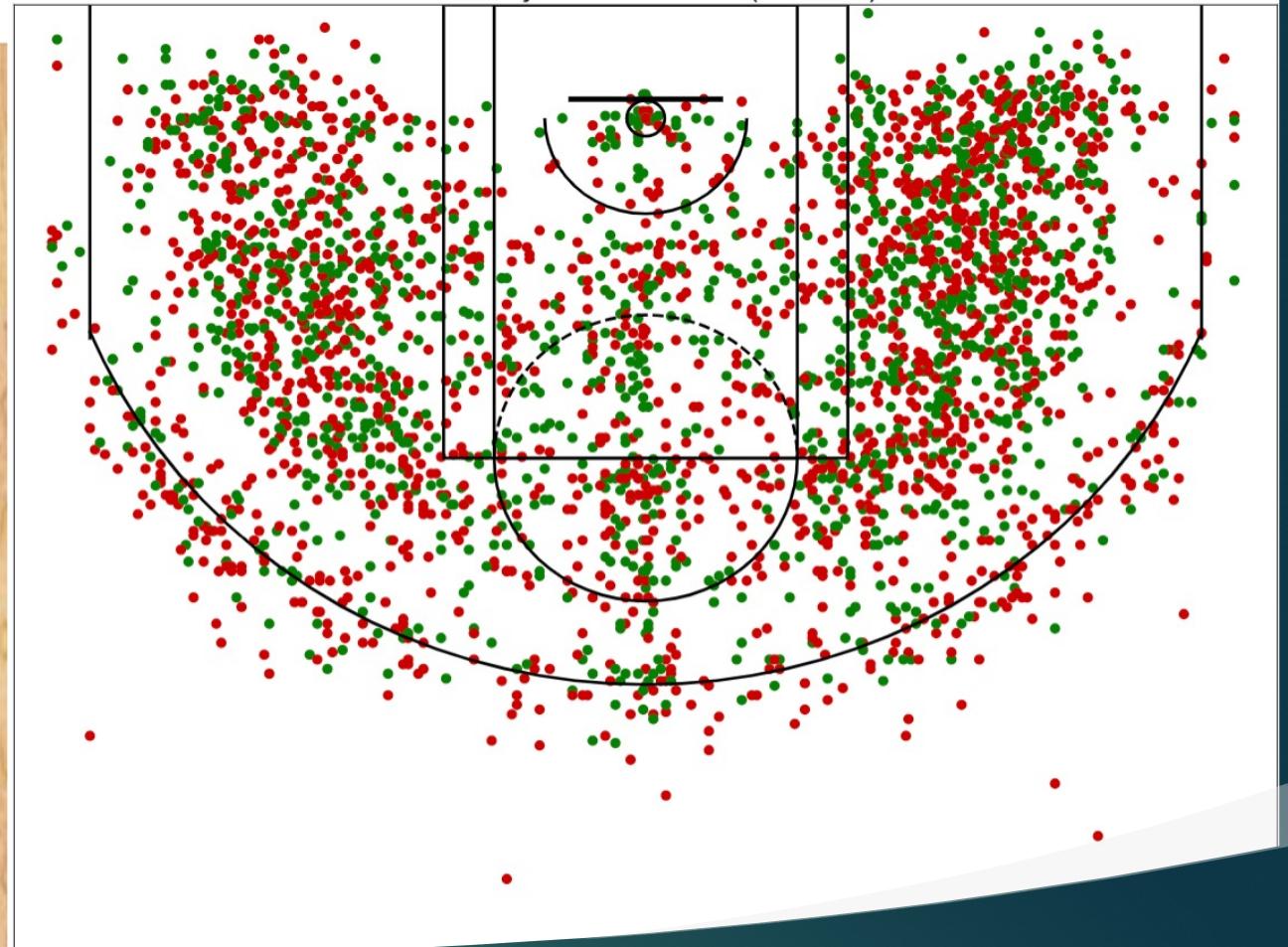
