Three-Point Shooting Percentage Predictions for the 2015 NBA Season

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I. INTRODUCTION

Forecasting an NBA player's three-point shooting percentage for an upcoming season will always be a difficult proposition. The three-point shooting percentage depends on several factors, some of which can be taken into account, and others which it would be very difficult to be able to include in a prediction. When attempting to make predictions for all of the players in the league, it is wise to consider a simple algorithm, based only on easily obtained statistics, and which will make the best predictions for the widest range of players.

Most basically, the three-point shooting percentage is just the number of three-point shots made, divided by the number of three-point shots attempted. However, it is clear that there is always an uncertainty in the shooting percentage based on the number of shots a player has taken. A player who attempts 10 shots and makes 5 of them has a 0.500 shooting percentage, but so does a player who attempts 10,000 shots and makes 5,000 of them. We can be much more certain of the shooting percentage of the player who has taken 10,000 shots than the player who has only taken 10. So, we must define the uncertainty in the shooting percentage for a player. Shooting percentages are examples of a binomial distribution, which has an uncertainty defined by [1]

$$\sigma_p = \frac{\sqrt{mp(1-p)}}{a} \ , \tag{1}$$

where m is the number of made shots, a is the number of attempted shots, and p is the shooting percentage. So, for the case of a player making 5 of 10 shots, the uncertainty is 0.11; while for the player attempting 10,000 shots, the uncertainty becomes 0.0035, significantly smaller than the player attempting only 10 shots.

NBA players generally shoot between 0 and 600 shots in a season. Players who shoot at the upper end of this range can get a pretty good estimate for their shooting percentage over the course of that season, but even then, it is not a particularly good estimate for how well they will do going into the next season. Take for instance Stephen Curry of the Golden State Warriors; in the 2013 season (note: seasons will be referred to by the year they ended), he led the league by attempting 600 three pointers, with a percentage of 0.453 ± 0.014, while the next season he attempted 615 three pointers, with a percentage of 0.424 ± 0.013. Both are extremely good percentages, but the 2014 season is a full two-sigma away from the previous season. Clearly the 2014 season was not simply a continuation of the 2013 season. Knowing that a player's shooting ability changes from year to year,

it is possible to take that into account when attempting to predict their shooting percentage for the next season.

Other factors that can be taken into account include how many three-point shots the player will attempt, what percentage of his shots are three-point shots vs two-point shots, his age, and the number of minutes he plays per game. Some factors cannot be taken into account: injuries, which even if they don't reduce playing time, can affect shooting ability; a change in philosophy, either of the player or the coaching staff, can significantly change shooting percentages; consider Stephen Curry again, in his first three years in the league he attempted 4.7 three-point shots per game, while in the next two seasons he attempted 7.8 shots per game; that significant change in philosophy could potentially have a big impact on shooting percentage, but is difficult to predict. Another example of this is Chris Bosh, of the Miami Heat, who had never attempted more than 1 three-pointer per game until the 2014 season when he nearly tripled that, shooting 2.8 per game. In doing so he well out-performed his career three-point shooting percentage. Any predictions of his 2014 three-point shooting percentage would be way off. Similarly, changing teams or coaches can affect the shooting percentages as well. And there is no way, simply based on statistics, that one can account for someone who dedicates themselves to practicing in the off-season. A few other factors that can affect predictions, but would be difficult to include in predictions are changes in league rules, injuries to teammates, the loss of significant teammates due to trade or free-agency, the team's performance changing considerably from the last year, etc.

Given the restrictions on the predictive power of simply using statistics, and the limits to how well it is possible to predict future performance based only on past performance, it is still possible to come up with an accurate prediction for most players. Starting in Section II, the data used in the analysis will be discussed, as well as any data that have been ignored. In Section III, the method used to predict the three-point shooting percentages for the upcoming season will be developed. In Section IV, this method will be used for the 2014 NBA season and compared to the actual results to show the power of this method. Then, in Section V, the predictions for the 2015 NBA season will be presented. Finally, some discussion of improvements that could be made to the methods presented will be discussed in Section VI.

II.   DATA

Most of the data used in this analysis were obtained from the Basketball Reference website [3], which has the statistics for every professional basketball player in NBA and ABA history. For the purposes of predicting the three-point shooting percentages it was only necessary to get the statistics for players starting with the 1979 basketball season, when the three-point shot was first introduced into the NBA. These statistics include, for each season, which team the player played for; his age; the number of games and minutes played; the number of made and attempted two-point shots, three-point shots, and free throws; as well as offensive and defensive rebounds; assists; turnovers; steals; blocks; personal fouls; and total number of points scored. Not all of the statistics gathered were necessary the predictions. A total of 2,311 players' career information were collected, comprising 13,600 individual seasons.

Before analysing the data, certain cuts were made on whether to consider a season for the analysis. The player must have played at least 100 minutes in the season, and attempted at least 1 three-point shot per every 100 minutes played that season, which amounts to a shot every two games. More extensive cuts were considered, such as requiring at least 41 three-point shots attempted in a season, but these were found to be too restrictive.

A cut was also placed on the years to consider. Figure 1 shows the number of number of two- and three-point shots attempted per minute in the seasons selected. The two-point shots show a normal distribution with a Gaussian mean of 0.258, corresponding to a two-point shot attempted roughly every four minutes of playing time on average. However, the plot of the three-point shots seems to show two different distributions on top of one another. There is the normal distribution centered at 0.09, or a three-point shot roughly every 10 minutes of playing time, but there is also another distribution centered at 0.015, or roughly once every 65 minutes of playing time. At first it seemed that this was simply due to power-forwards or centers, who rarely shoot threes, but the peak was too high, and all positions showed the same low peak, although in different degrees.

Looking at the number of three-point attempts per minute played as a function of time revealed the answer. Figure 2 shows how the number of three-point shots attempted has evolved with time. Prior to 1994, there is a strong band of red in the 0.01 bin of three-point shots attempted per minute, indicating that the majority of players took three-point shots very infrequently in those seasons. It was only in 1994, when the NBA moved the three-point line in to a uniform 22 feet, that all guards started regularly taking threes. Even after the line was moved back in 1997 the guards continued taking threes. Small-forwards started taking threes regularly in the late 1990s and early 2000s, and even some power-forwards now take threes regularly; centers, however, remain very unlikely to attempt threes. As a result of this discrep-
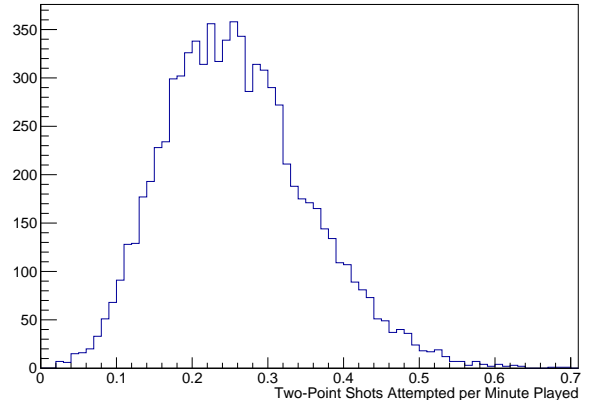
(a)
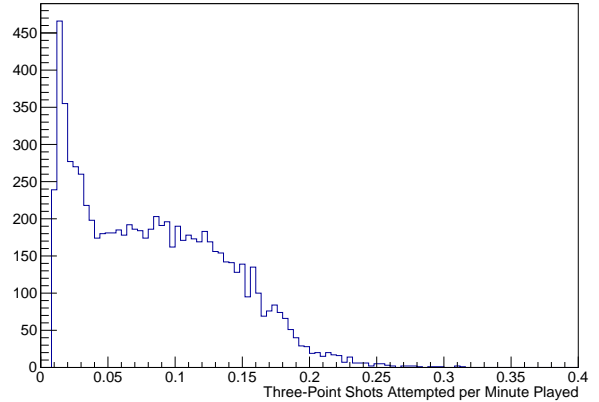
(b)

FIG. 1. The number of (a) two-point shots, and (b) three-point shots attempted by all NBA players in every season since 1980, except those where the player played less than 100 minutes or attempted less than 1 three-point shot per 100 minutes played.

ancy, only the seasons after 1994 are considered in the method of this paper. Figure 3 shows the number of three-point shots attempted per minute in the selected season after 1994. The peak near 0.015 has been greatly reduced, although it is still there, largely due to centers and power-forwards.

For analyzing rookies seasons it was necessary to look at college stats for the players, and those were obtained from a sister site of Basketball Reference, Sports Reference [4]. For players from overseas the website RealGM Basketball [5] was used.

