12-22-2016

Creating the Perfect NBA Team: A Look at PER and How It Affects Wins

Gregory Hamalian

Follow this and additional works at: http://vc.bridgew.edu/honors_proj

Part of the Mathematics Commons

Recommended Citation
Copyright © 2016 Gregory Hamalian

This item is available as part of Virtual Commons, the open-access institutional repository of Bridgewater State University, Bridgewater, Massachusetts.
Creating the Perfect NBA Team: A look at PER and how it affects wins

Gregory Hamalian

Submitted in Partial Completion of the
Requirements for Departmental Honors in Mathematics

Bridgewater State University

December 22, 2016

Dr. Ward Heilman, Thesis Mentor
Dr. John Pike, Committee Member
Dr. Kevin Rion, Committee Member
**Table of Contents**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Abstract</td>
<td>3</td>
</tr>
<tr>
<td>2. Introduction</td>
<td>3</td>
</tr>
<tr>
<td>3. Nature of Research</td>
<td>4</td>
</tr>
<tr>
<td>4. What Player Efficiency Rating Is, and Some Problems with the Statistic</td>
<td>5</td>
</tr>
<tr>
<td>5. Methods</td>
<td>9</td>
</tr>
<tr>
<td>6. Results</td>
<td>11</td>
</tr>
<tr>
<td>7. Conclusions</td>
<td>20</td>
</tr>
<tr>
<td>8. Areas for Future Research</td>
<td>21</td>
</tr>
<tr>
<td>9. Appendix</td>
<td>23</td>
</tr>
<tr>
<td>10. Bibliography</td>
<td>29</td>
</tr>
</tbody>
</table>
1. ABSTRACT

Ever since Oakland Athletics’ general manager Billy Beane began applying analytical tools to compose a baseball team, professional sports teams have used advanced metrics to build competitive rosters. We use an exploratory data analysis strategy to find what statistics best predict team wins. Finding that the Player Efficiency Rating (PER) statistic best correlate with wins, we investigate the statistic to find its strengths and weaknesses. We look for ways to improve the statistic and adjust it to better evaluate player effectiveness. We also look for methods to best predict how the PER will change from one season to the next based on player age and experience in the league.

2. INTRODUCTION

In 2003, Michael Lewis published the book *Moneyball: The Art of Winning an Unfair Game*. The book describes how the general manager of the Oakland Athletics, Billy Beane, took advantage of analytic gauges of player performance, including but not limited to defensive runs saved, average balls in play, and Wins Above Replacements, instead of traditional statistics like runs batted in, batting average, and stolen bases, to assemble a roster that could be competitive against franchises that had a larger budget. Since then, teams have being searching for methods to better evaluate talent, and smaller market teams have looked to get the most bang for their buck when signing players. Baseball, a sport with no salary cap, has a little more leeway when finding the price point (how much the team is willing to spend) of a player. However, the NBA is a salary cap league with guaranteed contracts. A team needs to be sure that a certain player can help their roster before extending an offer to that player, or it can set the team back for years to come. When a team overpays for a player that does not deliver results, it hinders that team’s
ability to sign other free agents that could help the team because the team does not have space within the salary cap.

When analyzing what makes a team successful or unsuccessful, one must consider a litany of information. In basketball, previous research has shown that Player Efficiency Rating is a great indicator for team wins. However, the PER statistic has some flaws, such as certain positions, on average, receiving higher ratings than other positions.

Not only could this new research benefit NBA teams, but also its methods might be applied to a wider category of decision problems, such as the design of successful hiring methods for companies. Every organization has a budget and efficiency allocating funds is key to being successful. As implied by the definition of the word, maximizing value helps a particular entity (whether it is a business, team, or organization, etc.) to achieve maximum success.

3. NATURE OF RESEARCH

As previously mentioned, the analytic and quantitative methods of building a professional sports team roster became popularized by Billy Beane, general manager of the Oakland Athletics. Oakland was a smaller market team, and Beane looked for a way to build a competitive roster while keeping the payroll small. Not only did he look at the analytics of a player in terms of how well they played the game, but he also looked at teams that had a high rate of “wins per dollar spent” (WPDS). Essentially, WPDS measures how many wins a team accrues for each dollar spent on player salary. This became a very effective method of building a team as the A’s became a consistent playoff team. The method was replicated by teams such as the Tampa Bay Rays and later the Kansas City Royals. While wins per dollar spent is a very powerful tool for smaller market teams in Major League Baseball (a non-salary capped league), it is almost irrelevant in the National Basketball League (NBA). The NBA has a salary cap and
teams spend approximately the same amount of money for total player salary, meaning the best teams in the league will naturally have the most wins per dollar spent.

Another attribute of a player that teams consider when deciding whether or not to pursue them is the player’s personality. There is certainly something to be said for team chemistry and having players who like one another. It is commonly believed that when players are putting the team’s collective success above individual accomplishments, the team will achieve more of their potential than a team of superstars focused on individual accomplishments. We are also aware that a team’s mental-toughness is an incredibly important factor in success. Will the team overcome adversity? Will they be able to execute in the final minutes of a close game and come away with a victory? All of these are important factors in a team’s success, however, it is beyond the scope of this research to quantify the exact amount of importance that should be placed on those factors. Anecdotally, one can make the argument that a portion of the error we find in the research can be attributed to our lack of knowledge of how chemistry and mental toughness affect success. So, instead of making an attempt to quantify an intangible statistic, we will only focus on the information we can compute using the data available to us.

Our studies continue previous research on the nature of NBA team success and what leads to wins. Previous research showed that the Player Efficiency Rating (PER) was a strong indicator of team success, but we believe the statistic is not as strong as it could be. While the errors in our regressions were small, we believe we can reduce them further. The way we will do this is by taking a deeper look at PER and how the statistic is calculated. We conjecture that there are some flaws in the statistic, leading to aspects such as power forwards and centers having drastically higher ratings on average than other positions. Additionally, variables in the statistic such as adjusting for a team’s pace seems unnecessary on a team scale (versus
comparing individual players, where pace can show what player is more effective per possession), as a team’s pace has little to no correlation in predicting team success, which we will explain later.

4. WHAT PLAYER EFFICIENCY RATING IS AND SOME PROBLEMS WITH THE STATISTIC

Player Efficiency Rating (PER) is a per-minute statistic that essentially quantifies a given player’s effectiveness on the court. The league average of PER is set to 15.00, meaning players are measured against others in the league. So, if the average player in 2016 is better than the average player in 1992, then a “good” player in 2016 must be better than a “good” player in 1992.

In addition to the per-minute statistic, PER is also adjusted for pace. Pace is the number of possessions (think opportunities for a player to score, assist, rebound, etc.) a team has in a game. By adjusting for speed and pace, all players are graded on the same scale.

