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# NCPMS 2019



PMI OVOC proudly presents

**NCPMS 2019**



# How AI is Changing the Game: The Use of AI in Professional Sports

Presented By: Michael Rogers



LIXAR

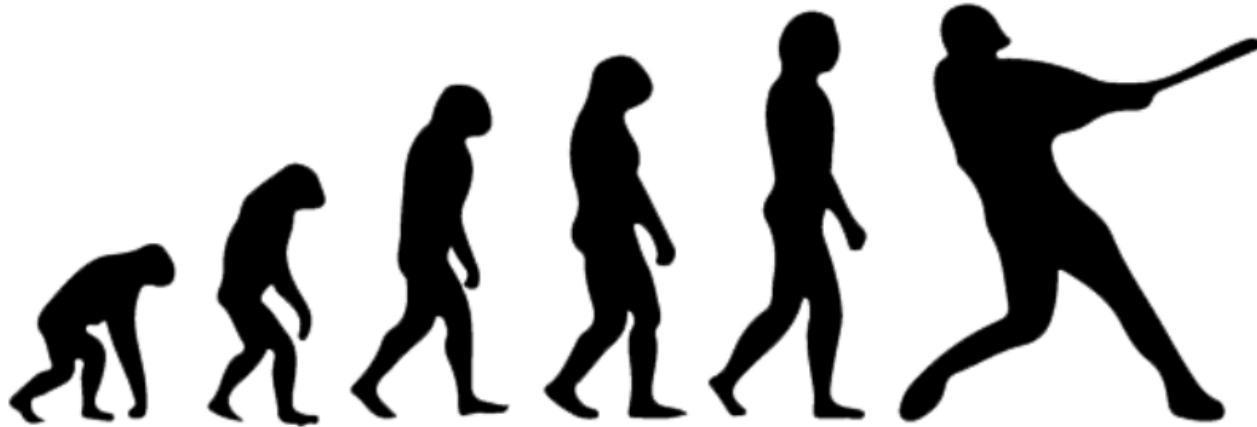


DRIVEN  
BY DATA

PREMIER AI & DATA COMPANY



# Change, Adapt, Lead





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# All 30 NBA arenas to have SportVU cameras



NBA commissioner David Stern's league is at the forefront of technology.. (AP Photo/Wilfredo Lee)



The NBA will install STATS' SportVU Player Tracking technology in every NBA arena beginning with the 2013-14 season.

SportVU was created in 2005 by Israeli scientists, Gal Oz and Miky Tamir, who had a background in missile tracking and advanced optical recognition.