III.   METHOD

In order to predict the three-point shooting percentage for a player in a season based only on how they have per-

FIG. 2. The number of three-point shots attempted by all NBA players in every season since 1980, except those where the player played less than 100 minutes or attempted less than 1 three-point shot per 100 minutes played, as a function of the year.
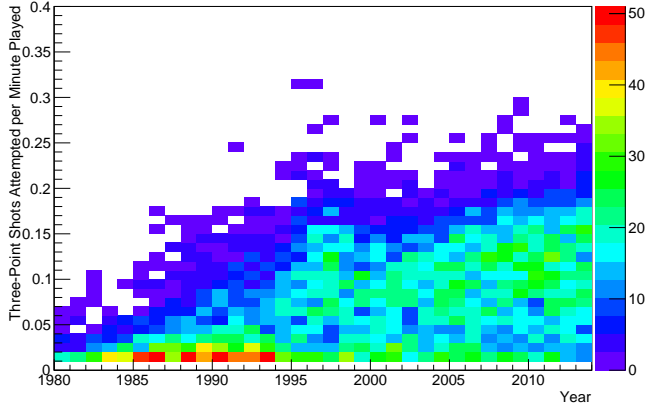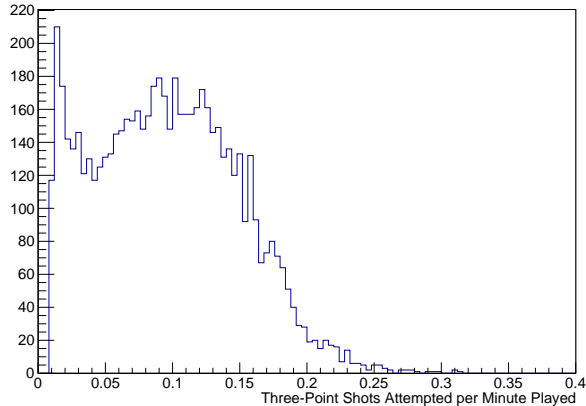

FIG. 3. The number of three-point shots attempted by all NBA players in every season since 1994, except those where the player played less than 100 minutes or attempted less than 1 three-point shot per 100 minutes played, as a function of the year. The peak near 0.015 has been greatly reduced, but is still present, due largely to power-forwards and centers.

formed in the past, I have elected to use a method that is similar to the signal-background subtraction method that was used in my thesis work [2]. The basis of this method is that given a particular player's season statistics, a number of similar seasons are found, and then based on how the players in those seasons performed in their next season, a prediction can be made about the next season of the player in question.

The first question is how to define a similar season. The factors that were discussed in Section I that can be taken into consideration were the previous season's three-

Statistic	Weight	Width
Games	0.05	42
Two-point attempts/min	0.05	0.082
Three-point attempts/min	0.1	0.054
Three-point percentage	0.35	0.061
Three-point attempts/min career	0.1	0.046
Three-point percentage career	0.35	0.042

TABLE I. Statistics used in the distance calculation.

point shooting percentage, three-point shots attempted, two-point shots attempted and the percentage made, the player's age and years of experience in the league, the number of minutes he plays, and the number of games played. It would also be useful to include his career statistics for three-point shooting percentage, and three-points shots attempted per minute of playing time. Following the method of [2], we define a distance metric to be

$$d_{ij}^2 = \sum_{k=1}^{4} \left[\frac{w_k(x_k^i - x_k^j)}{r_k}\right]^2 , \qquad (2)$$

where d_{ij} is the distance between seasons i and j, where season i is the season in question, the x_k are the statistics we will be using, the w_k are the weights assigned to those statistics, and the r_k are the Gaussian widths of those statistics, obtained by fitting a Gaussian to the distribution of that statistic. Table I shows the statistics used in the calculations, along with their weights and Gaussian widths. The weights were selected to highly favor three-point shooting percentages, both for the last season and for the career. The remaining weights were determined by trying to minimize the reduced χ^2, which will be discussed later.

To predict the three-point shooting percentage for the next season for a given player, their last season is compared to every season by every player since 1994, and the nearest ten seasons, based on the distance calculation, are collected. Then, we use the average of the next season for each of those ten players as the prediction for the player in question, and the standard deviation of those ten seasons is used as the uncertainty. This allows us to see how players generally perform in the season following such a performance, and gives a range for how precisely we can predict the next season.

Note that this method does not work for rookies because they do not have a previous season to use for comparisons. Another method must be used for them.

A. Example

Let us take as an example Ray Allen of the Miami Heat in the 2014 NBA season. The ten seasons closest to the season he had in 2013 and his career to that point were: Ray Allen (2009), Marco Belinelli (2011), Kyle

Korver (2011), Reggie Miller (2002) and (2004), Tracy Murray (2000), Wesley Person (1998), Eric Piatkowski (2001) and (2005), and J.J. Reddick (2012). Note that we do include previous seasons of the player in question's own career, like Ray Allen's 2009 season in this example. In the ensuing seasons those players shot 0.363, 0.377, 0.435, 0.355, 0.322, 0.350, 0.375, 0.466, 0.273, and 0.366, which leads to an average of 0.368 ± 0.054, and he actually shot 0.375 in that season, well within the uncertainty. Note that this is well less than his 2013 season, when he shot 0.419, and significantly less than the 2011 and 2012 seasons, when he shot 0.453 and 0.459 respectively.

B. Rookies

As mentioned above, this method does not work for rookies, because they do not have any prior seasons in the NBA to base their performance off. A similar distance method could be developed for rookies as for the veterans, but there have only been 1,455 rookies since 1994, not all of them played in college but were from overseas or straight out of high school, and a significant chunk of them played less than 100 minutes in their first year. This means the pool from which to find similar seasons would be quite small. So an altogether different method must be employed for them.

While a more sophisticated method could be produced (see Section VI), this basic method produces good results. I started by gathering the college statistics for players who played at least one season in college, excluding foreign players and direct-from-high-school players. Then the ratio of their three-point shooting percentage from their first year in the NBA to their last year in college was calculated and a distribution was generated, see Figure 4. A Gaussian function was then fit to this distribution, resulting in a mean of 0.84 ± 0.25, indicating that rookies generally have a slight downturn in their shooting percentage as they become professional players, which is to be expected, given the jump in skill level as well as the longer distance for threes in the NBA. Then their predicted shooting percentage in their rookie year is

$$p_{rookie} = 0.84 \times p_{college} \ , \qquad (3)$$

where $p_{college}$ is their three-point shooting percentage in their last year of college. The error on this value is then

$$\sigma_{p_{rookie}} = p_{rookie} \sqrt{\left(\frac{\sigma_{p_{college}}}{p_{college}}\right)^2 + \left(\frac{0.25}{0.84}\right)^2} \ , \qquad (4)$$

where $\sigma_{p_{college}}$ is computed according to Equation 1.

This method should be accurate for players coming from college, and should be at least a decent estimate for players coming from Europe, although the level of play amongst professionals in Europe is probably higher than that of American colleges.
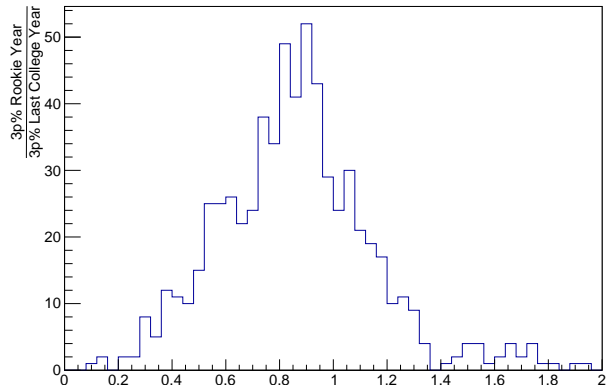
FIG. 4. The ratio of the three-point shooting percentages from their rookie year and their last year of college for all rookies in the league since 1994 who played at least one year of college basketball.

IV. THE 2014 SEASON

As a test of this method, we have predicted the three-point shooting percentages for each player, except rookies, in the 2014 season, based only on statistics from the 2013 season and before. The predictions are then compared to the actual results of the season using the reduced χ^2 method. χ^2 is computed as

$$\chi^2 = \sum_{players} \left[\frac{(p_{pred}^{player} - p_{actual}^{player})^2}{\sigma_{p_{pred}}^2 + \sigma_{p_{actual}}^2} \right] \ , \qquad (5)$$

where the sum is over all players in the league, p_{pred} is the predicted three-point shooting percentage, $\sigma_{p_{pred}}$ is the uncertainty on that percentage, p_{actual} is the actual shooting percentage, $\sigma_{p_{actual}}$ is the uncertainty on that percentage calculated using Equation 1. The reduced χ^2 is just χ^2/NDF, where NDF is the number of degrees of freedom, which in this case is just the number of players minus 1. A reduced χ^2 of near 1 is considered optimal.

The results for the 2014 season can be found in Table II, and can be seen visually in Figure 5. The index number from the table corresponds to the number on the graph. Overall the agreement is excellent, with a reduced χ^2 of 1.31. For comparison, simply using the career average three-point shooting percentage for each player, along with the error for that percentage calculated according to Equation 1 results in a significantly higher reduced χ^2 of 7.66, which indicates much worse agreement.

