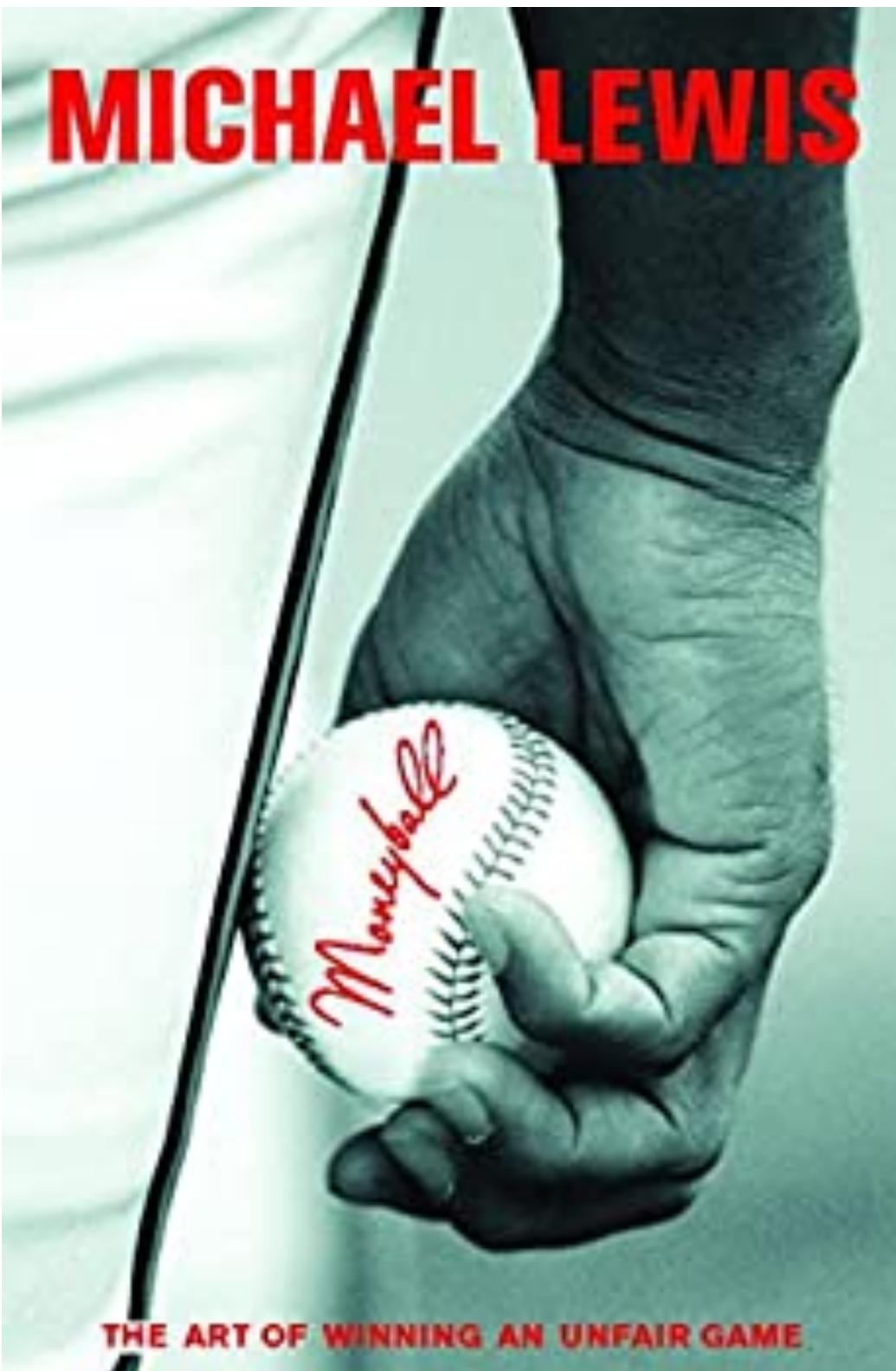


Moneyball

ranking baseball players

Problem Background

MICHAEL LEWIS

A close-up photograph of a baseball player's hand gripping a baseball. The baseball is white with red stitching and has the word "Moneyball" written across its surface in a red, cursive font. The player is wearing a dark green baseball glove. In the background, the edge of a baseball bat is visible against a light-colored, possibly wooden, surface.

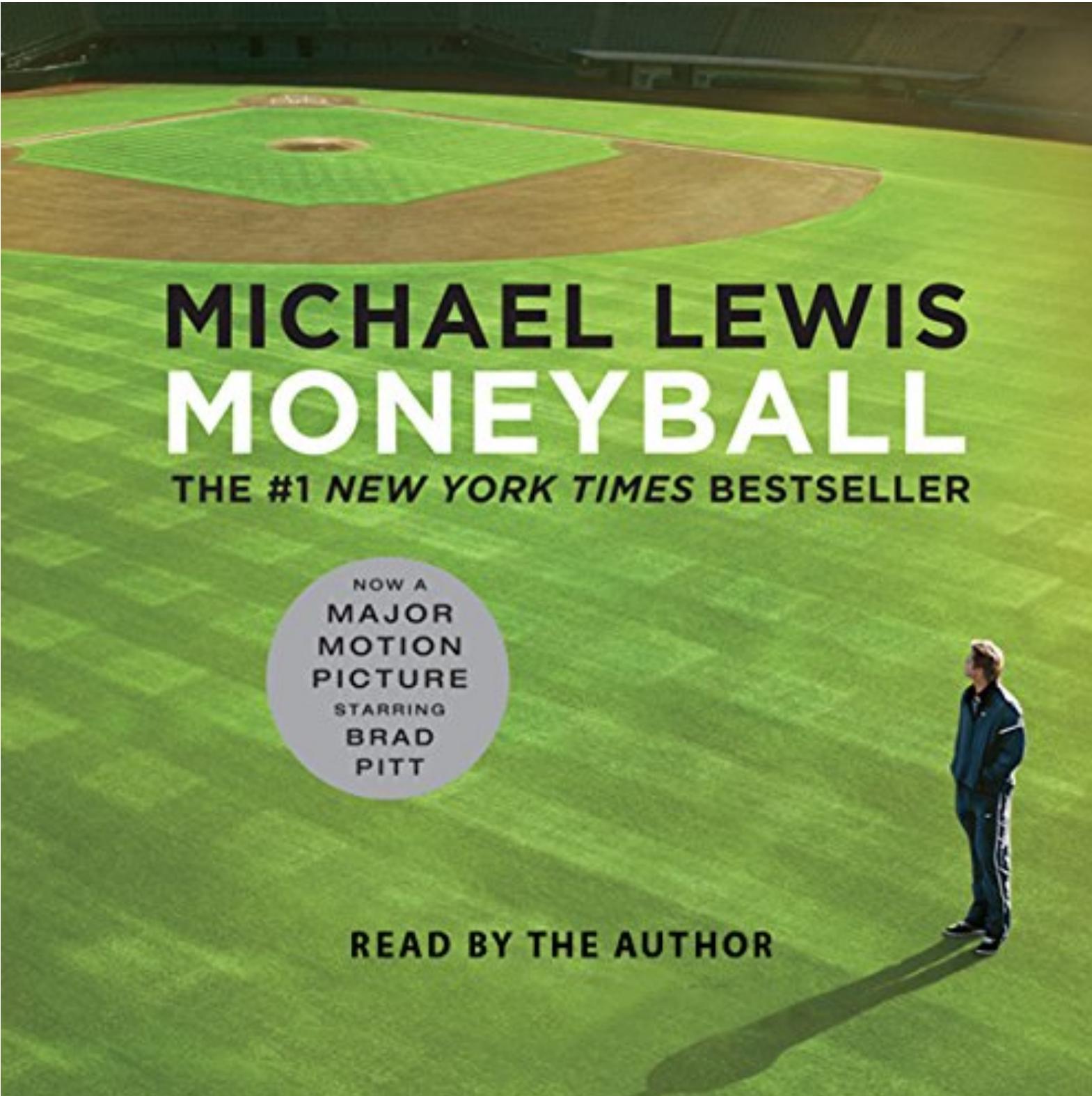
Moneyball

THE ART OF WINNING AN UNFAIR GAME

BRAD PITT MONEYBALL

JONAH HILL PHILIP SEYMOUR HOFFMAN
BASED ON A TRUE STORY





MICHAEL LEWIS

MONEYBALL

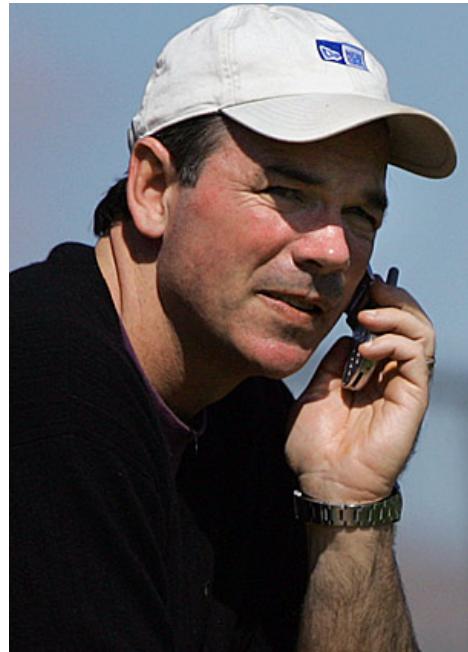
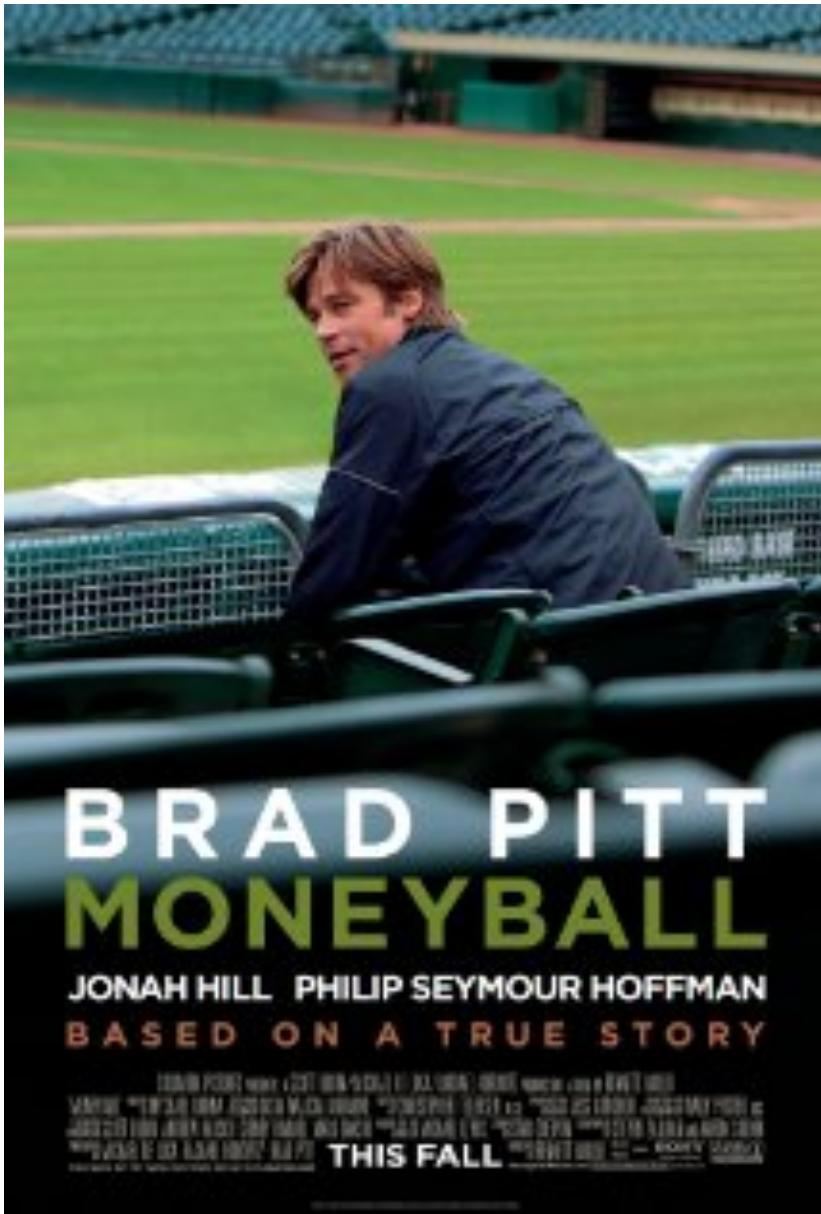
THE #1 NEW YORK TIMES BESTSELLER

NOW A
MAJOR
MOTION
PICTURE
STARRING
BRAD
PITT

READ BY THE AUTHOR



Baseball and Billy (2001)



Billy Beane

Divisional
Series

League Championship
Series

World
Series

League Championship
Series

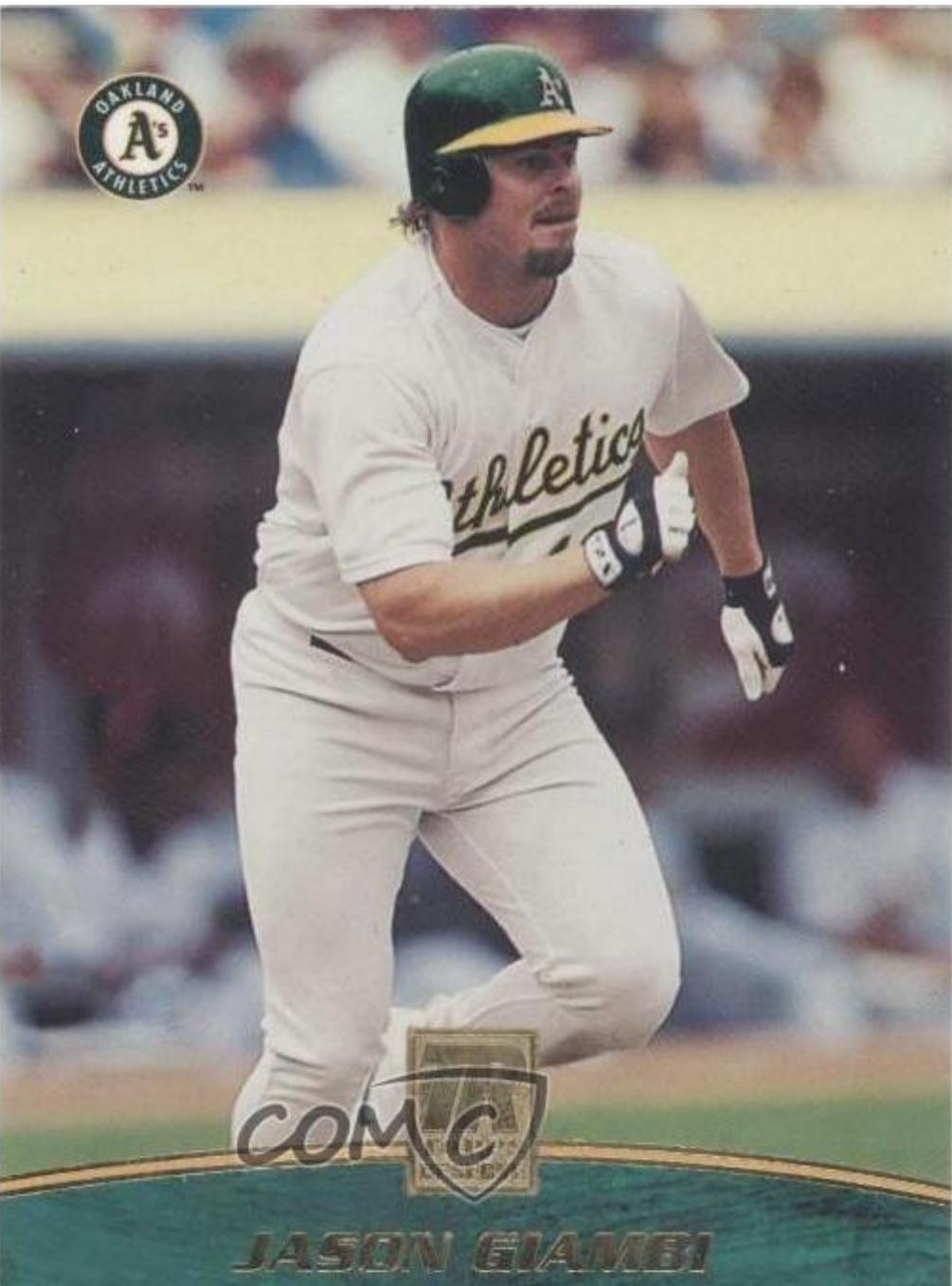
Divisional
Series

2001

MLB PLAYOFFS



Oakland A's (2001)



22 **JASON GIAMBI**

FIRST BASE HT: 6'3" WT: 225
BATS: LEFT | THROWS: RIGHT

BORN: 1-8-71, West Covina, CA
DRAFTED: Athletics #2-June, 1992
ACQUIRED: Via Draft

Giambi earned the 2000 AL MVP Award as much for his leadership as for his monstrous numbers. His .636 AVG with the bases loaded indicates how he responds in the clutch.

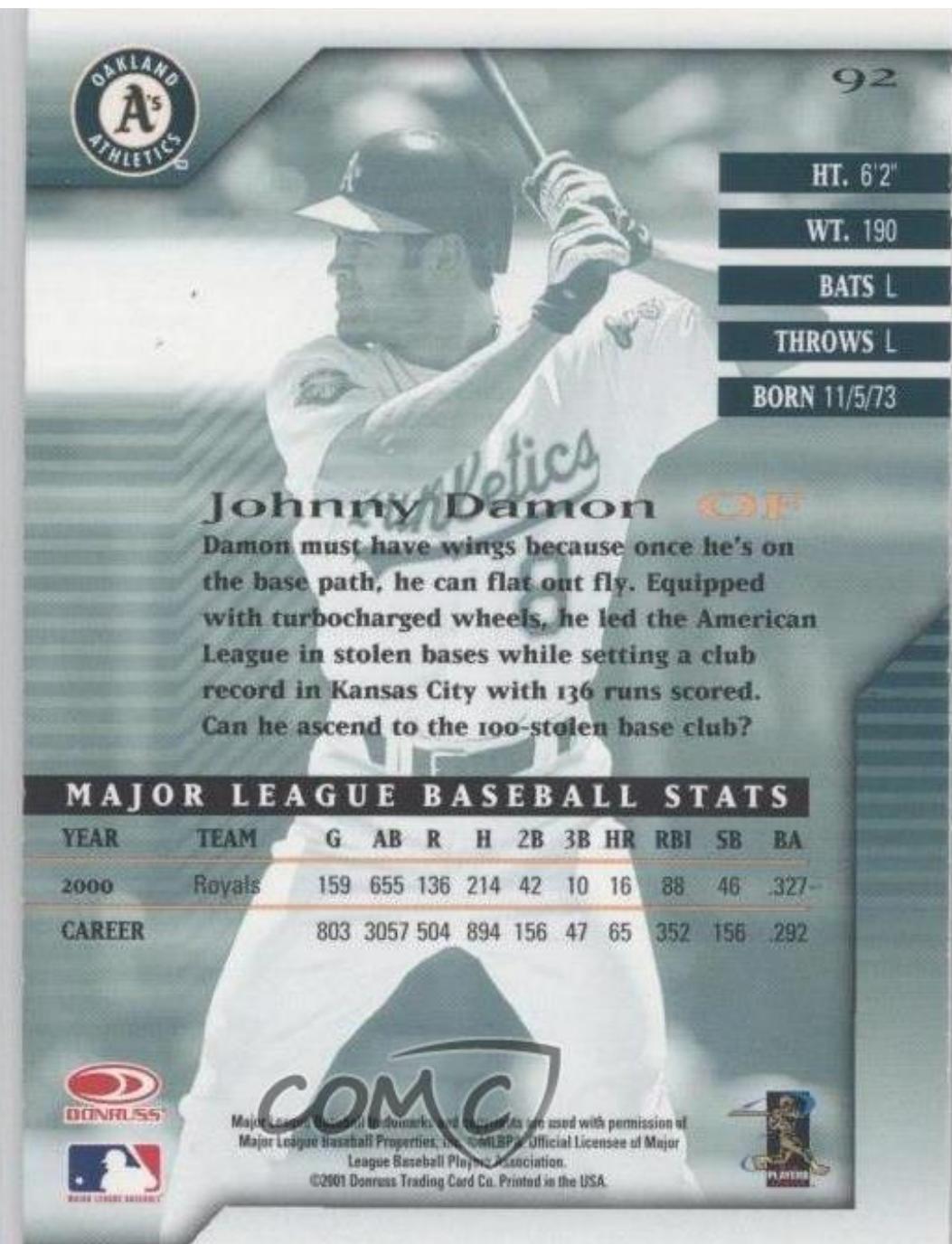
MLB STATS

Year	G	AB	H	HR	RBI	SLG	AVG
1998	153	562	166	27	110	.489	.295
1999	158	575	181	33	123	.553	.315
2000	152	510	170	43	137	.647	.333
Career	799	2878	870	149	555	.524	.302

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comc

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© MLBA, OFFICIAL LICENSEE - MAJOR LEAGUE BASEBALL PLAYERS ASSOCIATION.