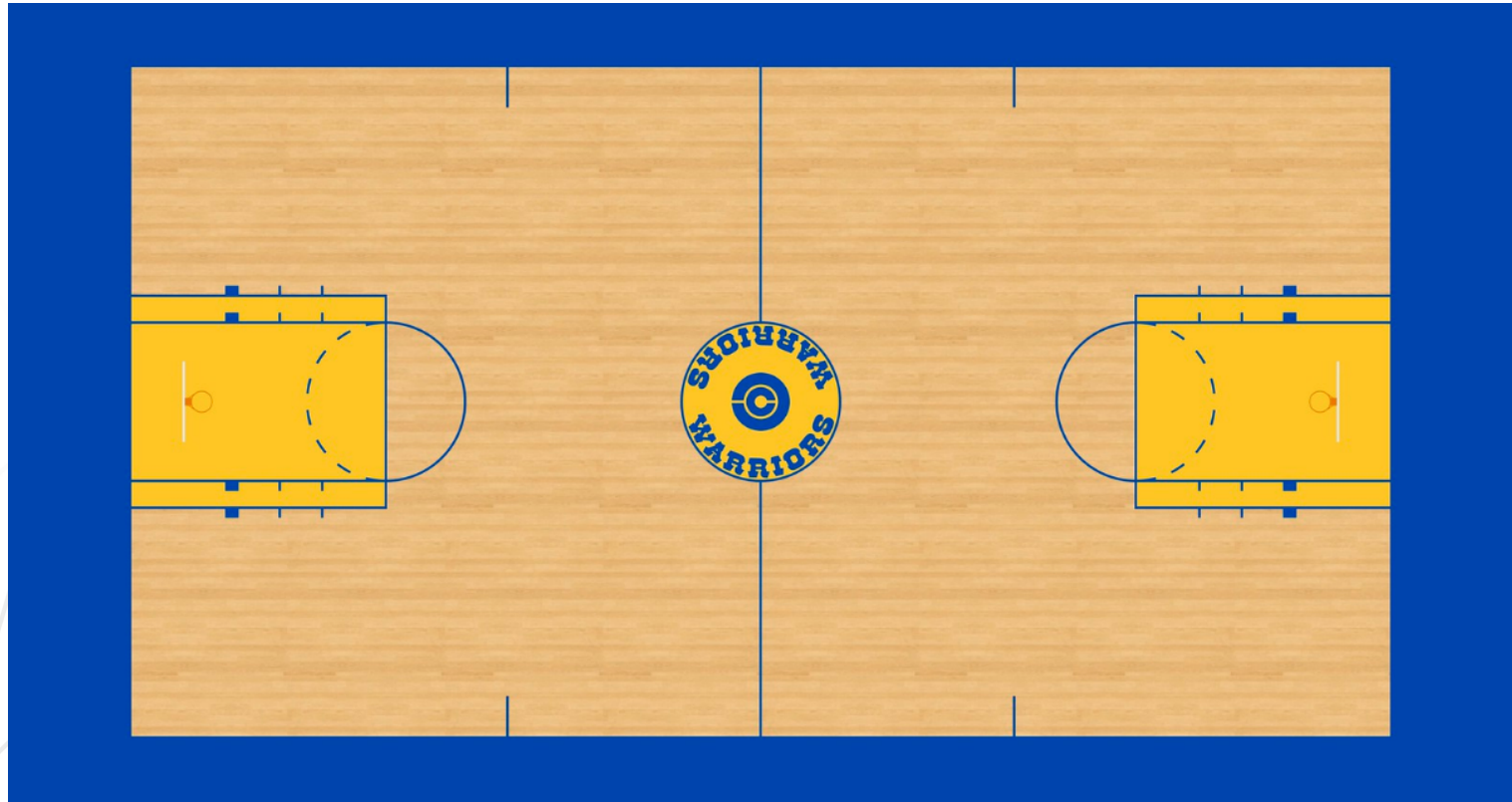


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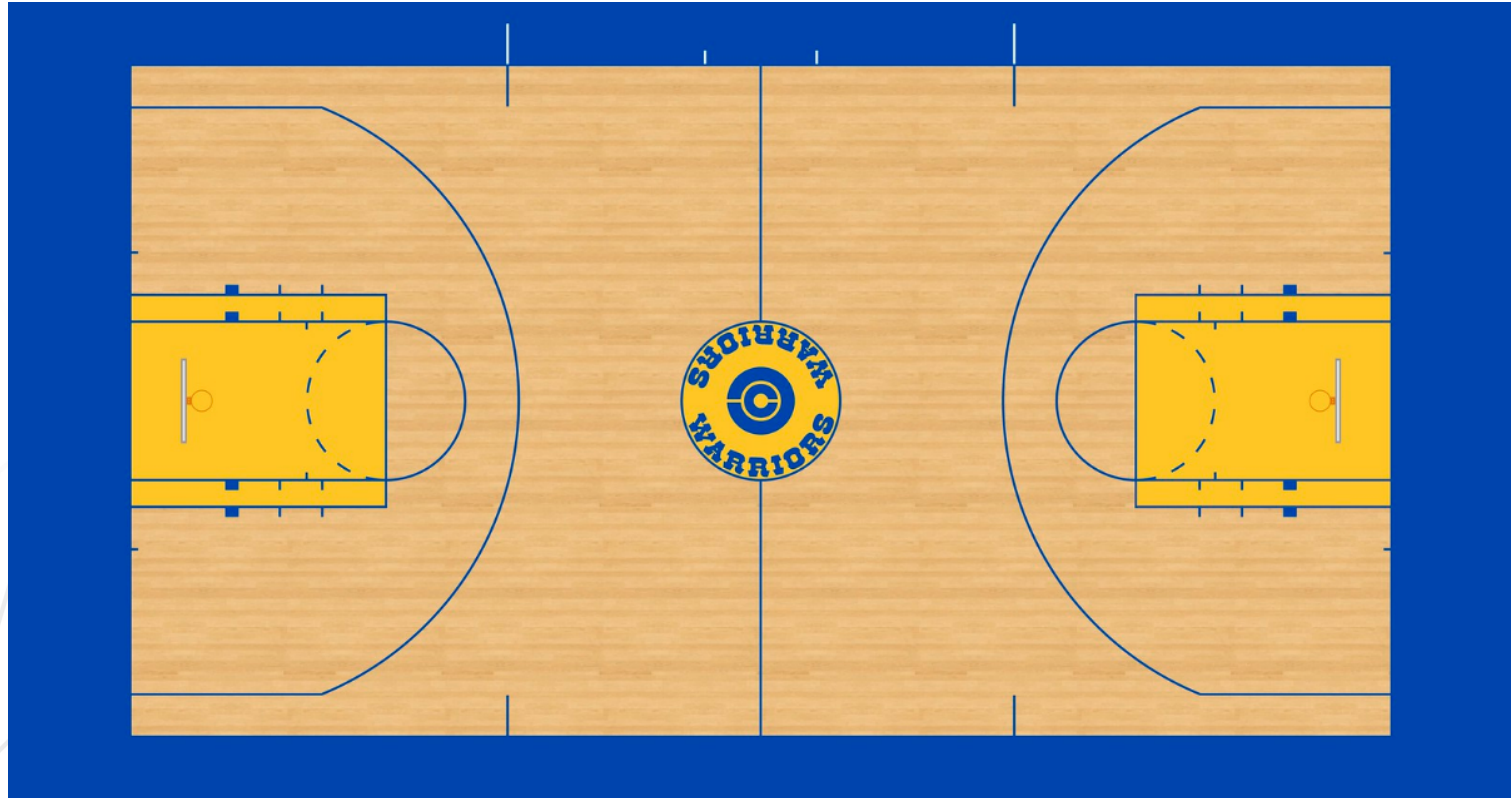
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## Oakland Coliseum Arena 1975 - 1979

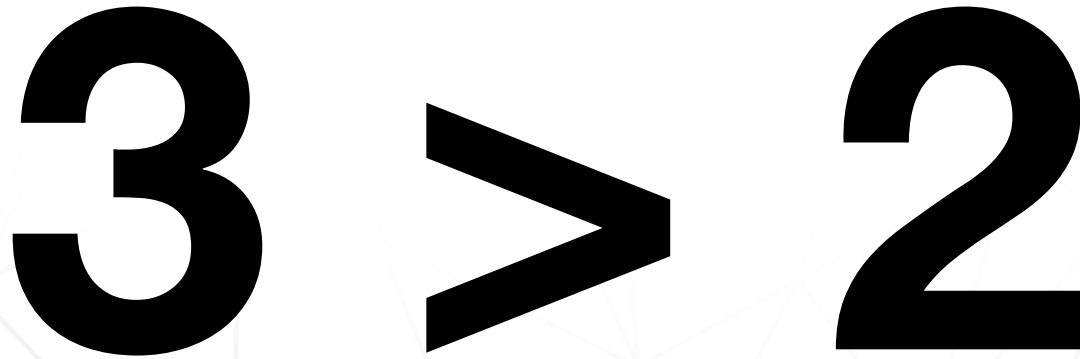


## Oakland Coliseum Arena 1979 - 1983





“The whole 3 is greater than 2 thing.”  
- Bill Simmons, 2019

The mathematical expression '3 > 2' is displayed in a large, bold, black font. The background features a light gray geometric pattern of interconnected lines and dots, resembling a network or a stylized map.

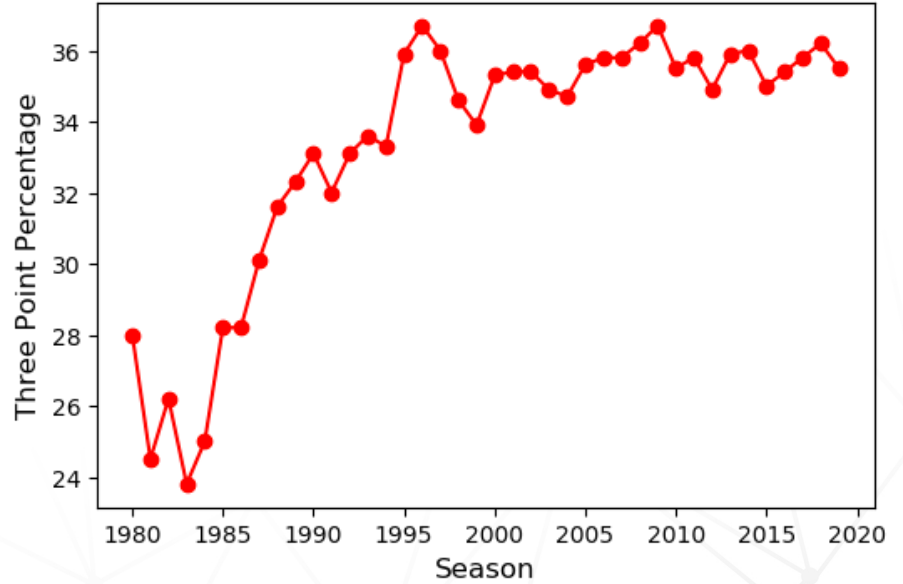
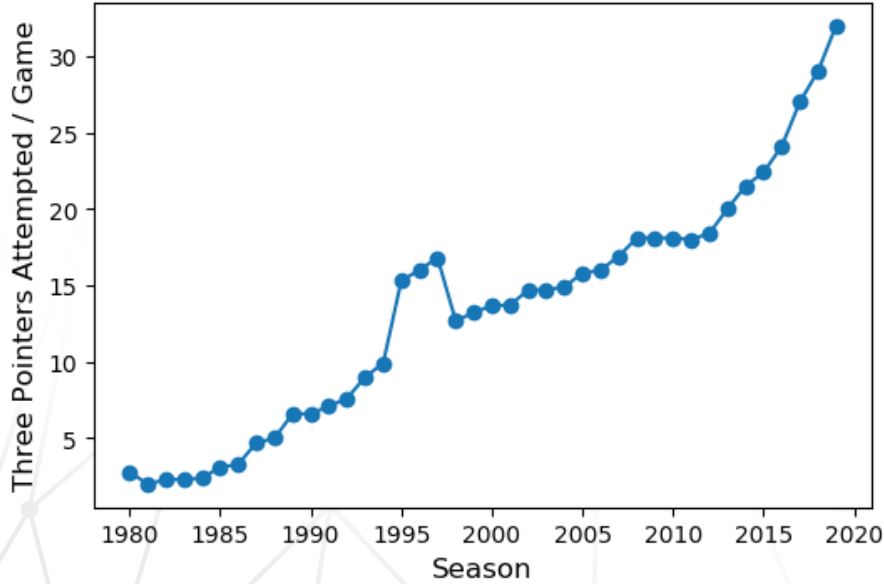




