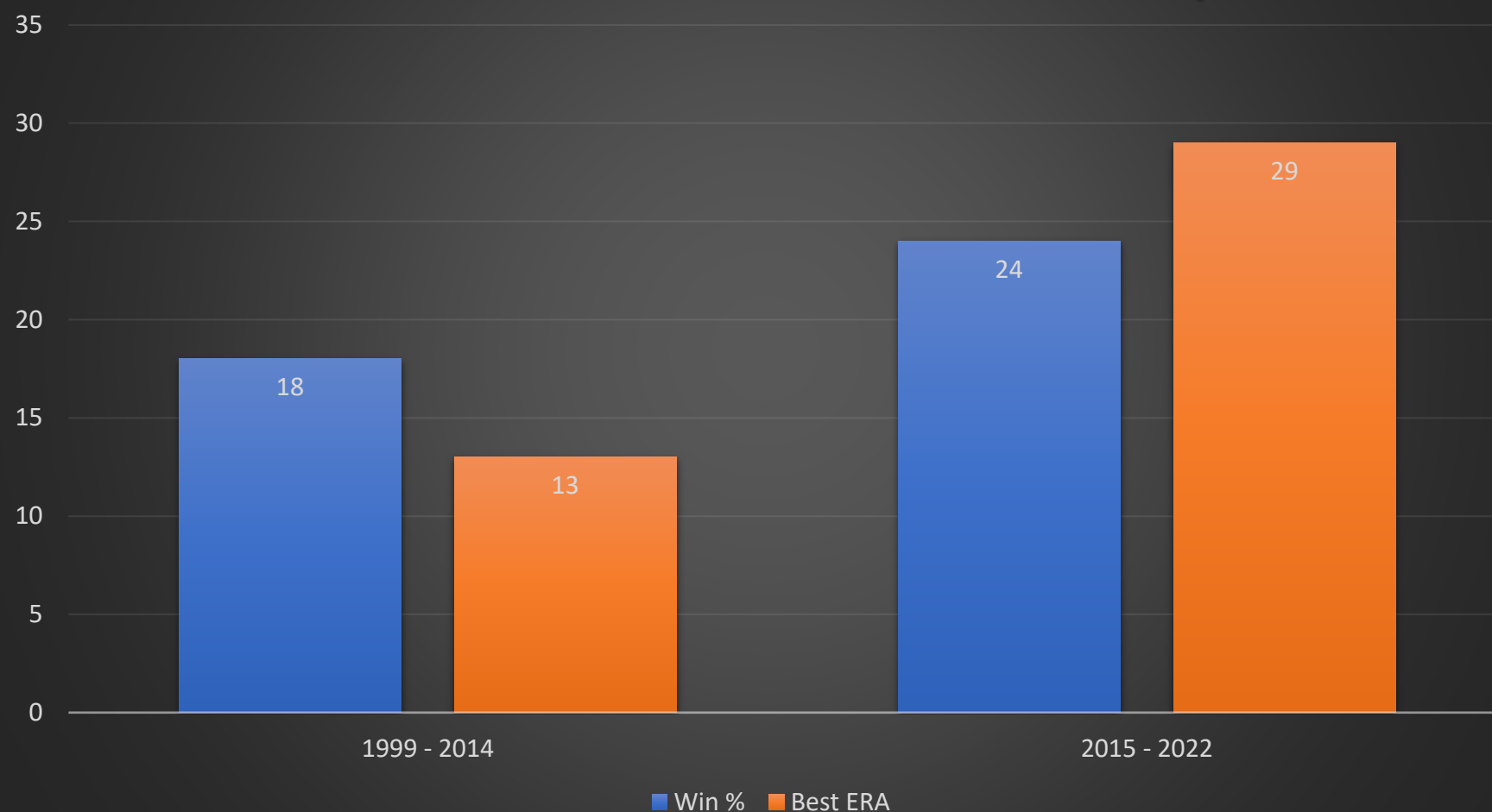
There are 23 total pitchers comprising the 2015-2017 group; 13 of them had both their best ERA and Winning % logged in that span of years (not necessarily the same year)

