NBA Team Synergy and Style of Play Analysis

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Abstract

The purpose of the study was to discover patterns characteristic of top seeded teams in the NBA, particularly looking at the patterns in the Eastern V. Western division. This study focused on the top 8 seeded teams in both the Eastern and Western division, for the 2011-2012 season. Throughout our study many associations were found including: findings that suggest a different style of game play between eastern and western teams, a different team composition between highest ranked teams and others, and also findings that suggest player rank is largely dependent on the number of touches a player has and his position on the court. It is particularly interesting to find that the player's position on the court is a significant predictor of player rank because it is currently not a factor used in the NBA's ranking system. These findings suggest that further analysis of the player ranking system may be needed, and team composition and pace of play differ in the east and west, which may impact player trades between different divisions.

Introduction

From previous literature, team chemistry in Basketball has been defined by a mathematical formula that quantifies the positive or negative "synergies" between players. According to another research paper, combinations of player "clusters" determine wins or losses. We draw inspiration from these previous researchers as we use numerous statistical methods of analysis to define team chemistry in Basketball. These methods are outlined below and serve as a preliminary assessment of the findings. The methods are primarily exploratory and assist in the understanding of patterns and trends amongst teams.

Method

Participants

This study is observational and was conducted on data gathered from Basketball-Reference.com [1], BasketballValue.com [2], and ESPN.com [3]. Information on the top 8 seeded teams in the Eastern and Western divisions from the 2011-2012 NBA season were the primary focus of this study. The participating teams in the East include: Atlanta Hawks, Boston Celtics, Chicago Bulls, Indiana Pacers, Miami Heat, New York Knicks, Philadelphia 76ers, and the Orlando Magic. The participating teams in the West include: Los Angeles Lakers, Los Angeles Clippers, Denver Nuggets, Memphis Grizzlies, Oklahoma City Thunder, San Antonio Spurs, Utah Jazz and Dallas Mavericks.

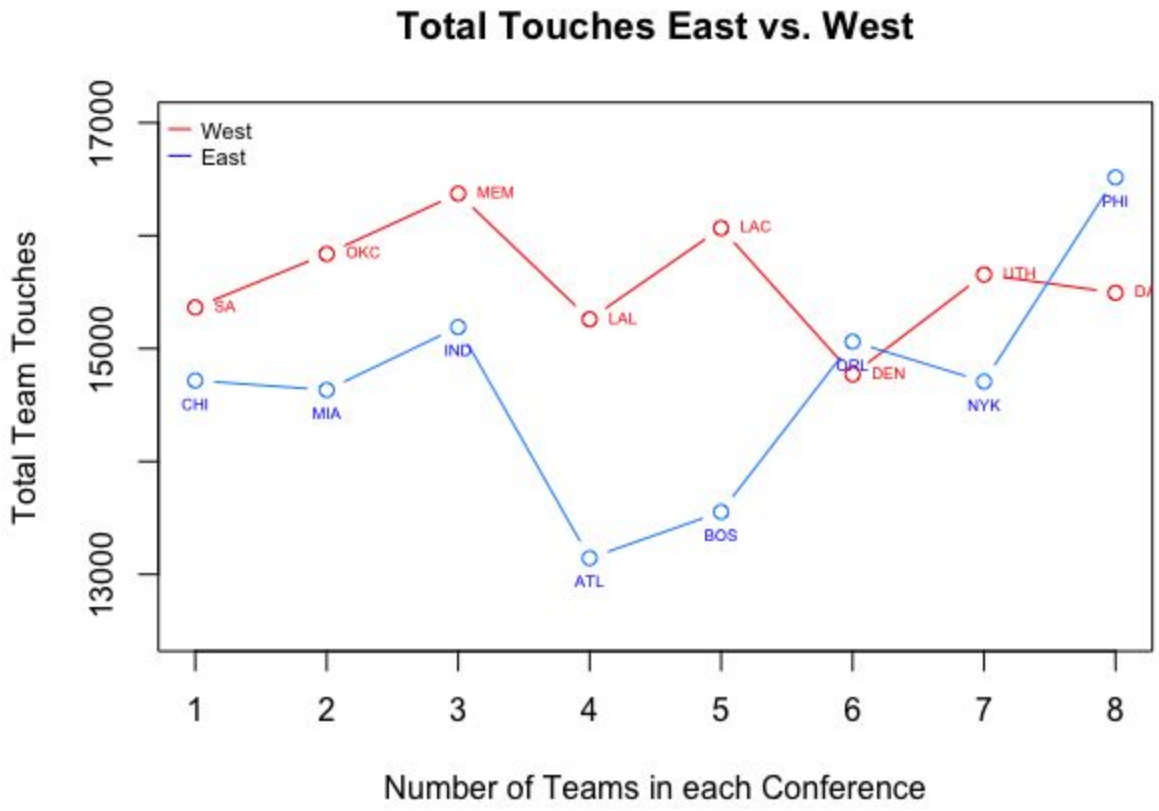
Assessments and Measures

Methods used in assessment and measurement include graphical exploration with scatter plots to visually see how the data is behaving and notable trends, Welch's Two-Sample t-tests to

measure if populations are similar in means, and ANOVA's to analyze the variance of the populations. The assessments conducted in this study are defined below.