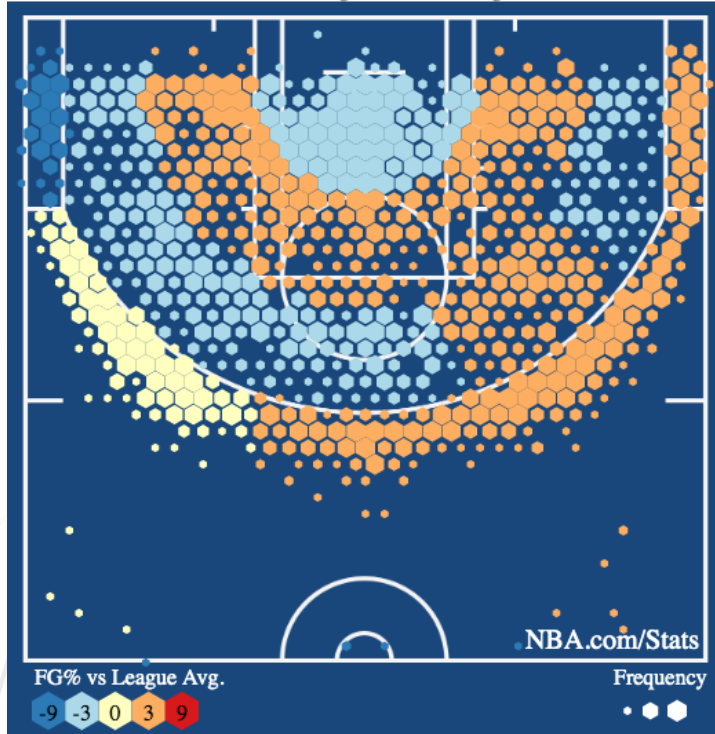
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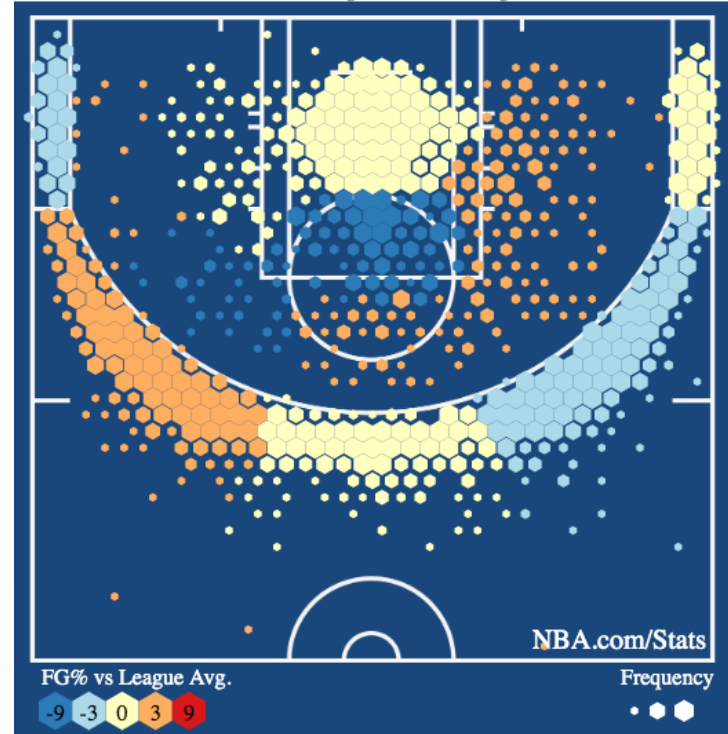
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FGA for the Houston Rockets during the 2008-09 Regular Season



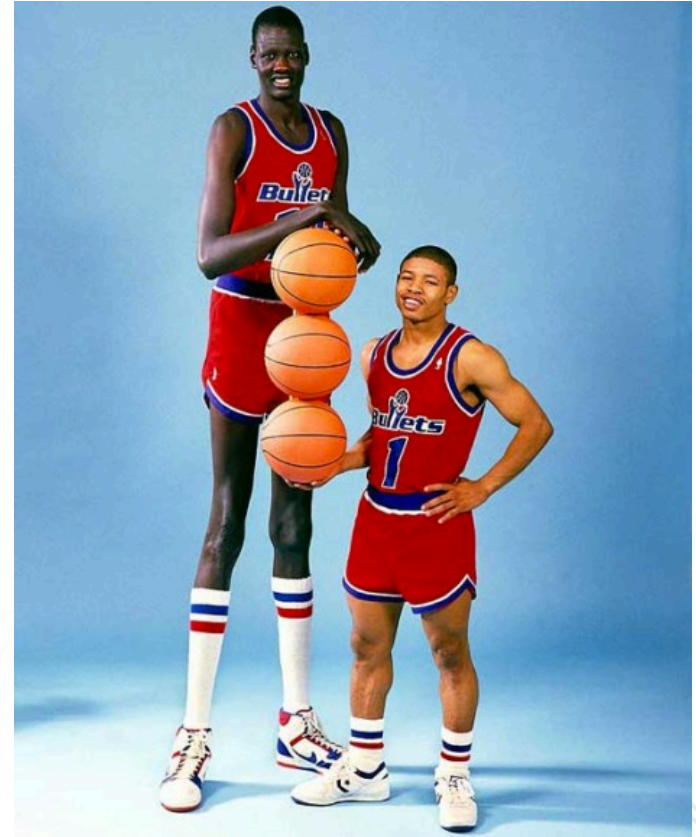
FGA for the Houston Rockets during the 2018-19 Regular Season



In 2018, the Houston Rockets became the first team in NBA history to attempt more 3s than 2s over a full schedule, they did this again in 2019: 45.4 3PA, 87.4 FGA.

## Some Consequences

- Fast break *threes*.
- Floor spacing.
- Goodbye traditional centres — at one point it was estimated that as many as 20% of the eligible 7 footers made the NBA, spacing and emphasis on shooting has opened game up for smaller players.
- George Mikan: Said the three-pointer "would give the smaller player a chance to score and open up the defence to make the game more enjoyable for the fans."





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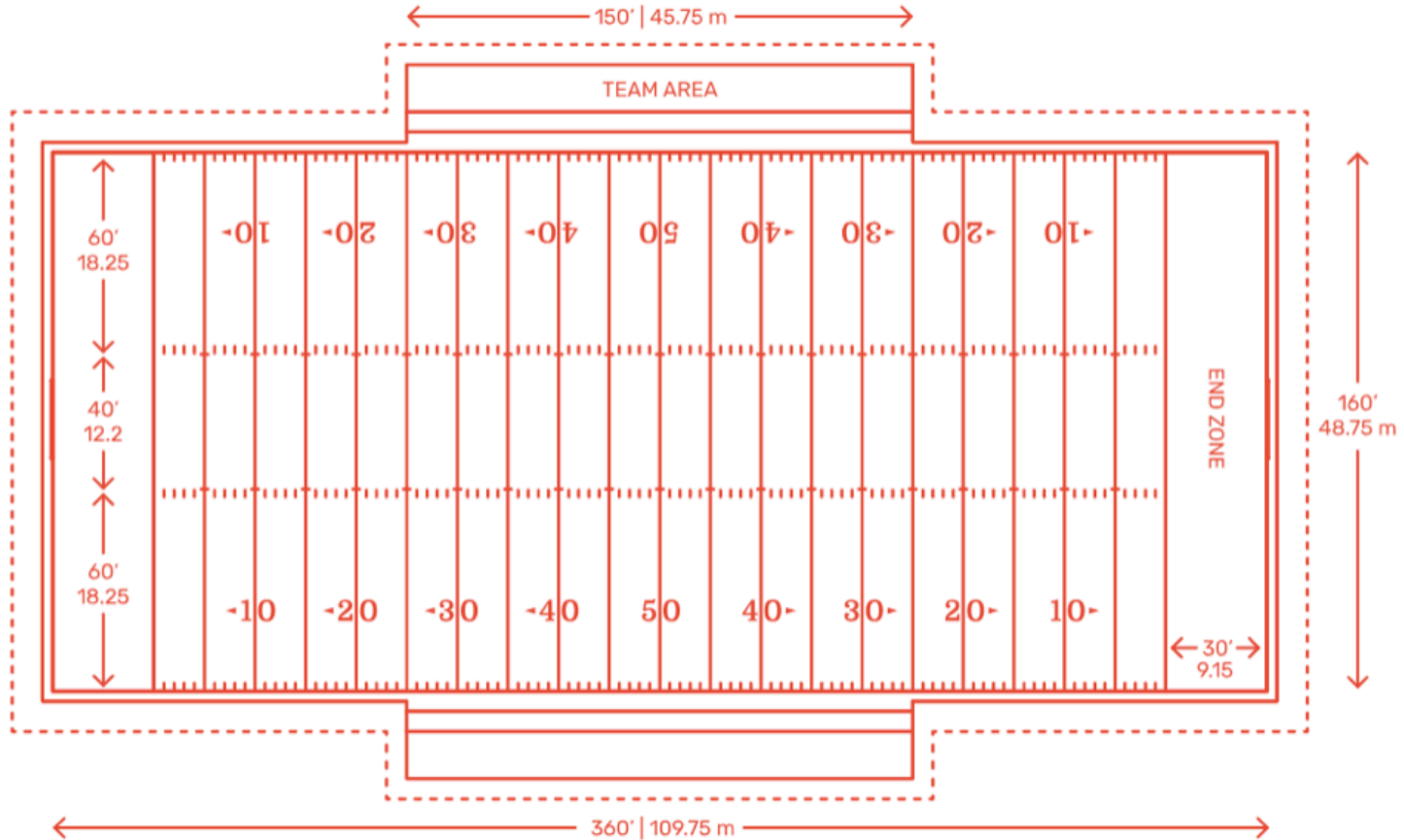
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# Football