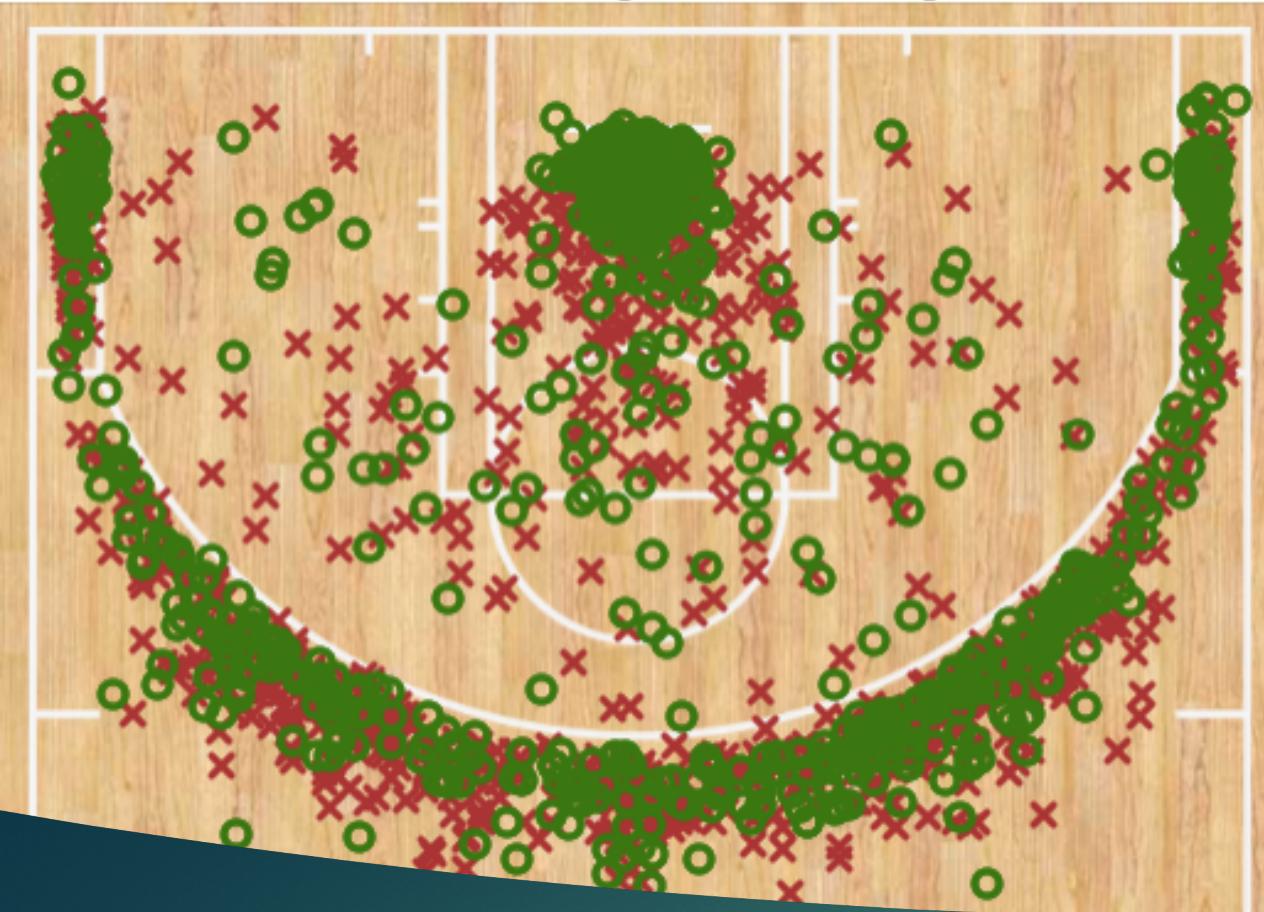