To begin to calculate PER, one must start with uPER. uPER stands for Unadjusted Player Efficiency Rating. Before the league average is adjusted to a PER of 15.00, every player has their uPER. The formula for uPER is
uPER =

\[
(1/MP) \\
\times \\
3P\ Made \\
+ \\
Value\ of\ assist \\
+ \\
Value\ of\ field\ goal\ relative\ to\ league\ field\ goals \\
+ \\
Value\ of\ a\ free\ throw \\
- \\
Cost\ of\ turnover \\
- \\
Cost\ of\ a\ missed\ field\ goal\ attempt\ based\ on\ league\ DRB\%,\ because\ your\ team\ loses\ possession \\
- \\
Cost\ of\ missed\ FT,\ as\ your\ team\ did\ had\ a\ chance\ to\ score\ but\ did\ not \\
+ \\
Value\ of\ a\ defensive\ rebound,\ securing\ a\ possession\ for\ team \\
+ \\
Value\ of\ an\ offensive\ rebound,\ maintaining\ your\ team’s\ possession \\
+ \\
Value\ of\ a\ steal \\
+ \\
Value\ of\ a\ blocked\ shot \\
- \\
Cost\ of\ a\ foul
\]

Where,

Factor = \(2 / 3\) - \(0.5 \times (\text{total assists in league} / \text{total field goals in league})\) / (2 \times (\text{total field goals in league} / \text{total free throws in league}))

Value of Possession (VOP) = \text{total points in league} / \text{total (approximate) possessions in league}

DRB\% = league’s defensive rebound percentage, calculated by

(total defensive rebounds) / (total rebounds)

Value of assist = \(2/3 \times \text{total assists}\)

Value of a field goal = \((2 - \text{factor} \times (\text{total team assists} / \text{total team field goals})) \times \text{field goals}\)

Value of free throw = \((\text{Total free throws} \times 0.5 \times (1 + (1 - (\text{total team assists} / \text{total team field goals}))) + (2/3) \times (\text{total team assists} / \text{total team field goals}))\)

Cost of turnover = VOP \times \text{total turnovers}

Cost of a missed field goal attempt = VOP \times \text{number of missed shots} \times \text{DRB\%}

Cost of missed free throw = VOP \times 0.44 \times (0.44 + (0.56 \times \text{DRB\%})) \times \text{missed free throws}

Value of defensive rebound = VOP \times (1 - \text{DRB\%}) \times \text{total defensive rebounds}

Value of offensive rebound = VOP \times \text{DRB\%} \times \text{total offensive rebounds}

Value of a steal = VOP \times \text{total steals}

Value of a blocked shot = VOP \times \text{DRB\%} \times \text{total blocked shots}

Cost of a foul = VOP \times ((\text{league free throws made} / \text{league personal fouls committed}) - 0.44 \times (\text{league free throws attempt} / \text{league personal fouls committed})) \times \text{personal fouls committed}
Each player is awarded a uPER, and then the PER can be calculated.

\[ \text{uPER}_{\text{Pace}} = (\text{uPER} \times \text{average league pace/ individual’s team pace}) \]

\[ \text{PER} = \text{uPER}_{\text{Pace}} \times \frac{15}{\text{avg}(\text{uPER}_{\text{Pace}})} \]

Where

- \text{PACE} = \text{number of offensive possessions a team has}
- \text{League average uPER} = \frac{\text{total uPER in league}}{\text{number of players in league}}^2

As we can see, calculating uPER is a long formula. However, after uPER is calculated, PER is fairly easy to calculate as it is simply adjusting the score based on the team pace relative to the league and adjusting uPER to get to a league average of 15.00.

When researching the origins of PER, it seems the inventor of the statistic, John Hollinger, gave weights to values he believed would accurately represented the true strength of a player. It was not evident that he ran any type of regression to weight components of uPER. While the statistic may have been a great indicator of player skill and effectiveness when it was first calculated, the style of play has changed in the NBA and the statistic needs to be reexamined to ensure the weights of components are most accurately rating players according to their contributions on the court.

Immediately, we see a few problems with PER. The first being adjusting for pace. PER is adjusted for team pace, but it is likely a given player does not play at exactly his team’s pace. In fact, strategy regarding pace often changes when substitutions are made. Suppose a team has an incredible young point guard. The point guard likes to run the floor and play an up-tempo style of play, so when he is on the floor, the team has a high PACE. However, his backup is a savvy veteran player that works the defense methodically to get his team the best shot. The entire team may have an average pace, but the young point guard will have an inflated PER while the veteran has a deflated PER, because during their time on the court, the team PACE is
dramatically different that the overall team PACE. However, while this may hurt an individual player’s PER, for the purpose of our study we will ignore this fact as team pace does not appear to correlate to team success, which we will show later.

Additionally, when looking at PER across position, and not across the league, the average is rarely 15.00. For some reason, power forwards (PF) and centers (C) have a PER higher than point guards (PG), shooting guards (SG), and small forwards (SF). We will discuss possible causes for difference in PER among positions in due time, but for now we simply see this as a potential flaw in PER. As mentioned earlier, the style of play in the NBA has changed and centers and power forwards are no longer considered the most important part of teams.

In the 2013-14 and 2014-15 season, players that played at least 6.09 minutes per game had their PER measured. In that season, the average PER for all players at a given position were as follows,

<table>
<thead>
<tr>
<th></th>
<th>2013-14</th>
<th>2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>14.58</td>
<td>14.79</td>
</tr>
<tr>
<td>SG</td>
<td>13.34</td>
<td>12.94</td>
</tr>
<tr>
<td>SF</td>
<td>13.16</td>
<td>13.02</td>
</tr>
<tr>
<td>PF</td>
<td>15.04</td>
<td>14.96</td>
</tr>
<tr>
<td>C</td>
<td>16.21</td>
<td>16.91</td>
</tr>
</tbody>
</table>

With standard deviations,

<table>
<thead>
<tr>
<th></th>
<th>2013-14</th>
<th>2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>4.06</td>
<td>4.32</td>
</tr>
<tr>
<td>SG</td>
<td>3.30</td>
<td>3.70</td>
</tr>
<tr>
<td>SF</td>
<td>4.48</td>
<td>4.11</td>
</tr>
<tr>
<td>PF</td>
<td>4.31</td>
<td>4.03</td>
</tr>
<tr>
<td>C</td>
<td>3.66</td>
<td>3.74</td>
</tr>
</tbody>
</table>

Additionally, the medians for the seasons were as follows,

<table>
<thead>
<tr>
<th></th>
<th>2013-14</th>
<th>2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>14.20</td>
<td>13.92</td>
</tr>
<tr>
<td>SG</td>
<td>13.44</td>
<td>12.36</td>
</tr>
<tr>
<td>SF</td>
<td>12.05</td>
<td>12.33</td>
</tr>
<tr>
<td>PF</td>
<td>14.20</td>
<td>15.03</td>
</tr>
<tr>
<td>C</td>
<td>16.17</td>
<td>16.21</td>
</tr>
</tbody>
</table>

As we can see, centers and power forwards tended to have higher averages, as well as a higher median PER. Two different measures of central tendency give similar results, which suggest there is some real phenomena occurring which rates centers and power forwards higher than other positions. We will attempt to adjust the weights of certain variables to give a more
level distribution of PER across different positions. While this research looks at making the PER statistic more evenly distributed across positions, we acknowledge some would like to use different weights for different positions, and set each position average to 15.00. This would compare players against their own position, which some might find more desirable. However, we choose to evaluate all players together as our main goal is to use PER and predict team wins, and winning involves contributions from all positions working together.