Oakland A's (2001)



2001 (payroll)



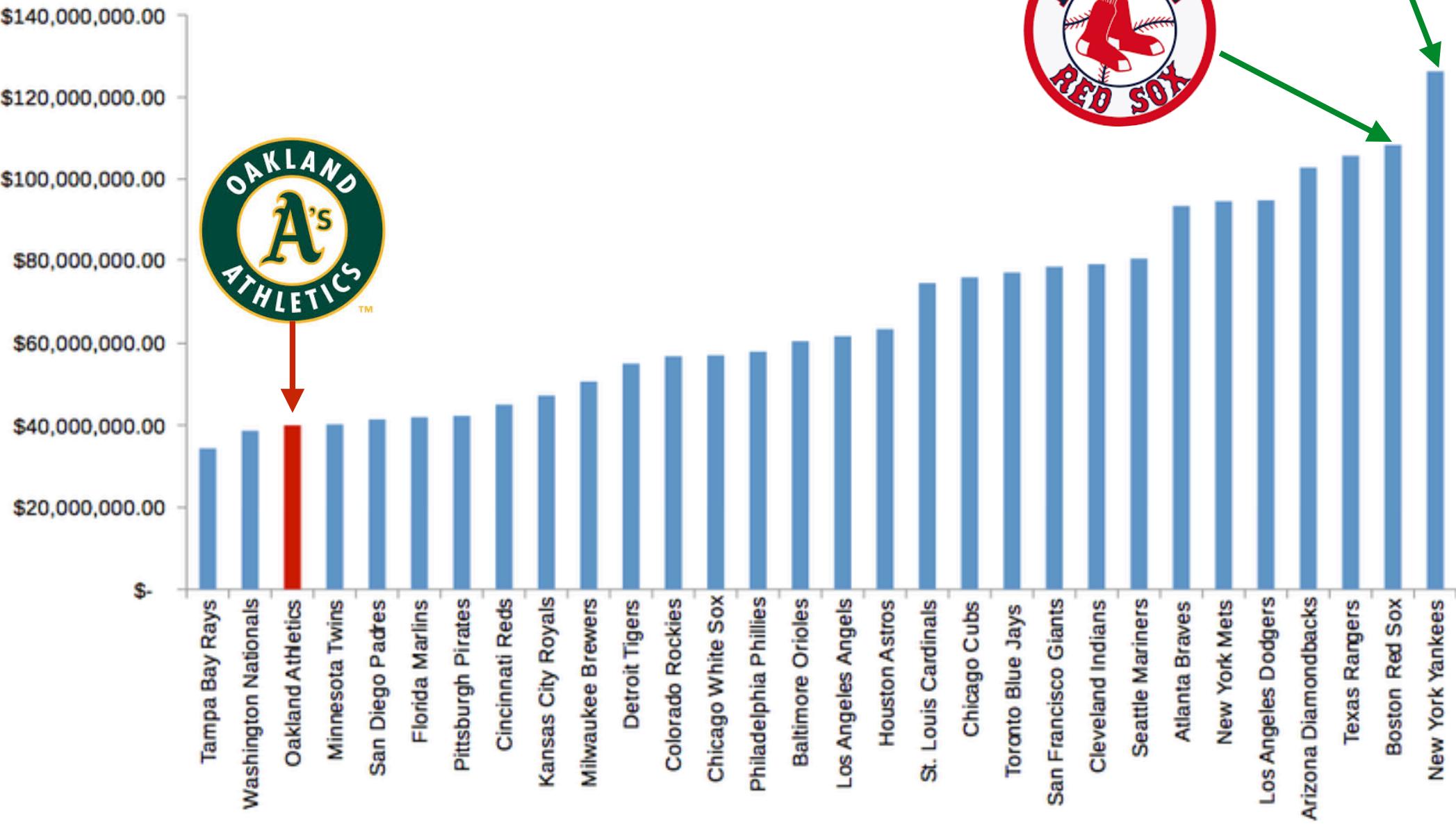
\$114,457,768

vs

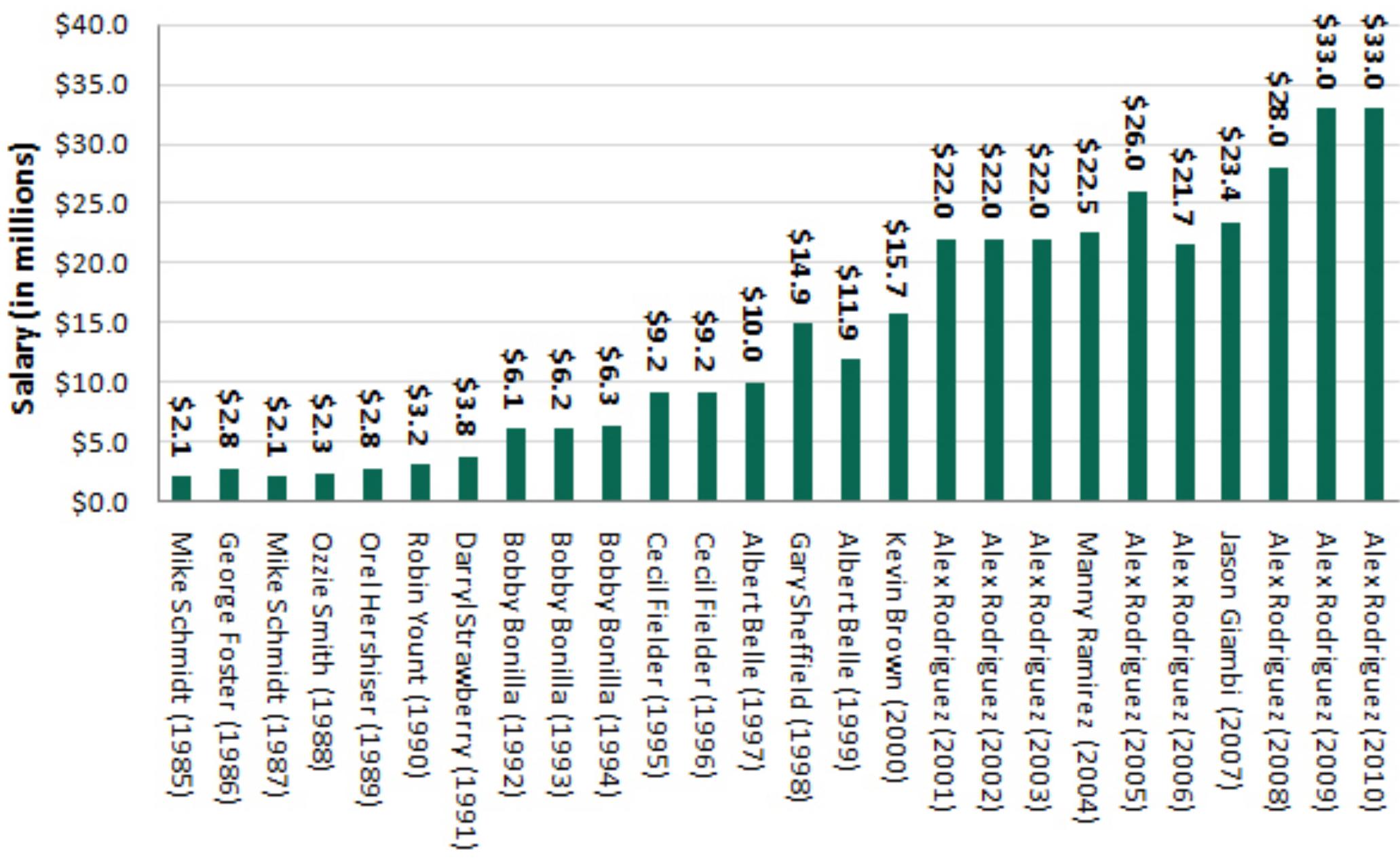


\$ 39,722,689

Payroll in 2002

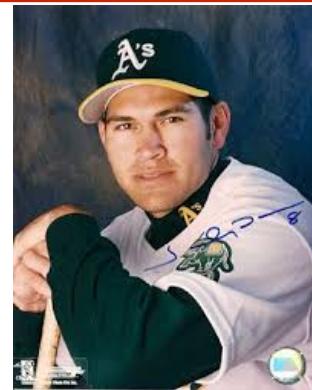


Baseball's Highest-Paid Player





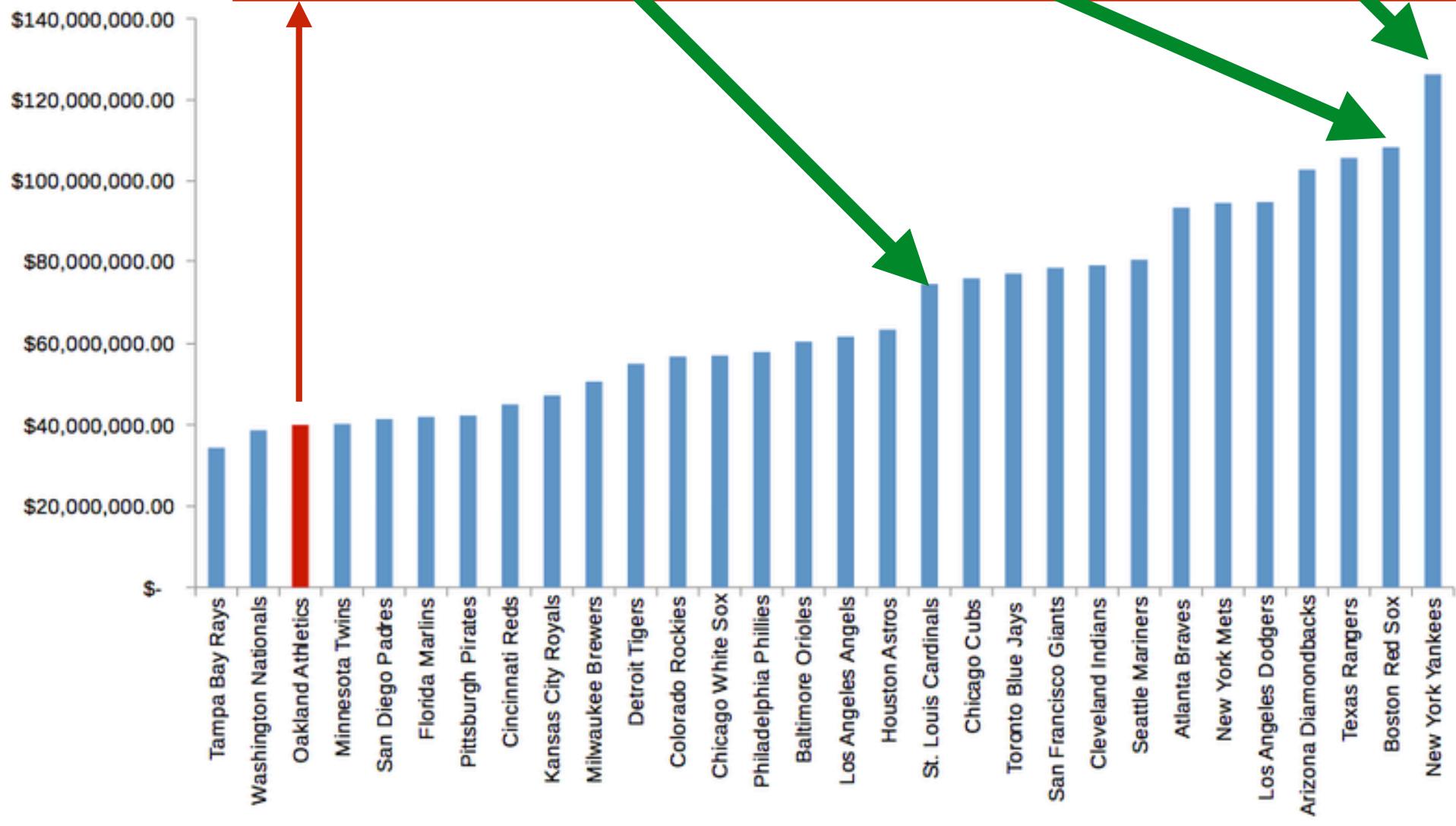
Jason Isringhausen



Johnny Damon



Jason Giambi



with a small payroll (2002) lose best players



Jason Giambi

\$ 10.4M



Johnny Damon

\$ 7.5M



Jason Isringhausen

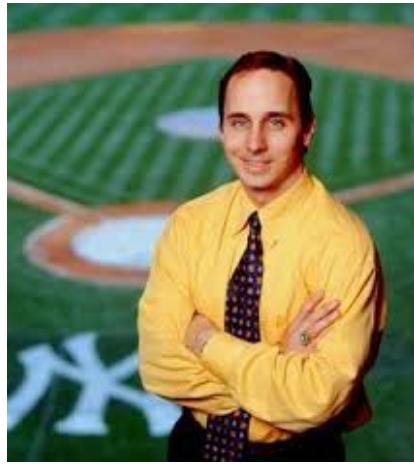
\$ 2.8M



How does the baseball business work?



boss (owner)



manager (CEO)



Scout (HR)



Player (employee)



Team (Company)



Fans (customer)

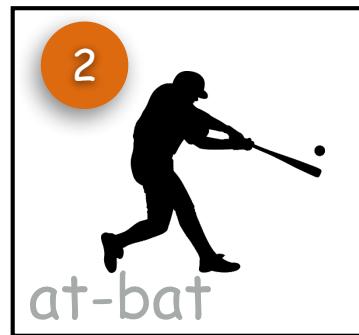
Batter Ranking Problem



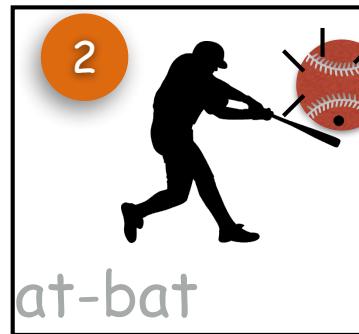
Batter Ranking Problem

playerID	Batter	Salary	Hits	At-Bats
1		1M	35	47
2		3M	46	100
3		2M	20	68

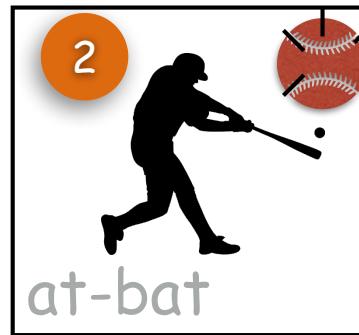
(1) Random Hit



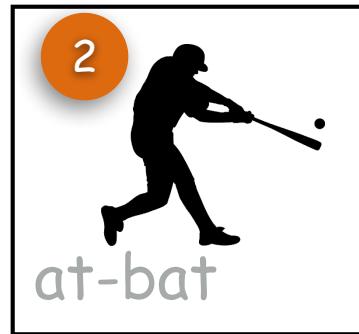
not hit



hit



hit



not hit

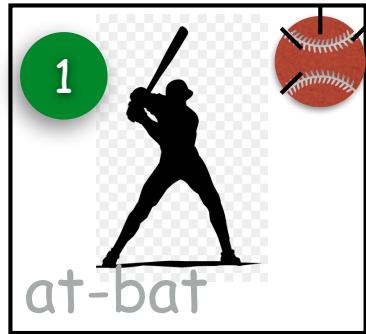
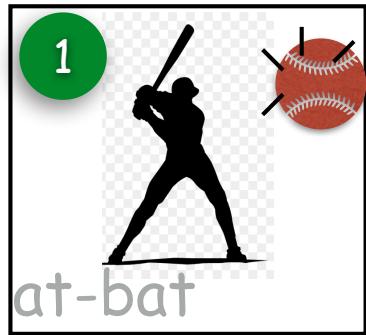
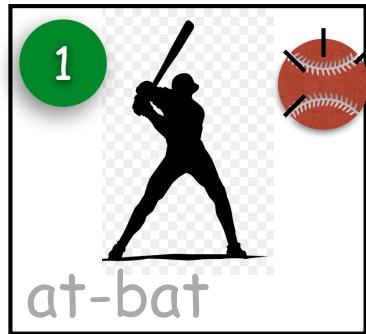
...

(2) Different Hit Probabilities for Different Batters

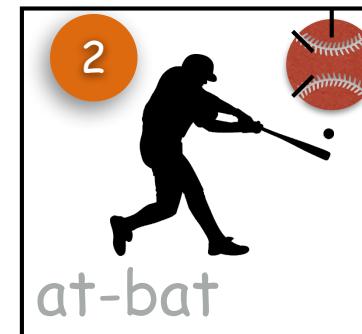
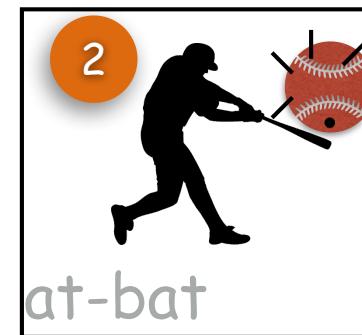
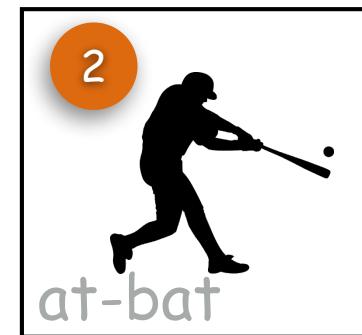
70%

50%

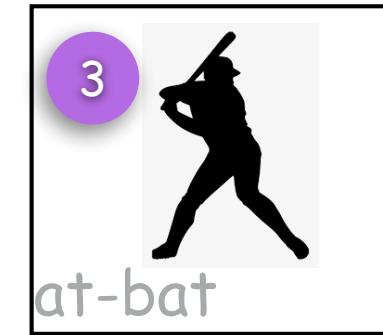
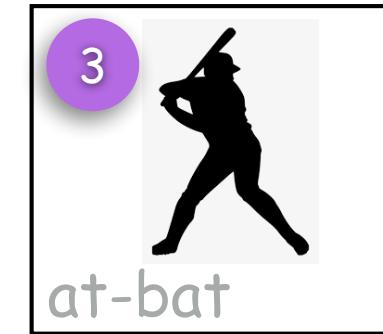
20%