As mentioned, the agreement overall is excellent, but there are some players whose predictions are more than 2σ away from their actual results. A few of them can be examined to see why the predictions were poor. Carmelo Anthony was predicted to shoot 0.353 ± 0.023, but in fact had the best year of his career at 0.402, attempting 400+

threes for only the second time. Harrison Barnes was expected to improve on his rookie season and instead went down a little bit more than expected. MarShon Brooks was predicted to have a shooting percentage of 0.330 ± 0.044 and actually shot 0.520. He played only 35 games on three different teams, shooting only 25 threes, well down from the 55 and 150 threes he attempted in his first two years in the league. Kobe Bryant was expected to shoot 0.331 ± 0.028, and only shot 0.188. Of course, he only played in 6 games last year, shooting only 16 threes. Landry Fields was expected to shoot 0.283 ± 0.055, and actually didn't hit a single three the entire season. His playing was significantly reduced this past season and seems to have stopped taking threes, after taking more than 200 in his first season and 100 in his second. Ben Gordon was expected to hit 0.381 ± 0.032, but coming off the bench in his new city of Charlotte shot only 29 threes in 19 games after shooting 200+ in all but one previous season. Tobias Harris was expected to shoot 0.363 ± 0.045, and actually shot 0.254. This is a significant difference, especially considering he shot a similar number of threes to the 2013 season. Ersan Ilyasova was predicted to shoot 0.377 ± 0.037, and well under-performed at 0.282. It is unclear what caused this decline as he still shot well over 100 threes and played in more than 50 games. Stephen Jackson had an abbreviated season, leading to him only playing in 9 games and attempting 14 threes. Coming off the bench Antawan Jamison shot only 41 threes, and was below expectations after attempting 200+ threes in most of his previous seasons. John Jenkins shot 138 threes his rookie season and then only 18 last season, making it difficult to get a good average. In total there were 25 out of 240 players who were more than 2σ away from their predicted values, roughly 10%, which is right at the expected amount we should expect to be outside of 2σ, indicating our estimates and their errors are reasonable. Many of the outliers are there due to injuries, trades, or significantly reduced minutes. The ones who exceeded their predictions generally had the best years of their career.

From these results it is safe to say that this method is sound and should be accurate to predict the 2015 season.

Index	Player Name	Prediction ± Error	Actual
0	Arron Afflalo	0.385 ± 0.053	0.427
1	Tony Allen	0.226 ± 0.105	0.234
2	Ray Allen	0.368 ± 0.054	0.375
3	Alan Anderson	0.327 ± 0.045	0.339
4	Ryan Anderson	0.366 ± 0.042	0.409
5	James Anderson	0.348 ± 0.044	0.328
6	Carmelo Anthony	0.353 ± 0.023	0.402
7	Trevor Ariza	0.342 ± 0.038	0.407
8	Darrell Arthur	0.289 ± 0.106	0.375
9	D.J. Augustin	0.364 ± 0.062	0.401
10	Luke Babbitt	0.335 ± 0.041	0.379
11	Leandro Barbosa	0.356 ± 0.068	0.280
12	Jose Barea	0.334 ± 0.035	0.316
13	Andrea Bargnani	0.376 ± 0.056	0.278
14	Harrison Barnes	0.381 ± 0.017	0.347
15	Matt Barnes	0.340 ± 0.035	0.343
16	Will Barton	0.315 ± 0.093	0.303
17	Shane Battier	0.358 ± 0.061	0.348
18	Nicolas Batum	0.359 ± 0.030	0.361
19	Jerryd Bayless	0.364 ± 0.035	0.358
20	Kent Bazemore	0.338 ± 0.046	0.336

Index	Player Name	Prediction ± Error	Actual
21	Bradley Beal	0.388 ± 0.030	0.402
22	Michael Beasley	0.308 ± 0.075	0.389
23	Marco Belinelli	0.364 ± 0.041	0.430
24	Patrick Beverley	0.350 ± 0.050	0.361
25	Chauncey Billups	0.360 ± 0.068	0.292
26	Steve Blake	0.351 ± 0.060	0.376
27	Andray Blatche	0.228 ± 0.097	0.278
28	Eric Bledsoe	0.317 ± 0.041	0.357
29	Matt Bonner	0.372 ± 0.064	0.429
30	Chris Bosh	0.345 ± 0.107	0.339
31	Avery Bradley	0.319 ± 0.056	0.395
32	Corey Brewer	0.321 ± 0.081	0.280
33	Ronnie Brewer	0.270 ± 0.073	0.125
34	Aaron Brooks	0.365 ± 0.058	0.387
35	MarShon Brooks	0.330 ± 0.044	0.520
36	Kobe Bryant	0.331 ± 0.028	0.188
37	Chase Budinger	0.372 ± 0.029	0.350
38	Alec Burks	0.365 ± 0.049	0.350
39	Caron Butler	0.340 ± 0.074	0.394
40	Jimmy Butler	0.351 ± 0.040	0.283
41	Will Bynum	0.328 ± 0.070	0.323
42	Jose Calderon	0.416 ± 0.088	0.449
43	DeMarre Carroll	0.318 ± 0.074	0.362
44	Vince Carter	0.386 ± 0.026	0.394
45	Omri Casspi	0.351 ± 0.041	0.347
46	Mario Chalmers	0.390 ± 0.032	0.385
47	Wilson Chandler	0.353 ± 0.032	0.348
48	Earl Clark	0.320 ± 0.036	0.336
49	Victor Claver	0.284 ± 0.070	0.167
50	Norris Cole	0.334 ± 0.037	0.345
51	Darren Collison	0.340 ± 0.066	0.376
52	Nando De Colo	0.371 ± 0.041	0.340
53	Mike Conley	0.366 ± 0.023	0.361
54	Chris Copeland	0.395 ± 0.047	0.418
55	Jordan Crawford	0.320 ± 0.068	0.316
56	Jamal Crawford	0.359 ± 0.028	0.361
57	Jae Crowder	0.335 ± 0.021	0.331
58	Stephen Curry	0.379 ± 0.063	0.424
59	Austin Daye	0.329 ± 0.062	0.324
60	DeMar DeRozan	0.314 ± 0.081	0.305
61	Luol Deng	0.320 ± 0.070	0.302
62	Boris Diaw	0.325 ± 0.059	0.402
63	Toney Douglas	0.352 ± 0.037	0.304
64	Goran Dragic	0.369 ± 0.051	0.408
65	Jared Dudley	0.329 ± 0.091	0.360
66	Mike Dunleavy	0.396 ± 0.025	0.380
67	Kevin Durant	0.384 ± 0.044	0.391
68	Wayne Ellington	0.361 ± 0.066	0.424
69	Monta Ellis	0.342 ± 0.041	0.330
70	Tyreke Evans	0.323 ± 0.061	0.221
71	Raymond Felton	0.375 ± 0.051	0.318
72	Landry Fields	0.283 ± 0.055	0.000
73	Derek Fisher	0.291 ± 0.138	0.384
74	Evan Fournier	0.401 ± 0.047	0.376
75	Randy Foye	0.373 ± 0.051	0.380
76	Jimmer Fredette	0.387 ± 0.032	0.476
77	Francisco Garcia	0.359 ± 0.036	0.358
78	Diante Garrett	0.256 ± 0.130	0.375
79	Rudy Gay	0.346 ± 0.036	0.330
80	Alonzo Gee	0.335 ± 0.055	0.328
81	Paul George	0.359 ± 0.054	0.364
82	Manu Ginobili	0.359 ± 0.045	0.349
83	Drew Gooden	0.216 ± 0.115	0.412
84	Ben Gordon	0.381 ± 0.032	0.276
85	Eric Gordon	0.365 ± 0.027	0.391
86	Danny Green	0.429 ± 0.025	0.415
87	Willie Green	0.347 ± 0.027	0.339
88	Draymond Green	0.242 ± 0.117	0.333
89	Gerald Green	0.373 ± 0.074	0.400
90	Jeff Green	0.386 ± 0.043	0.341
91	Blake Griffin	0.237 ± 0.099	0.273
92	Jordan Hamilton	0.349 ± 0.034	0.354
93	James Harden	0.358 ± 0.045	0.366
94	Maurice Harkless	0.342 ± 0.054	0.383
95	Al Harrington	0.337 ± 0.055	0.340
96	Tobias Harris	0.363 ± 0.045	0.254
97	Devin Harris	0.340 ± 0.037	0.307
98	Spencer Hawes	0.291 ± 0.112	0.416
99	Gordon Hayward	0.399 ± 0.044	0.304
100	Gerald Henderson	0.338 ± 0.087	0.348
101	Xavier Henry	0.314 ± 0.060	0.346
102	George Hill	0.339 ± 0.055	0.365
103	Kirk Hinrich	0.361 ± 0.035	0.351
104	Jrue Holiday	0.354 ± 0.039	0.390
105	Serge Ibaka	0.350 ± 0.077	0.383
106	Andre Iguodala	0.351 ± 0.023	0.354
107	Ersan Ilyasova	0.377 ± 0.037	0.282
108	Kyrie Irving	0.366 ± 0.032	0.358