A final issue with the statistic is that it does not appropriately capture a player’s defensive impact on the game. The only pure defensive statistics measured by PER are steals and blocks, and defensive rebounds are in part a defensive statistic. However, there is much more that goes into defense than simply steals and blocked shots. In a previous study done by Franks, Miller, Bornn, and Goldberry, the authors argue that there are quantitative ways to measure a player’s effectiveness defensively beyond simply blocks and steals. The study looked at data that measured how frequently an opponent attempted a shot against a defensive player, as well as how frequently the opponent scored on the defender. While this research can be extremely informative and give us great results, we chose to ignore the findings for this particular research into PER, but acknowledge that using this information in future research may provide us with better results.

5. METHODS

We continue the research we performed in the ATP Summer Research Program. During the research program, we discovered that PER was a great predictor of wins, but also that the statistic fell short in some areas. One of the big flaws with the statistic is that when it ranked players, though the league average was set to 15.00, centers and power forwards consistently out-rated other positions. Our main goal will be to try to adjust certain variables in the formula
that calculates PER in order to make the statistic give more uniform ratings across positions. This will require an exploratory analysis approach.

One of the weaknesses of PER is that centers and power forwards, on average score higher than PG, SG, and small forwards. However, though all positions are important, today’s NBA game places less importance on a dominant post player and many analysts would agree that the inside game in the NBA is a dying art. In an article published for the Atlantic, Kevin Fixler argues NBA centers are disappearing and post play has seen a dramatic decline in recent years. He argues that the play of guards and small forwards have dramatically increased. So why, if post play is not very strong, do post players, on average rank higher in PER? We believe this is due to the relative weighting scales for the statistics.

In examining the 2013-14 season, centers and power forwards had an average PER above 16, while point guards, shooting guards, and small forwards were all below the league average of 15. In order to correct this, we adjust the relative weights of particular statistics and try to even out the average so all 5 positions score relatively the same. As stated earlier, guards and small forwards are now the more dominant players in the NBA. From 1993-2004, only three times did a non-post player win the MVP award (Michael Jordan twice and Allen Iverson). When the PER was developed, centers did play an important role in team success. However, since 2004, no traditional low-post player has won an MVP award. Because modern basketball is changing, it is necessary to adjust the PER formula to accurately represent the current NBA.

Another negative aspect of PER is when it adjusts for team pace. While it is understandable to want to level the field when it comes to the opportunity to contribute to team success, statistics show that there is no correlation between team pace and wins. In the 2013-14 and 2015-16 seasons, teams that played at a relatively slower pace tended to be more successful.
However, in the 2014-15 season, teams that played at a quicker pace tended to be more successful. Because of this, we believe including pace in the PER statistic is overcomplicating and over-standardizing the statistic.

6. RESULTS

In looking at the 2013-14 season, ignoring the pace ratio in the PER equation, point guards and shooting guards had an average PER of 14.57 and 14.09 respectively. Small forwards were 13.68 while power forwards and centers had a PER of 16.5 and 16.44. The standard deviation of these scores was 1.33. However, when we made a slight adjustment to PER by weighting assists 50% more and 3 point shots 30% more (to adjust for guards), we saw the PER levels go to 16.12 for PG, 14.40 for SG, 13.56 for SF, 15.58 for PF and 15.15 for C. This brought the standard deviation between the 5 positions to 1.00. We then increased the cost of turnovers, by a factor of 10% and got the following results.

<table>
<thead>
<tr>
<th></th>
<th>PG</th>
<th>SG</th>
<th>SF</th>
<th>PF</th>
<th>C</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified PER</td>
<td>16.06</td>
<td>14.45</td>
<td>13.56</td>
<td>15.59</td>
<td>15.11</td>
<td>0.98</td>
</tr>
</tbody>
</table>

At this point, one might question why these were the two variables we chose to adjust, and why we chose to adjust by the factors that we did. We begin by explaining why assists were increased by 50%. In the PER formula, rebounds are given almost a full VOP. This is because a defensive rebound ends the possession for the opponent and an offensive rebound continues the possession for a player’s team. Centers and power forwards are typically the tallest players on the court and play the closest to the basket. They tend to get more rebound when compared to
point guards, shooting guards, and small forwards. In the 2013-14 season, the average rebounds per minute across the position were as follows

<table>
<thead>
<tr>
<th>Point Guard</th>
<th>Shooting Guards</th>
<th>Small Forwards</th>
<th>Power Forwards</th>
<th>Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>.107</td>
<td>.121</td>
<td>.168</td>
<td>.248</td>
<td>.296</td>
</tr>
</tbody>
</table>

As we can see from the table, centers rebound at nearly three times the rate of Guards and twice as often as small forwards, while power forwards also rebound at over twice the rate of guards and 1.5 times as frequently as small forwards. We assert this is one reason why C’s and PF’s tend to have higher PERs. In fact, if we calculate PER for the 2013-14 season without considering individual rebounds a player gathers, we find a dramatically different PERs across positions. The results are as follows.