hit



not hit

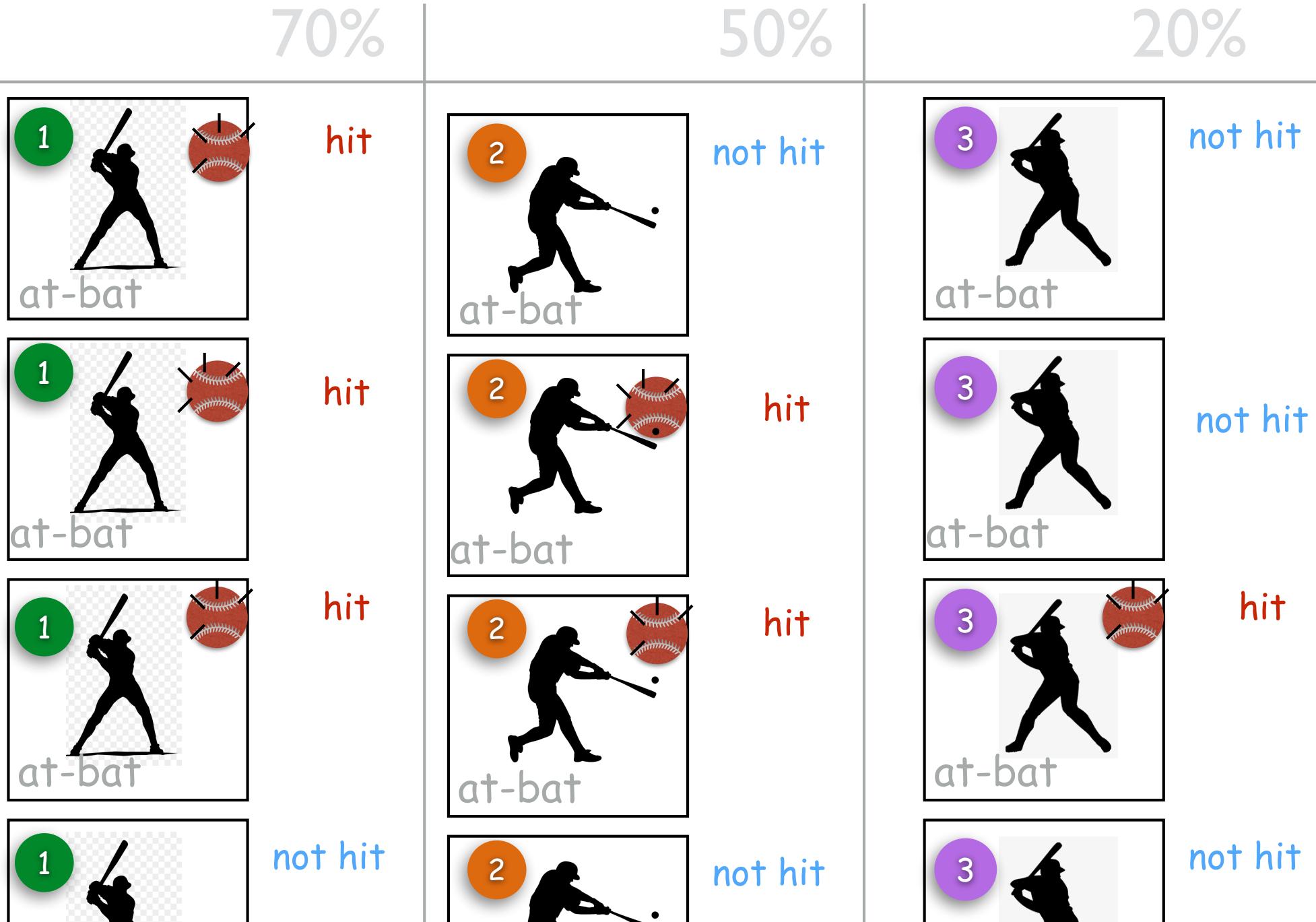


not hit

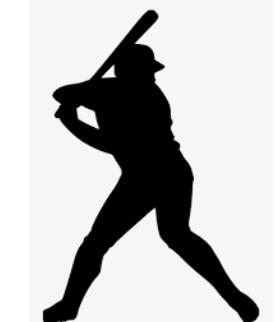
hit

not hit

(3) Unknown Hit Probabilities

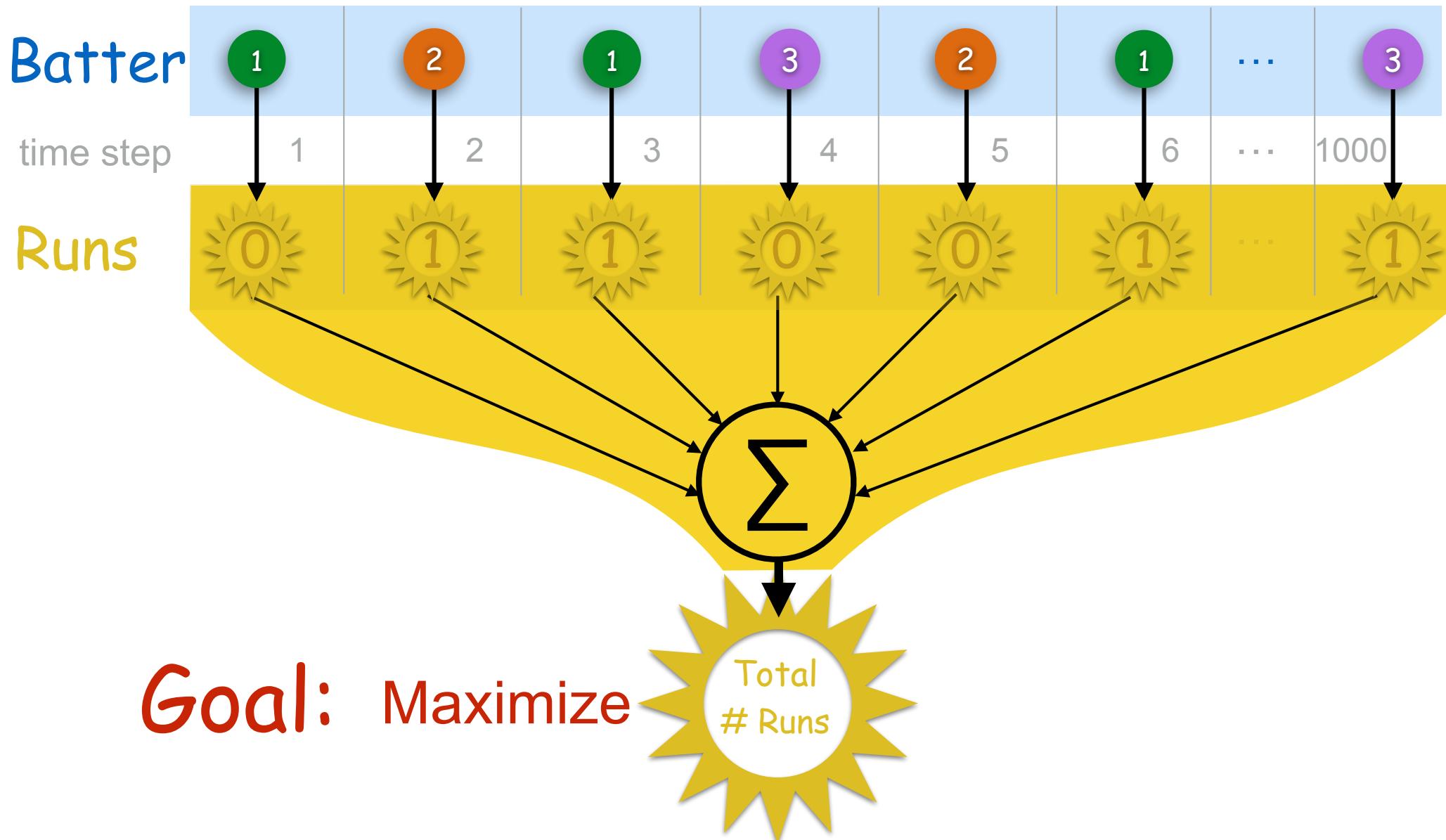


(4) Different Salary for Different Players

playerID	Batter	Salary
1		1M
2		3M
3		2M

(5) A Different Goal

Team



How to put everything together?

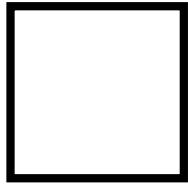
Batter Ranking Problem

playerID	Batter	Salary	Hits	At-Bats	Our Score
3		2M	20	68	78
2		3M	46	100	60
1		1M	35	47	48

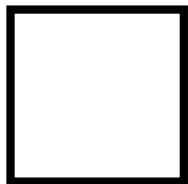
Batter Ranking Problem



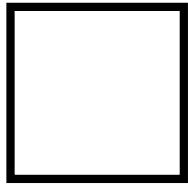
Challenge 1: Randomness in Hits



Challenge 2: Unknown Hit Rate



Challenge 3: A Different Goal



Challenge 4: Different Salaries

Prize Wheel

Action: spin the wheel

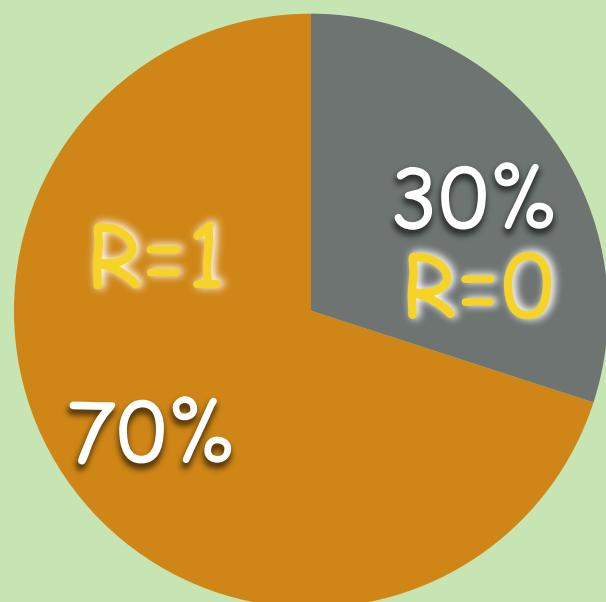
Random Reward

Winning probabilities are known

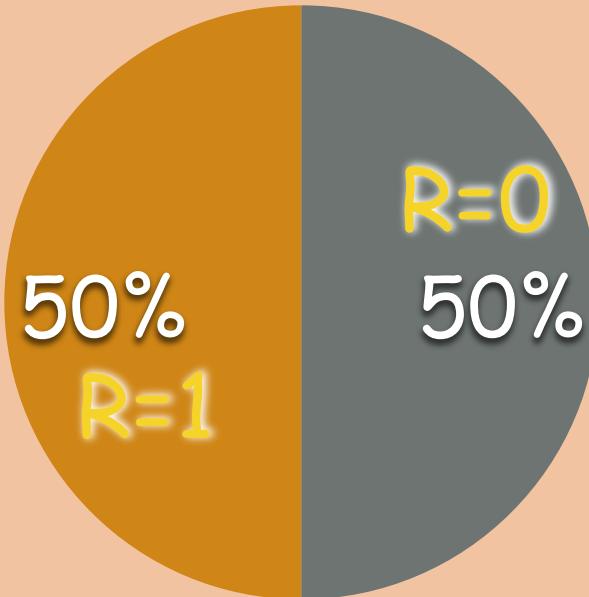
Possible rewards are known



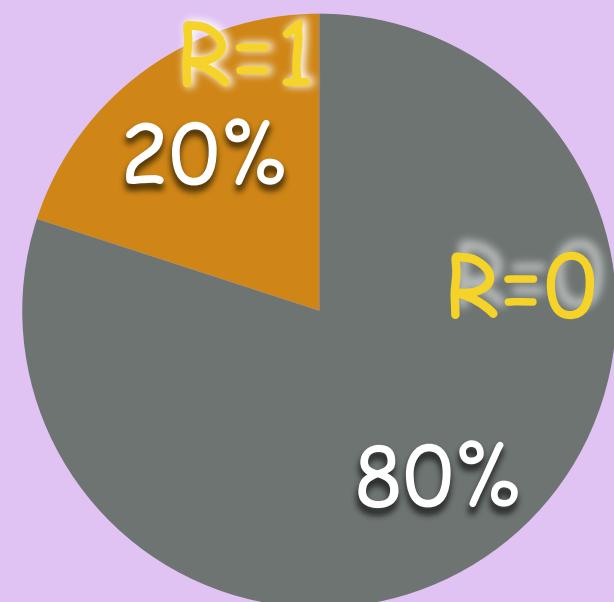
you can choose which one wheel to spin



spin wheel 1



spin wheel 2



spin wheel 3

or

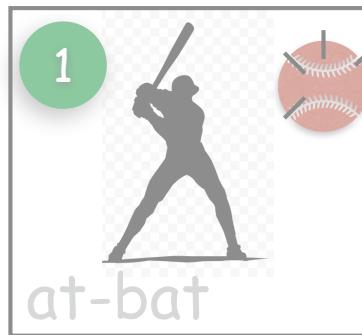
or

Solution: Rank by Hit Rate

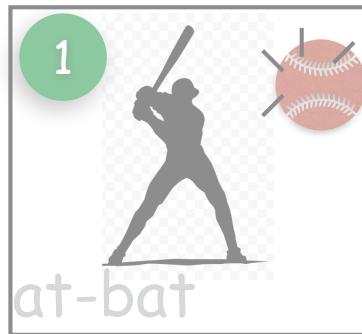
70%

50%

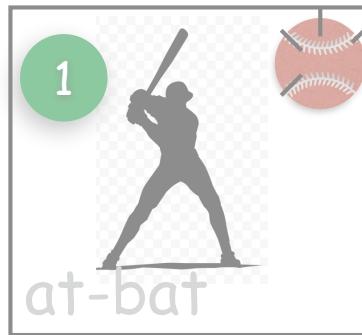
20%



hit



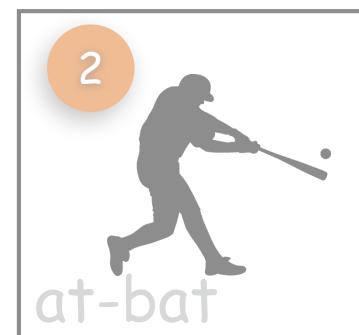
hit



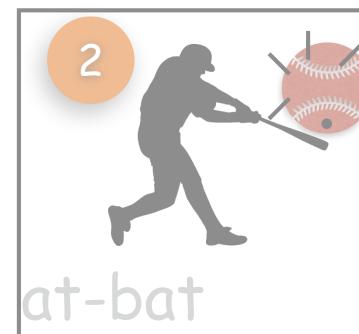
hit



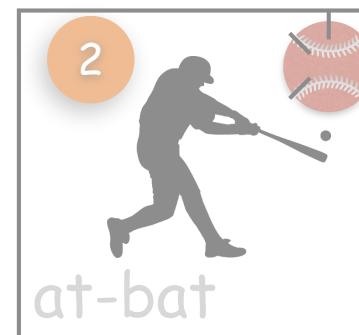
not hit



not hit



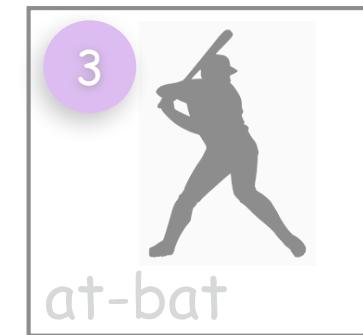
hit



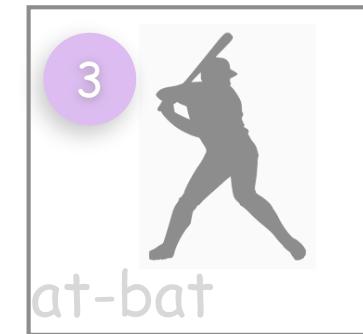
hit



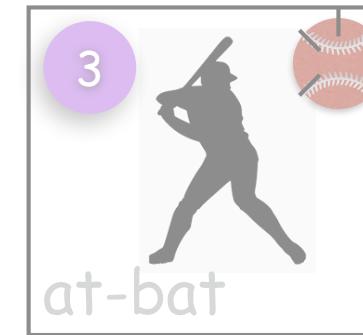
not hit



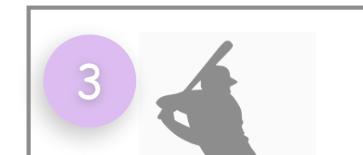
not hit



not hit



hit



not hit

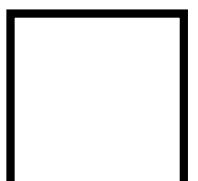
Batter Ranking Problem



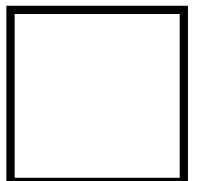
Challenge 1: Randomness in Hits



Challenge 2: Unknown Hit Rate

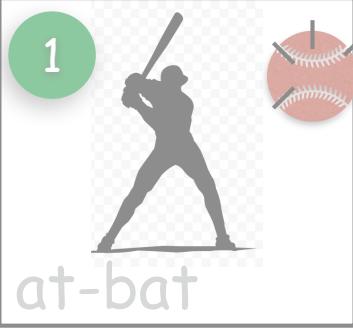
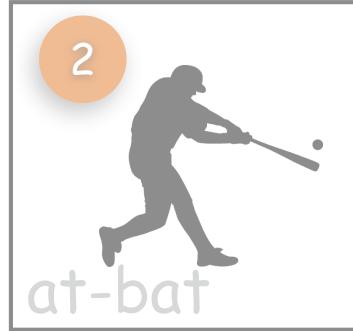
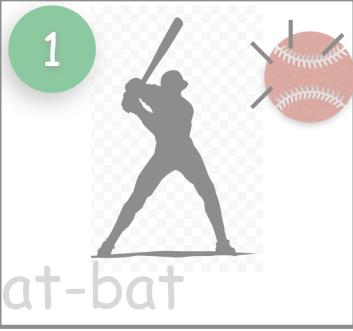
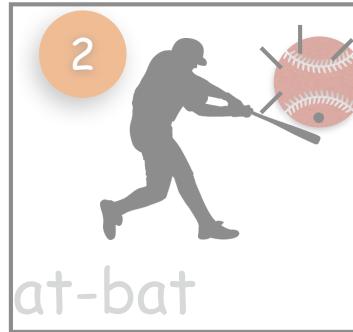
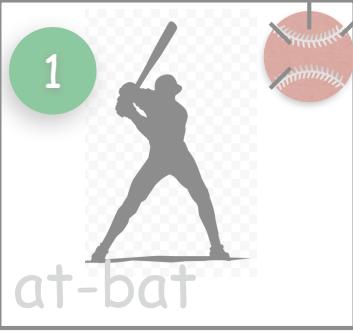
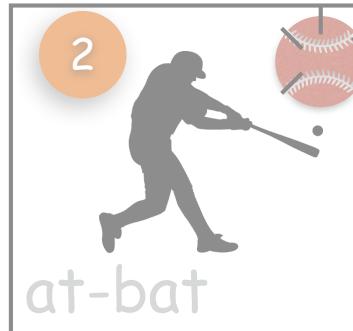
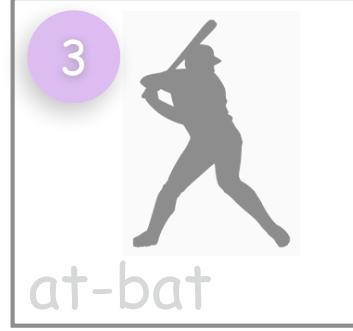
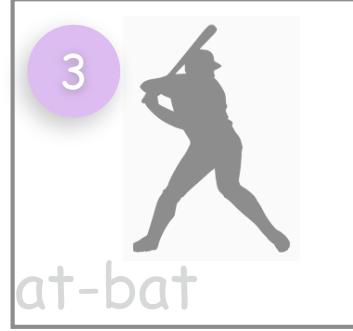
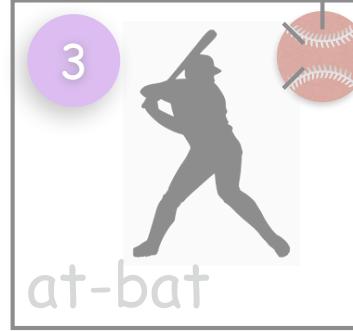
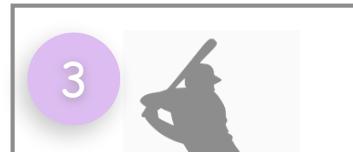


Challenge 3: A Different Goal



Challenge 4: Different Salaries

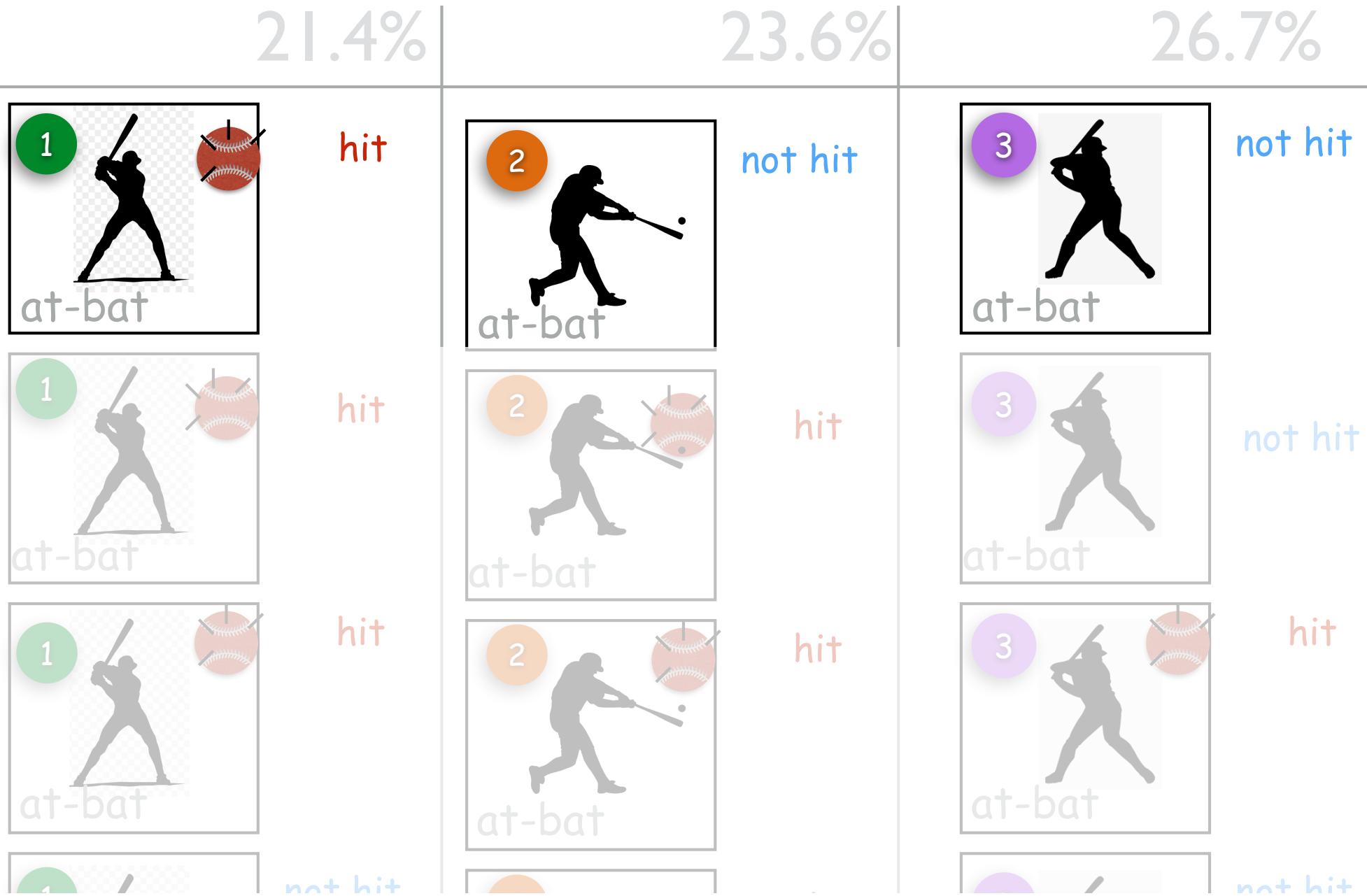
Unknown Hit Rate

?	hit	?	not hit
	hit		not hit
	hit		hit
	hit		hit
	not hit		not hit
	not hit		not hit
	hit		not hit



player selection: Scout

Observed Hits in a Game



A Simpler Problem

the hits follows a Bernoulli Distribution

True Distribution

(unknown)