Index	Player Name	Prediction ± Error	Actual
109	Jarrett Jack	0.356 ± 0.048	0.341
110	Stephen Jackson	0.325 ± 0.065	0.071
111	Reggie Jackson	0.312 ± 0.085	0.339
112	LeBron James	0.329 ± 0.039	0.379
113	Antawn Jamison	0.345 ± 0.041	0.195
114	Richard Jefferson	0.351 ± 0.048	0.409
115	John Jenkins	0.386 ± 0.033	0.222
116	Brandon Jennings	0.359 ± 0.029	0.337
117	Jonas Jerebko	0.332 ± 0.063	0.419
118	Wesley Johnson	0.324 ± 0.041	0.369
119	Chris Johnson	0.339 ± 0.037	0.339
120	James Johnson	0.232 ± 0.068	0.253
121	Joe Johnson	0.380 ± 0.039	0.401
122	Orlando Johnson	0.384 ± 0.037	0.191
123	Terrence Jones	0.292 ± 0.051	0.307
124	James Jones	0.358 ± 0.052	0.519
125	Cory Joseph	0.293 ± 0.113	0.316
126	Brandon Knight	0.349 ± 0.022	0.325
127	Kyle Korver	0.415 ± 0.022	0.472
128	Jeremy Lamb	0.331 ± 0.024	0.356
129	Doron Lamb	0.393 ± 0.057	0.400
130	Ty Lawson	0.333 ± 0.069	0.356
131	Courtney Lee	0.360 ± 0.034	0.371
132	Kawhi Leonard	0.376 ± 0.026	0.379
133	Jon Leuer	0.245 ± 0.081	0.469
134	Rashard Lewis	0.394 ± 0.029	0.343
135	Damian Lillard	0.361 ± 0.043	0.394
136	Jeremy Lin	0.366 ± 0.058	0.358
137	Kevin Love	0.323 ± 0.065	0.376
138	Kyle Lowry	0.342 ± 0.055	0.380
139	John Lucas	0.354 ± 0.043	0.298
140	Shelvin Mack	0.335 ± 0.079	0.337
141	Shawn Marion	0.354 ± 0.073	0.358
142	Kendall Marshall	0.315 ± 0.096	0.399
143	Cartier Martin	0.377 ± 0.053	0.391
144	Kevin Martin	0.402 ± 0.031	0.387
145	Roger Mason	0.386 ± 0.036	0.354
146	Wesley Matthews	0.398 ± 0.036	0.393
147	Eric Maynor	0.340 ± 0.063	0.324
148	O.J. Mayo	0.386 ± 0.048	0.370
149	Josh McRoberts	0.254 ± 0.152	0.361
150	Jodie Meeks	0.352 ± 0.039	0.401
151	Khris Middleton	0.307 ± 0.057	0.414
152	C.J. Miles	0.332 ± 0.032	0.393
153	Darius Miller	0.380 ± 0.041	0.325
154	Andre Miller	0.217 ± 0.074	0.524
155	Mike Miller	0.399 ± 0.069	0.459
156	Patrick Mills	0.361 ± 0.054	0.425
157	Paul Millsap	0.264 ± 0.075	0.358
158	E'Twaun Moore	0.382 ± 0.040	0.354
159	Darius Morris	0.361 ± 0.049	0.316
160	Marcus Morris	0.361 ± 0.030	0.381
161	Markieff Morris	0.333 ± 0.073	0.315
162	Anthony Morrow	0.401 ± 0.113	0.451
163	Donatas Motiejunas	0.333 ± 0.035	0.250
164	Luc Mbah a Moute	0.305 ± 0.063	0.235
165	Byron Mullens	0.295 ± 0.071	0.371
166	Steve Nash	0.420 ± 0.039	0.333
167	Gary Neal	0.382 ± 0.047	0.378
168	Jameer Nelson	0.359 ± 0.037	0.348
169	Steve Novak	0.405 ± 0.052	0.426
170	Dirk Nowitzki	0.382 ± 0.031	0.398
171	Travis Outlaw	0.348 ± 0.067	0.350
172	Jannero Pargo	0.350 ± 0.047	0.400
173	Tony Parker	0.298 ± 0.121	0.373
174	Chandler Parsons	0.386 ± 0.039	0.370
175	Patrick Patterson	0.347 ± 0.060	0.364
176	Chris Paul	0.353 ± 0.042	0.368
177	Metta World Peace	0.344 ± 0.030	0.315
178	Paul Pierce	0.383 ± 0.020	0.373
179	Quincy Pondexter	0.335 ± 0.099	0.324
180	Ronnie Price	0.304 ± 0.068	0.209
181	Pablo Prigioni	0.343 ± 0.066	0.464
182	Tayshaun Prince	0.351 ± 0.071	0.290
183	Anthony Randolph	0.276 ± 0.113	0.295
184	J.J. Redick	0.398 ± 0.032	0.395
185	Luke Ridnour	0.345 ± 0.047	0.343
186	Austin Rivers	0.344 ± 0.065	0.364
187	Brian Roberts	0.368 ± 0.029	0.360
188	Nate Robinson	0.357 ± 0.041	0.377
189	Rajon Rondo	0.221 ± 0.085	0.289
190	Terrence Ross	0.332 ± 0.032	0.395
191	Ricky Rubio	0.321 ± 0.082	0.331
192	John Salmons	0.348 ± 0.050	0.387
193	Thabo Sefolosha	0.355 ± 0.066	0.316
194	Ramon Sessions	0.316 ± 0.081	0.282
195	Iman Shumpert	0.365 ± 0.063	0.333
196	Alexey Shved	0.332 ± 0.031	0.294
197	Kyle Singler	0.363 ± 0.039	0.382

Index	Player Name	Prediction ± Error	Actual
198	Chris Singleton	0.305 ± 0.074	0.368
199	Donald Sloan	0.256 ± 0.064	0.238
200	Ishmael Smith	0.329 ± 0.049	0.043
201	J.R. Smith	0.347 ± 0.038	0.394
202	Josh Smith	0.333 ± 0.070	0.264
203	Lance Stephenson	0.319 ± 0.071	0.352
204	Rodney Stuckey	0.341 ± 0.049	0.273
205	Tyshawn Taylor	0.380 ± 0.059	0.250
206	Jeffery Taylor	0.367 ± 0.045	0.269
207	Jeff Teague	0.372 ± 0.037	0.329
208	Marquis Teague	0.299 ± 0.113	0.278
209	Mirza Teletovic	0.332 ± 0.036	0.390
210	Garrett Temple	0.313 ± 0.068	0.207
211	Jason Terry	0.365 ± 0.040	0.379
212	Isaiah Thomas	0.373 ± 0.036	0.349
213	Klay Thompson	0.389 ± 0.034	0.417
214	Marcus Thornton	0.360 ± 0.049	0.345
215	Jamaal Tinsley	0.308 ± 0.063	0.067
216	Anthony Tolliver	0.346 ± 0.039	0.413
217	P.J. Tucker	0.294 ± 0.123	0.387
218	Hedo Turkoglu	0.301 ± 0.137	0.440
219	Evan Turner	0.333 ± 0.125	0.321
220	Beno Udrih	0.366 ± 0.069	0.452
221	Greivis Vasquez	0.358 ± 0.032	0.377
222	Charlie Villanueva	0.345 ± 0.030	0.250
223	Dwyane Wade	0.274 ± 0.075	0.281
224	Dion Waiters	0.340 ± 0.038	0.368
225	Kemba Walker	0.330 ± 0.038	0.333
226	John Wall	0.277 ± 0.085	0.351
227	Gerald Wallace	0.323 ± 0.083	0.297
228	C.J. Watson	0.386 ± 0.042	0.366
229	Earl Watson	0.262 ± 0.137	0.286
230	Martell Webster	0.387 ± 0.028	0.392
231	Russell Westbrook	0.335 ± 0.040	0.318
232	Deron Williams	0.362 ± 0.038	0.366
233	Derrick Williams	0.333 ± 0.043	0.263
234	Louis Williams	0.358 ± 0.026	0.342
235	Marvin Williams	0.331 ± 0.053	0.359
236	Mo Williams	0.365 ± 0.040	0.369
237	Dorell Wright	0.373 ± 0.029	0.342
238	Tony Wroten	0.298 ± 0.055	0.213
239	Nick Young	0.375 ± 0.042	0.386

TABLE II: Predictions for the three-point shooting percentage for each player in the 2014 season, based on the 2013 season. Rookies are not included on this table.

V. THE 2015 SEASON

For the 2015 season I will predict the three-point shooting percentage for all players who played in the 2014 season, regardless of whether or not they are currently signed to a team or have retired in the off-season. However, they must have played at least 100 minutes and attempted at least 1 three-point shot per 100 minutes of playing time. Players who do not meet these requirements are listed, but their prediction is listed as N/A, as their expected shooting percentage is either 0.000 or would have very large error bars. The veterans are listed in Table III.