- Madison Bumgarner (Giants)
 - Rick Porcello (Tigers)
 - Jon Lester (Red Sox)
 - Jake Arrieta (Cubs)
 - Kyle Hendricks (Cubs)
- Corey Kluber (Guardians)
- Carlos Carrasco (Guardians)
 - Dallas Keuchel (Astros)
 - Brad Peacock (Astros)
 - Alex Wood (Dodgers)
 - Rich Hill (Dodgers)
- Stephen Strasburg (Nationals)
- Zack Greinke (Astros)

WS Pitchers Broken down to Pre-Statcast Era vs Statcast Era

Statcast Era saw 33.3% increase in Win% and 123.1% increase in ERA!

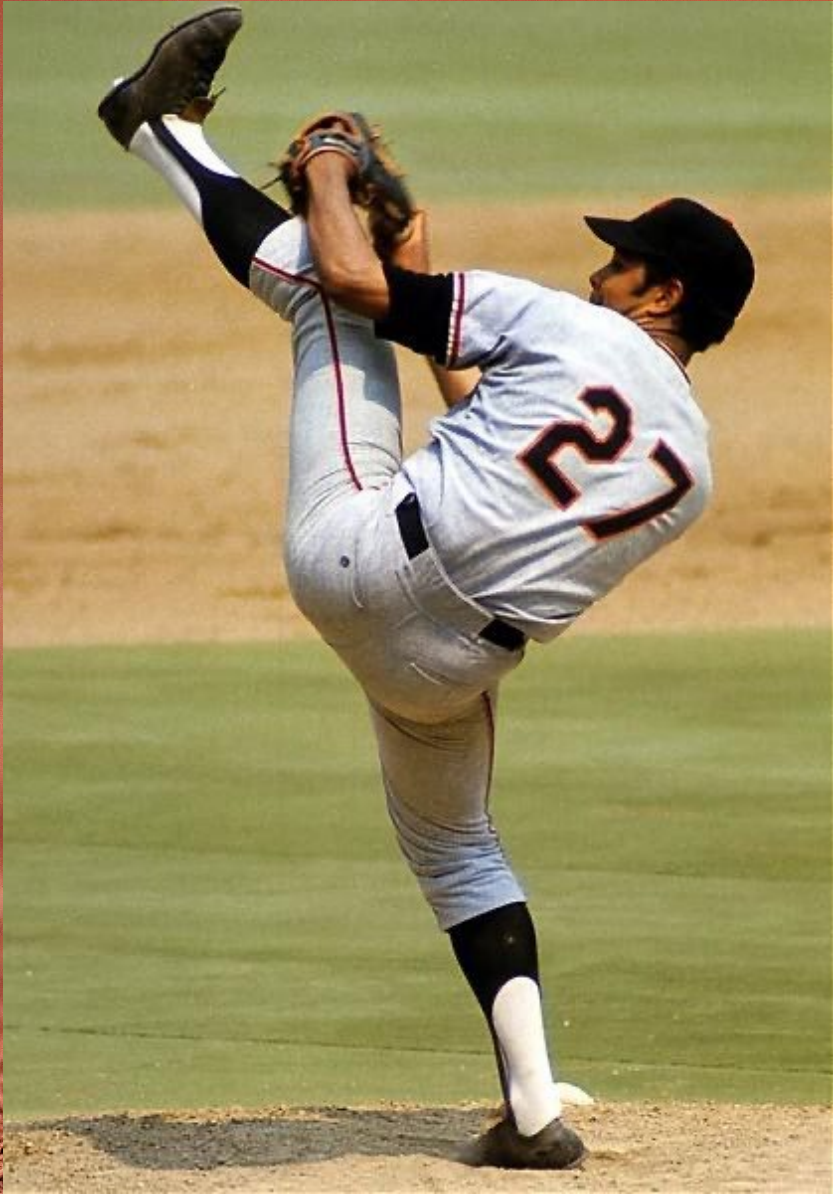
2010 - 2021 (Excluding 2020) World Series Starters
Season Best Win % & Best ERA by Year



Who did really well, and when?
Of the 42 pitchers, 8 out of 9 of them had a season best ERA less than or equal to 2.25 in Statcast Era:

Zack Greinke – 1.66 in 2015
Clayton Kershaw – 1.69 in 2016
Jacob DeGrom – 1.7 in 2018
Justin Verlander – 1.75 in 2022
Jake Arrieta – 1.77 in 2015
Kyle Hendricks – 2.13 in 2016
Trevor Bauer – 2.21 in 2018
Corey Kluber – 2.25 in 2018
Johnny Cueto – 2.25 in 2014

Who Has a Leg Up? Pitcher or Hitter?