The Development and Current State of Basketball Analytics

MILES KEE

FGA for the Houston Rockets during the 2017-18 Regular Season



The Three Point Revolution

Basketball on Paper

- ▶ Dean Oliver's 2004 book on analyzing the game of basketball planted the seeds for the analytics revolution that would follow
- ▶ The two biggest analytical concepts this book introduced were:
 1. Offensive and defensive ratings
 2. Evaluating teams via the four factors: EFG%, TO%, ORB%, FT/FGA

Offensive and Defensive Ratings

- ▶ Early measures of NBA offenses and defenses were based on points scored per game and points allowed per game, respectively
- ▶ Shown to the right are the top 10 teams in points scored (top) and allowed (bottom) for the 2022-23 NBA season
- ▶ However, these metrics seem to have little correlation with team success, as 3 out of the top 10 offenses and 4 out of the top 10 defenses didn't even make the playoffs last year

TEAM	GP	PTS
 Sacramento Kings	82	120.7
 Golden State Warriors	82	118.9
 Atlanta Hawks	82	118.4
 Boston Celtics	82	117.9
 Oklahoma City Thunder	82	117.5
 Los Angeles Lakers	82	117.2
 Utah Jazz	82	117.1
 Milwaukee Bucks	82	116.9
 Memphis Grizzlies	82	116.9
 Indiana Pacers	82	116.3

TEAM	GP	PTS
 Cleveland Cavaliers	82	106.9
 Miami Heat	82	109.8
 Philadelphia 76ers	82	110.9
 Toronto Raptors	82	111.4
 Boston Celtics	82	111.4
 Phoenix Suns	82	111.6
 Chicago Bulls	82	111.8
 Denver Nuggets	82	112.5
 New Orleans Pelicans	82	112.5
 Brooklyn Nets	82	112.5

Offensive and Defensive Ratings

- ▶ Offensive (bottom left) and defensive (bottom right) rating adjust raw scoring stats to the pace that a team played at
 - ▶ Teams that play at a faster pace will have more possessions in their, and therefore more opportunities to score/allow points
 - ▶ Offensive and defensive ratings take pace out of the equation by adjusting for how fast a team plays, and these stats can be read as points scored/allowed per 100 possessions
- ▶ These statistics become even more predictive when combined to create net rating (offensive-defensive), shown at the top
- ▶ Now, 8/10 of the top offenses, 8/10 of the top 10 defenses, and 9/10 of the top net rating teams made the playoffs

TEAM	GP	W	L	MIN	OFFRTG	DEFRTG	NETRTG
Boston Celtics	82	57	25	3996.0	117.3	110.6	6.7
Cleveland Cavaliers	82	51	31	3976.0	115.5	109.9	5.6
Philadelphia 76ers	82	54	28	3976.0	117.0	112.7	4.4
Memphis Grizzlies	82	51	31	3956.0	114.7	110.7	4.0
Milwaukee Bucks	82	58	24	3966.0	114.3	110.9	3.4
Denver Nuggets	82	53	29	3951.0	116.8	113.5	3.3
New York Knicks	82	47	35	3991.0	117.0	114.2	2.8
Sacramento Kings	82	48	34	3966.0	118.6	116.0	2.6
Phoenix Suns	82	45	37	3956.0	114.5	112.3	2.2
New Orleans Pelicans	82	42	40	3971.0	113.8	112.0	1.9

TEAM	GP	W	L	MIN	OFFRTG
Sacramento Kings	82	48	34	3966.0	118.6
Boston Celtics	82	57	25	3996.0	117.3
Philadelphia 76ers	82	54	28	3976.0	117.0
New York Knicks	82	47	35	3991.0	117.0
Denver Nuggets	82	53	29	3951.0	116.8
Dallas Mavericks	82	38	44	3986.0	115.9
Atlanta Hawks	82	41	41	3971.0	115.5
Cleveland Cavaliers	82	51	31	3976.0	115.5
Utah Jazz	82	37	45	3961.0	115.3
Golden State Warriors	82	44	38	3966.0	115.1

TEAM	GP	W	L	MIN	OFFRTG	DEFRTG
Cleveland Cavaliers	82	51	31	3976.0	115.5	109.9
Boston Celtics	82	57	25	3996.0	117.3	110.6
Memphis Grizzlies	82	51	31	3956.0	114.7	110.7
Milwaukee Bucks	82	58	24	3966.0	114.3	110.9
Chicago Bulls	82	40	42	3981.0	112.8	111.5
New Orleans Pelicans	82	42	40	3971.0	113.8	112.0
Phoenix Suns	82	45	37	3956.0	114.5	112.3
Philadelphia 76ers	82	54	28	3976.0	117.0	112.7
Miami Heat	82	44	38	3961.0	112.3	112.8
Minnesota Timberwolves	82	42	40	3966.0	113.3	113.1