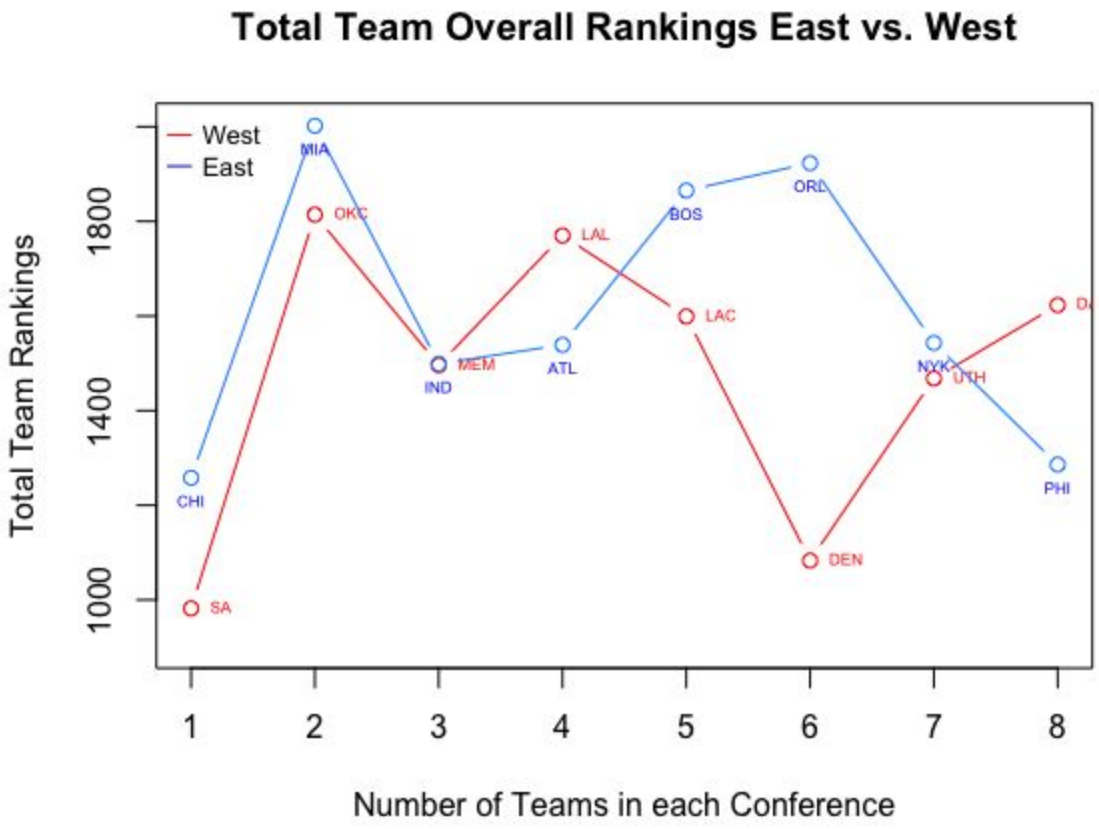
Preliminary Findings

Figure 1. The graph below shows the trend of Total Touches between Eastern and Western conference teams



The graph above shows the distribution of total team rankings for the top 8 teams of the eastern division compared to the top 8 teams of the western division. The trend appears to fluctuate, suggesting that some of the top ranked teams have different levels of overall player rank. Some teams such as the Miami Heat, have a very poor overall player rank, despite having three of the top ranked players in the NBA.