SHORPY





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# Recent Super Bowl Results

winner

loser

winner

loser

XXXVI	February 3, 2002	New England Patriots <sup>A</sup> (3, 1-2)	20-17 [n 15]	St. Louis Rams <sup>N</sup> (3, 1-2)	XLVI	February 5, 2012	New York Giants <sup>N</sup> (5, 4-1)	21-17	New England Patriots <sup>A</sup> (7, 3-4)
XXXVII	January 26, 2003	Tampa Bay Buccaneers <sup>N</sup> (1, 1-0)	48-21	Oakland Raiders <sup>A</sup> (5, 3-2)	XLVII	February 3, 2013	Baltimore Ravens <sup>A</sup> (2, 2-0)	34-31	San Francisco 49ers <sup>N</sup> (6, 5-1)
XXXVIII	February 1, 2004	New England Patriots <sup>A</sup> (4, 2-2)	32-29	Carolina Panthers <sup>N</sup> (1, 0-1)	XLVIII	February 2, 2014	Seattle Seahawks <sup>N</sup> (2, 1-1)	43-8	Denver Broncos <sup>A</sup> (7, 2-5)
XXXIX	February 6, 2005	New England Patriots <sup>A</sup> (5, 3-2)	24-21	Philadelphia Eagles <sup>N</sup> (2, 0-2)	XLIX	February 1, 2015	New England Patriots <sup>A</sup> (8, 4-4)	28-24	Seattle Seahawks <sup>N</sup> (3, 1-2)
XL	February 5, 2006	Pittsburgh Steelers <sup>A</sup> (6, 5-1)	21-10	Seattle Seahawks <sup>N</sup> (1, 0-1)	50 [n 18]	February 7, 2016	Denver Broncos <sup>A</sup> (8, 3-5)	24-10	Carolina Panthers <sup>N</sup> (2, 0-2)
XLI	February 4, 2007	Indianapolis Colts <sup>A</sup> (3, 2-1)	29-17	Chicago Bears <sup>N</sup> (2, 1-1)	LI	February 5, 2017	New England Patriots <sup>A</sup> (9, 5-4)	34-28 (OT) <sup>[n 19]</sup>	Atlanta Falcons <sup>N</sup> (2, 0-2)
XLII	February 3, 2008	New York Giants <sup>N</sup> (4, 3-1)	17-14	New England Patriots <sup>A</sup> (6, 3-3)	LII	February 4, 2018	Philadelphia Eagles <sup>N</sup> (3, 1-2)	41-33	New England Patriots <sup>A</sup> (10, 5-5)
XLIII	February 1, 2009	Pittsburgh Steelers <sup>A</sup> (7, 6-1)	27-23	Arizona Cardinals <sup>N</sup> (1, 0-1)	LIII	February 3, 2019	New England Patriots <sup>A</sup> (11, 6-5)	13-3	Los Angeles Rams <sup>N</sup> (4, 1-3)
XLIV	February 7, 2010	New Orleans Saints <sup>N</sup> (1, 1-0)	31-17	Indianapolis Colts <sup>A</sup> (4, 2-2)					
XLV	February 6, 2011	Green Bay Packers <sup>N</sup> (5, 4-1)	31-25	Pittsburgh Steelers <sup>A</sup> (8, 6-2)					



## Ernie Adams — Director of football research, New England Patriots

- Met Bill Belichick in boarding school
- His three obsessions were Latin, naval history and, football.



Courtesy of Phillips Academy, copyright John Hurley 2005

Adams looks -- and thinks -- like an investment banker, but he owns three Super Bowl rings.



# Do Firms Maximize? Evidence from Professional Football

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David Romer

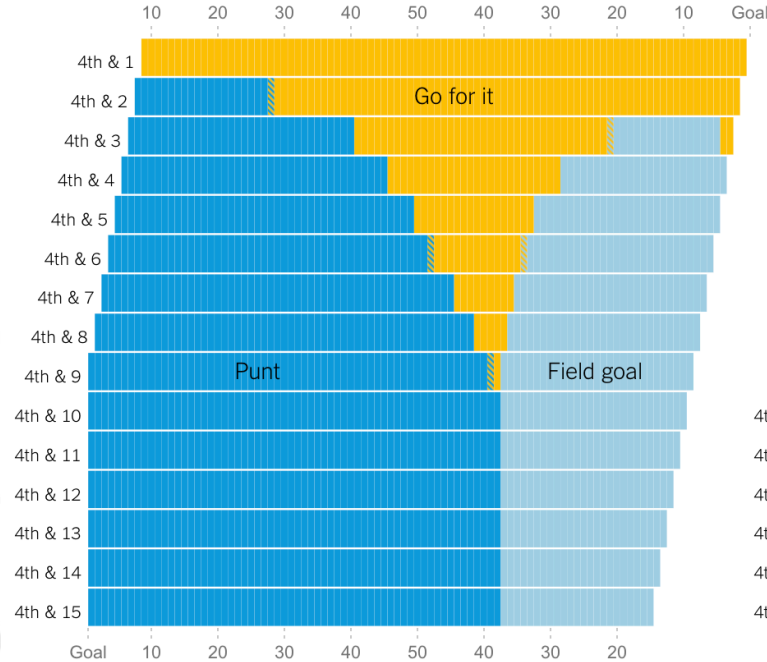
*University of California, Berkeley and National Bureau of Economic Research*

This paper examines a single, narrow decision—the choice on fourth down in the National Football League between kicking and trying for a first down—as a case study of the standard view that competition in the goods, capital, and labor markets leads firms to make maximizing choices. Play-by-play data and dynamic programming are used to estimate the average payoffs to kicking and trying for a first down under different circumstances. Examination of actual decisions shows systematic, clear-cut, and overwhelmingly statistically significant departures from the decisions that would maximize teams' chances of winning. Possible reasons for the departures are considered.