The Four Factors

- ▶ Oliver also proposed that there were four factors that contributed to a team's offensive and defensive rating:
 1. Effective field goal percentage (EFG%): Measures a team's shooting ability and is used in place of raw FG% because it adjusts for a team's 3PT shooting ability
 2. Turnover percentage (TO%): The percentage of a team's possessions that end in a turnover
 3. Offensive rebounding percentage (ORB%): The percentage of a team's misses on offense that they rebound
 4. Free throw rate (FT/FGA): This is a simple calculation that measures how many free throws a team shoots per each shot they take
- ▶ These four metrics, when combined and weighted, are enough on their own to evaluate a team's offense, and their reverses are enough to evaluate a team's defense

The Four Factors

- ▶ In the NBA, the four factors are not used often because the amount of games played in the NBA and the balanced schedule leads to stats needing little adjustment or context
 - ▶ Adjusting for possessions is often enough to give valuable insight into NBA offenses and defenses
- ▶ In college basketball, however, the four factors are needed to properly evaluate teams
 - ▶ NCAA basketball scheduling is very imbalanced, and statistics need to be given a lot more context and adjustment because of this
 - ▶ Stats from college basketball are often adjusted for possessions and opponent strength
 - ▶ Oliver proposed the following relative weights for the four factors:
 $.4*EFG+.25*TOV+.2*ORB+.15*FTR$

Kenpom

- ▶ Kenpom.com, created and developed by Ken Pomeroy, is the leader in college basketball analytics
- ▶ This data is used by scouts, coaches, and fans

2024 Pomeroy College Basketball Ratings

[help](#) · [data](#)

99.00 01.02 03.04 05.06 07.08 09.10 11.12 13.14 15.16 17.18 19.20 21.22 23.24

Data through games of Thursday, November 9 (289 games)

Rk	Team	Conf	W-L	AdjEM	AdjO	AdjD	AdjT	Luck	Strength of Schedule			NCSOS AdjEM								
									AdjEM	OppO	OppD									
1	Purdue	B10	1-0	+28.06	117.6	1	89.6	7	70.2	255	+0.000	19	-3.51	159	99.6	164	103.1	161	-3.51	159
2	Houston	B12	1-0	+27.17	115.3	5	88.1	4	67.8	344	+0.000	19	-16.83	253	91.9	257	108.8	250	-16.83	253
3	Kansas	B12	1-0	+27.04	114.5	9	87.5	2	71.3	180	+0.000	19	-16.39	251	92.2	253	108.6	246	-16.39	251
4	Connecticut	BE	1-0	+26.66	114.9	6	88.2	5	70.5	239	+0.000	19	-9.50	199	97.3	193	106.8	211	-9.50	199
5	Gonzaga	WCC	0-0	+25.39	117.3	2	91.9	26	74.2	30	+0.000	19	-99.00	296	0.0	296	200.0	296	-99.00	296
6	Arizona	P12	1-0	+23.79	115.4	4	91.6	24	75.0	15	+0.000	19	-20.73	276	90.0	271	110.8	276	-20.73	276
7	Baylor	B12	2-0	+23.70	115.5	3	91.8	25	71.9	141	+0.000	19	+20.45	27	112.4	25	92.0	37	+20.45	27
8	Duke	ACC	1-0	+23.48	114.9	7	91.4	21	69.3	305	+0.000	19	-13.37	231	95.0	222	108.4	243	-13.37	231
9	Tennessee	SEC	1-0	+23.45	110.3	30	86.9	1	69.5	291	+0.000	19	-18.07	261	91.0	261	109.1	256	-18.07	261
10	Alabama	SEC	1-0	+23.12	114.1	10	91.0	17	75.8	6	+0.000	19	-8.72	194	98.8	179	107.5	224	-8.72	194
11	Creighton	BE	1-0	+22.90	114.0	11	91.1	18	70.9	208	+0.000	19	-21.39	280	87.9	286	109.3	266	-21.39	280
12	Arkansas	SEC	1-0	+22.11	112.2	17	90.1	11	73.1	72	+0.000	19	-11.50	217	96.3	206	107.8	236	-11.50	217
13	Marquette	BE	1-0	+21.97	114.7	8	92.7	34	74.8	147	+0.000	19	-10.80	206	96.8	199	107.6	230	-10.80	206
14	Kentucky	SEC	1-0	+21.93	113.9	12	92.0	27	70.4	244	+0.000	19	-6.60	183	98.1	189	104.7	182	-6.60	183
15	USC	P12	2-0	+21.76	112.0	18	90.2	13	73.4	59	+0.032	11	+2.38	128	102.0	135	99.6	120	+2.38	128
16	Wisconsin	B10	1-0	+20.71	111.6	20	90.9	14	71.8	154	+0.000	19	-5.16	176	99.3	168	104.5	176	-5.16	176
17	Texas	B12	1-0	+20.68	110.4	29	89.7	10	72.9	83	+0.000	19	-23.57	286	89.6	276	113.1	285	-23.57	286
18	Auburn	SEC	0-1	+20.46	112.5	16	92.0	29	73.3	63	+0.000	19	+23.69	17	115.5	11	91.8	34	+23.69	17
19	North Carolina	ACC	1-0	+20.44	112.8	15	92.4	31	73.0	80	+0.000	19	-4.27	168	100.3	153	104.6	178	-4.27	168
20	Illinois	B10	1-0	+20.14	111.4	21	91.2	20	72.3	115	+0.000	19	-19.73	273	88.2	282	108.0	238	-19.73	273