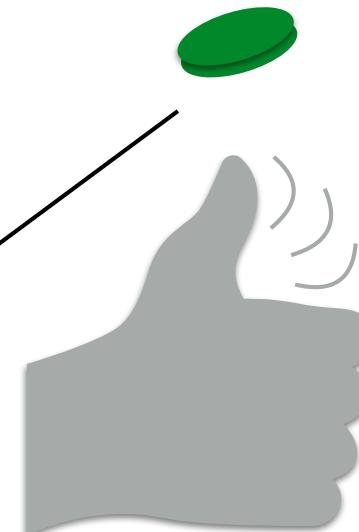
a biased coin



$$h^* = 0.7$$

1

We can flip this coin to collect data



Action: flip



1 hit



0 not hit

If flipped many times:



Estimate:

$$E(R) = ?$$

A Simpler Problem

the reward follows a Bernoulli Distribution

True Distribution

(unknown)

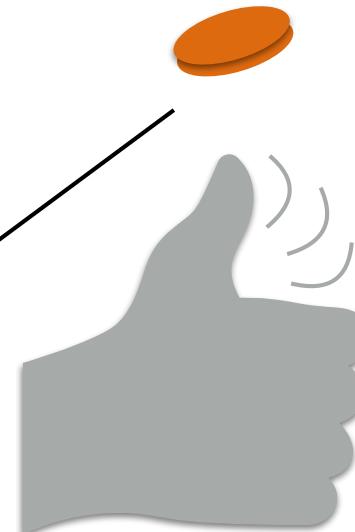
an unbiased coin



$$h^* = 0.5$$

2

We can flip this coin to collect data



Action: flip

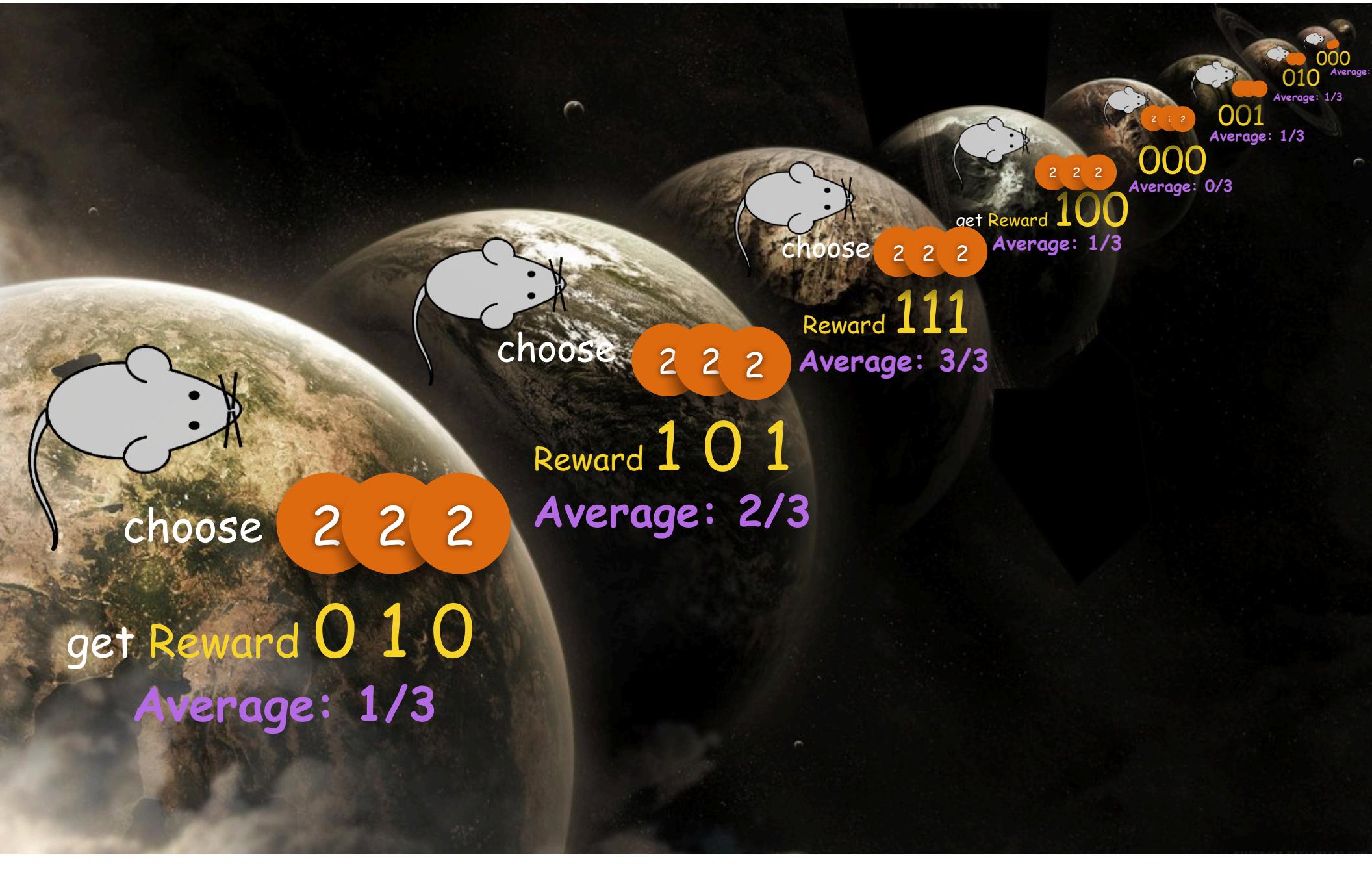
Result: reward

If flipped many times:



Estimate:
 $E(R) = ?$

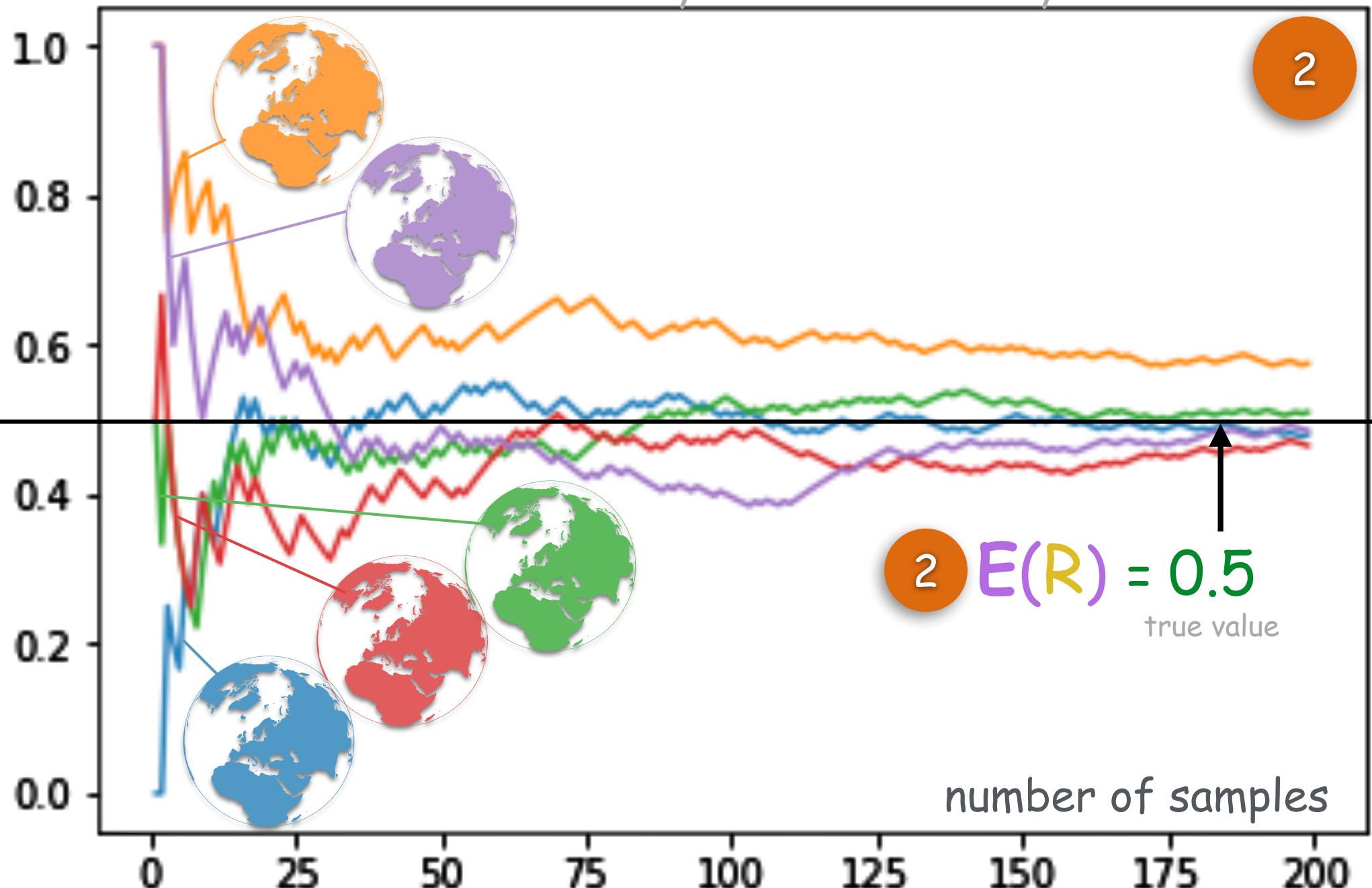
Average Reward Observed in Different Universes