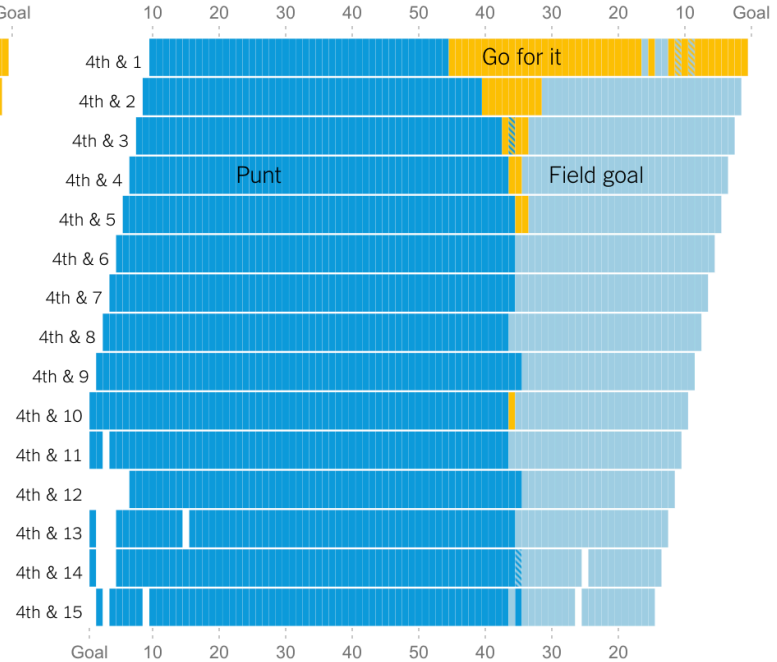
[ *Journal of Political Economy*, 2006, vol. 114, no. 2]

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WHAT NYT 4TH DOWN BOT RECOMMENDS ON 4TH DOWN



WHAT N.F.L. COACHES DO MOST OFTEN



The model includes the difference in score, the time remaining in the game, and the number of timeouts each team has left. It also includes the likelihood that a team makes a field goal and the likelihood that it will convert a first down.



## NEW ENGLAND PATRIOTS

### Belichick defends decision to go for it on fourth down vs. Colts



Associated Press

Published: Nov. 16, 2009 at 07:59 p.m. Updated: Sept. 27, 2012 at 03:29 p.m. 0 Likes | 0 Comments



Belichick: 'We all feel it'

FOXBOROUGH, Mass. -- Bill Belichick defended his decision to go for it on fourth down as criticism mounted Monday of the call that led to the New England Patriots stunning loss.

The coach hailed as one of the NFL's best was a target of columnists, talk radio callers and two of his former players. Why, they all wondered, did he gamble with a six-point lead and just over two minutes to go against the Indianapolis Colts?

The gamble failed and the Patriots lost 35-34 after leading by 17 points in the fourth quarter Sunday night.

"The same thing I said after the game," Belichick said at his regular Monday news conference. "I thought it was our best chance to win. I thought we needed to make that one play and then we could basically run out the clock. We weren't able to

#### Should Belichick have gone for it?

Bill Belichick's decision to go for it on fourth-and-2 from the Patriots' 28-yard line has been hotly debated. Read



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## Smart Coaches Don't Punt

The statistics say teams should go for it on fourth down. Are NFL teams finally wising up?

By CHASE STUART

NOV 10, 2017 • 12:01 PM



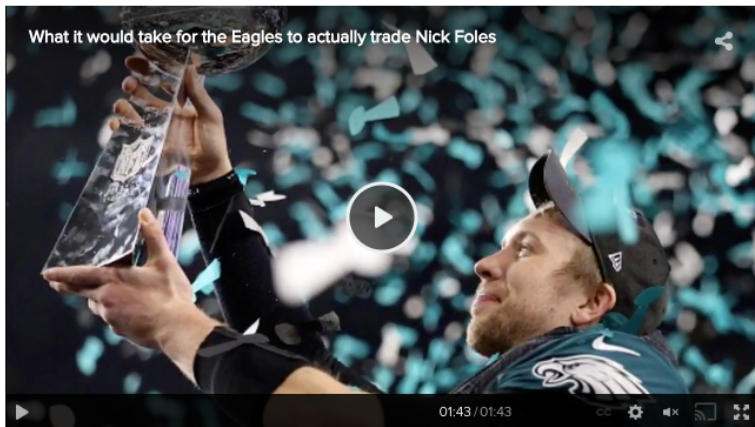
Head coach Doug Pederson of the Philadelphia Eagles during a preseason game against the New York Jets at MetLife Stadium on Aug. 31 in East Rutherford, New Jersey.

Jeff Zelevansky/Getty Images

The lowest-hanging fruit in the NFL's analytics revolution is for coaches to keep their offenses on the field on fourth-and-1. As pro offenses have become more effective, the state of *being on offense* has become increasingly valuable. Consider that in 1999, NFL teams averaged 1.56

## Eagles set NFL record for most fourth-down attempts last year

By JEFF KERR - Jul 12, 2018



The biggest staple of **Doug Pederson's** two-year coaching career with the Philadelphia Eagles has been his aggressiveness with his play-calling, especially when going for it on fourth down. Pederson's fourth-down play calling won the Eagles the Super Bowl, capturing their first title since 1960 and clinching their first Super Bowl in franchise history.

Pederson helped the Eagles set a NFL record for most fourth-down attempts in a season, going for it 29 times in 2017. The Eagles converted 17-of-26 fourth downs during the 2017 regular season, and finished at 65.38 percent (third in the NFL). The New Orleans Saints (80 percent) and the Jacksonville Jaguars (76.92 percent) were the only teams ranked higher.

“We confirmed,” said Joe Banner, the former Eagles president who helped set up the department, “that there’s a competitive advantage in analytics in a league that is structured to prevent you from having a competitive advantage.”



## Dirk Koetter: Percentages say go for it on fourth down, but if I fail I'm out of here

Posted by Michael David Smith on September 15, 2018, 11:08 AM EDT

Buccaneers coach Dirk Koetter says there are two choices on fourth down: Play the percentages, or play it safe. And he usually chooses to play it safe.



"The percentages say **you should go for it** almost every time," Koetter said. "We've studied the analytics on it and the problem with looking at it like that – those are all looking at all fourth downs over the course of the season. **You might get three in a row, but if I don't get it in this particular game, we might be losing, and I might be out of here.** We've got a plan for every game. We have a plan for the season and then we do an analytical plan based on the team we're playing. **There's analytic numbers that tell you what to do on every play, but this game isn't played by computers.** It's combination there – you've got to make decisions in real time and not look back."



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## The Team That Never Punts

Head Coach Kevin Kelley of Pulaski Academy views himself not as a risk-taker, but as a pragmatist who follows the numbers.

State championships (football): 2003, 2011, 2014, 2015, 2016, 2017





# Baseball



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# Box Score



- Henry Chadwick, a sportswriter in New York, developed the box score in 1858.
- This was the first way statisticians were able to describe the sport of baseball.

Saturday, October 26, 1991  
Hubert H. Humphrey Metrodome, Minneapolis, Minnesota

Atlanta	0	0	0	0	2	0	1	0	0	0	0	-	3	9	1
Minnesota	2	0	0	0	1	0	0	0	0	0	1	-	4	9	0

Atlanta Braves	ab	r	h	rbi	bb	so	po	a
Smith dh	3	1	0	0	1	0	0	0
Pendleton 3b	5	1	4	2	0	0	1	2
Gant cf	5	0	0	1	0	0	2	0
Justice rf	4	0	0	0	1	1	3	0
Bream lb	4	0	1	0	1	0	12	2
Mitchell pr,lf	0	0	0	0	0	0	0	0
Hunter lf,lb	5	0	0	0	0	0	1	0
Olson c	5	0	0	0	0	1	6	0
Lemke 2b	4	1	2	0	0	0	2	3
Belliard ss	2	0	1	0	0	1	1	4
Gregg ph	0	0	0	0	0	0	0	0
Blauser ph,ss	2	0	1	0	0	1	1	3
Totals	39	3	9	3	3	4	30	14

FIELDING - Atlanta

DP: 2. Bream-Belliard-Bream, Blauser-Lemke-Bream.