The rookies for the 2015 season are listen in Table IV. For players who played in college in the United States, those stats were used to predict their performance. For players from outside of the United States, the stats from their most recent *full* season were used. In the case of several European players this excluded parts of the 2014-2015 season that they have already played. I was unable to obtain any stats for Dante Exum and have not provided a prediction for him. P.J. Hairston did not play in
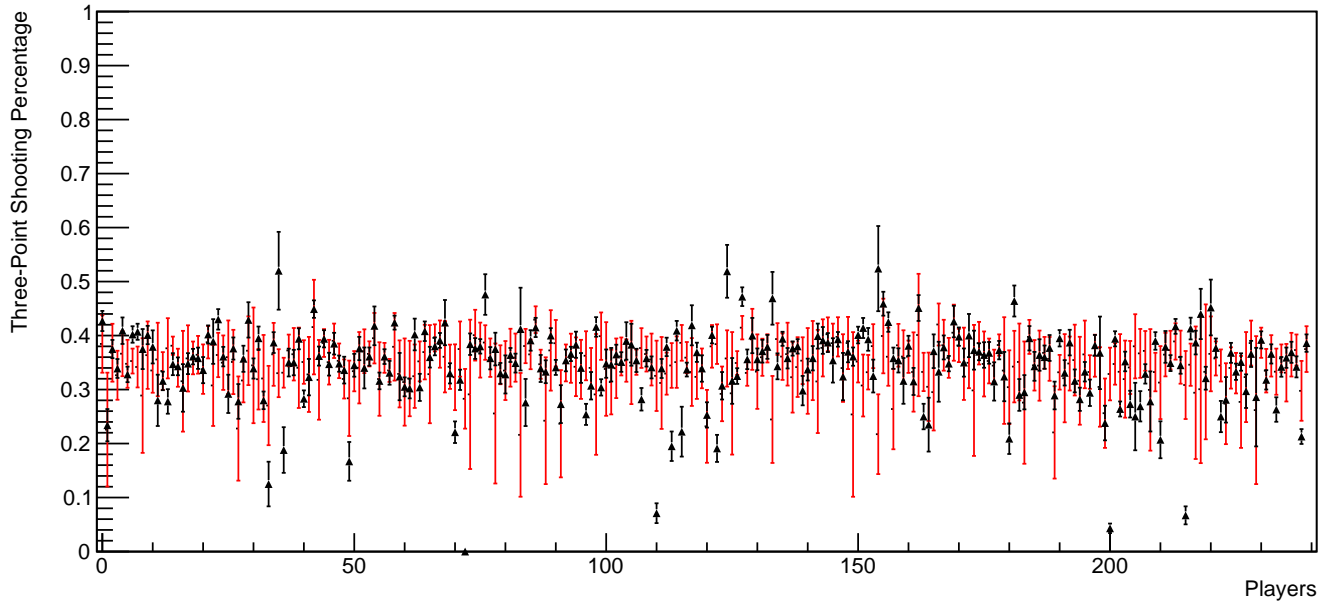
FIG. 5. Predictions for the three-point shooting percentage for each player in the 2014 season, based on the 2013 season. Rookies are not included on this plot. The red bars are the predicted values, the black points with error bars are the actual results with associated error calculated according to Equation 1.

college last season, so I have used his 2013 season stats. There were seven players which were drafted in 2013 or before but had not yet played in the NBA that have been included at the bottom of the table for rookies. For these players the stats from the last season they played in college or overseas were used.

Index	Player Name	Prediction ± Error	Team
0	Quincy Acy	0.262 ± 0.095	NYK
1	Steven Adams	N/A	OKC
2	Jeff Adrien	N/A	HOU
3	Arron Afflalo	0.379 ± 0.034	DEN
4	Alexis Ajinca	N/A	NOP
5	Cole Aldrich	N/A	NYK
6	LaMarcus Aldridge	N/A	POR
7	Lavoy Allen	0.288 ± 0.096	IND
8	Tony Allen	0.271 ± 0.083	MEM
9	Ray Allen	0.405 ± 0.061	
10	Al-Farouq Aminu	0.367 ± 0.085	DAL
11	Louis Amundson	N/A	CLE
12	Chris Andersen	N/A	MIA
13	Alan Anderson	0.347 ± 0.027	BRK
14	Ryan Anderson	0.368 ± 0.044	NOP
15	James Anderson	0.350 ± 0.041	PHI
16	Giannis Antetokounmpo	0.363 ± 0.051	MIL
17	Joel Anthony	N/A	DET
18	Carmelo Anthony	0.352 ± 0.044	NYK
19	Pero Antic	0.359 ± 0.038	ATL
20	Trevor Ariza	0.329 ± 0.099	HOU
21	Hilton Armstrong	N/A	GSW
22	Darrell Arthur	0.341 ± 0.036	DEN
23	Omer Asik	N/A	NOP
24	D.J. Augustin	0.403 ± 0.022	DET
25	Gustavo Ayon	N/A	
26	Jeff Ayres	N/A	SAS
27	Chris Babb	0.340 ± 0.060	BOS
28	Luke Babbitt	0.382 ± 0.033	NOP
29	Leandro Barbosa	0.320 ± 0.071	GSW

Index	Player Name	Prediction ± Error	Team
30	Jose Barea	0.355 ± 0.065	MIN
31	Andrea Bargnani	0.323 ± 0.061	NYK
32	Harrison Barnes	0.358 ± 0.034	GSW
33	Matt Barnes	0.344 ± 0.030	LAC
34	Will Barton	0.326 ± 0.079	POR
35	Brandon Bass	N/A	BOS
36	Shane Battier	0.322 ± 0.078	
37	Nicolas Batum	0.354 ± 0.062	POR
38	Jerryd Bayless	0.380 ± 0.031	MIL
39	Aron Baynes	N/A	SAS
40	Kent Bazemore	0.338 ± 0.065	ATL
41	Bradley Beal	0.387 ± 0.031	WAS
42	Michael Beasley	0.346 ± 0.055	
43	Marco Belinelli	0.370 ± 0.054	SAS
44	Anthony Bennett	0.304 ± 0.064	MIN
45	Patrick Beverley	0.371 ± 0.042	HOU
46	Andris Biedrins	N/A	UTA
47	Chauncey Billups	0.362 ± 0.062	
48	Bismack Biyombo	N/A	CHA
49	DeJuan Blair	N/A	WAS
50	Steve Blake	0.343 ± 0.124	POR
51	Andray Blatche	0.297 ± 0.096	
52	Eric Bledsoe	0.334 ± 0.061	PHO
53	Vander Blue	N/A	
54	Keith Bogans	N/A	
55	Andrew Bogut	N/A	GSW
56	Matt Bonner	0.399 ± 0.056	SAS
57	Trevor Booker	N/A	
58	Carlos Boozer	N/A	LAL
59	Chris Bosh	0.352 ± 0.039	MIA
60	Avery Bradley	0.370 ± 0.078	BOS
61	Elton Brand	N/A	ATL
62	Corey Brewer	0.328 ± 0.072	MIN
63	Ronnie Brewer	0.260 ± 0.069	
64	Aaron Brooks	0.358 ± 0.061	CHI
65	MarShon Brooks	0.361 ± 0.112	
66	Lorenzo Brown	0.304 ± 0.098	
67	Shannon Brown	N/A	MIA
68	Kobe Bryant	0.281 ± 0.075	LAL
69	Chase Budinger	0.367 ± 0.036	MIN
70	Reggie Bullock	0.335 ± 0.024	LAC
71	Trey Burke	0.323 ± 0.029	UTA