Sample Averages Observed in 5 Universes

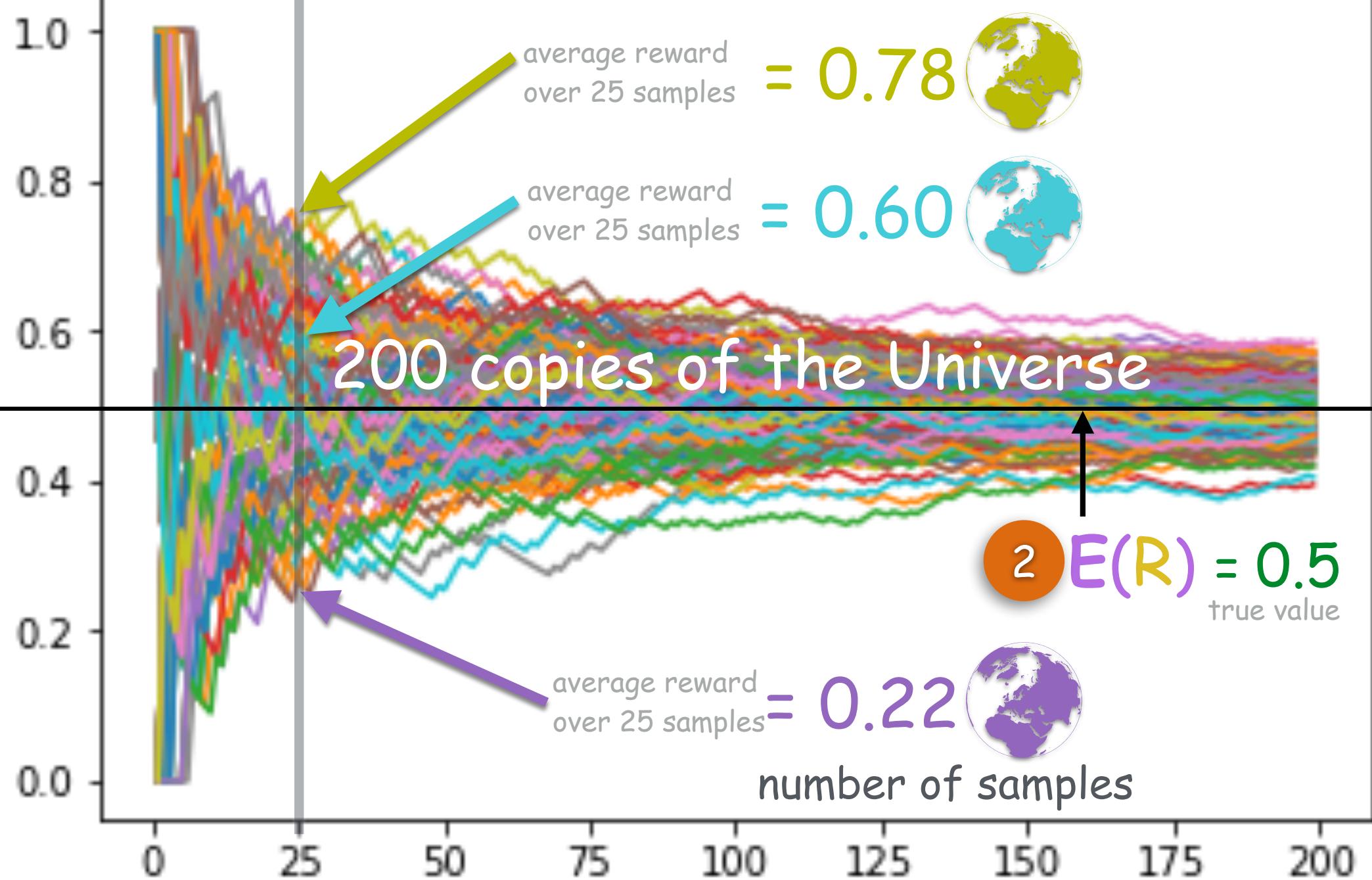
Note: you cannot choose your universe

average



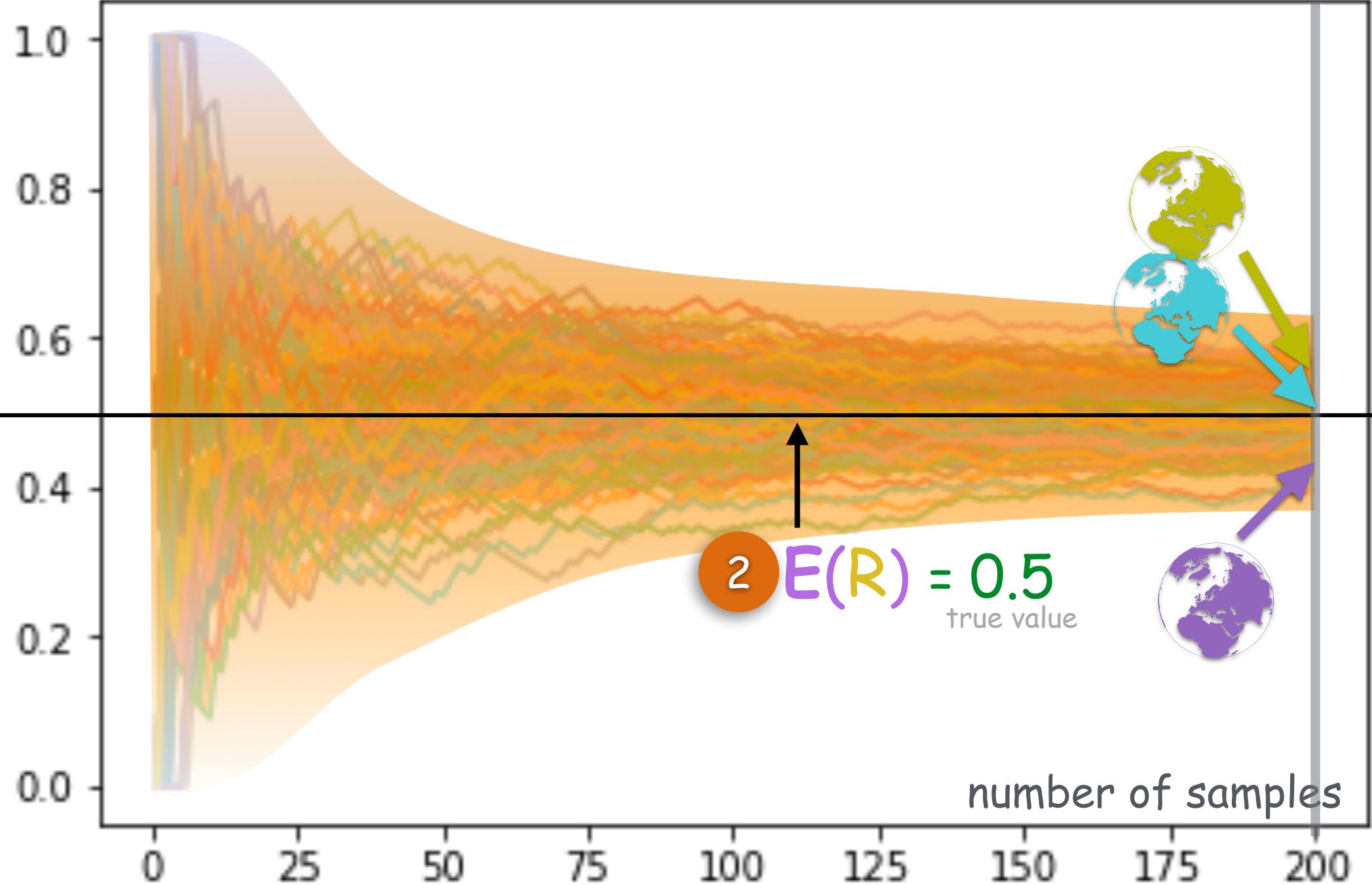
More Universes

average reward



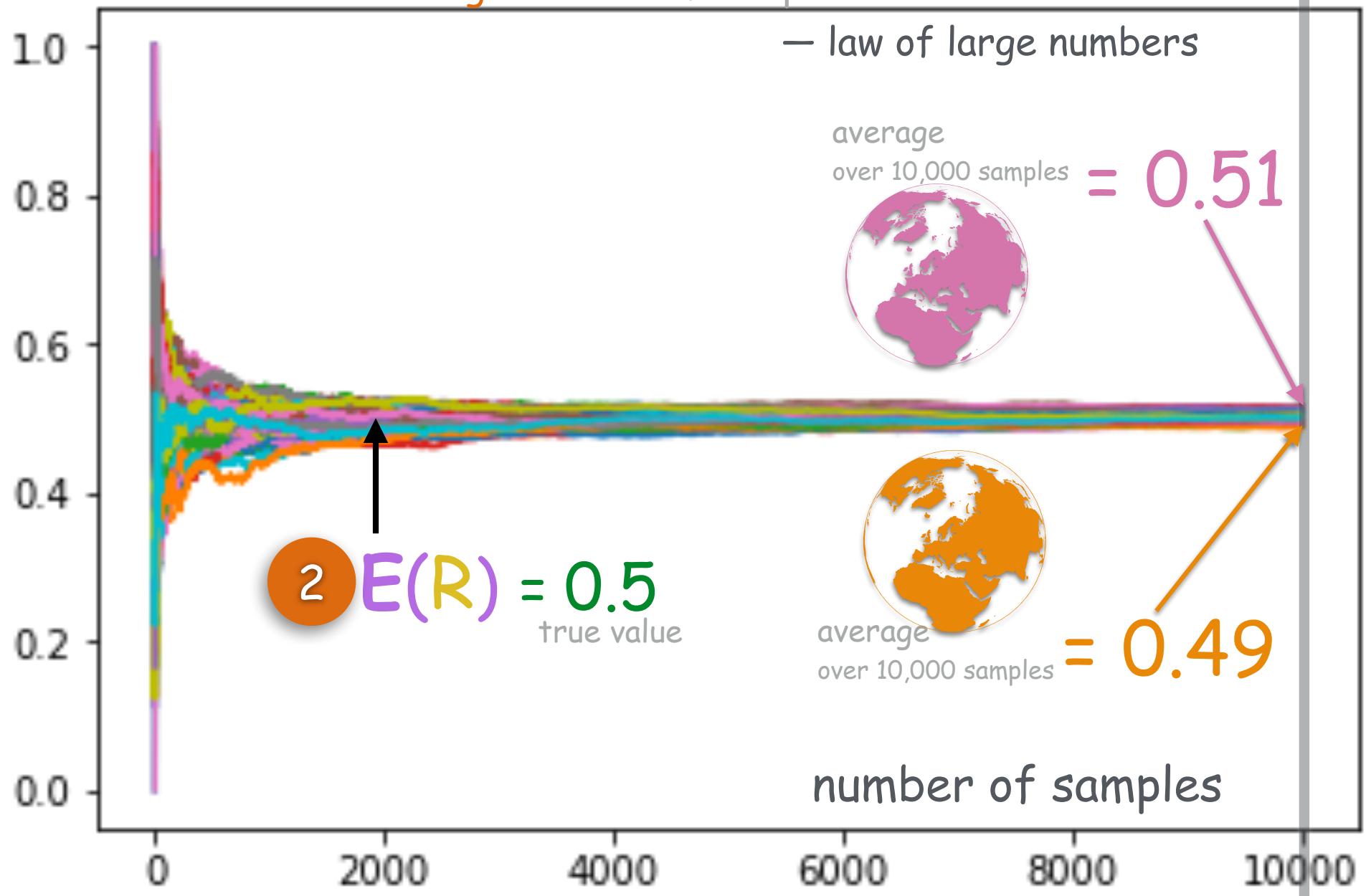
More Universes

average reward



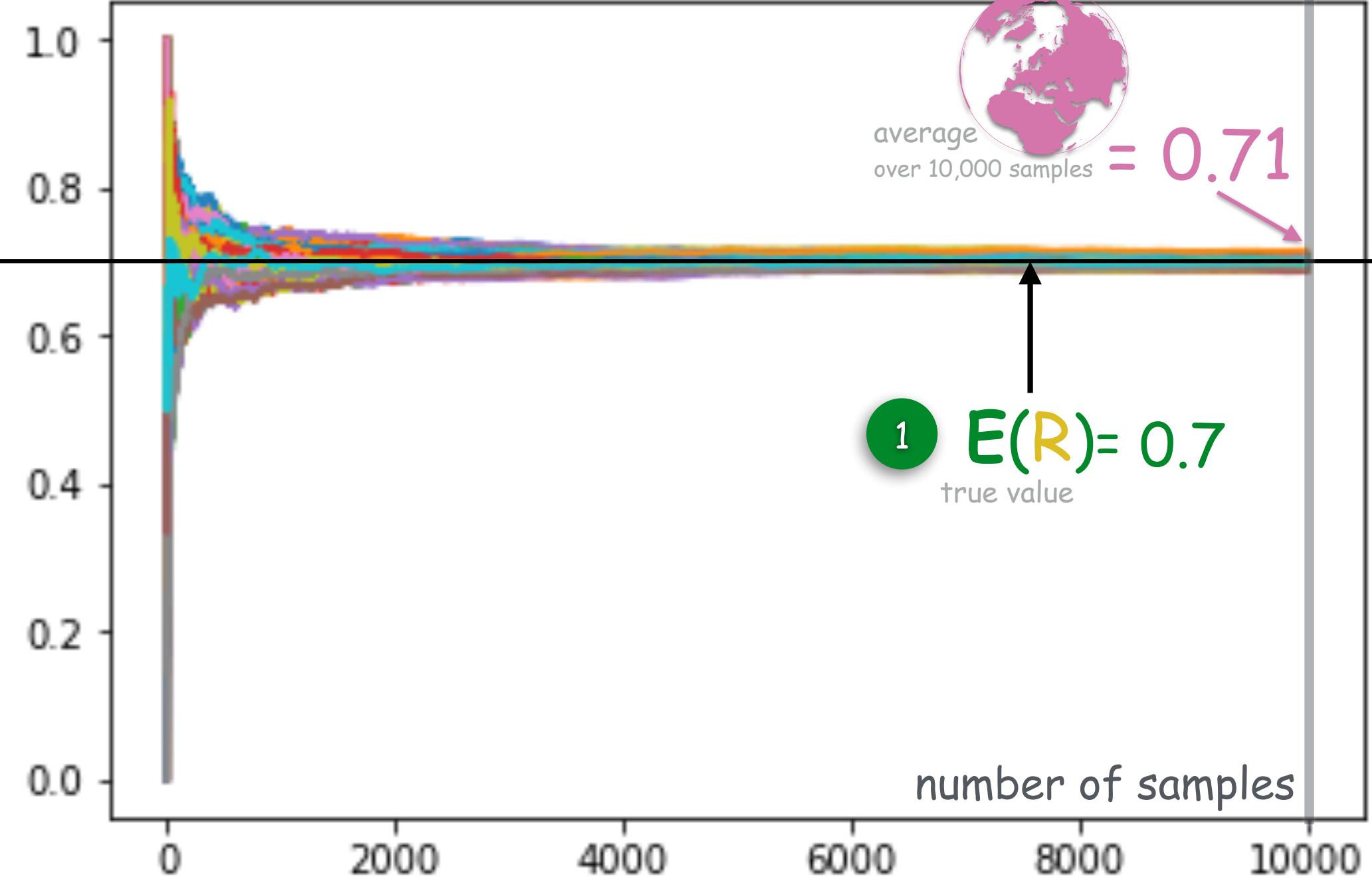
More Samples

average
reward



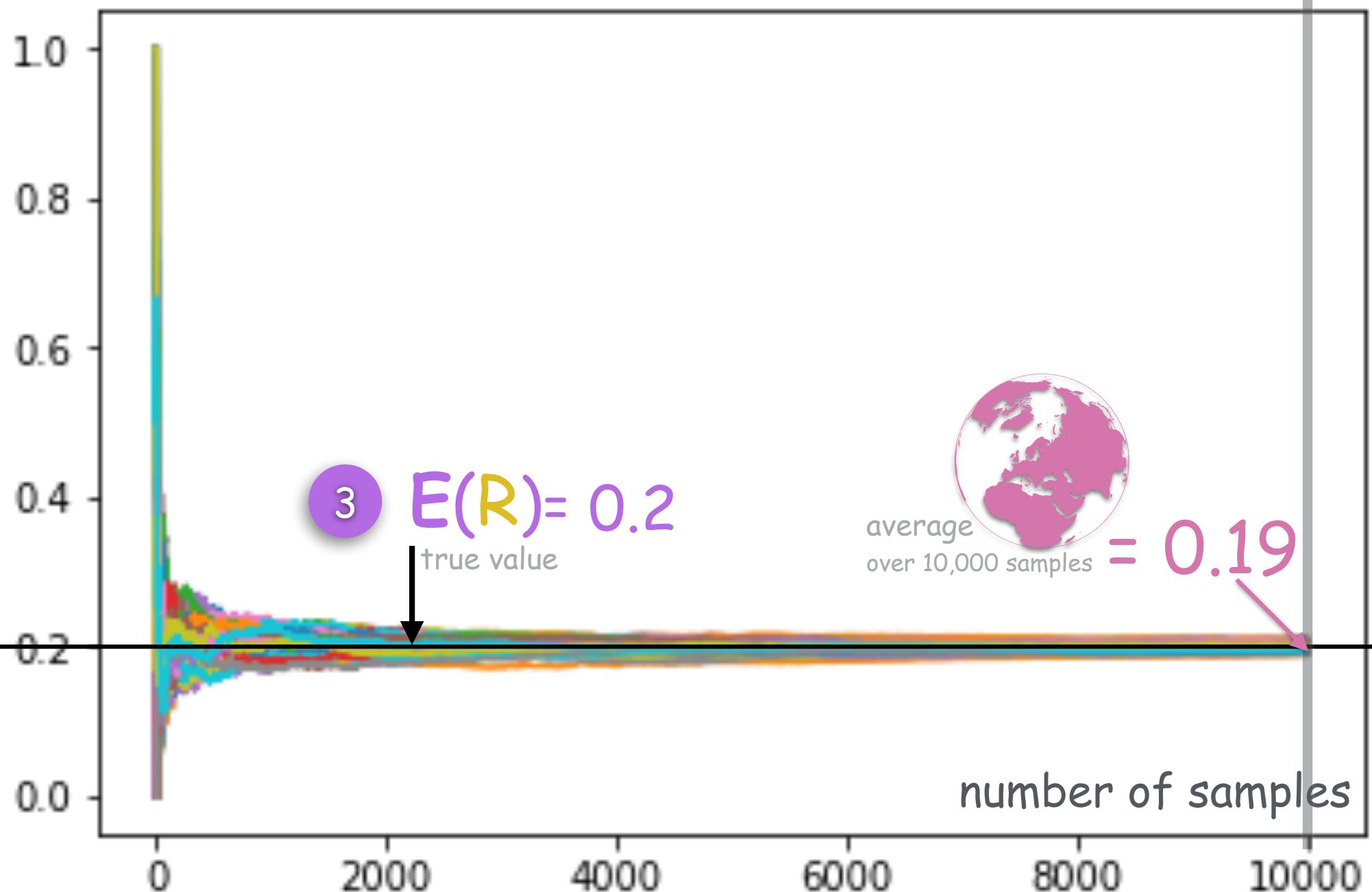
Just Use Sample Average

average
reward



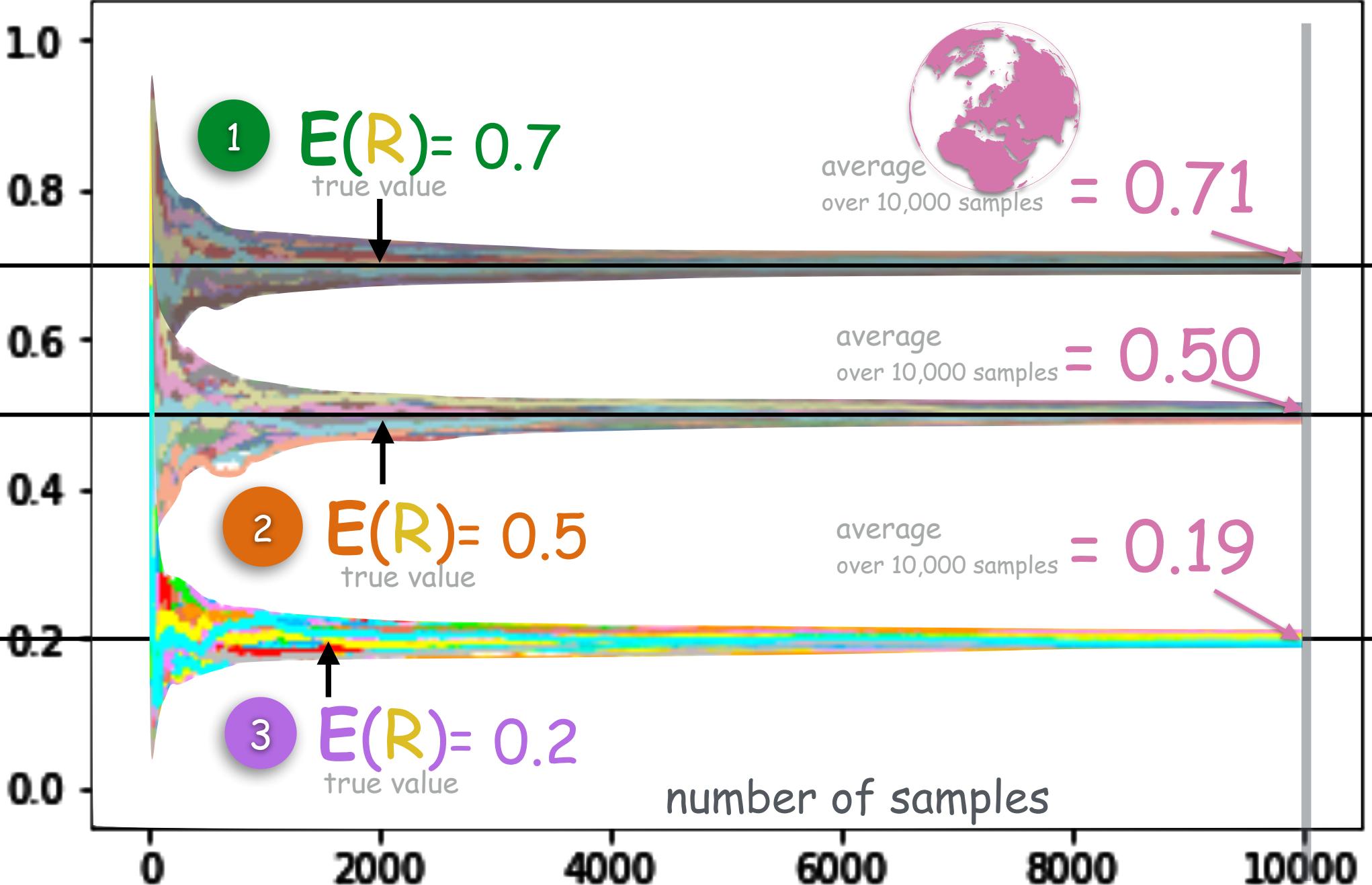
average
reward

Just Use Sample Average



Comparing Actions

average
reward





Scout: work with small samples

How do we choose players?



appearance?

How do we choose players?



style?

How to choose players?

style?

appearance?

age?

attitude?



How were the players picked?



https://youtu.be/pWgyy_rlMag?t=1s

FREE AGENTS

DYE RF

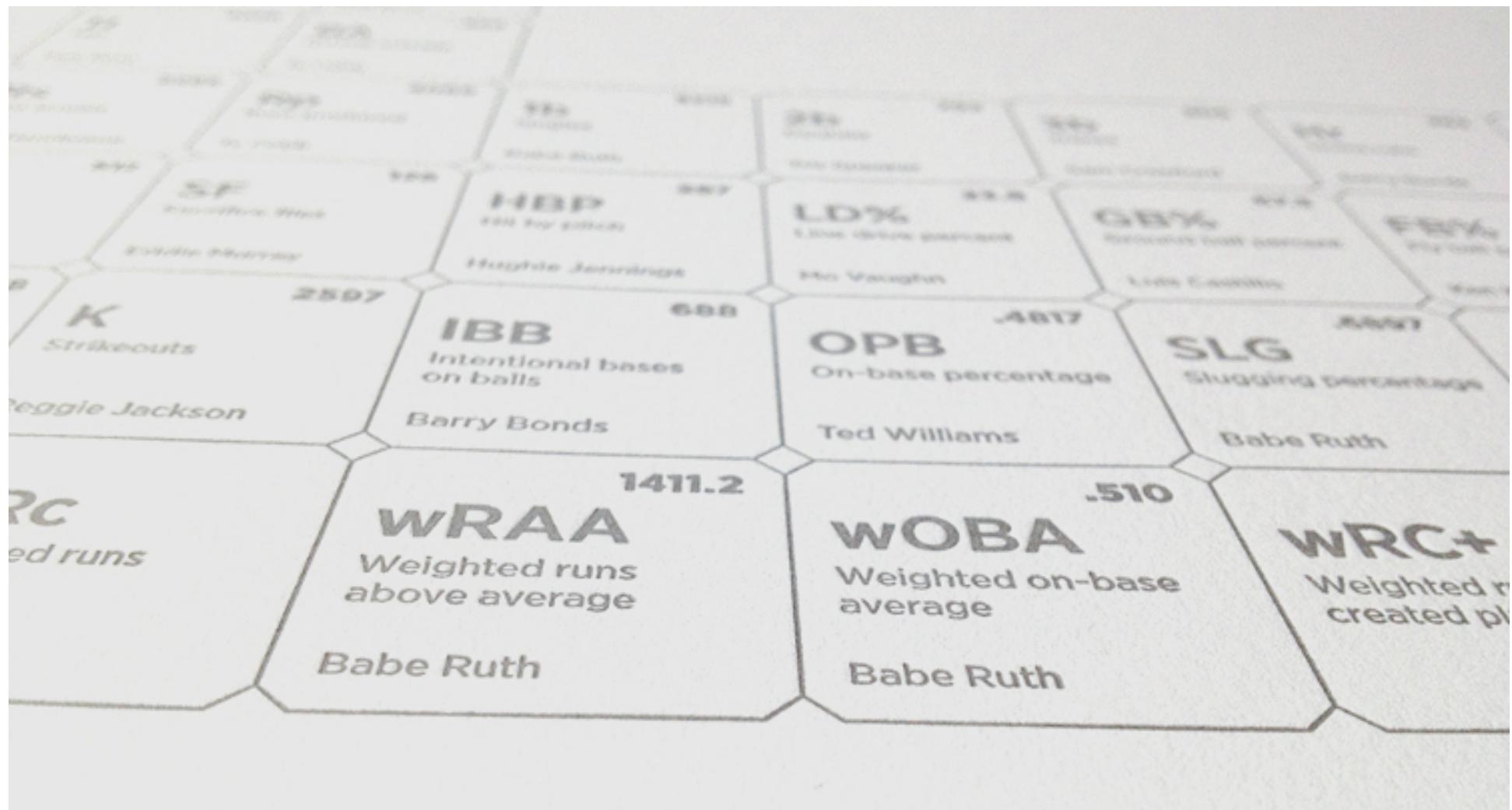
GIAMBI 1B

DAMON CF

ISRINGHAUSEN RHP

Sabermetrics

- the empirical analysis of baseball, especially baseball statistics that measure **in-game activity**.



Data

CS	BB	SO	BA	OBP	SLG	OPS	TB	GDP	HBP	SH	SF
2	29	28	.269	.352	.347	.699	75	6	0	2	2
2	22	22	.277	.349	.361	.710	69	6	0	2	2
0	7	6	.200	.375	.240	.615	6	0	0	0	0
3	41	49	.232	.327	.300	.626	89	6	2	1	3
3	48	50	.261	.373	.396	.769	111	11	2	3	0
3	42	38	.278	.393	.432	.824	98	6	1	1	0
0	6	12	.189	.283	.245	.529	13	5	1	2	0
3	39	58	.242	.331	.386	.717	118	16	3	2	2

At-Bat (AB)

"times at bat," "turns at bat"

<http://m.mlb.com/glossary/standard-stats/at-bat>



An official at-bat comes when a batter reaches base via a fielder's choice, hit or an error (not including catcher's interference) or when a batter is put out on a non-sacrifice. (Whereas a plate appearance refers to each completed turn batting, regardless of the result.)

Hits (H)

<http://m.mlb.com/glossary/standard-stats/hit>



A hit occurs when a batter strikes the baseball into fair territory and reaches base without doing so via an error or a fielder's choice. There are four types of hits in baseball: singles, doubles, triples and home runs. All four are counted equally when deciphering batting average. If a player is thrown out attempting to take an extra base (e.g., turning a single into a double), that still counts as a hit.

Batting Average (BA)

https://en.wikipedia.org/wiki/Batting_average



the number of hits divided by at bats

$$BA = \frac{H}{AB}$$

A player with a batting average of .300 is "batting three-hundred."

Ranking with BA

#	Player	Avg ^[15]	Team(s)	Year(s)
1	Ty Cobb	.366	Philadelphia (AL), Detroit (AL)	1905-1928
2	Rogers Hornsby	.358	St. Louis (NL), New York (NL), Boston (NL), Chicago (NL), St. Louis (NL), St. Louis (AL)	1915–37
3	Shoeless Joe Jackson	.356	Philadelphia (AL), Cleveland (AL), Chicago (AL)	1908-20
4	Lefty O'Doul	.349	New York (AL), Boston (AL), New York (NL), Philadelphia (NL), Brooklyn	1919–23, 1928–34
5	Ed Delahanty	.346	Philadelphia (NL), Cleveland (PL), Philadelphia (NL), Washington	1888–1903
6	Tris Speaker	.345	Boston (AL), Cleveland, Washington (AL), Philadelphia (AL)	1907–28
7	Billy Hamilton	.34442	Kansas City (AA), Philadelphia (NL), Boston (NL)	1888–1901
8	Ted Williams	.34441	Boston (AL)	1939–42, 1946–60
9	Dan Brouthers	.34212	Troy, Buffalo, Detroit (NL), Boston (NL), Boston (PL), Brooklyn (NL), Baltimore (NL), Louisville, Philadelphia (NL), New York (NL)	1879–96, 1904
10	Babe Ruth	.34206	Boston (AL), New York (AL), Boston (NL)	1914–36

CS	BB	SO	BA	OBP	SLG	OPS	TB	GDP	HBP	SH	SI
2	29	28	.269	.352	.347	.699	75	6	0	2	2
2	22	22	.277	.349	.361	.710	69	6	0	2	2
0	7	6	.200	.375	.240	.615	6	0	0	0	0
3	41	49	.232	.327	.300	.626	89	6	2	1	3
3	48	50	.261	.373	.396	.769	111	11	2	3	0

Batter Ranking Problem



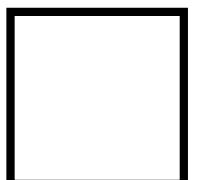
Challenge 1: Randomness in Hits



Challenge 2: Unknown Hit Rate



Challenge 3: A Different Goal

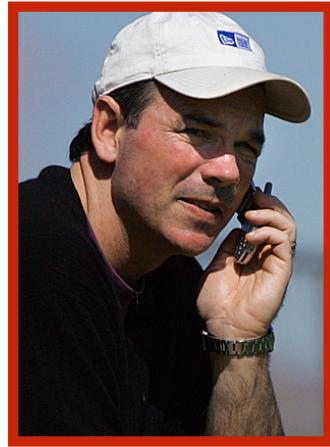


Challenge 4: Different Salaries

If you were Billy, what should you do?



board



manager (Billy)



Scout (HR)



Player (employee)



Team (Company)



Fans (customer)

What's your goal?

buy star players?



buy wins?



buy "cheap" player?