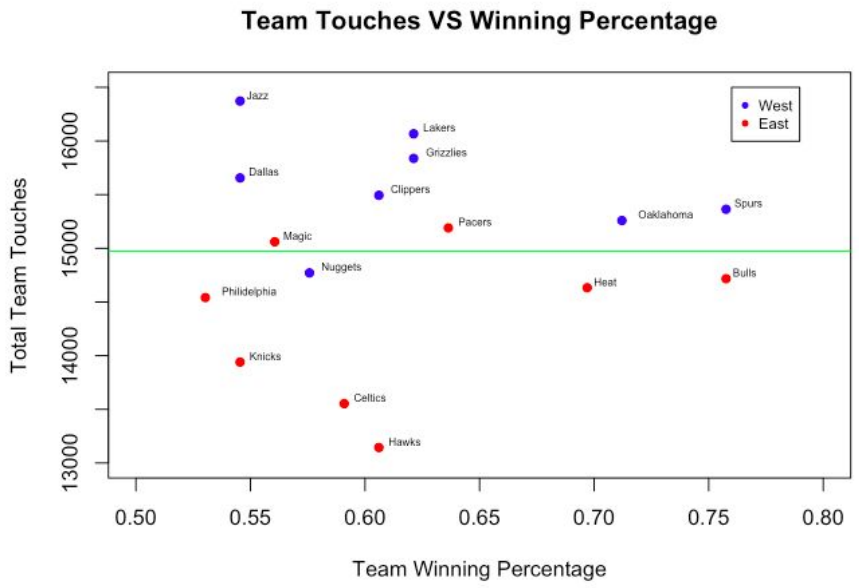
Figure 2. The graph below shows the trend of total teams overall NBA rankings between Eastern and Western conference teams.



Total Team Touches V. Winning Percentage Between Divisions.

The purpose of this assessment was to determine whether or not total team touches differed between the Eastern and Western divisions and whether or not there was a relationship between total team touches and team winning percentage. Figure 1 below illustrates this relationship.

Figure 3. Plot of total team touches vs team winning percentage. Each point represents a team. Blue points represent West teams and red, East teams.



The above plot shows the mean team touches as a horizontal green line at about 15000 touches. Teams that had a closer to average amount of touches generally had a higher winning percentage than teams that had touches that were much higher or lower than average. It is clear that there is a difference between the number of ball touches the west has compared to the east regardless of winning percentage. The teams in the west that had the highest winning percentage had more touches than teams in the east that did similarly well. To test whether or not this finding is significant or statistically valid, we use Welch's Two-Sample t-test the findings are shown below.

```
##  Welch Two Sample t-test
## data:  eastsumtouches and westsumtouches
## t = -4.0183, df = 12.381, p-value = 0.001604
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1933.524  -576.934
## sample estimates:t-t
```

```
## mean of x mean of y
##  14347.40  15602.62
```

The results of the test show that the difference between the average total team touches in the west and in the east is significantly different.

Total Team Player Rank and Winning Percentage. The purpose of this assessment was to examine team composition. It is interesting to note the differences in team player rank among the top ranked teams and the team who won the championship during the 2011-2012 season, the Miami Heat over Oklahoma City Thunder. What is noticeable when looking at the plot of total team player rank against winning percentage is that the two teams who made it to the championship are clustered together above the mean team player rank, meaning their teams had an overall worse player rank than the average teams. When we examine the top four teams more closely (by winning percentage) we see that Miami and Oklahoma, had team compositions consisting of 3-4 'key' players, while Chicago and San Antonio had different compositions consisting of an all around better group of players.

Figure 4. Plot below shows the team rank versus team winning percentage for the east (red) versus the west (blue).

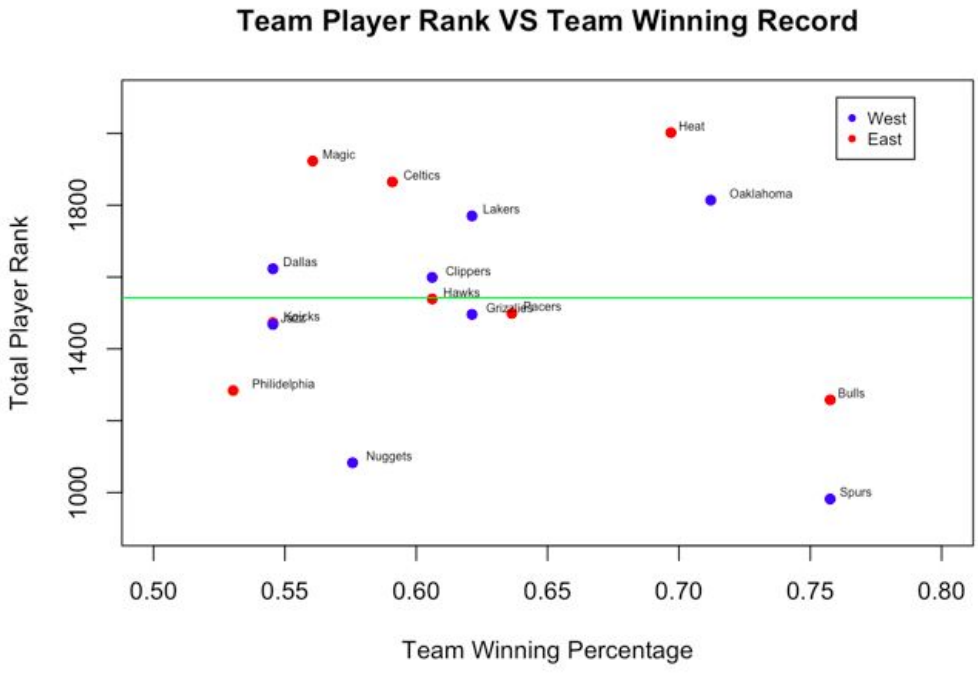


Figure 5. The below plot shows the team overall player rank and touches distribution for Chicago (red) and San Antonio (blue).