2024 Four Factors

[data\(o/d\)](#)

99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Data through games of Thursday, November 9

Team	Conf	AdjTempo	Offense						Defense															
			AdjOE	eFG%	TO%	OR%	FTRate	AdjDE	eFG%	TO%	OR%	FTRate												
Purdue	B10	70.2	255	117.6	1	67.7	6	19.9	176	38.7	47	35.5	137	89.6	7	28.7	3	19.9	117	25.0	80	20.6	51	
Gonzaga	WCC	74.2	30	117.3	2	0.0	296	100.0	295	0.0	296	0.0	296	100.0	296									
Baylor	B12	71.9	144	115.5	3	50.8	130	19.6	172	36.8	64	56.7	26	91.8	25	51.6	178	19.6	121	36.8	235	39.7	196	
Arizona	P12	75.0	15	115.4	4	63.2	16	9.0	9	55.0	3	42.1	85	91.6	24	45.5	105	32.2	3	25.0	80	26.8	95	
Houston	B12	67.8	344	115.3	5	51.6	118	15.8	85	50.0	5	47.5	56	88.1	4	32.1	8	39.4	1	27.8	125	43.6	217	
Connecticut	BE	70.5	239	114.9	6	62.3	23	13.1	40	45.5	16	64.9	10	88.2	5	36.4	23	16.0	211	20.5	51	27.1	97	
Duke	ACC	69.3	305	114.9	7	70.3	2	13.3	42	20.8	243	20.3	245	91.4	21	37.5	32	19.1	134	26.3	101	30.4	120	
Marquette	BE	71.8	147	114.7	8	59.0	48	12.3	33	37.1	60	31.3	170	92.7	34	42.1	74	19.1	136	39.1	254	22.9	63	
Kansas	B12	71.3	180	114.5	9	81.2	1	15.1	74	22.2	235	17.9	264	87.5	2	40.4	53	13.6	247	21.4	58	31.6	125	
Alabama	SEC	75.8	6	114.1	10	64.9	11	17.7	124	46.7	12	66.7	6	91.0	17	49.2	144	20.4	107	33.3	193	30.6	122	
Creighton	BE	70.9	208	114.0	11	70.1	3	13.3	45	53.1	4	23.9	221	91.1	18	36.7	26	8.9	288	14.3	10	14.1	15	
Kentucky	SEC	70.4	244	113.9	12	56.2	73	8.6	6	28.9	154	29.2	186	92.0	27	36.6	25	25.8	25	15.8	17	8.9	3	
Villanova	B10	69.4	300	113.7	13	62.7	20	10.5	18	34.5	86	32.2	161	94.7	52	41.1	63	16.5	203	27.9	129	25.8	88	
Iowa	B10	74.9	16	113.6	14	61.3	27	8.6	7	29.7	142	26.7	203	98.4	98	43.3	83	23.4	43	26.7	113	25.4	84	
North Carolina	ACC	73.0	80	112.8	15	58.2	58	15.4	78	34.3	87	37.7	111	92.4	34	46.2	113	16.8	196	30.6	168	15.2	18	
Auburn	SEC	73.3	63	112.5	16	51.6	119	19.6	172	36.8	64	39.7	95	92.0	29	50.8	165	19.6	121	36.8	235	56.7	268	
Arkansas	SEC	73.1	72	112.2	17	63.0	18	19.5	169	42.4	26	68.5	5	90.1	11	42.2	75	22.2	63	18.9	44	51.0	254	
USC	P12	73.4	59	112.0	18	58.7	54	20.6	196	30.5	133	35.7	135	90.2	13	40.6	57	22.0	69	37.2	242	27.3	101	
Miami FL	ACC	73.1	73	111.7	19	62.5	21	11.8	27	36.1	70	23.6	224	96.1	69	40.4	55	21.0	93	27.1	118	16.2	24	
Wisconsin	B10	71.8	154	111.6	20	70.0	4	17.2	109	28.0	170	50.0	46	90.9	14	44.1	92	20.9	94	27.8	125	55.9	267	