<table>
<thead>
<tr>
<th>PER</th>
<th>PG</th>
<th>SG</th>
<th>SF</th>
<th>PF</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18.31</td>
<td>14.24</td>
<td>12.96</td>
<td>14.90</td>
<td>13.79</td>
</tr>
<tr>
<td>Change</td>
<td>+3.74</td>
<td>+.156</td>
<td>-.72</td>
<td>-1.60</td>
<td>-2.65</td>
</tr>
</tbody>
</table>

This shows us that rebounds dramatically influence individual PER. While we recognize the importance of rebounds, rebounds occur at approximately twice the rate of assists, explaining why players that accrue rebounds at a higher rate have a much higher PER. Because assists happen less frequently, their relative importance is increased. Another way to understand the value of an assist compared to a rebound is to think about the very definition of a rebound. After a missed shot, somebody will secure a rebound. Essentially, a rebound HAS to happen (unless the ball goes out of bounds on a missed shot attempt, which is very infrequent). However, made shots do not necessarily imply an assist. Assists do NOT have to happen, but rebounds do. In the 2013-2014 season, there were 101,689 total rebounds, compared to 52,226 assists. In the
2014-15 season, there were 106,502 total rebounds to 54,190 assists. By its very definition, an assist is a pass that directly leads to a score. Because an assist has a direct impact on a team’s ability to score and thus win the game, we believe it should play a more important role in determining an individual’s PER. Additionally, guards and small forwards tend to have higher assists than power forwards and centers. In 2013-14, the average assists per minute were as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Assists Per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point Guard</td>
<td>.165</td>
</tr>
<tr>
<td>Shooting Guards</td>
<td>.082</td>
</tr>
<tr>
<td>Small Forwards</td>
<td>.071</td>
</tr>
<tr>
<td>Power Forwards</td>
<td>.053</td>
</tr>
<tr>
<td>Centers</td>
<td>.051</td>
</tr>
</tbody>
</table>

The table shows that on average, point guards record assists at 3 times the rate of power forwards and centers. Shooting guards and small forwards also record assists at approximately 1.5 times the rate. By giving more value to assists, we are able to level PER across positions.

Additionally, we believe 3-Point field goals were undervalued in the PER formula. The NBA is evolving and more emphasis is placed on teams that can shoot the 3-ball effectively. It is difficult to quantitatively evaluate the exact impact of 3-point field goals, but we can qualitatively see it gives teams an advantage. With that said, plotting team wins for over the past three seasons (2013-14, 2014-15, 2015-16) against 3-point shots made and 3-point shooting percentage, we do see some positive correlation between the deep-ball and wins.
The ability to shoot well has a greater impact than just the points added in the shot. Good three-point shooters do something called “stretch-the-floor.” We can see that shooting percentage gives a much stronger correlation than simply making three-point shots. The R-value for threes made is around .4, while three-point percentage is roughly .65. Essentially, stretching the floor means the defense has to play further away from the basket in order to cover the shooter, which opens up more lanes to penetrate for teammates of the shooter and gives post players more room to operate. The more shooters a team has on the court, the more space (relative distance from one defender to the next) is created for the team offensively because the defense is further away from the basket covering these shooters which tends to lead to more efficient offensive play. An article on offensive theory states,

“The most valuable commodity in any offense is space. Proper spacing provides operating room for offensive players, good opportunities for screening and allows you to control matchups. In addition, good spacing forces the defense to make decisions and adjustments that are contrary to good defense. It limits help possibilities, creates bad matchups and switches and allows time for the offense to study the floor when making decisions.”

Guards and small forwards tend to be better shooters than centers and power forwards. In 2013-14, average 3-point field goals made per minute were as follows

<table>
<thead>
<tr>
<th>Point Guard</th>
<th>Shooting Guards</th>
<th>Small Forwards</th>
<th>Power Forwards</th>
<th>Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0412</td>
<td>.0490</td>
<td>.0386</td>
<td>.0164</td>
<td>.0026</td>
</tr>
</tbody>
</table>

The table shows us that the players making the three-point shots are the PG, SG, and SF. By giving more weight to 3-point field goals, we again we able to make a more uniform distribution of PER among different positions, as well as more accurately showing a real contribution for team success.

There is one more change we believe we must make in order to get a PER that more accurately shows how a player contributes to team wins, which is an adjustment for turnovers.
In the current PER formula, turnovers only hurt the rating because it considers a turnover a loss of team possession. However, a turnover is much more than a loss of team possession, as you give the ball back to your opponent. There are two kinds of turnovers, dead-ball and live-ball turnovers. A dead-ball turnover occurs when the offensive team commits a foul or a violation (such as traveling or throwing the ball out of bounds). A dead-ball turnover allows for a team to reset their defense and play as they normally would. A live-ball turnover occurs when a player simply loses possession of the ball and the defending team gains possession without a stoppage in play. Live ball turnovers are more costly for a team as they allow their opponent to have the ball in what is called “transition,” where they are more likely to get an open shot or a layup because the other team was unable to properly set up their defense. According to a website called unpredictable.com, between the 2011 and 2015 NBA seasons, the VOP of a possession after a live-ball turnover is roughly 1.194, whereas a dead ball turnover is only .986. Additionally, live ball turnovers account for roughly 60% of a team’s turnovers.³

In our study, we are looking at the 2013-14 NBA season, where the league VOP was 1.047. Recall that a live-ball turnover gave the opposing a VOP of 1.194. This means a live-ball turnover adds approximately .15 VOP (difference of 1.194 and 1.047) to opposing teams. In the 2013-14 season, live ball turnovers accounted for 65% of team turnovers. This means on average, a turnover gave the opposing approximately a better VOP by .1, calculated .65 * .15. This added .1 in VOP means the opposing team will score approximate 10% more frequently (as VOP is approximately 1) as a result of a turnover, so we adjust the cost of a turnover by 10%, as it improved the other team’s chance to score by roughly that much. This is our final adjustment to the PER formula.
Our next step is to take our new PERs and test them against team wins in order to see how well they work as predictors of team success. In previous research, we examined the top player PER overall, top 2 players overall, and top 3, 5 and 7 players based on minutes played. When we made the decision to differentiate between overall ratings and minutes played, we did so because we believe it gives the most accurate portrayal of a team. Frequently, the best player on a team will not play the most minutes, even though they make the most contributions. For this reason, we wanted to look at the top player and top 2 player PER. However, after the two best players, we believe that time on the court is a better indicator of a player’s true value to a team. This is because the top two players are consistently accumulate the top 3 minutes on their team, and more time on the court means the player has more impact on the result of games. Because PER is a per-minute statistic, sometimes players that come in only a few minutes occasionally, or only play in “garbage time” (end of game when the score is not close), their own PER can be inflated even though they did not contribute much to team success.

Previously we found,

Top player PER, regression of best-fit was \( \text{Wins} = 42.005\ln(\text{PER}) - 88.235 \) with an \( R^2 = 0.2394 \).

Top two player PER we had \( \text{Wins} = 55.317\ln(\text{PER}) - 163.3 \) with an \( R^2 = 0.2976 \).

Cumulative 3 Player PER- Wins = 78.52ln(PER) - 268.49 with an \( R^2 = 0.6323 \).

Cumulative 5 Player PER- Wins = 90.481ln(PER) - 355.98 with an \( R^2 = 0.4443 \).

Cumulative 7 Player PER- Wins = 124.31ln(PER) - 540.94 with an \( R^2 = 0.551 \).