Year	Hits (H)	Homeruns (HR)	Strikeouts (SO)	Batting Avg. (BA)	ERA	Runs (R)
2023	8.4	1.21	8.61	0.248	4.33	4.62
2022	8.16	1.07	8.4	0.243	3.96	4.28
2021	8.13	1.22	8.68	0.244	4.26	4.53
2020	8.04	1.28	8.68	0.245	4.44	4.65
2019	8.65	1.39	8.81	0.252	4.49	4.83
2018	8.44	1.15	8.48	0.248	4.14	4.45
2017	8.69	1.26	8.25	0.255	4.35	4.65
2016	8.71	1.16	8.03	0.255	4.18	4.48
2015	8.67	1.01	7.71	0.254	3.95	4.25
2014	8.56	0.86	7.7	0.251	3.74	4.07
2013	8.66	0.96	7.55	0.253	3.86	4.17
2012	8.65	1.02	7.5	0.255	4.01	4.32
2011	8.7	0.94	7.1	0.255	3.94	4.28
2010	8.76	0.95	7.06	0.257	4.07	4.38
2009	8.96	1.04	6.91	0.262	4.31	4.61
2008	9.06	1	6.77	0.264	4.32	4.65
2007	9.25	1.02	6.62	0.268	4.46	4.8
2006	9.28	1.11	6.52	0.269	4.52	4.86

Comparing Statcast Era Stats (x_1) to Post Steroid Era Stats (x_2)

NORMAL FLOAT AUTO REAL RADIAN MP

2-SampTTest

$\mu_1 \neq \mu_2$
 $t = -3.501853002$
 $p = 0.0029529039$
 $df = 15.9960792$
 $\bar{x}_1 = 8.432222222$
 $\bar{x}_2 = 8.875555556$
 $Sx_1 = 0.2664478269$
 $\downarrow Sx_2 = 0.2706525037$

Hits Per Team Game

NORMAL FLOAT AUTO REAL RADIAN MP

2-SampTTest

$\mu_1 \neq \mu_2$
 $t = 4.594589692$
 $p = 4.609675882E-4$
 $df = 13.45106645$
 $\bar{x}_1 = 1.194444444$
 $\bar{x}_2 = 0.9888888889$
 $Sx_1 = 0.113700386$
 $\downarrow Sx_2 = 0.0713169763$

HR's Per Team Game

NORMAL FLOAT AUTO REAL RADIAN MP

2-SampTTest

$\mu_1 \neq \mu_2$
 $t = 7.189697351$
 $p = 2.552892741E-6$
 $df = 15.53638804$
 $\bar{x}_1 = 8.405555556$
 $\bar{x}_2 = 7.081111111$
 $Sx_1 = 0.3554261917$
 $\downarrow Sx_2 = 0.4231856698$

SO's Per Team Game

NORMAL FLOAT AUTO REAL RADIAN MP

2-SampTTest

$\mu_1 \neq \mu_2$
 $t = -3.671940368$
 $p = 0.0023612795$
 $df = 14.59008928$
 $\bar{x}_1 = 0.2493333333$
 $\bar{x}_2 = 0.2593333333$
 $Sx_1 = 0.0047958315$
 $\downarrow Sx_2 = 0.0066143783$

Batting Average

NORMAL FLOAT AUTO REAL RADIAN MP

2-SampTTest

$\mu_1 \neq \mu_2$
 $t = 0.8612700552$
 $p = 0.4032688826$
 $df = 14.33221742$
 $\bar{x}_1 = 4.233333333$
 $\bar{x}_2 = 4.136666667$
 $Sx_1 = 0.1932614809$
 $\downarrow Sx_2 = 0.2757263136$

Earned Run Avg.