Goal: Buy Players or Buy Wins ?



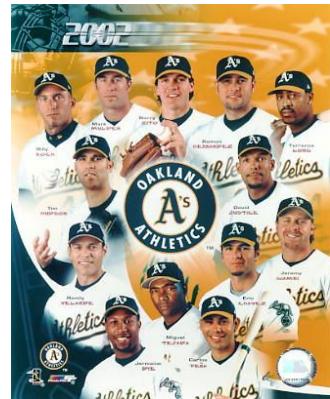
https://www.youtube.com/watch?v=rMJ2IcD_fFc

<https://youtu.be/TpBcwGOvO80?t=4s>



Their goal in player selection

find a team

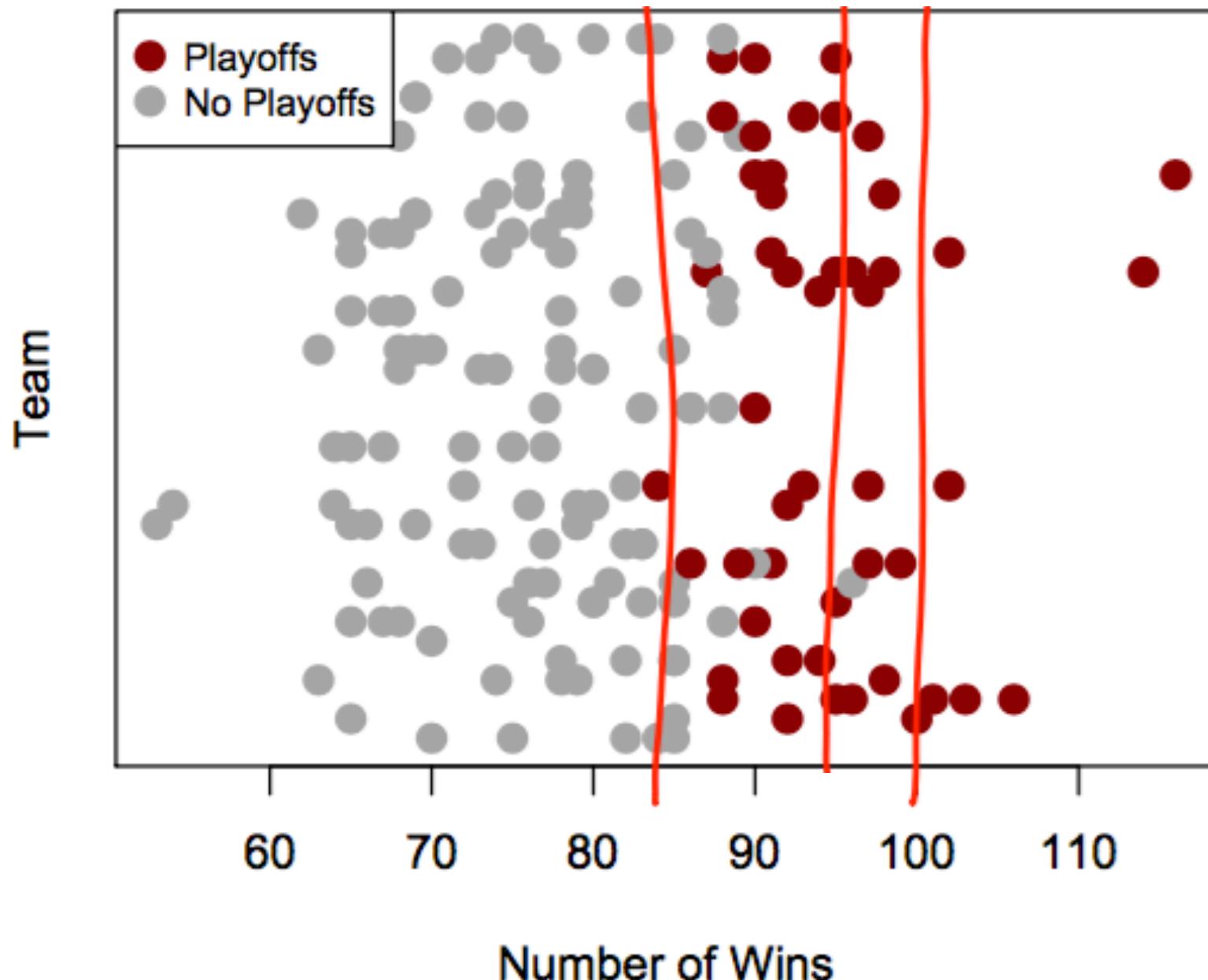


maximize # (wins | team)



s.t. cost of the team < payroll budget

How many wins do we need for playoffs ?



The Goal

Win **99** games

$$\frac{\text{RUNS SCORED}^2}{\text{RUNS SCORED}^2 + \text{RUNS ALLOWED}^2} = \text{WIN \%}$$

score at least **814 runs**
allow no more than 645 runs

OAK
2002
PROJECTION

$$\frac{814^2}{814^2 + 645^2} = \frac{662596}{1078621} = .6143$$

* LOSE GIAMBI, DAMON ISRINGHAUSEN

Runs

[https://en.wikipedia.org/wiki/Run_\(baseball\)](https://en.wikipedia.org/wiki/Run_(baseball))



when a player advances around first, second and third base and returns safely to home plate, touching the bases in that order

The object of the game is for a team to score more runs than its opponent.

Pythagorean Expectation

https://en.wikipedia.org/wiki/Pythagorean_expectation

The chalkboard displays the Pythagorean expectation formula:

$$\frac{\text{RUNS SCORED}^2}{\text{RUNS SCORED}^2 + \text{RUNS ALLOWED}^2} = \text{WIN \%}$$

Below the formula, the 2001 Oakland Athletics (OAK) are used as an example:

$$\frac{884^2}{884^2 + 645^2} = \frac{781456}{1197481}$$



Bill James

How do we compute runs?



given a team of players, how to estimate the number of runs?

Runs Created formula (Bill James)

https://en.wikipedia.org/wiki/Runs_created

$$RC = \frac{(hits + walks) \times (total\ bases)}{(at\text{-}bats) + (walks)}$$

Batter Ranking Problem



Challenge 1: Randomness in Hits



Challenge 2: Unknown Hit Rate



Challenge 3: A Different Goal



Challenge 4: Different Salaries

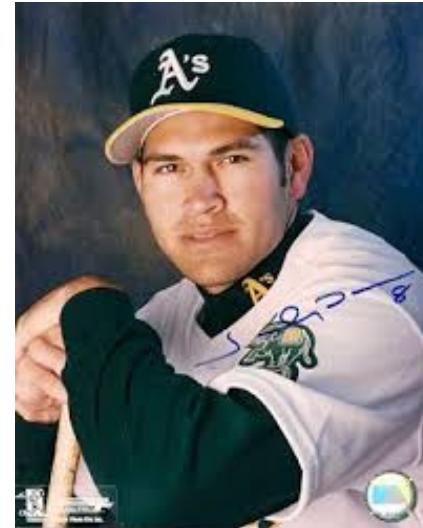
Hiring with BA



Jason Giambi

BA: .342

\$ 10.4M



Johnny Damon

BA: .256

\$ 7.5M



Scott Hatteberg

BA: .245

\$ 1M

In 2001, most teams evaluate players based on BA (Batting Average)



Chad Bradford (Pitcher)

https://en.wikipedia.org/wiki/Chad_Bradford



Chad Bradford					
Bats:	Right	Born:	Sept. 2, 1975	Position:	Pitcher
Throws:	Right	Height:	6' 5"	Years:	13
Weight:	205 lb.	Drafted:	13th round	Team:	Colorado Rockies
Year	Age	Tm	Lg	Le	W-L
2000	25	CHW	AL	MLB	0-0



His **ERA** stayed around **3.00** for his entire career until 2004
(Earned Run Average) https://en.wikipedia.org/wiki/Earned_run_average

\$237,000

Base on Balls (Walks) (BB)

https://en.wikipedia.org/wiki/Base_on_balls



a batter receives **four pitches** that the umpire calls balls, and is in turn **awarded first base** without the possibility of being called out

On Base Percentage (OBP)

https://en.wikipedia.org/wiki/On-base_percentage

how frequently a batter reaches base

$$OBP = \frac{H + BB + HBP}{AB + BB + HBP + SF}$$

$$OBP = \frac{\text{base hits} + \text{walks} + \text{times hit by a pitch}}{\text{at-bats} + \text{walks} + \text{times hit by a pitch} + \text{sacrifice flies}} = \frac{131 + 42 + 8}{434 + 42 + 8 + 6} = \frac{181}{490} = .369$$

base hits walks times hit by a pitch

at-bats walks times hit by a pitch sacrifice flies

Oakland mainly used this metric (instead of BA) to evaluate players

Hit By Pitch (HBP)

https://en.wikipedia.org/wiki/Hit_by_pitch



a batter or his clothing or equipment (other than his bat) is **struck** directly by a pitch from the pitcher; the batter is called a hit batsman (HB). A hit batsman is **awarded first base**

Sacrifice Fly (SF)

https://en.wikipedia.org/wiki/Sacrifice_fly

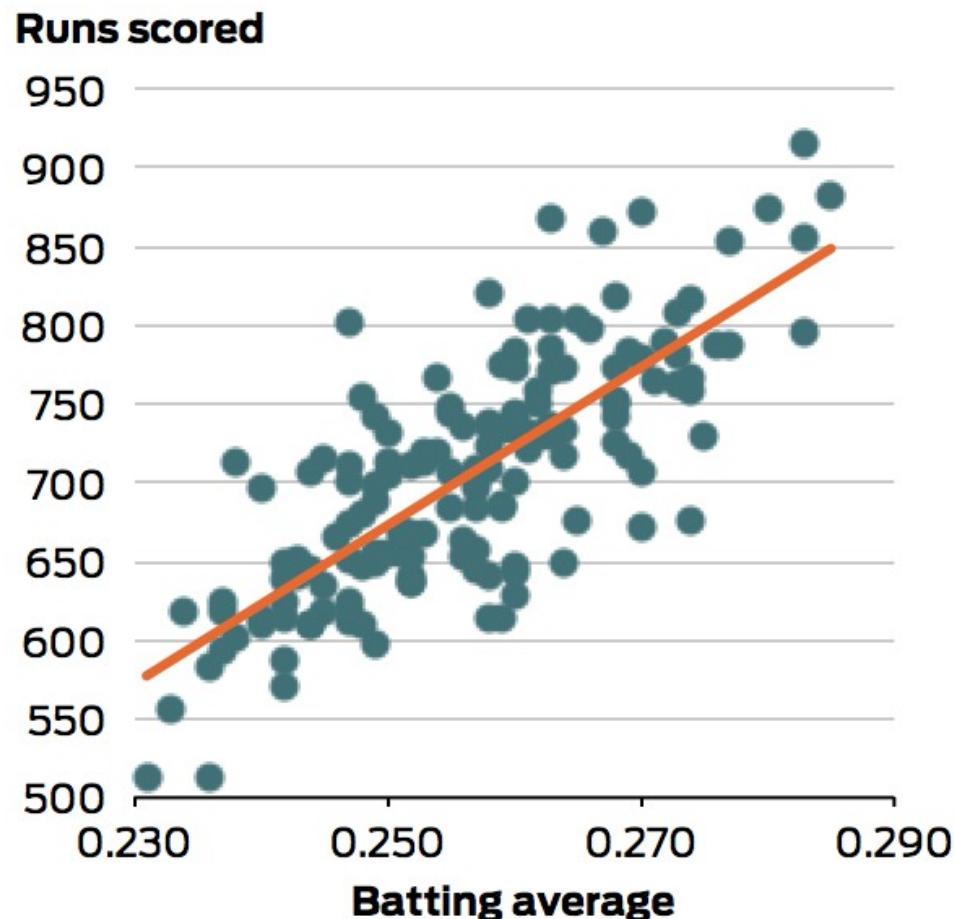
<https://www.youtube.com/watch?v=SyJnHBMfMqE>



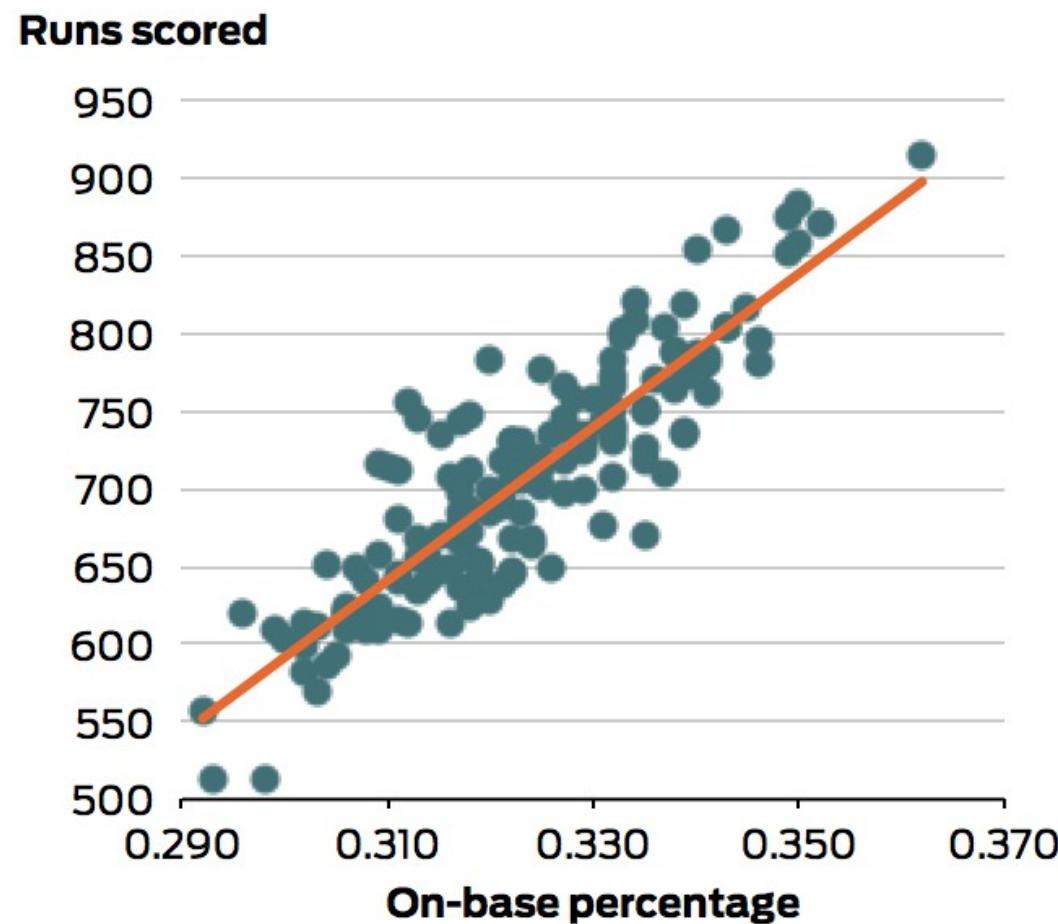
Score a sacrifice fly when, before two are out, the batter hits a ball in flight handled by an outfielder or an infielder running in the outfield in fair or foul territory that

1. is caught, and a run scores after the catch, or
2. is dropped, and a runner scores, if in the scorer's judgment the runner could have scored after the catch had the fly ball been caught.

Batting Average vs. Runs Scored 2009 - 2013



On-Base Percentage vs. Runs Scored 2009 - 2013

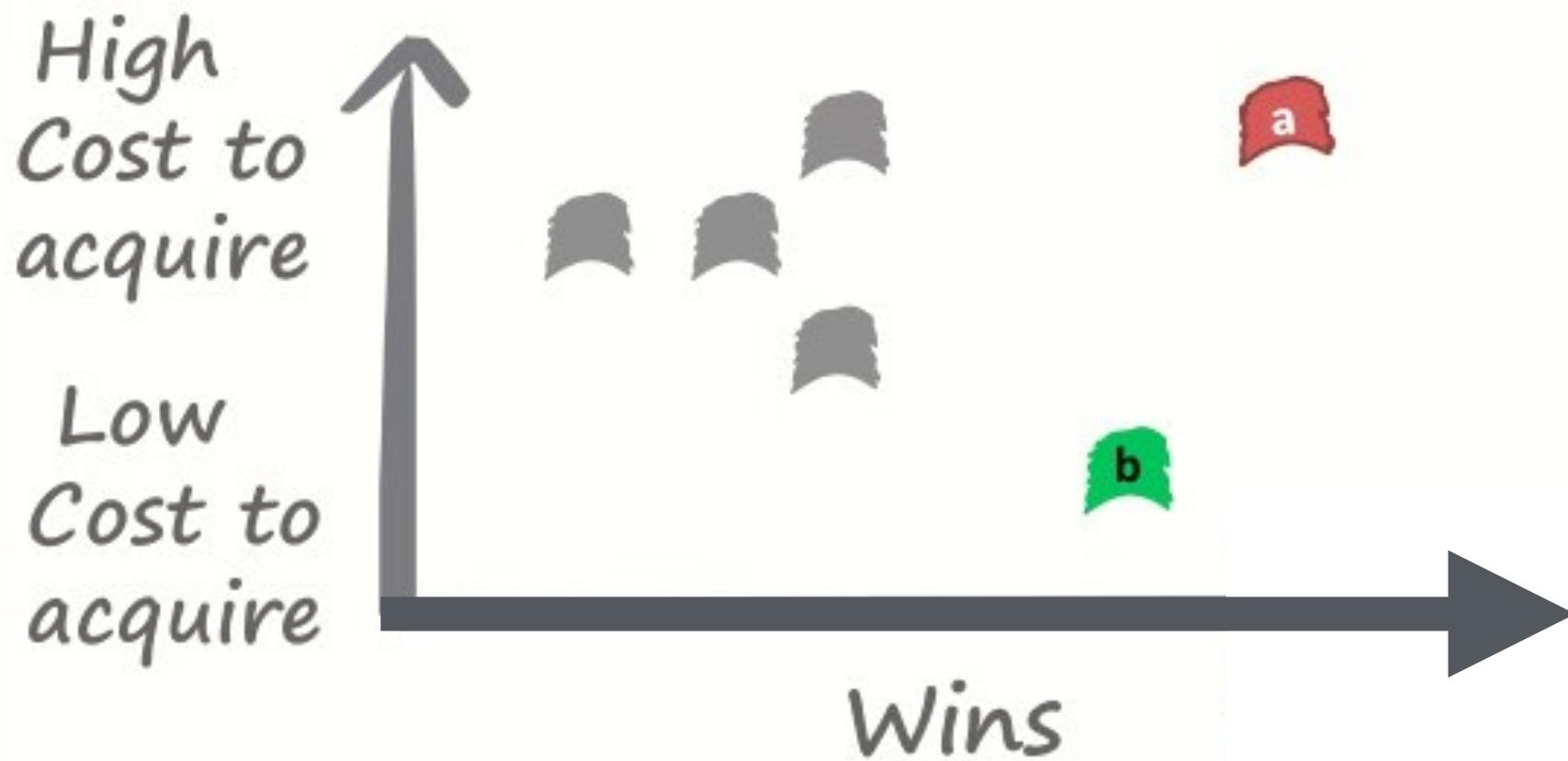


$$BA = \frac{H}{AB}$$

$$OBP = \frac{H + BB + HBP}{AB + BB + HBP + SF}$$

OBP is as effective as BA, but not used by other teams.