Shot Quality

- ▶ Shotquality.com is another resource devoted to college basketball analytics
- ▶ This site attempts to give more context to offensive statistics by examining the expected points a team would score based on their shot attempts

Team	Conference	adj SQ	adjOFF SQ	adjDEF SQ	Rim & 3 Rate	Record	SQ Record	Win%	SQ Win%	Record Luck
UCLA	PAC 12	+0.36 1	1.21 9	0.85 1	67% 356	31-6	31-6	83%	83%	-0.11
Connecticut	BigEast	+0.31 2	1.25 3	0.94 24	82% 77	31-8	29-10	79%	75%	-3.99
Creighton	BigEast	+0.31 3	1.23 5	0.92 11	80% 108	24-13	28-9	64%	74%	+9.68
Gonzaga	WestCoast SEC	+0.30 4	1.29 1	0.99 75	76% 237	30-6	27-9	83%	74%	-8.60
Tennessee	SEC	+0.30 5	1.18 18	0.88 2	75% 258	25-11	27-9	69%	74%	+4.90

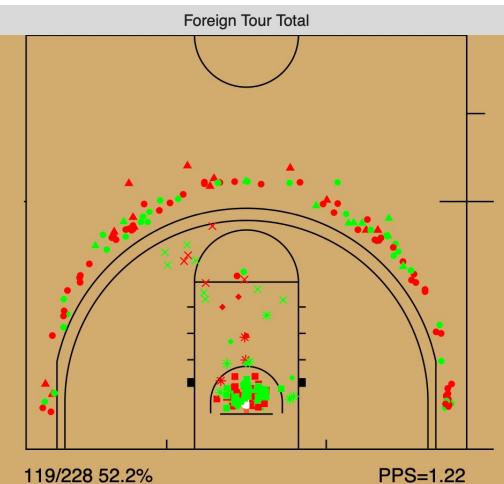
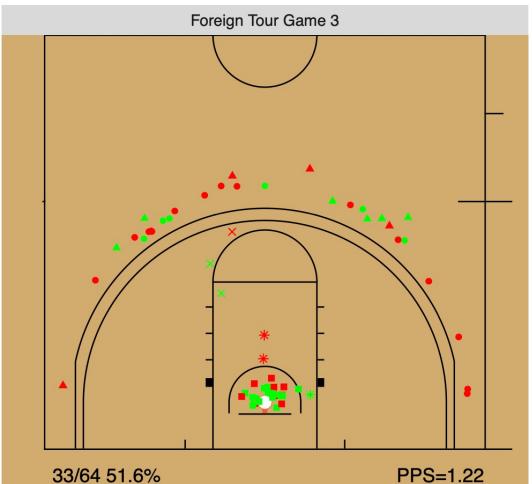
In House Analytics