E: Hunter (1).

BATTING - Atlanta

HR: Pendleton (2,5th inning off Erickson 1 on 1 out).

HBP: Smith (1,by Erickson).

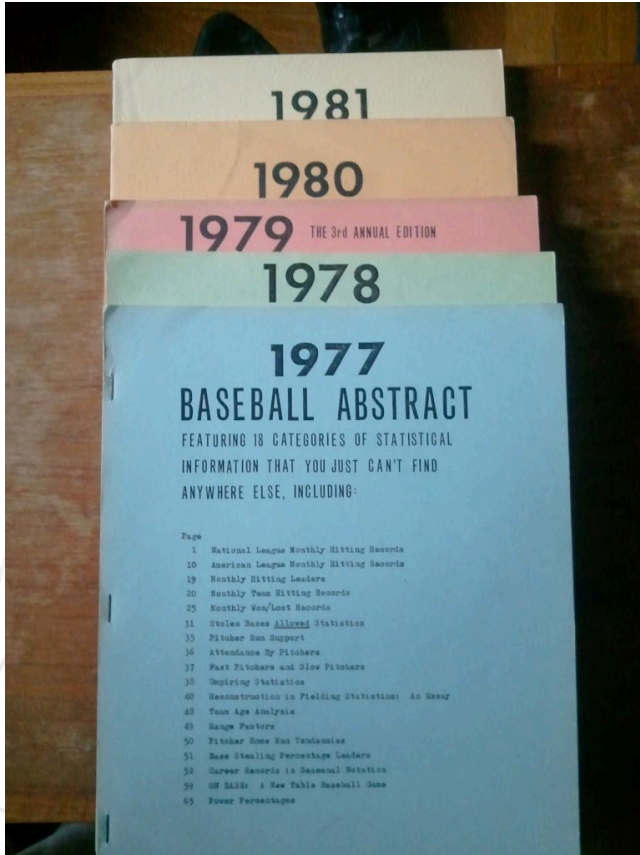
GDP: Smith (1,off Willis).

Team LOB: 7.

BASERUNNING - Atlanta

CS: Mitchell (1,2nd base by Aguilera/Harper).

# Sabermetrics



- Sabermetrics research began in the middle of the 20th century. Earnshaw Cook was one of the earliest researchers who contributed to this idea. Cook gathered the majority of his research into his 1964 book, *Percentage Baseball*.

- The idea of advanced baseball statistics did not become prominent in the baseball community until **Bill James** began writing his annual *Baseball Abstracts* in 1977.

- The term was coined by Bill James, and is derived from the acronym SABR, which stands for the Society for American Baseball Research, founded in 1971.

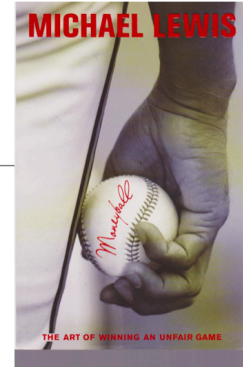
## Sabermetrics in the Big Leagues



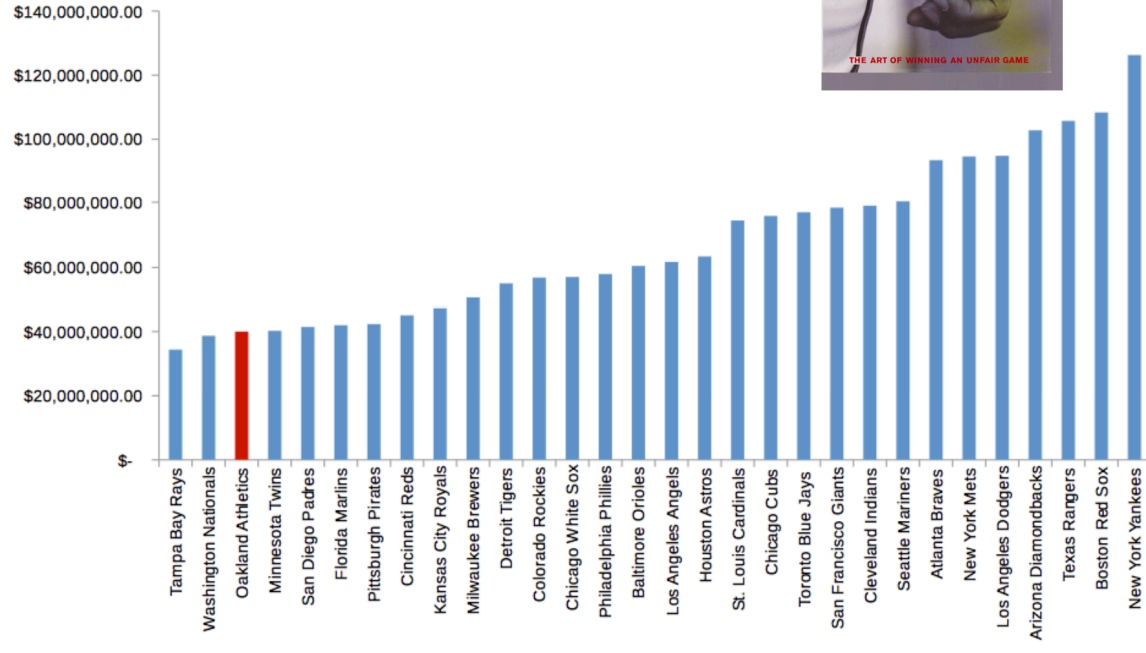
- The Oakland Athletics began to use a more quantitative approach to baseball by focusing on sabermetric principles in the 1990s.
- This initially began with Sandy Alderson as the former general manager of the team when he used the principles toward obtaining relatively undervalued players.
- His ideas were continued when Billy Beane took over as general manager in 1997.