- a. Batting average
- b. On-base percentage



So it is possible to find cheap players using OBP because no other team uses this metric (some teams only use OBP as a tie-breaker)

Slugging Percentage (SLG)

https://en.wikipedia.org/wiki/Slugging_percentage

a measure of the batting productivity of a hitter
total bases divided by at bats

$$SLG = \frac{1B + 2 \times 2B + 3 \times 3B + 4 \times HR}{AB}$$

or

$$SLG = \frac{H + 2B + 2 \times 3B + 3 \times HR}{AB}$$

HR: home runs

Oakland also used this metric to evaluate players, in addition to OBP

players Oakland chose



David Justice

BA: .241

OBP: .333

SLG: .430

\$ 3.5M



Jason Giambi



Scott Hatteberg

BA: .245

OBP: .332

SLG: .345

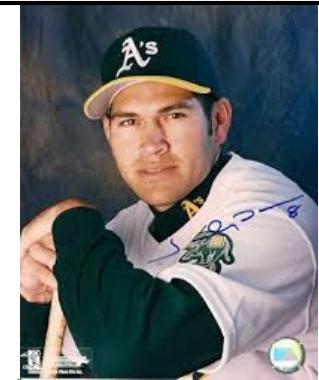
\$ 1M

BA: .342

OBP: .477

SLG: .660

\$ 10.4M



Johnny Damon



Jeremy Giambi

BA: .283

OBP: .391

SLG: .450

\$ 0.9M

no data

\$ 2.8M



Jason Isringhausen

David Justice (Outfielder)

Career Statistics



runs: 305
walks (BB): 903
hits (H): 1571
at base (AB): 5625

BA: .279
OBP: .378
SLG: .500

Divisional
Series

League Championship
Series

World
Series

League Championship
Series

Divisional
Series

2002 MLB PLAYOFFS



PrintYourBrackets.com

TM

Both teams got 103 wins

Cost per Win (2002)



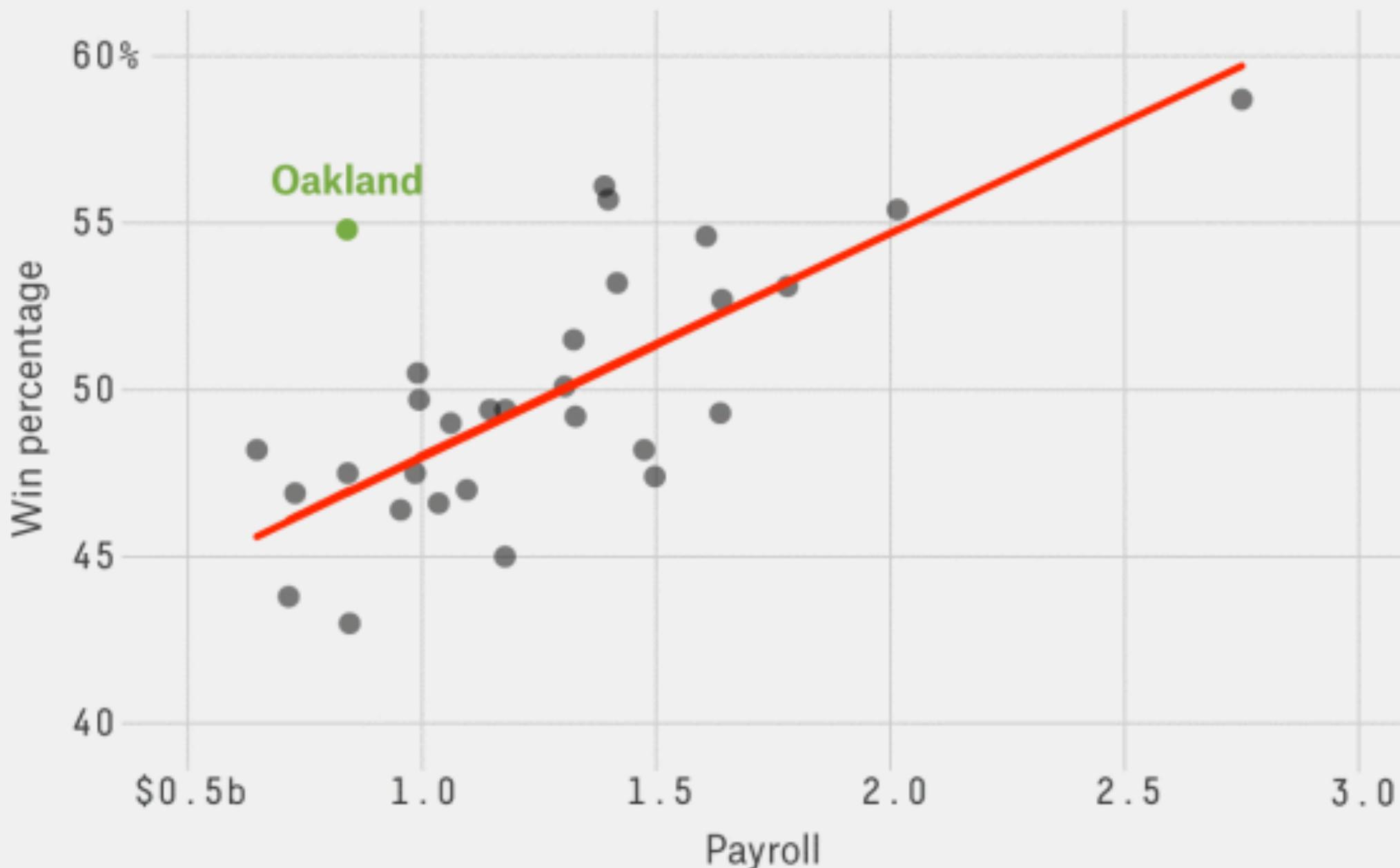
\$1.4M



\$0.26M

MLB Teams' Overall Win Percentage vs. Payroll

Since 2000



20 Streak in 2002



116	August 9	@ Yankees	3–2 (16)	Bowie (2–0)	Hitchcock (1–1)	—	54,316	67–49
117	August 10	@ Yankees	8–0	Lidle (5–9)	Wells (12–6)	—	54,439	68–49
118	August 11	@ Yankees	5–8	Mussina (14–6)	Mulder (13–7)	—	54,703	68–50
119	August 12	Blue Jays	1–2	Loaiza (5–6)	Harang (4–3)	Escobar (24)	14,178	68–51
120	August 13	Blue Jays	5–4	Zito (16–5)	Carpenter (4–5)	Koch (29)	17,466	69–51
121	August 14	Blue Jays	4–2	Hudson (9–9)	Walker (5–3)	Koch (30)	40,528	70–51
122	August 16	White Sox	1–0	Lidle (6–9)	Buehrle (15–9)	Koch (31)	22,622	71–51
123	August 17	White Sox	9–2	Mulder (14–7)	Garland (8–9)	—	40,658	72–51
124	August 18	White Sox	7–4	Zito (17–5)	Wright (8–11)	—	31,489	73–51
125	August 19	@ Indians	8–1	Hudson (10–9)	Báez (9–10)	—	27,696	74–51
126	August 20	@ Indians	6–3	Harang (5–3)	Westbrook (1–2)	Koch (32)	27,527	75–51
127	August 21	@ Indians	6–0	Lidle (7–9)	Rodríguez (0–1)	—	26,916	76–51
128	August 22	@ Indians	9–3	Mulder (15–7)	Phillips (1–2)	Bradford (2)	27,759	77–51
129	August 23	@ Tigers	9–1	Zito (18–5)	Powell (1–3)	—	21,807	78–51
130	August 24	@ Tigers	12–3	Hudson (11–9)	Lima (4–6)	—	19,045	79–51
131	August 25	@ Tigers	10–7	Mecir (4–3)	Walker (1–1)	Koch (33)	24,346	80–51
132	August 26	@ Royals	6–3	Lidle (8–9)	May (3–9)	Koch (34)	11,096	81–51
133	August 27	@ Royals	6–4	Mulder (16–7)	Hernández (3–3)	Koch (35)	13,077	82–51
134	August 28	@ Royals	7–1	Zito (19–5)	Sedlacek (3–4)	—	15,952	83–51
135	August 30	Twins	4–2	Hudson (12–9)	Radke (6–4)	Koch (36)	25,221	84–51
136	August 31	Twins	6–3	Mecir (5–3)	Romero (8–2)	Koch (37)	42,841	85–51

September: 18–8 (Home: 11–2 ; Away: 7–6)

[hide]

#	Date	Opponent	Score	Win	Loss	Save	Attendance	Record
137	September 1	Twins	7–5	Koch (7–2)	Guardado (1–3)	—	37,676	86–51
138	September 2	Royals	7–6	Koch (8–2)	Grimsley (3–5)	—	26,325	87–51
139	September 4	Royals	12–11	Koch (9–2)	Grimsley (3–6)	—	55,528	88–51
140	September 6	@ Twins	0–6	Radke (7–4)	Lidle (8–10)	—	27,409	88–52
141	September 7	@ Twins	2–0	Mulder (17–7)	Mays (3–6)	Koch (38)	43,628	89–52

<https://youtu.be/nK1jtVhimPA?t=8s>

2016

https://en.wikipedia.org/wiki/List_of_Major_League_Baseball_longest_winning_streaks

Rank	Games	Team	Season(s)
1	26	New York Giants^	1916
2 (tie)	21	Chicago White Stockings^	1880
2 (tie)	21	Chicago Cubs	1935
4 (tie)	20	St. Louis Maroons	1884
4 (tie)	20	Providence Grays	1884
4 (tie)	20	Oakland Athletics	2002
7 (tie)	19	Chicago White Sox^	1906*
7 (tie)	19	New York Yankees	1947*

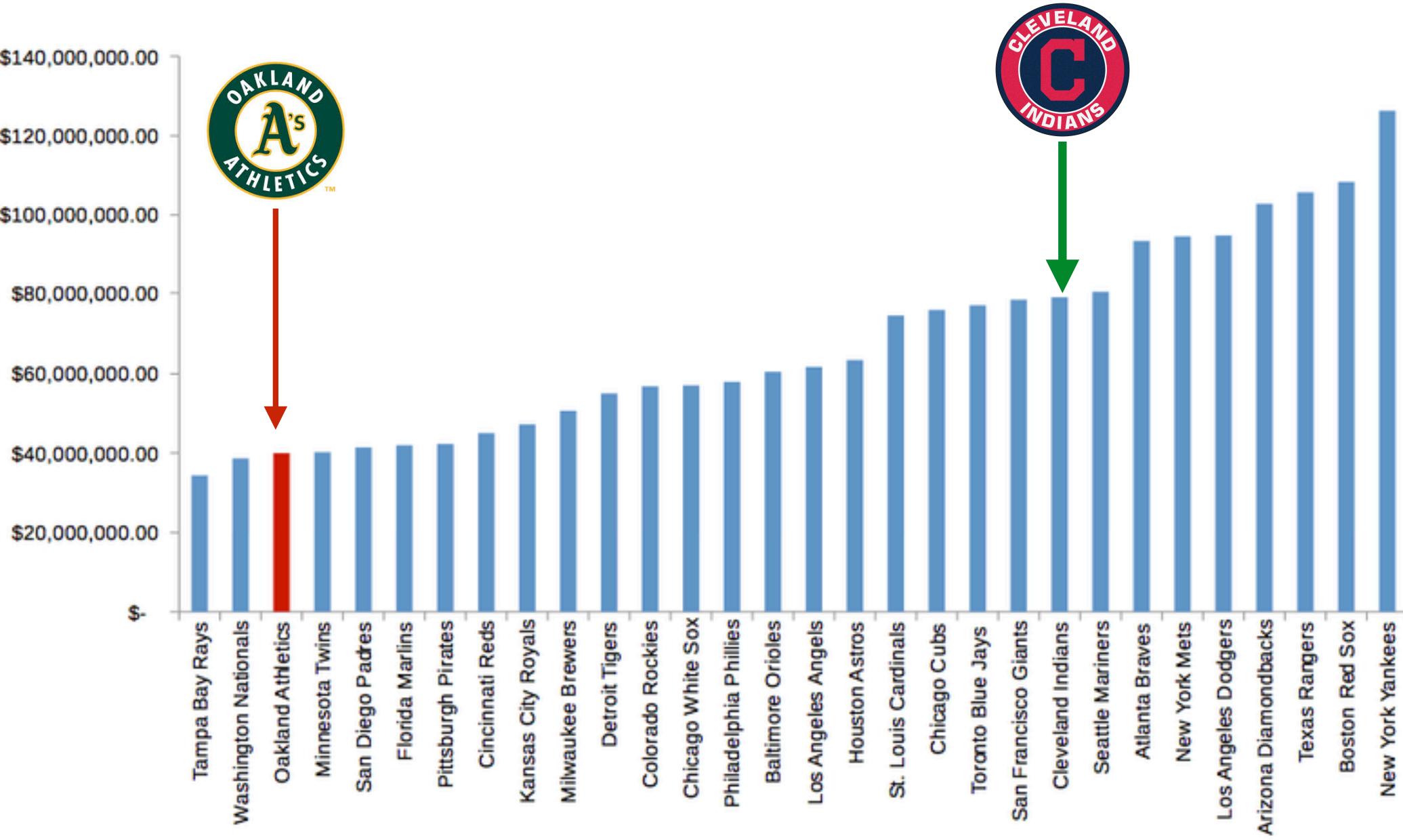


15 years later, after 2002

Rank	Games	Team	Season(s)
1	26^	New York Giants	1916
2	22	Cleveland Indians	2017
3 (tie)	21^	Chicago White Stockings	1880
3 (tie)	21	Chicago Cubs	1935
5 (tie)	20	St. Louis Maroons	1884
5 (tie)	20	Providence Grays	1884
5 (tie)	20	Oakland Athletics	2002
8 (tie)	19^	Chicago White Sox	1906*
8 (tie)	19	New York Yankees	1947*
10 (tie)	18	Chicago White Stockings	1885



Rich teams, Poor teams



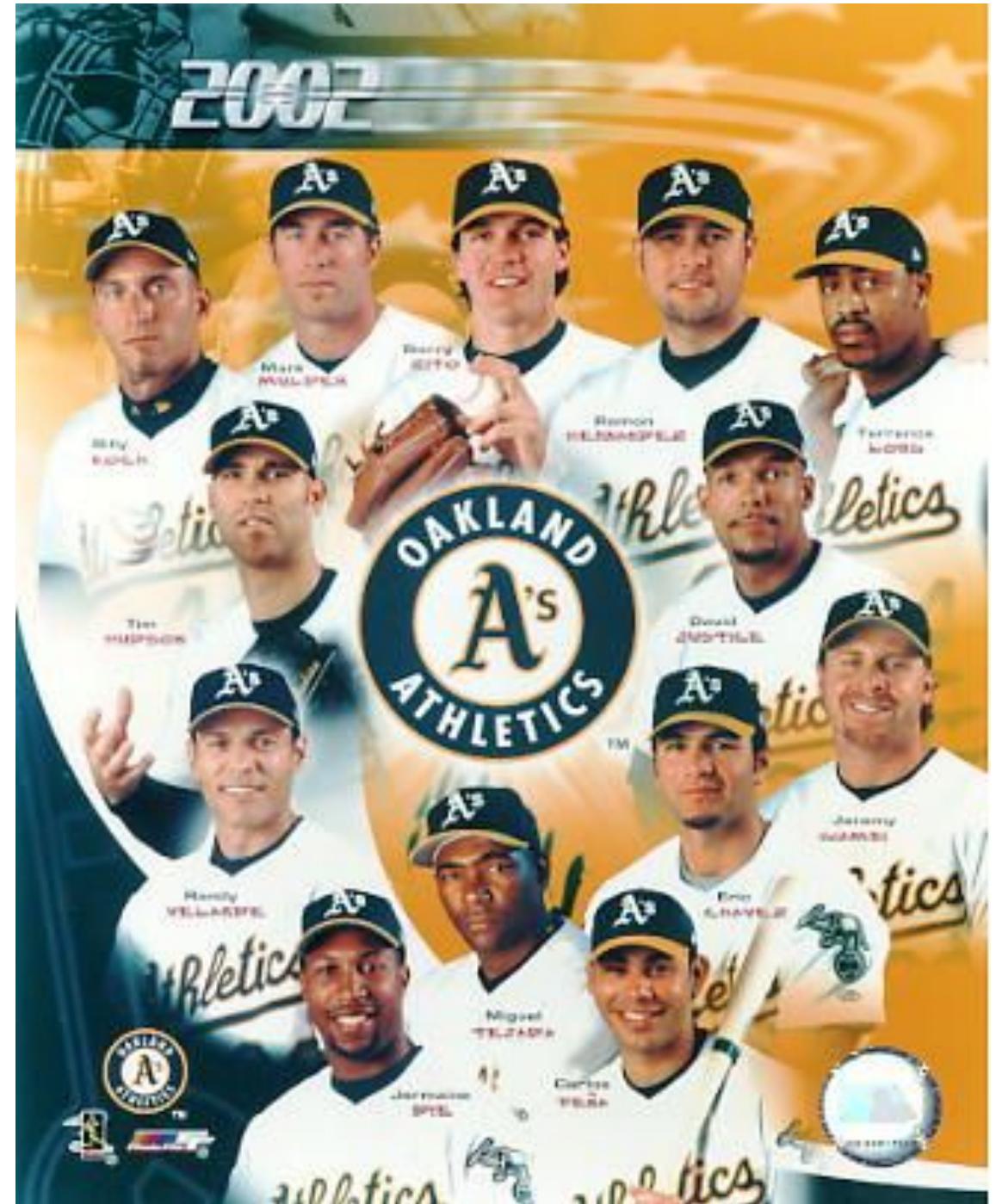
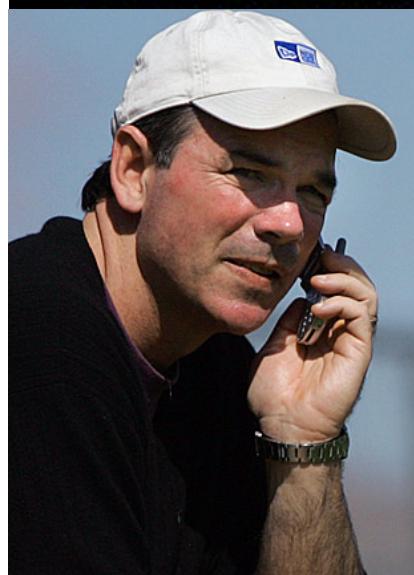
The Team of 2002



**BRAD PITT
MONEYBALL**

CHARLIE HOFFMAN
TRUE STORY
AOL.COM
\$19.95
\$14.95
\$12.95
\$9.95
\$7.95
\$5.95
\$3.95
\$1.95
\$0.95

Billy Beane



Boston Red Sox

try to hire



hire



Billy Beane

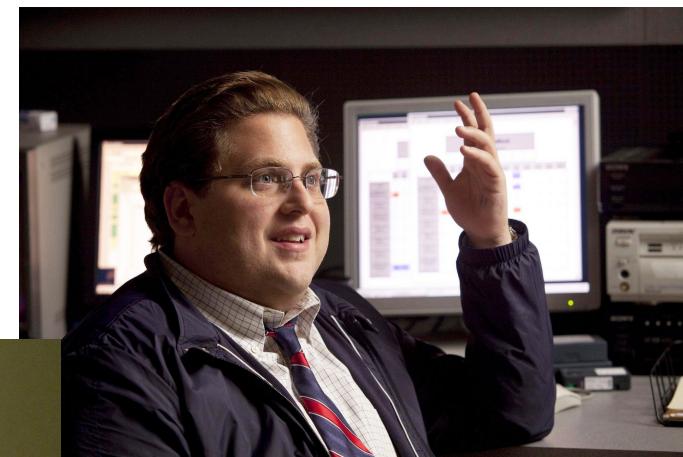


Bill James
data scientist

Red Sox Wins World Series in 2004



the data scientist

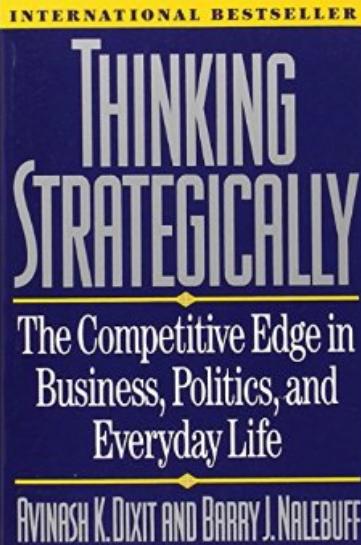


**CLEVELAND
BROWNS**

Paul DePodesta

Strategy to Win





1983 America's Cup

Dennis Conner



VS



(Liberty) 3 : 1 (Australia II)



Date	Winner	Yacht	Loser	Yacht	Score	Delta
September 14, 1983	<i>Liberty</i>	US-40	<i>Australia II</i>	KA-6	0-1	1:10
September 15, 1983	<i>Liberty</i>	US-40	<i>Australia II</i>	KA-6	0-2	1:33
September 18, 1983	<i>Australia II</i>	KA-6	<i>Liberty</i>	US-40	1-2	3:14
September 20, 1983	<i>Liberty</i>	US-40	<i>Australia II</i>	KA-6	1-3	0:43
September 21, 1983						
September 22, 1983						
September 26, 1983						

<https://youtu.be/gJ96kcXUhwl?t=32m10s>

in 5th Game

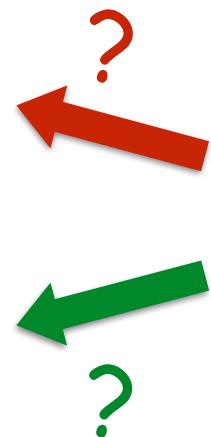
sailing direction

Choice A

turn 5
degree

Choice B

head
straight



Dennis Conner
chose A



Liberty



Australia II

1983 America's Cup



Dennis Conner



VS



Loss!