Index	Player Name	Prediction ± Error	Team	Index	Player Name	Prediction ± Error	Team
72	Alec Burks	0.358 ± 0.046	UTA	155	Francisco Garcia	0.345 ± 0.072	HOU
73	Caron Butler	0.356 ± 0.035	DET	156	Kevin Garnett	N/A	BRK
74	Rasual Butler	0.365 ± 0.053	WAS	157	Diante Garrett	0.348 ± 0.058	
75	Jimmy Butler	0.291 ± 0.054	CHI	158	Marc Gasol	N/A	MEM
76	Dwight Buycks	0.314 ± 0.083		159	Pau Gasol	N/A	CHI
77	Andrew Bynum	N/A		160	Rudy Gay	0.320 ± 0.033	SAC
78	Will Bynum	0.324 ± 0.074	BOS	161	Alonzo Gee	0.328 ± 0.075	DEN
79	Nick Calathes	0.333 ± 0.065	MEM	162	Paul George	0.355 ± 0.036	IND
80	Jose Calderon	0.416 ± 0.037	NYK	163	Taj Gibson	N/A	CHI
81	Kentavious Caldwell-Pope	0.336 ± 0.057	DET	164	Manu Ginobili	0.362 ± 0.044	SAS
82	Isaiah Canaan	0.341 ± 0.029	HOU	165	Rudy Gobert	N/A	UTA
83	DeMarre Carroll	0.330 ± 0.057	ATL	166	Ryan Gomes	N/A	
84	Vince Carter	0.383 ± 0.026	MEM	167	Drew Gooden	0.327 ± 0.082	WAS
85	Michael Carter-Williams	0.289 ± 0.050	PHI	168	Archie Goodwin	0.315 ± 0.093	PHO
86	Omri Casspi	0.345 ± 0.025	SAC	169	Ben Gordon	0.365 ± 0.080	ORL
87	Mario Chalmers	0.371 ± 0.033	MIA	170	Eric Gordon	0.394 ± 0.022	NOP
88	Tyson Chandler	N/A	DAL	171	Marcin Gortat	N/A	WAS
89	Wilson Chandler	0.344 ± 0.030	DEN	172	Danny Granger	0.375 ± 0.038	MIA
90	Josh Childress	N/A		173	Aaron Gray	N/A	DET
91	Dionte Christmas	0.332 ± 0.031	PHO	174	Danny Green	0.399 ± 0.051	SAS
92	Earl Clark	0.276 ± 0.084		175	Willie Green	0.332 ± 0.028	ORL
93	Ian Clark	0.357 ± 0.052	UTA	176	Draymond Green	0.346 ± 0.085	GSW
94	Victor Claver	0.257 ± 0.110	POR	177	Gerald Green	0.378 ± 0.046	PHO
95	Norris Cole	0.335 ± 0.065	MIA	178	Jeff Green	0.349 ± 0.020	BOS
96	Jason Collins	0.256 ± 0.064		179	Blake Griffin	0.266 ± 0.099	LAC
97	Darren Collison	0.354 ± 0.028	SAC	180	Jorge Gutierrez	0.292 ± 0.051	BRK
98	Nick Collison	0.292 ± 0.047	OKC	181	Jordan Hamilton	0.341 ± 0.050	UTA
99	Nando De Colo	0.355 ± 0.042		182	Justin Hamilton	N/A	MIA
100	Mike Conley	0.344 ± 0.066	MEM	183	Tyler Hansbrough	N/A	TOR
101	Chris Copeland	0.400 ± 0.052	IND	184	Tim Hardaway	0.361 ± 0.045	NYK
102	DeMarcus Cousins	N/A	SAC	185	James Harden	0.362 ± 0.042	HOU
103	Robert Covington	N/A		186	Maurice Harkless	0.317 ± 0.065	ORL
104	Allen Crabbe	0.408 ± 0.032	POR	187	Josh Harrellson	0.365 ± 0.053	
105	Jordan Crawford	0.343 ± 0.030		188	Al Harrington	0.317 ± 0.054	
106	Jamal Crawford	0.328 ± 0.047	LAC	189	Elias Harris	N/A	
107	Jae Crowder	0.349 ± 0.031	DAL	190	Manny Harris	0.369 ± 0.039	
108	Jared Cunningham	N/A	LAC	191	Mike Harris	N/A	
109	Dante Cunningham	N/A		192	Tobias Harris	0.293 ± 0.031	ORL
110	Seth Curry	N/A		193	Devin Harris	0.330 ± 0.061	DAL
111	Stephen Curry	0.398 ± 0.031	GSW	194	Udonis Haslem	N/A	MIA
112	Samuel Dalembert	N/A	NYK	195	Spencer Hawes	0.376 ± 0.037	LAC
113	Troy Daniels	N/A	HOU	196	Chuck Hayes	N/A	TOR
114	Luigi Datome	0.305 ± 0.146	DET	197	Gordon Hayward	0.358 ± 0.055	UTA
115	Brandon Davies	0.230 ± 0.109	PHI	198	Gerald Henderson	0.300 ± 0.063	CHA
116	Anthony Davis	N/A	NOP	199	Xavier Henry	0.308 ± 0.052	LAL
117	Ed Davis	N/A	LAL	200	John Henson	N/A	MIL
118	Glen Davis	N/A	LAC	201	Roy Hibbert	N/A	IND
119	Austin Daye	0.391 ± 0.026	SAS	202	J.J. Hickson	N/A	DEN
120	DeMar DeRozan	0.306 ± 0.067	TOR	203	Nene Hilario	N/A	WAS
121	Dewayne Dedmon	N/A	ORL	204	George Hill	0.356 ± 0.053	IND
122	Matthew Dellavedova	0.338 ± 0.056	CLE	205	Jordan Hill	N/A	LAL
123	Luol Deng	0.315 ± 0.062	MIA	206	Solomon Hill	0.282 ± 0.099	IND
124	Boris Diaw	0.338 ± 0.048	SAS	207	Kirk Hinrich	0.356 ± 0.045	CHI
125	Gorgui Dieng	N/A	MIN	208	Jrue Holiday	0.376 ± 0.044	NOP
126	Toney Douglas	0.296 ± 0.053		209	Ryan Hollins	N/A	SAC
127	Chris Douglas-Roberts	0.339 ± 0.054	LAC	210	Scotty Hopson	N/A	
128	Goran Dragic	0.375 ± 0.048	PHO	211	Al Horford	0.343 ± 0.076	ATL
129	Andre Drummond	N/A	DET	212	Dwight Howard	N/A	HOU
130	Jared Dudley	0.365 ± 0.041	MIL	213	Robbie Hummel	0.357 ± 0.037	MIN
131	Tim Duncan	N/A	SAS	214	Kris Humphries	N/A	WAS
132	Mike Dunleavy	0.345 ± 0.054	CHI	215	Serge Ibaka	0.332 ± 0.039	OKC
133	Kevin Durant	0.364 ± 0.031	OKC	216	Andre Iguodala	0.333 ± 0.060	GSW
134	Shane Edwards	N/A		217	Ersan Ilyasova	0.348 ± 0.056	MIL
135	Wayne Ellington	0.389 ± 0.029	LAL	218	Kyrie Irving	0.360 ± 0.032	CLE
136	Monta Ellis	0.331 ± 0.041	DAL	219	Royal Ivey	N/A	
137	Melvin Ely	N/A		220	Jarrett Jack	0.377 ± 0.037	BRK
138	Jeremy Evans	N/A	UTA	221	Stephen Jackson	0.293 ± 0.147	
139	Tyreke Evans	0.294 ± 0.088	NOP	222	Reggie Jackson	0.334 ± 0.042	OKC
140	Reggie Evans	N/A	SAC	223	Damion James	N/A	
141	Kenneth Faried	N/A	DEN	224	Bernard James	N/A	
142	Jordan Farmar	0.389 ± 0.027	LAC	225	Mike James	N/A	
143	Vitor Faverani	0.291 ± 0.077	BOS	226	LeBron James	0.332 ± 0.041	CLE
144	Derrick Favors	N/A	UTA	227	Antawn Jamison	0.330 ± 0.036	
145	Carrick Felix	N/A		228	Othyus Jeffers	N/A	
146	Raymond Felton	0.348 ± 0.041	DAL	229	Al Jefferson	N/A	CHA
147	Landry Fields	0.285 ± 0.133	TOR	230	Richard Jefferson	0.379 ± 0.033	DAL
148	Derek Fisher	0.342 ± 0.097		231	John Jenkins	0.328 ± 0.049	ATL
149	Evan Fournier	0.373 ± 0.036	ORL	232	Brandon Jennings	0.342 ± 0.034	DET
150	Randy Foye	0.373 ± 0.038	DEN	233	Jonas Jerebko	0.366 ± 0.042	DET
151	Jamaal Franklin	0.394 ± 0.068		234	Amir Johnson	0.303 ± 0.156	TOR
152	Jimmer Fredette	0.372 ± 0.041	NOP	235	Wesley Johnson	0.350 ± 0.058	LAL
153	Joel Freeland	N/A	POR	236	Chris Johnson	0.339 ± 0.049	PHI
154	Channing Frye	0.366 ± 0.037	ORL				