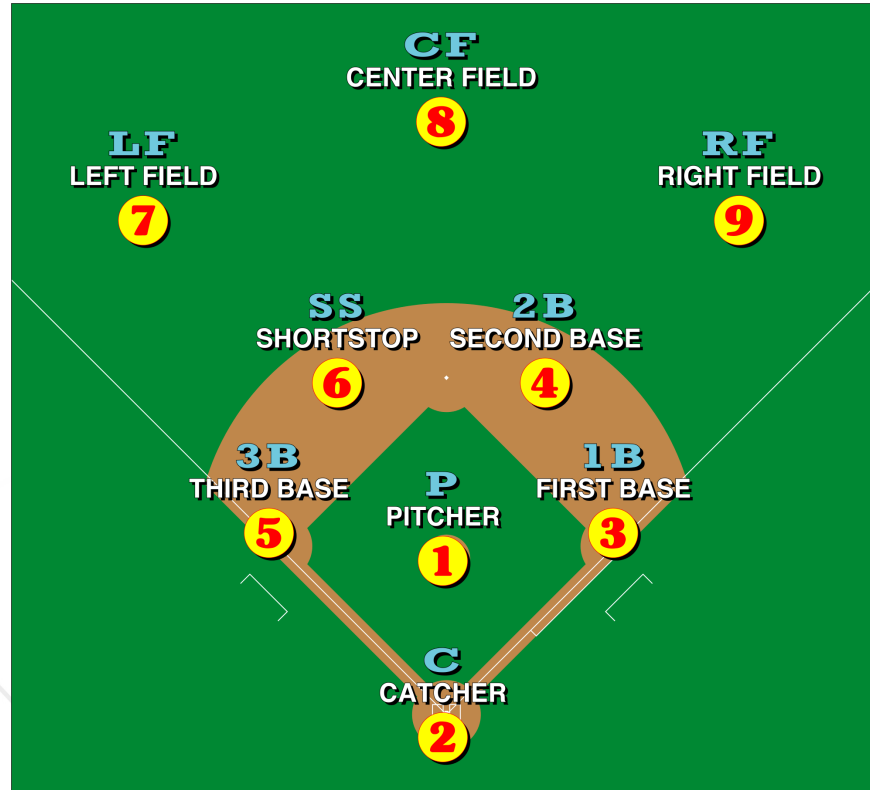
# Moneyball



**Moneyball Year (2002)  
MLB Team Salaries**



# Defense: Baseball Positions



# Albert Pujols





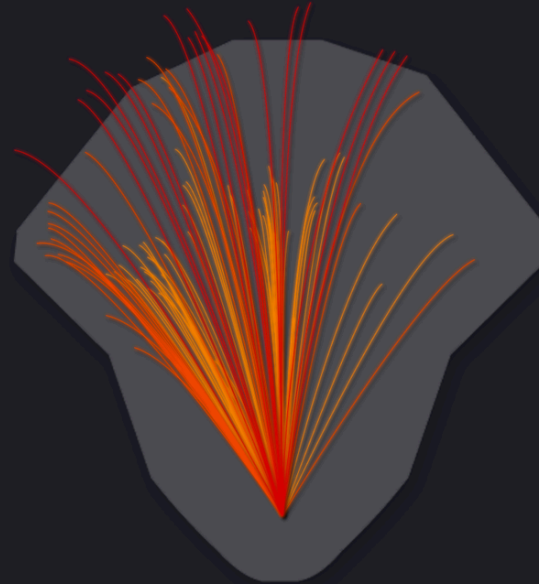
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# ALBERT PUJOLS

2010 HITTING SPRAY



# BUSCH STADIUM

SINGLES: 55 DOUBLES: 21 TRIPLES: 0 HOME RUNS: 17

JUSTIN R. BOPP | 2011





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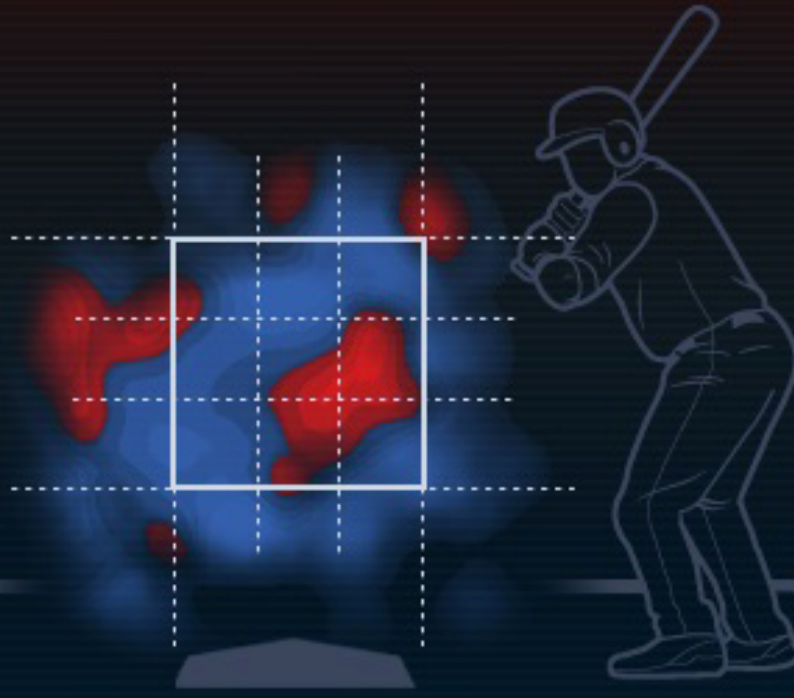
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# Albert Pujols

BA vs Curve/Slider From 2012-13



"I'm one of the victims," Pujols says now. "Just like so many others."



Career Stats

Season	Team	LG	G	AB	R	H	TB	2B	3B	HR	RBI	BB	IBB	SO	SB	CS	AVG	OBP	SLG	OPS	GO/AO
2001	STL	NL	161	590	112	194	360	47	4	37	130	69	6	93	1	3	.329	.403	.610	1.013	0.92
2002	STL	NL	157	590	118	185	331	40	2	34	127	72	13	69	2	4	.314	.394	.561	.955	1.09
2003	STL	NL	157	591	137	194	360	47	4	37	130	69	6	93	1	3	.359	.439	.667	1.106	1.02
2004	STL	NL	154	592	133	185	331	40	2	34	127	72	13	69	2	4	.331	.415	.657	1.072	0.93
2005	STL	NL	161	591	129	194	360	47	4	37	130	69	6	93	1	3	.330	.430	.609	1.039	0.90
2006	STL	NL	143	535	119	185	331	40	2	34	127	72	13	69	2	4	.331	.431	.671	1.102	0.75
2007	STL	NL	158	565	99	185	331	40	2	34	127	72	13	69	2	4	.327	.429	.568	.997	0.98
2008	STL	NL	148	524	100	185	331	40	2	34	127	72	13	69	2	4	.357	.462	.653	1.114	0.92
2009	STL	NL	160	568	124	186	374	45	1	47	135	115	44	64	16	4	.327	.443	.658	1.101	0.87
2010	STL	NL	159	587	115	183	350	39	1	42	118	103	38	76	14	4	.312	.414	.596	1.011	0.89
2011	STL	NL	147	579	105	173	313	29	0	37	99	61	15	58	9	1	.299	.366	.541	.906	1.15
2012	LAA	AL	154	607	85	173	313	50	0	30	105	52	16	76	8	1	.285	.343	.516	.859	1.04
2013	LAA	AL	99	391	49	101	171	19	0	17	64	40	8	55	1	1	.258	.330	.437	.767	0.91
2014	LAA	AL	159	633	89	172	305	27	1	20	105	52	16	76	8	1	.272	.324	.466	.790	1.30
2015	LAA	AL	157	602	85	147	295	37	1	20	105	52	16	76	8	1	.244	.307	.480	.787	0.99
2016	LAA	AL	152	593	71	159	295	37	1	20	105	52	16	76	8	1	.268	.323	.457	.780	1.13
2017	LAA	AL	149	593	53	143	295	37	1	20	105	52	16	76	8	1	.241	.286	.386	.672	1.11
2018	LAA	AL	117	465	50	114	295	37	1	20	105	52	16	76	8	1	.245	.289	.411	.700	0.98
2019	LAA	AL	42	149	18	35	295	37	1	20	105	52	16	76	8	1	.235	.304	.436	.740	0.81
MLB Career	-	-	2734	10345	1791	3117	295	37	1	20	105	52	16	76	8	1	.301	.381	.553	.934	0.99

Teams have shifted on Pujols 38 percent of the time since 2016, the second most among right-handed hitters with at least 1,000 plate appearances. Against the shift, he is batting just .219, 26 points below the league average.