(Liberty) 3 : 4 (Australia II)

Date	Winner	Yacht	Loser	Yacht	Score	Delta
September 14, 1983	Liberty	US-40	Australia II	KA-6	0-1	1:10
September 15, 1983	Liberty	US-40	Australia II	KA-6	0-2	1:33
September 18, 1983	Australia II	KA-6	Liberty	US-40	1-2	3:14
September 20, 1983	Liberty	US-40	Australia II	KA-6	1-3	0:43
September 21, 1983	Australia II	KA-6	Liberty	US-40	2-3	1:47
September 22, 1983	Australia II	KA-6	Liberty	US-40	3-3	3:25
September 26, 1983	Australia II	KA-6	Liberty	US-40	4-3	0:41



<https://youtu.be/gJ96kcXUhwl?t=37m14s>

Business Strategy



vs



1995-2001



The Browser Wars
Netscape v. Microsoft

Software in 1995

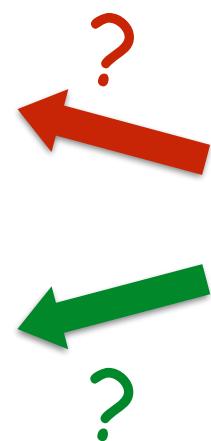
software product

Choice A

non-Internet
software

Choice B

Internet
(browser)



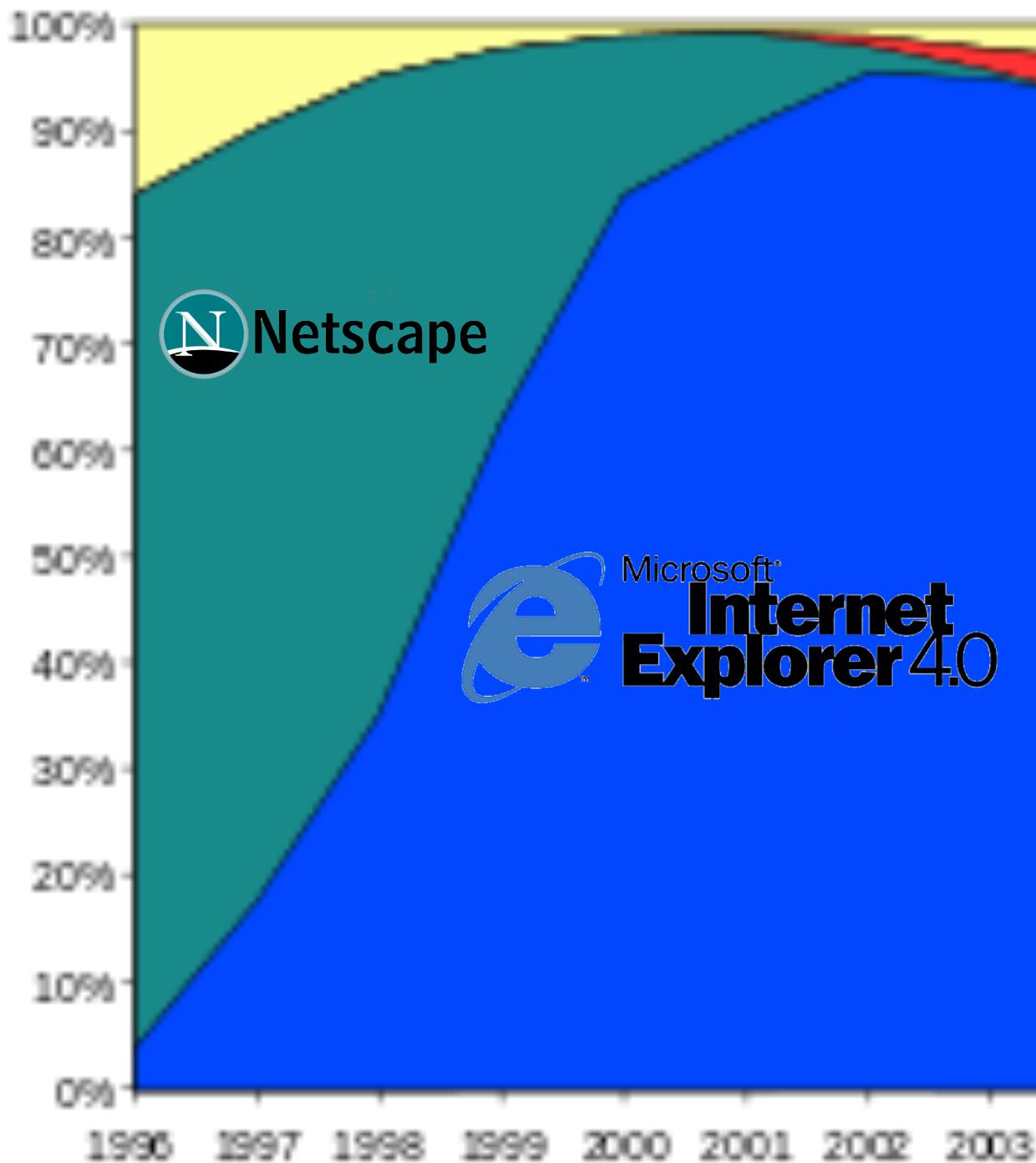
Bill Gates
also chose B

Microsoft®



Netscape
chose B

Browser War



The image shows the Yahoo! homepage from 1998. At the top, there are links for Auctions, Messenger, and Check Email. Below that is a banner for Yahoo! Mail with the tagline "free email for life". To the right of the banner are links for What's New, My Personalics, and Help. A large red "YAHOO!" logo is centered above a search bar. Below the search bar is a link to download Yahoo! Messenger. Further down, there are sections for "Fantasy Football" and "In the News". The "In the News" section lists several headlines: "U.S. busts major Colombian drug ring", "UA pilots reach tentative pact", and "Venezuelans win Little League World Series". There are also sections for "Marketplace", "Broadcast Events", and "Inside Yahoo!". The footer contains a list of categories: Auctions, Classifieds, Shopping, Travel, Yellow Pages, Maps, Media, News, Sports, Stock Quotes, TV, Weather, Chat, Clubs, Games, GeoCities, Greetings, Mail, Members, Messenger, Personals, People Search, For Kids, Personal, My Yahoo!, Addr Book, Calendar, Briefcase, Photos, Alerts, Bookmarks, Companion, Bill Pay, and more.

Google!

BETA

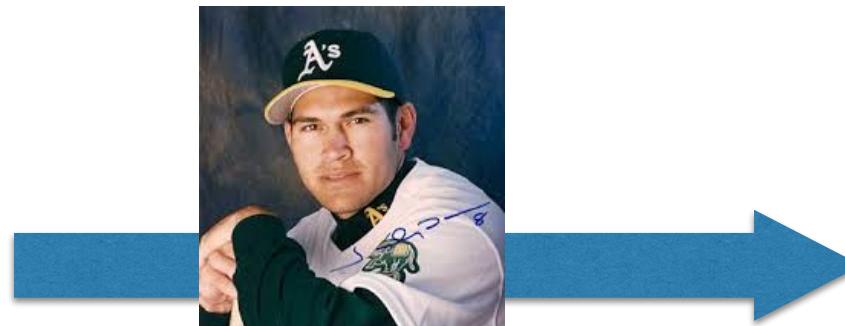
The image shows the Google homepage from 1998. It features a large search bar with the placeholder "Search the web using Google!". Below the search bar are two buttons: "Google Search" and "I'm feeling lucky". To the left of the search bar is a "Special Searches" section with links to Stanford Search and Linux Search. To the right is a "Help" section with links to About Google!, Company Info, and Google! Logos. At the bottom right is a form for "Get Google! updates monthly" with fields for "your e-mail", "Subscribe", and "Archive".

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Baseball in 2002



Jason Giambi



Johnny Damon



Jason Isringhausen



Baseball in 2002

player selection

choice B

OBP, SLG

choice A

BA



chose A



chose B

Movie Rental Business

Netflix vs Blockbuster



Movie Rental in 2002

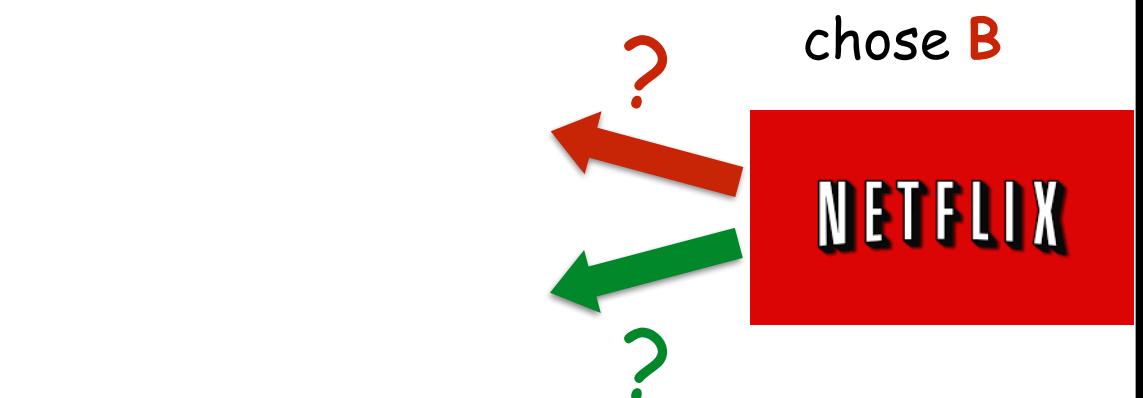
selling mode

choice B

mailing / online

choice A

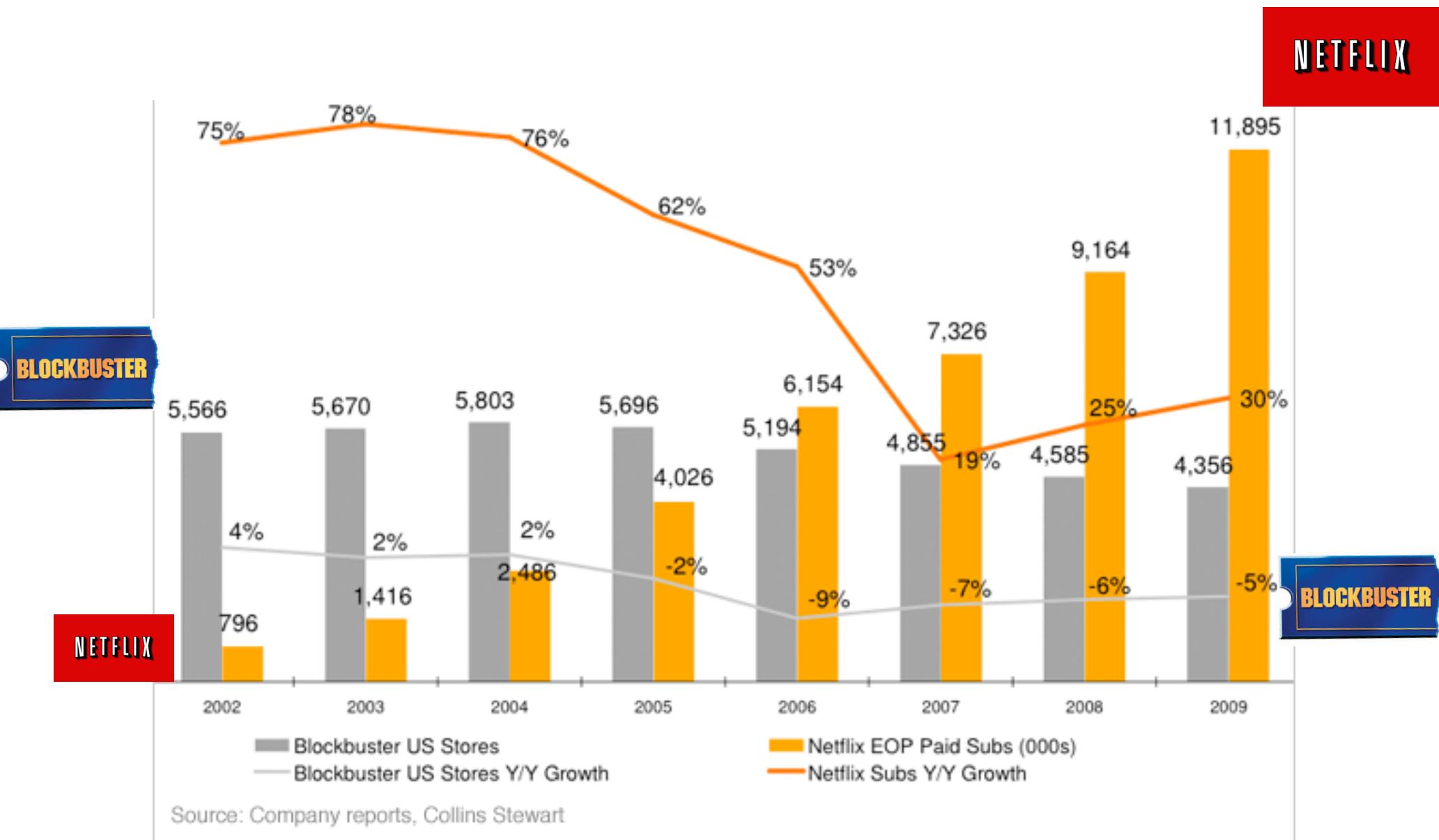
store



chose A



Movie Rental



in 2013

Business Strategy

Amazon vs Book Store



Business Strategy

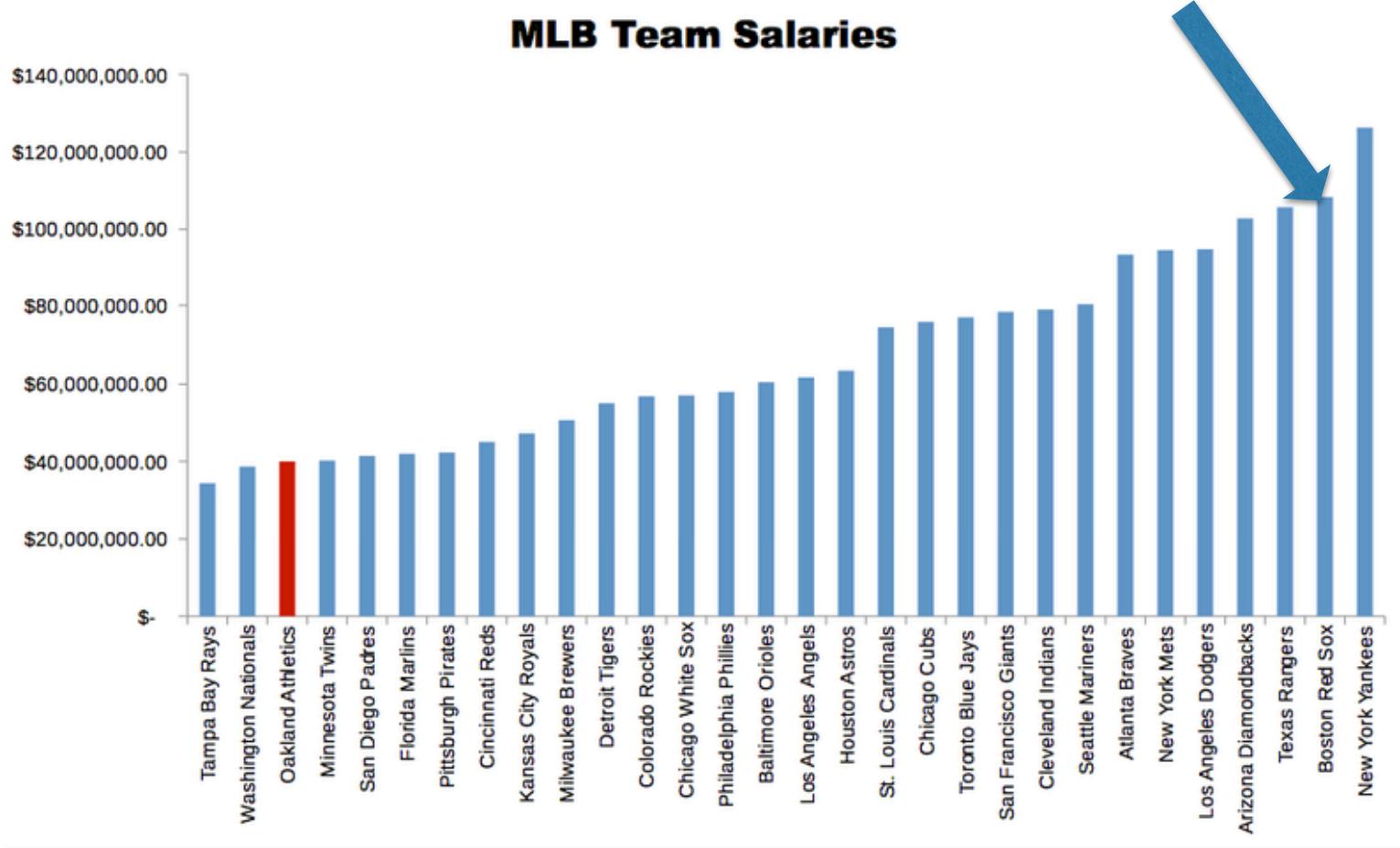
Uber vs Taxi Industry



Boston Red Sox in 2004



MLB Team Salaries



Boston Red Sox in 2004

try to hire



hire



Billy Beane



Bill James
data scientist

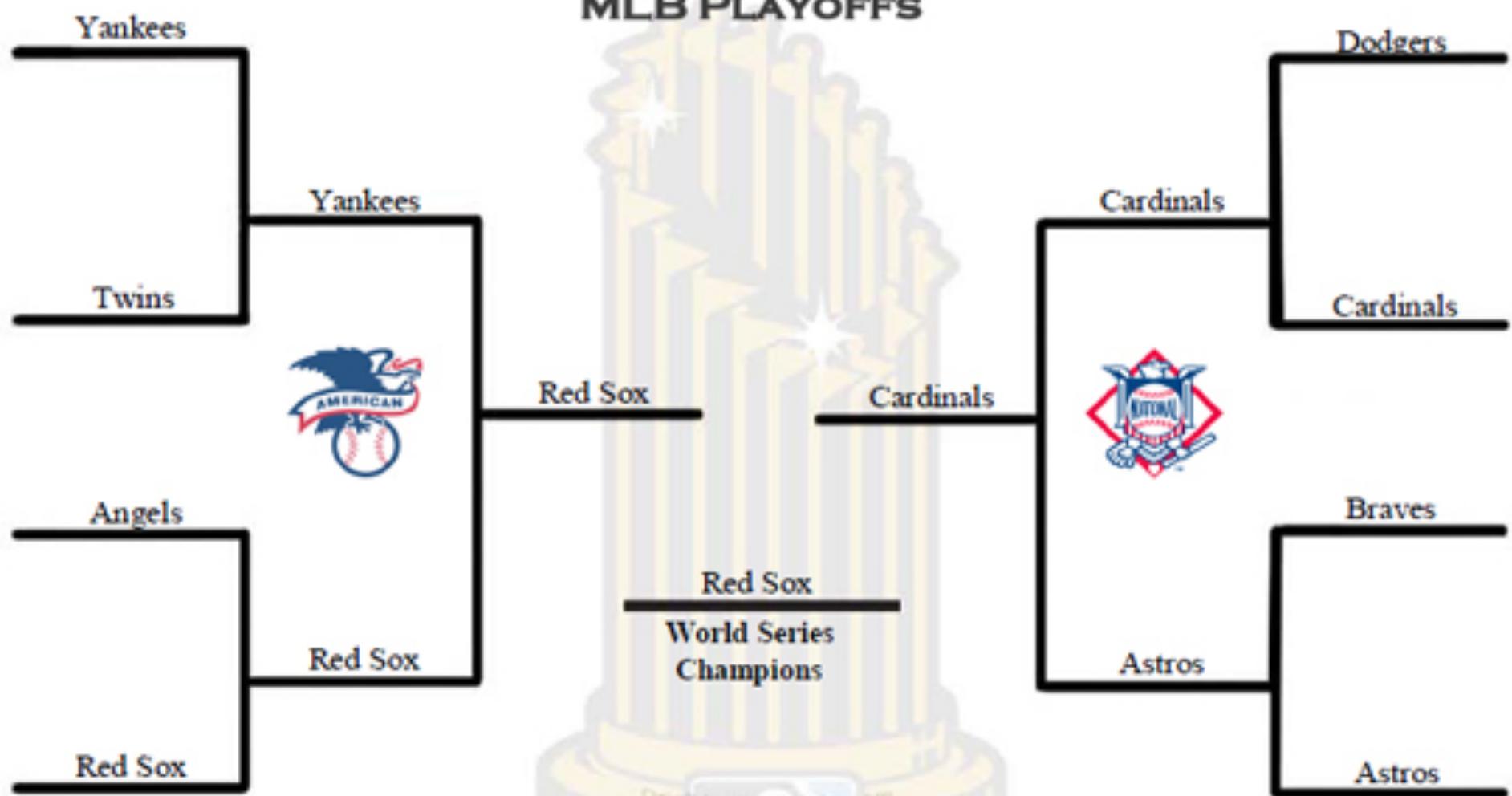
Divisional
Series

League Championship
Series

World
Series

League Championship
Series

Divisional
Series



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TMR