Where the \( R^2 \) value is the percentage of the response variable (i.e. wins) that is explained by our regression. We see that, generally, as we add more players to our model, the \( R^2 \) value increases. However, it is worth noting the 3-player cumulative PER has the best regression model. This suggests that having a strong three players is incredibly important in the NBA. After having a
solid core of three players, teams should then focus on their depth (number of quality players) to best increase their chances for success. Additionally, we can infer that having a many slightly above average players tend to lead to more success than one or two superstar players.

Our modified PER vs. Wins shows:

Top Player PER- Wins = 47.689\ln(\text{PER}) - 112.45 with an R^2 = 0.3748.

Top 2 Player PER- Wins = 61.631\ln(\text{PER}) - 194.97 with an R^2 = 0.357.

Cumulative 3 Player PER- Wins = 68.521\ln(\text{PER}) - 241.22 with an R^2 = 0.4217.

Cumulative 5 Player PER- Wins = 79.209\ln(\text{PER}) - 319.15 with an R^2 = 0.3662.

Cumulative 7 Player PER- Wins = 102.99\ln(\text{PER}) - 457.21 with an R^2 = 0.3861.

The following graphs show the two results with PER. The standard PER is on the left, while our modified PER is on the right.
Our modified PER has a stronger regression model with the top players and top two players, but loses strength with three players, five players, and seven players. Additionally, we see very little variation in the $R^2$ values in our modified PER (between 35% and 42%) whereas
the traditional PER shows a dramatic increase in how the accuracy of the regression model (23% to 63%). With both PERs, the three-player PER had the least amount of error. This suggests perhaps the most important factor to team success is a strong three players. The second strongest correlation was found in the seven player PER, further suggesting team depth is another important factor in team success. These are obviously mixed results, and in further research we will attempt to determine why the modified PER was stronger compared to traditional PER with the top player and top two players, but weaker with three, five, and seven players.
7. CONCLUSIONS

First, the regression models that gave us the highest $R^2$ value were logarithmic regressions. We also produced linear and exponential regressions, but these regressions produced more error. The reason we believe logarithmic growth is the most accurate is because there are a limited number of games in the NBA season. There are 82 games in a season, and therefore a team can win at max 82 games. As a team improves, it becomes harder to win more games simply because there are not as many “losses” to change to “wins.” Hypothetically, if a team loses 10 games in a season, adding a better player to their roster will only be able to affect those 10 losses. However, if a team loses 60 games, the better player can help the team win 60 more games. In short, as wins increase, it becomes harder to win more and more games.

Additionally, we see that the modified PERs are generally higher for the higher rated players and lower for the lesser rated players. We believe this is because the modified PER is more in line with the way coaches see the game and player effectiveness. The standard deviation among players in the modified PER in the 2013-14 season is 8.29, compared to under 4.15 in the standard PER system. The modified PER essentially rates better players higher, and less effective players lower. The modified PER took all league players into account when setting the league average to 15.00. We made this decision because we believe that standard PER of having “qualified players” skews results, because there is a difference between the average NBA player and the average qualified player. We wanted our PER to represent the entire league, not just a select portion of the league. Now, when we look at the minutes played of each player, this represents a coach’s decision. The decision on which particular players to have on the court has a tremendous influence on the results of a game. When we look at the 2013-14 NBA season, the mean for minutes played for all players in the league was 1242.98 minutes, with a standard
deviation of 897.76 minutes. The standard PER league average for the same season was 14.48 (note: the league average is not 15.00 because we included players under the minimum threshold of minutes played and thus were not included in the calculation of the statistic for that season), with a standard deviation of 4.15. In our modified PER, we find the league average to be 15.00, with a standard deviation of 8.29. Now, we want to look at the relative difference between the statistics and their standard deviations.

<table>
<thead>
<tr>
<th></th>
<th>Mean value</th>
<th>Standard Deviation</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes Played</td>
<td>1242.98</td>
<td>897.76</td>
<td>.722</td>
</tr>
<tr>
<td>Standard PER</td>
<td>14.48</td>
<td>4.15</td>
<td>.286</td>
</tr>
<tr>
<td>Modified PER</td>
<td>15.00</td>
<td>8.29</td>
<td>.553</td>
</tr>
</tbody>
</table>

The table shows us that our modified PER varies to relatively closer extent to minutes played than the standard PER statistic does. This suggests that there is a slight problem in the traditional PER where players are rated more closely together, but coaches see a dramatic difference in the player ability on the court. However, our modified PER more closely illustrates the difference in the level of quantitative effectiveness on the court and a coach’s perception of the player’s qualitative effectiveness.

8. AREAS FOR FUTURE RESEARCH

While this research gave some insight into the PER statistic and some of the ways it could improve, we believe there is much more work that can be done in exploring the statistic and making a powerful indicator of team success. John Hollinger, the creator of PER, acknowledges the statistics weakness in measuring defensive effectiveness. We believe one way to improve the statistic would be to further the done by Franks, Miller, Bornn, and Goldsberry to
give players a numerical value for their defensive prowess. Adding this value to the weight for PER would improve the statistic by including the area of the game it least represents. Another area for future research is to run regressions using multiple statistics to find appropriate weights for PER components. This research looked at one statistic at a time, and we acknowledge results may be different when combining statistics.
## 2013-14 NBA Player PER