- ▶ Every single NBA team, and many college teams, also have in house analysts who create and develop their own internal metrics to evaluate teams and players
 - ▶ These metrics are often very proprietary and are based off a combination of publicly available data and internal data such as player tracking data

What I Look At

- ▶ I have spent the last few months working as an analyst for our men's basketball team
- ▶ Some of the things I have done in my time there:
 - ▶ Create ways to analyze practice data like in-game data
 - ▶ Build up a database of player shots to evaluate efficiencies based on shot types
 - ▶ Use this database to create expected performance stats for in-game performance

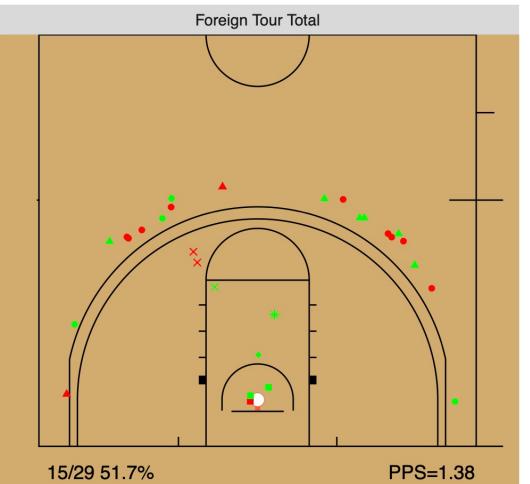
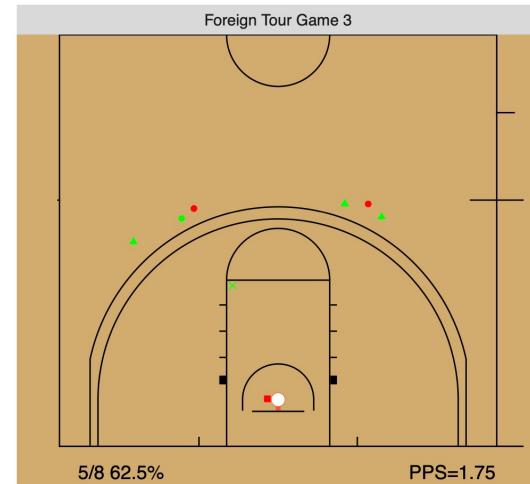
Team Shots



Shot Result
● Made
● Missed

Shot Type
● Catch and Shoot
● Floater/Moving
■ Layup/Dunk
× Off Dribble 2
▲ Off Dribble 3
* Post Move

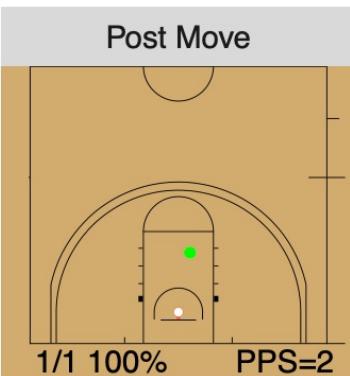
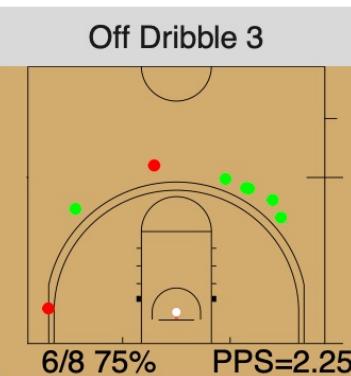
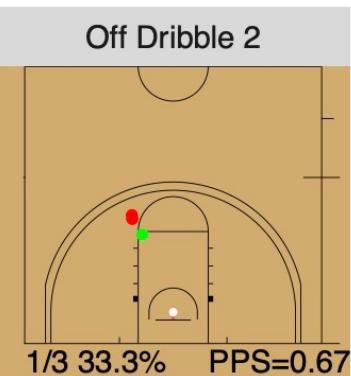
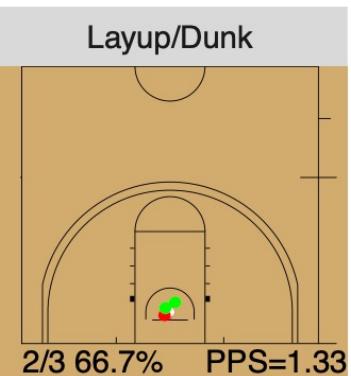
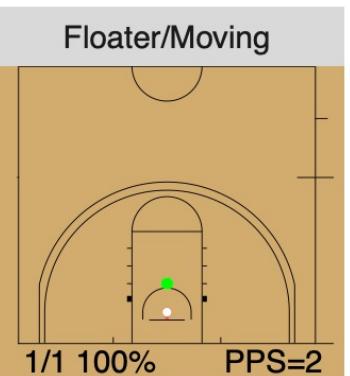
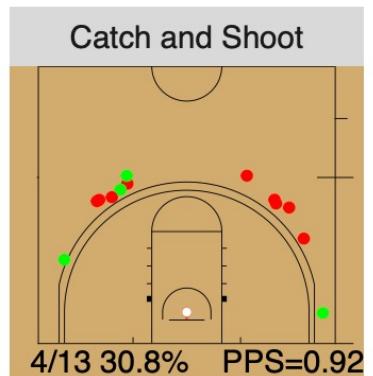
Cam Spencer