NORMAL FLOAT AUTO REAL RADIAN MP

2-SampTTest

$\mu_1 \neq \mu_2$
 $t = 0.5945039494$
 $p = 0.5617297729$
 $df = 13.89708619$
 $\bar{x}_1 = 4.526666667$
 $\bar{x}_2 = 4.46$
 $Sx_1 = 0.1859435398$
 $\downarrow Sx_2 = 0.2803569154$

Runs Per Team Game

It looks like the pitcher has more of a leg up

**“ARE YOU TRYING TO SAY
JESUS CHRIST CAN'T
HIT A CURVEBALL?”**

-MAJOR LEAGUE



- Pitchers are improving velocity
- Defenses are shifting more
EVEN with the rule change
- Hitters have more data
- Hitting is tough...0.41 seconds

What some coaches and hitters are saying...

Dominick Johnson: “Pitchers are loving it these days with hitters fixated on iPads and reports telling them what to look for in every situation. We see more hitters freeze on mistake fastballs than ever before. Tough to hit when so many hitters these days don’t trust themselves and stay committed to their own plan based on their eyes.”

Manny Ramirez: “When I look at nothing, I see everything.”

“Hitters now would rather guess because then they have an excuse when if it fails. It’s crazy. With all the pitch percentages, tipping (not a sure thing) and video available, now we get guessers. It’s an excuse so they don’t have to calm themselves down, see the ball and trust their subconscious self to hit.”



Chili Davis: “Chase rates and strikeouts are a by-product of top-down influence. Decision makers have chosen to focus on data that causes hitters to doubt their training. Data overload is hurting hitters. Indecision causes poor ball/strike decisions, which causes the swing to break down. Building better hitters requires training hitters to trust their brains. Spatial information from the eyes is processed by the brain. We should focus more on assisting it. Most things coaches use only complicate the ball/strike signaling of the brain.”

<https://www.baseballamerica.com/stories/high-velo-late-break-trust-your-eyes-or-the-data/>

But wait, there's more! What about homeruns?

“SOME LADY NAMED
RUTH. BABY RUTH.”
-THE SANDLOT

<https://rocklandpeakperformance.com/baseball-launch-angles-exit-velos/>

Batters have been steadily adjusting to the shift with launch angle:
Mentality: Let's just hit it out of the park!

		Launch Angle (degrees)									
		-5	0	5	10	15	18	20	25	30	35
Exit Speed (mph)	75	-	44	79	131	180	205	218	242	254	256
	80	-	46	86	145	202	229	243	268	280	280
	85	-	48	93	161	224	254	269	295	306	305
	90	-	50	100	177	248	280	296	323	333	329
	92	-	51	103	183	258	291	307	334	343	338
	95	-	52	107	194	273	307	324	351	359	352
	100	-	54	114	211	298	335	351	379	385	376
	105	-	55	122	229	325	364	382	408	412	399

These days in baseball, every batter is trying to find an angle

With increasingly sophisticated data available, major league hitters are focusing on getting the ball in the air.

<https://www.washingtonpost.com/graphics/sports/mlb-launch-angles-story/>

** Source: Dr. Alan Nathan, University of Illinois

Thank You!

jvargas@coloradomtn.edu

"The one constant through all the years, Ray, has been baseball. America has rolled by like an army of steamrollers. It has been erased like a blackboard, rebuilt and erased again. But baseball has marked the time. This field, this game: it's a part of our past, Ray. It reminds of us of all that once was good and it could be again."

-Field of Dreams

"God, I love baseball."

-The Natural

"I'd wake up at night with the smell of the ball park in my nose, the cool of the grass on my feet..."

The thrill of the grass."

-Field of Dreams

"There's no crying in baseball!"

-A League of Their Own

"Is this heaven?" "No, it's Iowa."

-Field of Dreams

"I'VE TRIED THEM ALL, I REALLY HAVE. AND THE ONLY CHURCH THAT TRULY FEEDS THE SOUL, DAY IN AND DAY OUT, IS THE CHURCH OF BASEBALL."

-BULL DURHAM

"This guy threw at his own kid in a father-son game."

-Major League