<table>
<thead>
<tr>
<th>Player</th>
<th>Team</th>
<th>PS</th>
<th>Mod PER</th>
<th>Traj PER</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>teague,jeff</td>
<td>atl</td>
<td>PG</td>
<td>21.6136</td>
<td>20.8459</td>
<td>2546</td>
</tr>
<tr>
<td>millspa,paul</td>
<td>atl</td>
<td>PF</td>
<td>22.9854</td>
<td>23.2822</td>
<td>2481</td>
</tr>
<tr>
<td>korve,kyle</td>
<td>atl</td>
<td>SG</td>
<td>16.746</td>
<td>15.8608</td>
<td>2413</td>
</tr>
<tr>
<td>carroll,demarre</td>
<td>atl</td>
<td>SF</td>
<td>16.1945</td>
<td>16.4065</td>
<td>2343</td>
</tr>
<tr>
<td>mack,shelvin</td>
<td>atl</td>
<td>PG</td>
<td>17.441</td>
<td>15.4703</td>
<td>1494</td>
</tr>
<tr>
<td>scott,mike</td>
<td>atl</td>
<td>SF</td>
<td>17.3349</td>
<td>17.941</td>
<td>1484</td>
</tr>
<tr>
<td>williams,josue</td>
<td>atl</td>
<td>SG</td>
<td>18.0663</td>
<td>16.6793</td>
<td>1445</td>
</tr>
<tr>
<td>brand,elton</td>
<td>atl</td>
<td>PF</td>
<td>15.4791</td>
<td>16.521</td>
<td>1416</td>
</tr>
<tr>
<td>horford,lal</td>
<td>atl</td>
<td>PF</td>
<td>21.969</td>
<td>25.8245</td>
<td>960</td>
</tr>
<tr>
<td>antic,pero</td>
<td>atl</td>
<td>PF</td>
<td>14.1043</td>
<td>13.7673</td>
<td>928</td>
</tr>
<tr>
<td>schnoer,dennis</td>
<td>atl</td>
<td>PG</td>
<td>8.35735</td>
<td>6.73756</td>
<td>641</td>
</tr>
<tr>
<td>ayo,guatavo</td>
<td>atl</td>
<td>PF</td>
<td>14.4091</td>
<td>15.222</td>
<td>429</td>
</tr>
<tr>
<td>mcusa,miike</td>
<td>atl</td>
<td>C</td>
<td>11.6395</td>
<td>12.7104</td>
<td>215</td>
</tr>
<tr>
<td>jenkins,john</td>
<td>atl</td>
<td>SG</td>
<td>6.1905</td>
<td>5.49013</td>
<td>157</td>
</tr>
<tr>
<td>pittman,dexter</td>
<td>atl</td>
<td>C</td>
<td>13.8803</td>
<td>15.519</td>
<td>3</td>
</tr>
<tr>
<td>green,jeff</td>
<td>bos</td>
<td>PF</td>
<td>14.9704</td>
<td>15.2445</td>
<td>2805</td>
</tr>
<tr>
<td>bus,brendon</td>
<td>bos</td>
<td>PF</td>
<td>16.1012</td>
<td>17.496</td>
<td>2262</td>
</tr>
<tr>
<td>sullinger,jared</td>
<td>bos</td>
<td>PF</td>
<td>18.2145</td>
<td>19.0702</td>
<td>2041</td>
</tr>
<tr>
<td>bradley,avery</td>
<td>bos</td>
<td>PG</td>
<td>14.4753</td>
<td>14.8149</td>
<td>1855</td>
</tr>
<tr>
<td>bayless,jerryd</td>
<td>bos</td>
<td>PG</td>
<td>14.8326</td>
<td>13.753</td>
<td>1686</td>
</tr>
<tr>
<td>wallace,gerald</td>
<td>bos</td>
<td>SF</td>
<td>12.9597</td>
<td>11.6396</td>
<td>1418</td>
</tr>
<tr>
<td>olmyyk,kelly</td>
<td>bos</td>
<td>PG</td>
<td>17.392</td>
<td>17.8314</td>
<td>1396</td>
</tr>
<tr>
<td>humphries,kris</td>
<td>bos</td>
<td>PF</td>
<td>19.5549</td>
<td>21.1786</td>
<td>1381</td>
</tr>
<tr>
<td>pressey,phil</td>
<td>bos</td>
<td>PG</td>
<td>12.9108</td>
<td>10.1859</td>
<td>1129</td>
</tr>
<tr>
<td>rondo,steven</td>
<td>bos</td>
<td>PG</td>
<td>21.0264</td>
<td>17.7295</td>
<td>998</td>
</tr>
<tr>
<td>johnson,chris</td>
<td>bos</td>
<td>SF</td>
<td>12.7167</td>
<td>12.5896</td>
<td>790</td>
</tr>
<tr>
<td>faverani,vitor</td>
<td>bos</td>
<td>C</td>
<td>12.1248</td>
<td>12.9807</td>
<td>488</td>
</tr>
<tr>
<td>anthony,joe</td>
<td>bos</td>
<td>C</td>
<td>8.38205</td>
<td>9.25932</td>
<td>190</td>
</tr>
<tr>
<td>habb,chris</td>
<td>bos</td>
<td>SG</td>
<td>4.77052</td>
<td>4.22298</td>
<td>135</td>
</tr>
<tr>
<td>bogans,keith</td>
<td>bos</td>
<td>SG</td>
<td>12.0616</td>
<td>11.5107</td>
<td>55</td>
</tr>
<tr>
<td>blue,vander</td>
<td>bos</td>
<td>SG</td>
<td>0.91918</td>
<td>0.49178</td>
<td>14</td>
</tr>
<tr>
<td>johnson,joe</td>
<td>bro</td>
<td>SG</td>
<td>18.0136</td>
<td>17.6009</td>
<td>2574</td>
</tr>
<tr>
<td>pierce,paul</td>
<td>bro</td>
<td>SF</td>
<td>19.0152</td>
<td>19.0451</td>
<td>2101</td>
</tr>
<tr>
<td>williams,deron</td>
<td>bro</td>
<td>PG</td>
<td>21.8015</td>
<td>20.1</td>
<td>2058</td>
</tr>
<tr>
<td>livingston,shaun</td>
<td>bro</td>
<td>PG</td>
<td>16.7174</td>
<td>16.5179</td>
<td>1976</td>
</tr>
<tr>
<td>anderson,alan</td>
<td>bro</td>
<td>SG</td>
<td>11.0122</td>
<td>10.7612</td>
<td>1770</td>
</tr>
<tr>
<td>thornton,marcus</td>
<td>bro</td>
<td>SG</td>
<td>13.7448</td>
<td>13.584</td>
<td>1742</td>
</tr>
<tr>
<td>blanche,andray</td>
<td>bro</td>
<td>PF</td>
<td>20.1022</td>
<td>21.3445</td>
<td>1622</td>
</tr>
<tr>
<td>teletovic,mirza</td>
<td>bro</td>
<td>PF</td>
<td>16.653</td>
<td>16.2774</td>
<td>1399</td>
</tr>
<tr>
<td>phinisee,maison</td>
<td>bro</td>
<td>PF</td>
<td>19.948</td>
<td>21.7364</td>
<td>1275</td>
</tr>
<tr>
<td>garnett,kevin</td>
<td>bro</td>
<td>PF</td>
<td>14.562</td>
<td>15.186</td>
<td>1111</td>
</tr>
<tr>
<td>kirilenko,andrei</td>
<td>bro</td>
<td>SF</td>
<td>13.8368</td>
<td>14.1523</td>
<td>856</td>
</tr>
<tr>
<td>terry,jason</td>
<td>bro</td>
<td>SG</td>
<td>10.1685</td>
<td>8.44581</td>
<td>570</td>
</tr>
<tr>