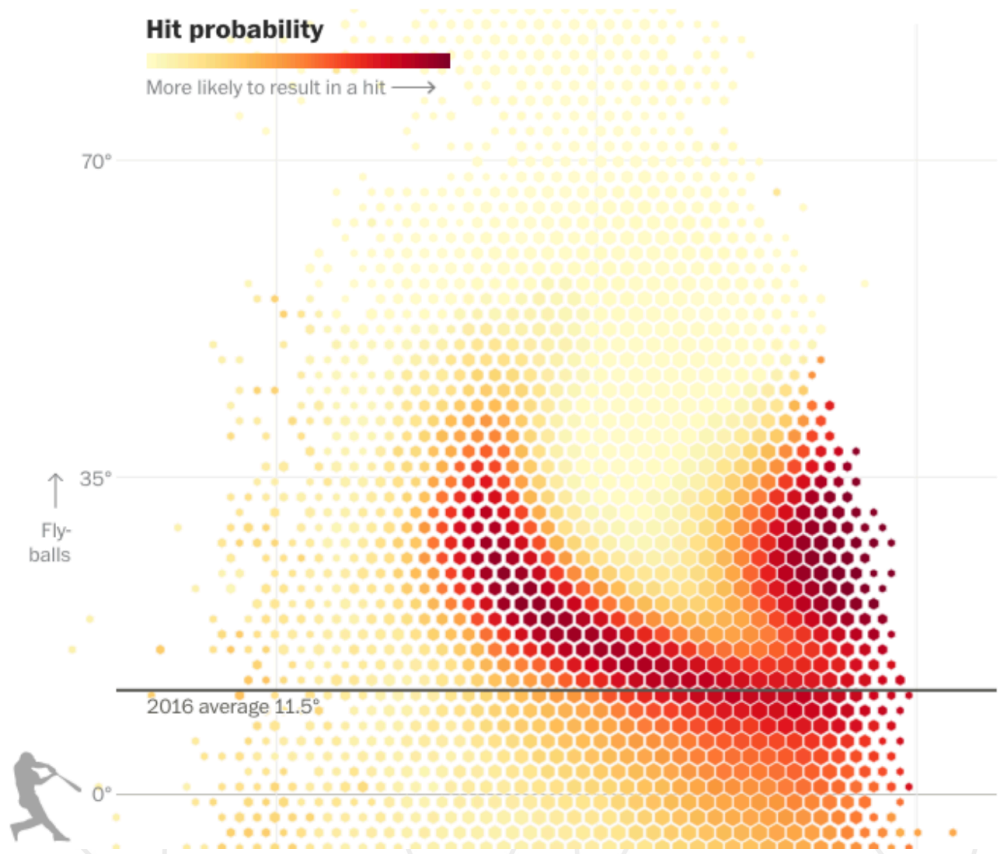
**Most Hard-Hit Outs Since 2015**

Albert Pujols	403
Manny Machado	396
Kendrys Morales	389
Christian Yelich	367

Source: Statcast



**Launch  
Angle**





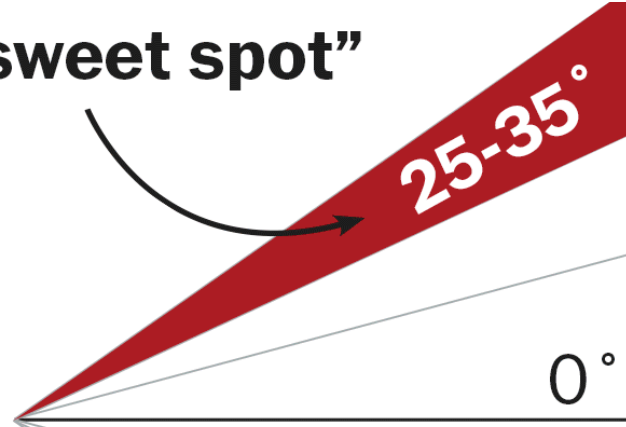
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## The “sweet spot”

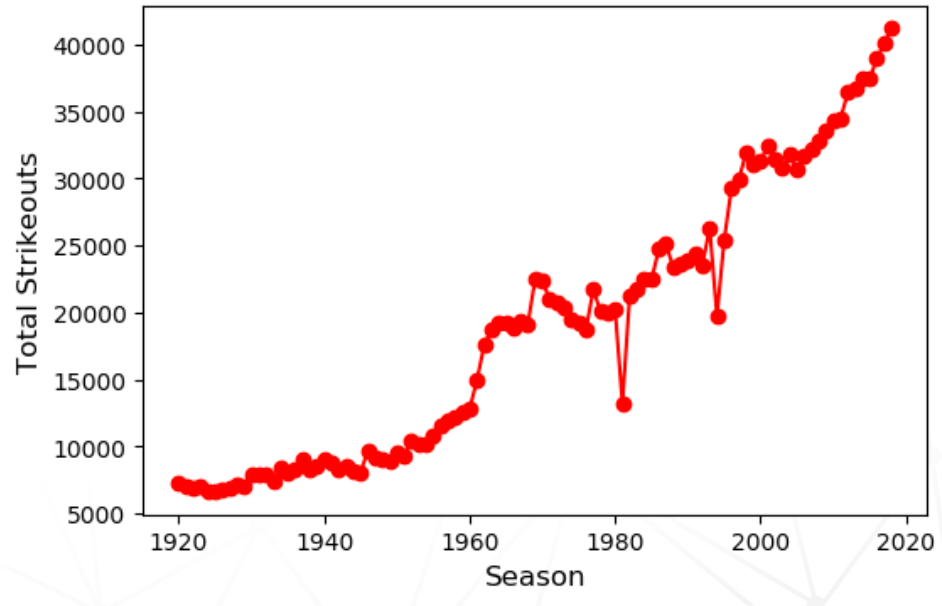
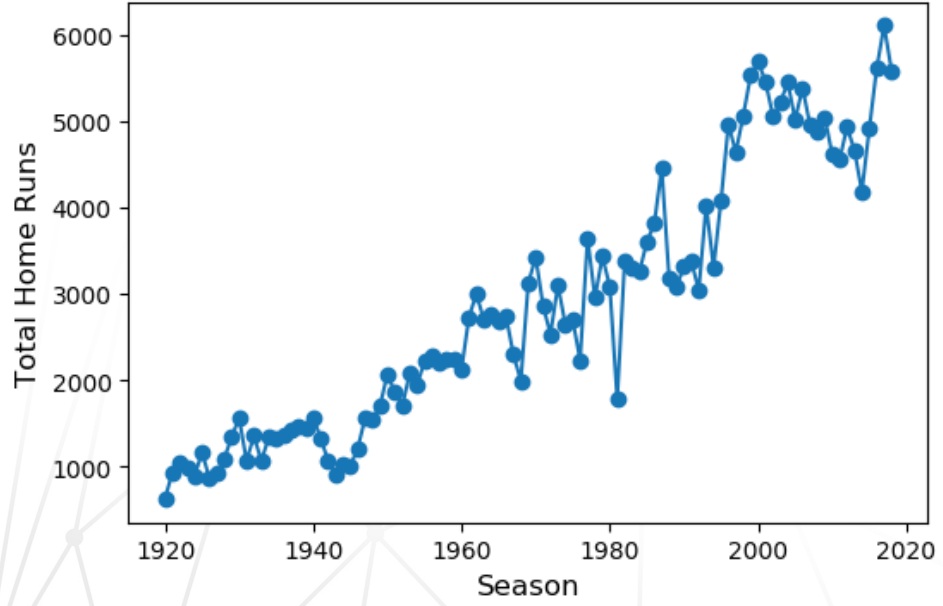




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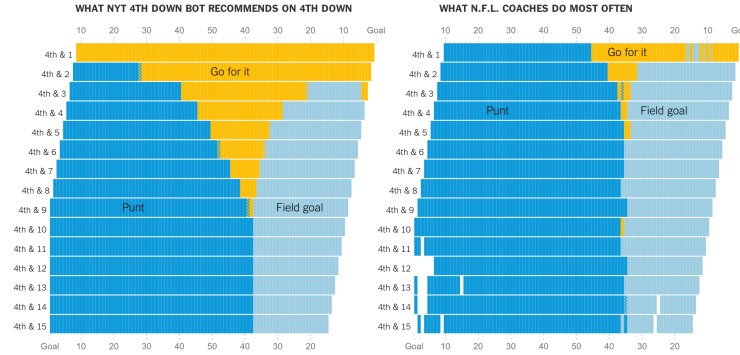
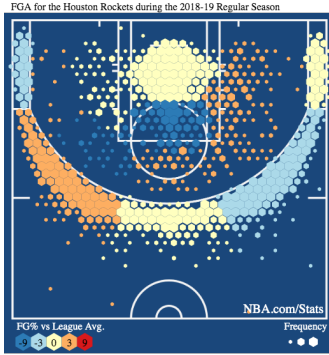
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# Summary

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Go for it!

The shift