Index	Player Name	Prediction ± Error	Team	Index	Player Name	Prediction ± Error	Team
237	James Johnson	0.312 ± 0.056	TOR	320	Byron Mullens	0.356 ± 0.029	
238	Joe Johnson	0.400 ± 0.030	BRK	321	Erik Murphy	N/A	
239	Orlando Johnson	0.296 ± 0.068		322	Toure' Murry	0.398 ± 0.045	UTA
240	Darius Johnson-Odom	N/A		323	Mike Muscala	0.309 ± 0.103	ATL
241	Terrence Jones	0.257 ± 0.126	HOU	324	Hamady N'Diaye	N/A	
242	James Jones	0.409 ± 0.054	CLE	325	Steve Nash	0.401 ± 0.035	LAL
243	Perry Jones	0.358 ± 0.051	OKC	326	Gary Neal	0.388 ± 0.041	CHA
244	Solomon Jones	N/A		327	Nemanja Nedovic	0.346 ± 0.086	GSW
245	DeAndre Jordan	N/A	LAC	328	Jameer Nelson	0.366 ± 0.037	DAL
246	Cory Joseph	0.294 ± 0.086	SAS	329	Andrew Nicholson	0.347 ± 0.051	ORL
247	Chris Kaman	N/A	POR	330	Joakim Noah	N/A	CHI
248	Enes Kanter	N/A	UTA	331	Steve Novak	0.395 ± 0.058	UTA
249	Sergey Karasev	0.286 ± 0.126	BRK	332	Dirk Nowitzki	0.382 ± 0.025	DAL
250	Ryan Kelly	0.370 ± 0.046	LAL	333	James Nunnally	0.351 ± 0.028	
251	Michael Kidd-Gilchrist	N/A	CHA	334	Jermaine O'Neal	N/A	
252	Andrei Kirilenko	N/A	BRK	335	Kyle O'Quinn	N/A	ORL
253	Brandon Knight	0.356 ± 0.039	MIL	336	Greg Oden	N/A	
254	Kyle Korver	0.405 ± 0.067	ATL	337	Victor Oladipo	0.342 ± 0.025	ORL
255	Kosta Koufos	N/A	MEM	338	Kelly Olynyk	0.350 ± 0.057	BOS
256	Viacheslav Kravtsov	N/A		339	Arinze Onuaku	N/A	
257	Ognjen Kuzmic	N/A	GSW	340	Daniel Orton	N/A	
258	Jeremy Lamb	0.369 ± 0.027	OKC	341	Travis Outlaw	0.358 ± 0.026	
259	Doron Lamb	0.357 ± 0.069		342	Zaza Pachulia	N/A	MIL
260	Carl Landry	N/A	SAC	343	Jannero Pargo	0.383 ± 0.036	CHA
261	Shane Larkin	0.332 ± 0.048	NYK	344	Tony Parker	0.329 ± 0.114	SAS
262	Ty Lawson	0.369 ± 0.037	DEN	345	Chandler Parsons	0.343 ± 0.058	DAL
263	Ricky Ledo	N/A	DAL	346	Patrick Patterson	0.388 ± 0.097	TOR
264	Courtney Lee	0.369 ± 0.030	MEM	347	Chris Paul	0.362 ± 0.044	LAC
265	David Lee	N/A	GSW	348	Metta World Peace	0.351 ± 0.038	
266	Alex Len	N/A	PHO	349	Nikola Pekovic	N/A	MIN
267	Kawhi Leonard	0.343 ± 0.036	SAS	350	Kendrick Perkins	N/A	OKC
268	Meyers Leonard	0.262 ± 0.066	POR	351	Paul Pierce	0.344 ± 0.068	WAS
269	Jon Leuer	0.370 ± 0.078	MEM	352	Dexter Pittman	N/A	
270	Rashard Lewis	0.351 ± 0.043		353	Miles Plumlee	N/A	PHO
271	DeAndre Liggins	N/A		354	Mason Plumlee	N/A	BRK
272	Damian Lillard	0.358 ± 0.044	POR	355	Quincy Pondexter	0.321 ± 0.088	MEM
273	Jeremy Lin	0.340 ± 0.057	LAL	356	Otto Porter	0.258 ± 0.108	WAS
274	Shaun Livingston	N/A	GSW	357	Josh Powell	N/A	
275	Brook Lopez	N/A	BRK	358	Phil Pressey	0.297 ± 0.049	BOS
276	Robin Lopez	N/A	POR	359	A.J. Price	N/A	CLE
277	Kevin Love	0.357 ± 0.035	CLE	360	Ronnie Price	0.289 ± 0.069	LAL
278	Kyle Lowry	0.368 ± 0.017	TOR	361	Pablo Prigioni	0.400 ± 0.075	NYK
279	John Lucas	0.364 ± 0.052		362	Tayshaun Prince	0.308 ± 0.078	MEM
280	Shelvin Mack	0.373 ± 0.025	ATL	363	Miroslav Raduljica	N/A	
281	Ian Mahinmi	N/A	IND	364	Anthony Randolph	0.296 ± 0.110	
282	Shawn Marion	0.325 ± 0.061	CLE	365	Shavlik Randolph	N/A	PHO
283	Kendall Marshall	0.350 ± 0.047		366	Zach Randolph	N/A	MEM
284	Cartier Martin	0.377 ± 0.122	DET	367	J.J. Redick	0.361 ± 0.068	LAC
285	Kenyon Martin	N/A		368	Glen Rice	0.329 ± 0.026	WAS
286	Kevin Martin	0.379 ± 0.027	MIN	369	Luke Ridnour	0.317 ± 0.056	ORL
287	Roger Mason	0.336 ± 0.066		370	Austin Rivers	0.343 ± 0.051	NOP
288	Wesley Matthews	0.388 ± 0.039	POR	371	Andre Roberson	0.301 ± 0.095	OKC
289	Jason Maxiell	N/A	CHA	372	Brian Roberts	0.358 ± 0.036	CHA
290	Eric Maynor	0.335 ± 0.050		373	Nate Robinson	0.347 ± 0.034	DEN
291	O.J. Mayo	0.384 ± 0.031	MIL	374	Thomas Robinson	N/A	POR
292	Ray McCallum	0.370 ± 0.039	SAC	375	Rajon Rondo	0.302 ± 0.078	BOS
293	C.J. McCollum	0.352 ± 0.045	POR	376	Derrick Rose	0.331 ± 0.046	CHI
294	JaVale McGee	N/A	DEN	377	Terrence Ross	0.374 ± 0.049	TOR
295	Ben McLemore	0.347 ± 0.029	SAC	378	Ricky Rubio	0.342 ± 0.075	MIN
296	Josh McRoberts	0.343 ± 0.035	MIA	379	Brandon Rush	0.383 ± 0.064	GSW
297	Jodie Meeks	0.354 ± 0.036	DET	380	Robert Sacre	N/A	LAL
298	Gal Mekel	0.302 ± 0.053	DAL	381	John Salmons	0.365 ± 0.039	NOP
299	Khris Middleton	0.384 ± 0.046	MIL	382	Larry Sanders	N/A	MIL
300	C.J. Miles	0.367 ± 0.033	IND	383	Dennis Schrder	0.282 ± 0.068	ATL
301	Darius Miller	0.319 ± 0.074	NOP	384	Luis Scola	N/A	IND
302	Andre Miller	0.358 ± 0.145	WAS	385	Mike Scott	0.319 ± 0.064	ATL
303	Quincy Miller	0.307 ± 0.074		386	Thabo Sefolosha	0.330 ± 0.063	ATL
304	Mike Miller	0.387 ± 0.055	CLE	387	Kevin Seraphin	N/A	WAS
305	Patrick Mills	0.402 ± 0.034	SAS	388	Ramon Sessions	0.307 ± 0.118	SAC
306	Paul Millsap	0.361 ± 0.053	ATL	389	Mustafa Shakur	N/A	
307	Tony Mitchell	N/A	DET	390	Tornike Shengelia	0.288 ± 0.100	
308	Nazr Mohammed	N/A	CHI	391	Iman Shumpert	0.349 ± 0.027	NYK
309	Greg Monroe	N/A	DET	392	Alexey Shved	0.332 ± 0.031	PHI
310	E'Twaun Moore	0.358 ± 0.063	CHI	393	Henry Sims	N/A	PHI
311	Darius Morris	0.348 ± 0.045		394	Kyle Singler	0.326 ± 0.095	DET
312	Marcus Morris	0.361 ± 0.036	PHO	395	Chris Singleton	0.349 ± 0.076	
313	Markieff Morris	0.328 ± 0.067	PHO	396	Peyton Siva	0.279 ± 0.068	
314	Anthony Morrow	0.430 ± 0.038	OKC	397	Donald Sloan	0.288 ± 0.133	IND
315	Donatas Motiejunas	0.299 ± 0.046	HOU	398	Chris Smith	N/A	
316	Arnett Moultrie	N/A	PHI	399	Greg Smith	N/A	DAL
317	Luc Mbah a Moute	0.245 ± 0.079	PHI	400	Ishmael Smith	0.251 ± 0.067	HOU
318	Timofey Mozgov	0.312 ± 0.090	DEN	401	J.R. Smith	0.353 ± 0.057	NYK
319	Shabazz Muhammad	0.297 ± 0.055	MIN				