<td>Lopez,brad</td>
<td>bro</td>
<td>C</td>
<td>26.1616</td>
<td>28.9775</td>
<td>533</td>
</tr>
<tr>
<td>teague,marquis</td>
<td>bro</td>
<td>PG</td>
<td>6.04878</td>
<td>4.45433</td>
<td>459</td>
</tr>
<tr>
<td>taylor,tyshawn</td>
<td>bro</td>
<td>PG</td>
<td>7.37963</td>
<td>6.09531</td>
<td>271</td>
</tr>
<tr>
<td>gutierrez,jorge</td>
<td>bro</td>
<td>PG</td>
<td>10.978</td>
<td>9.93472</td>
<td>244</td>
</tr>
<tr>
<td>collins,jason</td>
<td>bro</td>
<td>C</td>
<td>4.30608</td>
<td>4.68678</td>
<td>175</td>
</tr>
<tr>
<td>walker,kenba</td>
<td>cha</td>
<td>PG</td>
<td>20.602</td>
<td>19.2426</td>
<td>2617</td>
</tr>
<tr>
<td>jefferson,al</td>
<td>cha</td>
<td>C</td>
<td>24.1431</td>
<td>20.5657</td>
<td>2557</td>
</tr>
<tr>
<td>henderson,gerald</td>
<td>cha</td>
<td>SG</td>
<td>14.8804</td>
<td>15.0104</td>
<td>2461</td>
</tr>
<tr>
<td>mcavoy,josh</td>
<td>cha</td>
<td>PF</td>
<td>17.2643</td>
<td>15.8709</td>
<td>2365</td>
</tr>
<tr>
<td>kidd-gilchrist,m</td>
<td>cha</td>
<td>SF</td>
<td>12.3431</td>
<td>13.8917</td>
<td>1501</td>
</tr>
<tr>
<td>zeller,cody</td>
<td>cha</td>
<td>PF</td>
<td>14.3599</td>
<td>15.1314</td>
<td>1412</td>
</tr>
<tr>
<td>toliver,anthony</td>
<td>cha</td>
<td>PF</td>
<td>13.0471</td>
<td>10.6238</td>
<td>1380</td>
</tr>
<tr>
<td>ridnour,luke</td>
<td>cha</td>
<td>PG</td>
<td>12.2421</td>
<td>10.3279</td>
<td>1138</td>
</tr>
<tr>
<td>Neal,gary</td>
<td>cha</td>
<td>PG</td>
<td>14.7988</td>
<td>14.2973</td>
<td>1113</td>
</tr>
<tr>
<td>biyombo,bismack</td>
<td>cha</td>
<td>PG</td>
<td>13.6784</td>
<td>15.379</td>
<td>1073</td>
</tr>
<tr>
<td>douglas,roberts</td>
<td>cha</td>
<td>SF</td>
<td>14.0237</td>
<td>13.9819</td>
<td>1017</td>
</tr>
<tr>
<td>taylor,jeffery</td>
<td>cha</td>
<td>SF</td>
<td>6.93954</td>
<td>6.78551</td>
<td>629</td>
</tr>
<tr>
<td>gordon,ben</td>
<td>cha</td>
<td>SG</td>
<td>7.93786</td>
<td>7.31883</td>
<td>280</td>
</tr>
<tr>
<td>parco,janero</td>
<td>cha</td>
<td>PG</td>
<td>24.1285</td>
<td>21.5688</td>
<td>244</td>
</tr>
<tr>
<td>hamilton,justin</td>
<td>cha</td>
<td>C</td>
<td>12.0295</td>
<td>13.0561</td>
<td>74</td>
</tr>
<tr>
<td>white,d.e</td>
<td>cha</td>
<td>PF</td>
<td>2.50325</td>
<td>2.79878</td>
<td>10</td>
</tr>
<tr>
<td>noah,joakim</td>
<td>chi</td>
<td>C</td>
<td>22.6328</td>
<td>22.6563</td>
<td>2818</td>
</tr>
<tr>
<td>butler,jimmy</td>
<td>chi</td>
<td>SG</td>
<td>15.0024</td>
<td>15.1862</td>
<td>2594</td>
</tr>
<tr>
<td>dunleavy,nike</td>
<td>chi</td>
<td>SG</td>
<td>14.485</td>
<td>14.1458</td>
<td>2586</td>
</tr>
<tr>
<td>gibson,taj</td>
<td>chi</td>
<td>PF</td>
<td>16.4946</td>
<td>18.0154</td>
<td>2355</td>
</tr>
<tr>
<td>boozer,carlos</td>
<td>chi</td>
<td>PF</td>
<td>15.1266</td>
<td>16.2476</td>
<td>2143</td>
</tr>
<tr>
<td>hirnich,kirk</td>
<td>chi</td>
<td>SG</td>
<td>13.5404</td>
<td>12.0586</td>
<td>2120</td>
</tr>
<tr>
<td>augustin,d.j</td>
<td>chi</td>
<td>PG</td>
<td>19.876</td>
<td>18.1368</td>
<td>1942</td>
</tr>
<tr>
<td>snell,tomy</td>
<td>chi</td>
<td>SF</td>
<td>9.54152</td>
<td>8.9455</td>
<td>1235</td>
</tr>
<tr>
<td>martin,carrier</td>
<td>chi</td>
<td>SF</td>
<td>13.1811</td>
<td>12.9718</td>
<td>873</td>
</tr>
<tr>
<td>mohammed,nazar</td>
<td>chi</td>
<td>C</td>
<td>10.534</td>
<td>11.4768</td>
<td>562</td>
</tr>
<tr>
<td>rose,derrick</td>
<td>chi</td>
<td>PG</td>
<td>12.4451</td>
<td>10.8846</td>
<td>311</td>
</tr>
<tr>
<td>ammondson,lou</td>
<td>chi</td>
<td>PF</td>
<td>8.87075</td>
<td>9.85582</td>
<td>176</td>
</tr>
</tbody>
</table>
brower,ronnie
shergill,amrik
james,mike
murphy,erik
thompson,tristan
irving,kyrie
lue,spencer
jack,jarratt
gaug,laun
carter,alonzo
mile,s.e.j.
bennett,anthony
karasev,sergey
felix,earick
omura,arie
curry,steff
edwards,shahe
donson,scotty
ellis,mona
nowitzki,dirk
calderon,joce
marion,shawn
carter,vince
dalenberg,samuel
crowder,jae
blair,dejuan
wright,bran
harris,devin
larkin,shane
ellington,wayne
mikel,gal
james,bernad
terry,ricky
roy,randy
lawson,ty
faried,kenneth
chandler,wilson
hickson,j.j.
mozgov,zimo
brooks,aaron
fourier,eva
arthur,darrel
robinson,rae
miller,quincy
vesely,ian
randolph,anthony
meece,javael
smith,josh
jennings,brandon
monroe,greg
drummond,andre
singler,ty
stuckey,rodney
caldwell,ke
bynum,will
jerekho,tonas
harrellson,josh
billups,chauncey
danone,luigi
siva,peyton
villanueva,charl
mitchell,tony
thompson,klay
curry,stephen
lee,david
barnes,harrison
igouidala,andre
crawford,jordan
green,draymond
bogut,andrew
blake,steve
spalding,narres
o'neal,germaine
nedovic,nemanja
armonstrong,full
kuzmic,ognjen
parsons,chandler
pondexter, quincy
morris, darius
leuer, jon
udrih, beno
davis, ed
calathes, nick
allen, tony
koufos, kosta
miller, mike
prince, tayshaun