Shot Result
● Made
● Missed

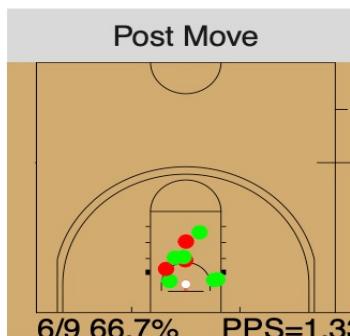
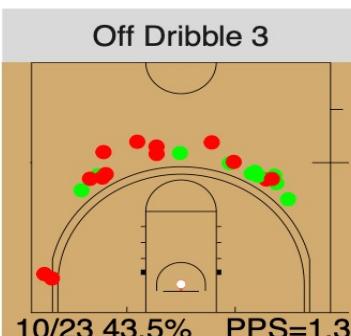
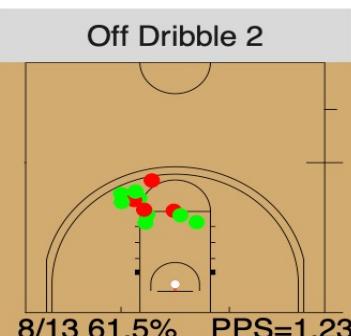
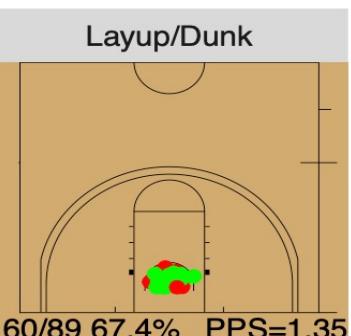
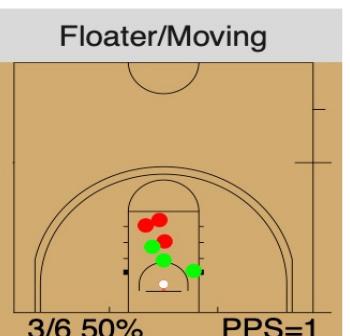
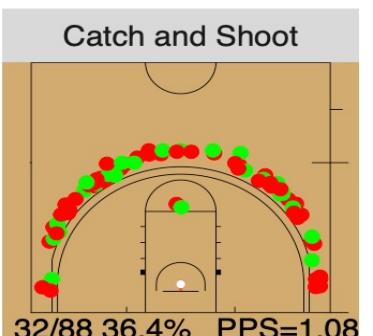
Shot Type
● Catch and Shoot
● Floater/Moving
■ Layup/Dunk
× Off Dribble 2
▲ Off Dribble 3
* Post Move

Cam Spencer



Shot Result
● Made
● Missed

Team Shots



Shot Result
● Made
● Missed

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