Index	Player Name	Prediction ± Error	Team
402	Jason Smith	N/A	NYK
403	Josh Smith	0.301 ± 0.059	DET
404	Tony Snell	0.354 ± 0.042	CHI
405	James Southerland	N/A	
406	Marreese Speights	0.269 ± 0.078	GSW
407	Tiago Splitter	N/A	SAS
408	D.J. Stephens	N/A	
409	Lance Stephenson	0.358 ± 0.037	CHA
410	Greg Stiemsma	N/A	TOR
411	Julyan Stone	0.290 ± 0.137	
412	Amar'e Stoudemire	N/A	NYK
413	Rodney Stuckey	0.266 ± 0.073	
414	Jared Sullinger	0.294 ± 0.057	BOS
415	Tyshawn Taylor	0.310 ± 0.054	
416	Jeffery Taylor	0.299 ± 0.041	CHA
417	Jeff Teague	0.309 ± 0.053	ATL
418	Marquis Teague	0.343 ± 0.045	
419	Mirza Teletovic	0.369 ± 0.049	BRK
420	Garrett Temple	0.301 ± 0.070	WAS
421	Jason Terry	0.361 ± 0.070	HOU
422	Hasheem Thabeet	N/A	
423	Adonis Thomas	N/A	
424	Isaiah Thomas	0.349 ± 0.025	PHO
425	Lance Thomas	N/A	OKC
426	Malcolm Thomas	N/A	
427	Tristan Thompson	N/A	CLE
428	Jason Thompson	N/A	SAC
429	Klay Thompson	0.403 ± 0.046	GSW
430	Hollis Thompson	0.363 ± 0.076	PHI
431	Marcus Thornton	0.351 ± 0.045	BOS
432	Jamaal Tinsley	0.246 ± 0.072	
433	Anthony Tolliver	0.363 ± 0.058	PHO
434	P.J. Tucker	0.375 ± 0.043	PHO
435	Ronny Turiaf	N/A	MIN
436	Hedo Turkoglu	0.385 ± 0.030	LAC
437	Evan Turner	0.391 ± 0.047	BOS
438	Jeremy Tyler	N/A	
439	Ekpe Udoh	N/A	LAC
440	Beno Udrih	0.401 ± 0.120	MEM
441	Jonas Valanciunas	N/A	TOR
442	Anderson Varejao	N/A	CLE
443	Jarvis Varnado	N/A	
444	Greivis Vasquez	0.372 ± 0.039	TOR
445	Jan Vesely	N/A	
446	Charlie Villanueva	0.290 ± 0.082	DAL
447	Nikola Vucevic	N/A	ORL
448	Sasha Vujacic	N/A	
449	Dwyane Wade	0.275 ± 0.082	MIA
450	Dion Waiters	0.355 ± 0.038	CLE
451	Kemba Walker	0.340 ± 0.057	CHA
452	John Wall	0.340 ± 0.042	WAS
453	Gerald Wallace	0.321 ± 0.083	BOS
454	Casper Ware	0.343 ± 0.024	
455	C.J. Watson	0.359 ± 0.055	IND
456	Earl Watson	0.345 ± 0.084	
457	Maalik Wayns	N/A	
458	Martell Webster	0.380 ± 0.049	WAS
459	David West	N/A	IND
460	Russell Westbrook	0.328 ± 0.037	OKC
461	D.J. White	N/A	
462	Royce White	N/A	
463	Deron Williams	0.318 ± 0.065	BRK
464	Derrick Williams	0.316 ± 0.056	SAC
465	Elliot Williams	0.308 ± 0.067	
466	Louis Williams	0.326 ± 0.014	
467	Marvin Williams	0.352 ± 0.033	CHA
468	Mo Williams	0.367 ± 0.030	MIN
469	Reggie Williams	N/A	
470	Shawne Williams	0.347 ± 0.050	MIA
471	Jeff Withey	N/A	NOP
472	Nate Wolters	0.347 ± 0.091	MIL
473	Brandan Wright	N/A	DAL
474	Dorell Wright	0.301 ± 0.101	POR
475	Tony Wroten	0.255 ± 0.080	PHI
476	Nick Young	0.366 ± 0.041	LAL
477	Thaddeus Young	0.323 ± 0.037	MIN
478	Cody Zeller	N/A	CHA
479	Tyler Zeller	N/A	BOS

TABLE III: Predictions for the three-point shooting percentage for each player in the 2015 season. Rookies are not included on this table.

Index	Player Name	Prediction ± Error	Team
0	Jordan Adams	0.299 ± 0.091	MEM
1	Kyle Anderson	0.406 ± 0.127	SAS
2	Thanasis Antetokounmpo	0.260 ± 0.079	NYK
3	Cameron Bairstow	0.280 ± 0.156	CHI
4	Bogdan Bogdanovic	0.224 ± 0.083	PHO
5	Alec Brown	0.353 ± 0.108	PHO
6	Markel Brown	0.318 ± 0.097	MIN
7	Bruno Caboclo	0.330 ± 0.110	TOR
8	Clint Capela	N/A	HOU
9	Semaj Christon	0.326 ± 0.104	MIA
10	Jordan Clarkson	0.236 ± 0.073	LAL
11	Nemanja Dangubic	0.243 ± 0.075	SAS
12	DeAndre Daniels	0.350 ± 0.107	TOR
13	Spencer Dinwiddie	0.347 ± 0.109	DET
14	Cleanthony Early	0.313 ± 0.095	NYK
15	Joel Embiid	0.168 ± 0.084	PHI
16	Tyler Ennis	0.297 ± 0.092	PHO
17	Dante Exum	N/A	UTA
18	Alessandro Gentile	0.297 ± 0.090	HOU
19	Aaron Gordon	0.299 ± 0.096	ORL
20	Jerami Grant	N/A	PHI
21	P.J. Hairston	0.333 ± 0.100	CHA
22	Joe Harris	0.315 ± 0.107	CLE
23	Gary Harris	0.296 ± 0.089	DEN
24	Rodney Hood	0.353 ± 0.107	UTA
25	Josh Huestis	0.284 ± 0.089	OKC
26	Johnny O'Bryant III	0.280 ± 0.156	MIL
27	Glenn Robinson III	0.257 ± 0.079	MIN
28	Damien Inglis	0.325 ± 0.107	MIL
29	Cory Jefferson	0.309 ± 0.100	BKN
30	Nick Johnson	0.308 ± 0.094	HOU
31	Nikola Jokic	0.302 ± 0.102	DEN
32	Zach LaVine	0.315 ± 0.096	MIN
33	Louis Labeyrie	0.436 ± 0.142	IND
34	Roy Devyn Marble	0.293 ± 0.089	ORL
35	K.J. McDaniels	0.255 ± 0.078	PHI
36	Doug McDermott	0.377 ± 0.114	CHI
37	Mitch McGary	N/A	OKC
38	Jordan McRae	0.295 ± 0.089	PHI
39	Vasilije Micic	0.260 ± 0.080	PHI
40	Shabazz Napier	0.340 ± 0.103	MIA
41	Jusuf Nurkic	0.168 ± 0.069	DEN
42	Jabari Parker	0.301 ± 0.093	MIL
43	Lamar Patterson	0.282 ± 0.087	ATL
44	Adreian Payne	0.355 ± 0.109	ATL
45	Elfrid Payton	0.218 ± 0.070	ORL
46	Dwight Powell	0.215 ± 0.071	CHA
47	Julius Randle	0.140 ± 0.051	LAL
48	Dario Saric	0.168 ± 0.084	ORL
49	Marcus Smart	0.251 ± 0.077	BOS
50	Russ Smith	0.325 ± 0.099	NOP
51	Nik Stauskas	0.371 ± 0.112	SAC
52	Jarnell Stokes	N/A	MEM
53	Walter Tavares	N/A	ATL
54	Xavier Thames	0.314 ± 0.096	BKN
55	Noah Vonleh	0.407 ± 0.131	CHA
56	T.J. Warren	0.224 ± 0.069	PHO
57	Andrew Wiggins	0.286 ± 0.088	MIN
58	C.J. Wilcox	0.328 ± 0.099	LAC
59	James Young	0.293 ± 0.089	BOS
60	Tarik Black	N/A	HOU
61	James Ennis	0.300 ± 0.091	MIA
62	Nerlens Noel	N/A	PHI
63	Kostas Papanikolaou	0.286 ± 0.087	HOU
64	Damjan Rudez	0.397 ± 0.120	IND
65	JaKarr Sampson	0.168 ± 0.084	PHI
66	Travis Wear	0.370 ± 0.123	NYK

TABLE IV: Predictions for the three-point shooting percentage for each rookie in the 2015 season.

VI. IMPROVEMENTS

There are several things that could be done to improve these calculations. A fairly simple step would be to remove last second *heave* shots, those from near mid-court and beyond. For a player with few three-point attempts this would be more significant. A more in-depth step would be to look at not only the last season and the career stats (to that point), but to include the last two years. This would be especially important in the case of a player who was injured. For instance Kobe Bryant is forecast to shoot only 0.281 this season, well below his career mark, but that is because the forecast mainly relies on last year's data, and he was hurt for all but six games last year. Also the weights for the stats used in the distance calculation are based on initial guesses, and then some fine tweaks to improve the reduced χ^2, but there are definitely improvements that can be made there, up to and including adding in other stats to find seasons more like the season under analysis.

These changes should be able to improve the predictions for the next season, however, there will always be uncertainty due to the human nature of the sport. You can never really predict injuries, or how adding or removing teammates will affect a player's shooting abilities.

The method for rookies could also use improvements. Separating players coming from college from those who come from overseas without professional experience, and those coming from professional leagues overseas, would improve their predictions. Among college players, separating out the *one-and-done* players from four-year collegians would make a difference as well. The problem with these attempts is that the sample size is already so small that cutting it up further would lead to significantly larger errors. More thought and analysis will be required to significantly improve predictions for rookies.

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[1] John R. Taylor, *An Introduction to Error Analysis, Second Edition*, University Science Books (1982).

[2] Brian Vernarsky. *First Measurements of the Polarized Spin Density Matrix Elements along with a Partial-Wave Analysis for $\gamma p \rightarrow p\omega$ using CLAS at Jefferson Lab.* Ph.D. thesis, Carnegie Mellon University, 2014.

[3] *http://www.basketball-reference.com*

[4] *http://www.sports-reference.com/cbb/*

[5] *http://basketball.realgm.com*