lee, courtney
kobe
kaman, chris
williams, shawne
henry, xavier
bazemore, kent
farmar, jordan
redick, j.j.
bryant, kobe
harden, james
howard, dwight
jones, terrence
lin, jeremy
beverley, patrick
caspnieri, diego
garcia, francisco
hamilton, jordan
ask, conor
otejenius, donat
caanu, isaiah
smith, greg
daniels, troy
cevington, robert
powell, josh
george, paul
stephenson, lance
west, david
turner, evan
hill, george
hubbert, roy
seol, hui
mahinmi, ian
watsone, c.
allen, kasey
bynum, andrew
slou, donald
butler, raul
edwards, c.hris
hill, solomon
jordan, deandre
griffin, blake
paul, aaron
brooks, jamal
collison, daren
barnes, matt
dudley, jared
singh, matt
meeks, jodie
johnson, wesley
gasol, pau
young, nick
marshall, kendall
hill, jordan
kelley, ryan
sacre, robert
farmar, jordan
baze Moore, kent
henry, xavier
williams, shawn
kaman, chris
brooks, marshall
nash, steve
harris, manny
bryant, kobe
harris, elias
randolph, zach
conley, mike
gasol, marc
lee, courtney
prince, zayshuan
miller, mike
koutsokosta, don
allen, tony
bell, nick
johnson, james
davis, ed
udrih, beno
leuer, jon
morris, darius
pondexter, quincy
<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Minutes</th>
<th>Points</th>
<th>Rebounds</th>
<th>Assists</th>
<th>Steals</th>
<th>Blocks</th>
<th>Turnovers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamalian</td>
<td>SG</td>
<td>27</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Hamalian 27
gay.rudy sac SF 20.6991 21.5724 2532
thomas.naiah sac PG 25.1917 24.108 2492
cousins.demarreus sac C 28.513 30.7533 2296
mchenmore.ben sac SG 9.27888 9.09736 2185
thompson.jason sac PF 11.8663 13.0448 2011
william.laurick sac PF 12.7993 13.649 1816
outlaw.travis sac SF 12.1883 12.1782 1068
evans.reggie sac PF 12.3415 13.7359 898
mecculam.roy sac PG 12.7345 11.3734 898
acquinceny sac SF 11.0357 11.8136 852
johnson.orlando sac SG 6.67616 6.26102 392
gray.aaron sac C 9.0068 9.36334 350
landry.carl sac PF 11.9594 13.1831 233
cunningham.jared sac SG 10.6983 9.9819 81
nidaye.hamady sac C 3.53423 3.40538 76
white.royce sac SF 8.76042 -0.79466 9
duncan.tim sam PF 23.9919 25.2327 2155
belinelli.marco sam SG 18.2166 17.7393 2015
parker.tony sam PG 23.2016 22.2631 2002
diaw.boris sam PF 16.8934 16.5943 1974
leonard.kawhi sam SF 22.0333 22.8528 1924
green.danny sam SG 16.814 16.3705 1652
ginobili.mau sam SG 24.8194 23.4885 1554
milki.patty sam PG 22.8193 22.1894 1523
splitter.tiago sam PF 18.3596 19.4785 1272
ayres.jeff sam PF 12.5243 13.1509 952
joseph.cory sam PG 17.5501 17.2368 941
bonner.matt sam PF 13.4247 13.1643 697
haynes.aron sam PF 11.0862 11.4628 491
day.austin sam PF 13.4119 12.6942 151
james.dumion sam SF 5.12488 4.68823 52
derozan.deamarin tor SG 20.7535 21.0105 3020
lowry.lavoye tor PG 25.6471 23.046 2861
valincunias.jona tor C 16.6793 18.5133 2283
johnson.amir tor PF 16.5938 17.6932 2214
ross.terrence tor SG 14.0181 13.8372 2156
vasteur.greivis tor PG 18.3601 16.2073 1778
salmons.john tor SF 9.93945 8.92971 1725
patterson.patric tor PF 16.259 16.7725 1536
hansbrough.jeremy tor PF 14.5389 16.2596 981
hayes.chuck tor PF 10.9074 11.537 755
novak.steve tor SF 13.1825 12.5842 545
decolo.nando tor PG 16.1318 15.2045 500
field.landy tor SF 9.75651 9.8719 322
bynum.dwight tor PG 8.73555 8.20838 147
stone.julian tor PG 8.46961 7.46724 122
huyward.gordon uta SF 19.0864 18.3851 2798
burke.trey uta PG 16.3682 14.2462 2262
jefferson.richar uta SF 13.7829 13.4839 2211
favors.derrick uta PF 19.7326 21.5989 2202
burks.alice uta PG 17.7334 17.9153 2192
kanter.cest uta C 16.1628 17.7899 2138
williams.marvin uta PF 15.7344 15.941 1673
evans.jeremy uta SF 17.0249 18.51 1208
garrett.dante uta SG 9.36905 8.0004 1050
luca.s jug uta PG 7.0304 5.88856 589
gobert.rudy uta C 13.0225 14.7009 436
rush.brandon uta SG 5.51219 4.62434 421
harrell.mike uta SF 15.7711 17.4958 224
clarke.jim uta SG 11.3869 10.3548 174
tinsley.jamal uta PG 5.30665 2.06958 110
thomas.malcomb uta PF 4.8021 5.34528 63
biedrins.andris uta C 2.24393 2.79889 44
wall.john was PG 24.5941 22.601 2980
ariza.trevor was SF 18.5165 18.3878 2723
goran.maric was C 18.9004 20.3938 2660
brad.reed was SG 17.1384 16.5382 2529
webber.martell was SF 13.6693 13.3243 2164
hilario.nene was C 18.5897 19.2717 1562
hooker.trevor was PF 16.113 17.4207 1553
miller.andre was PG 18.1346 14.6434 988
temple.garrett was SG 9.79541 8.94106 644
spencer.kevin was PF 13.6039 14.4622 578
harington.nual was PF 11.6091 11.1627 513
good.drew was PF 19.8495 21.3759 394
 porterotto was SF 6.71705 6.9336 322
singleton.chris was SF 9.82887 10.4254 249
rice.glenn was SG 8.84765 7.53262 111
Bibliography


Note: All statistics were retrieved from http://www.basketball-reference.com/