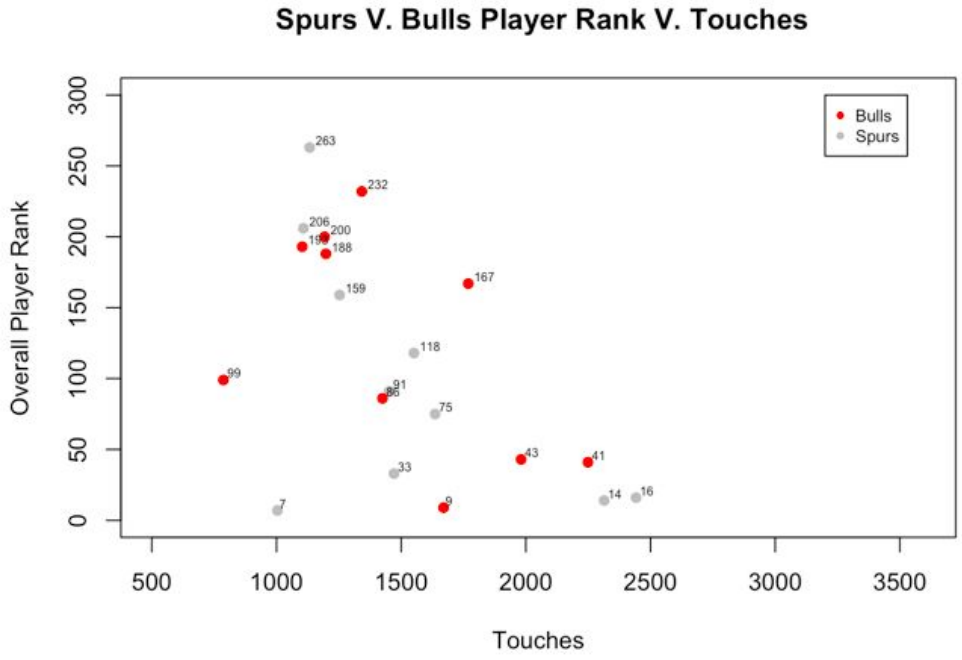
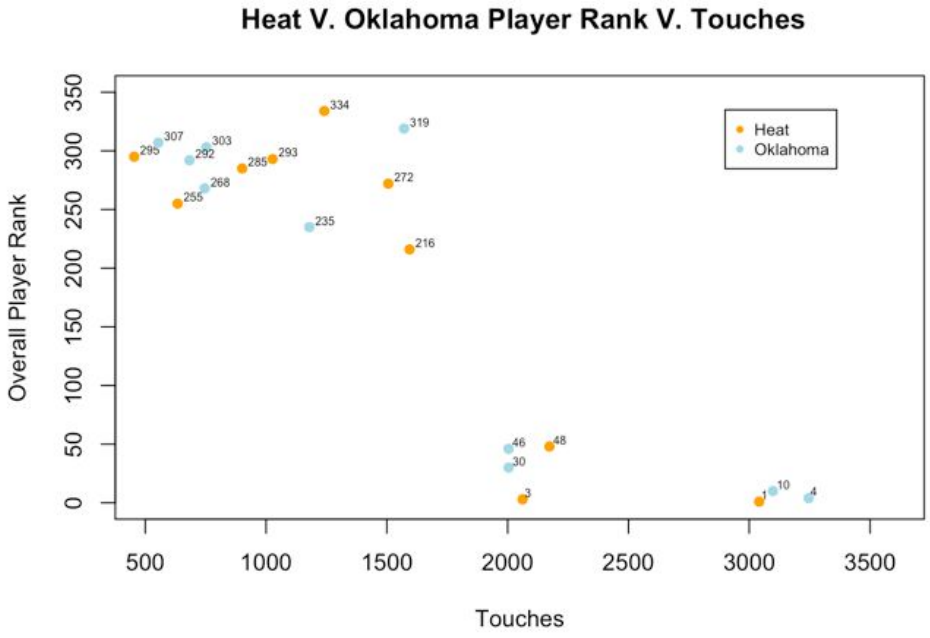


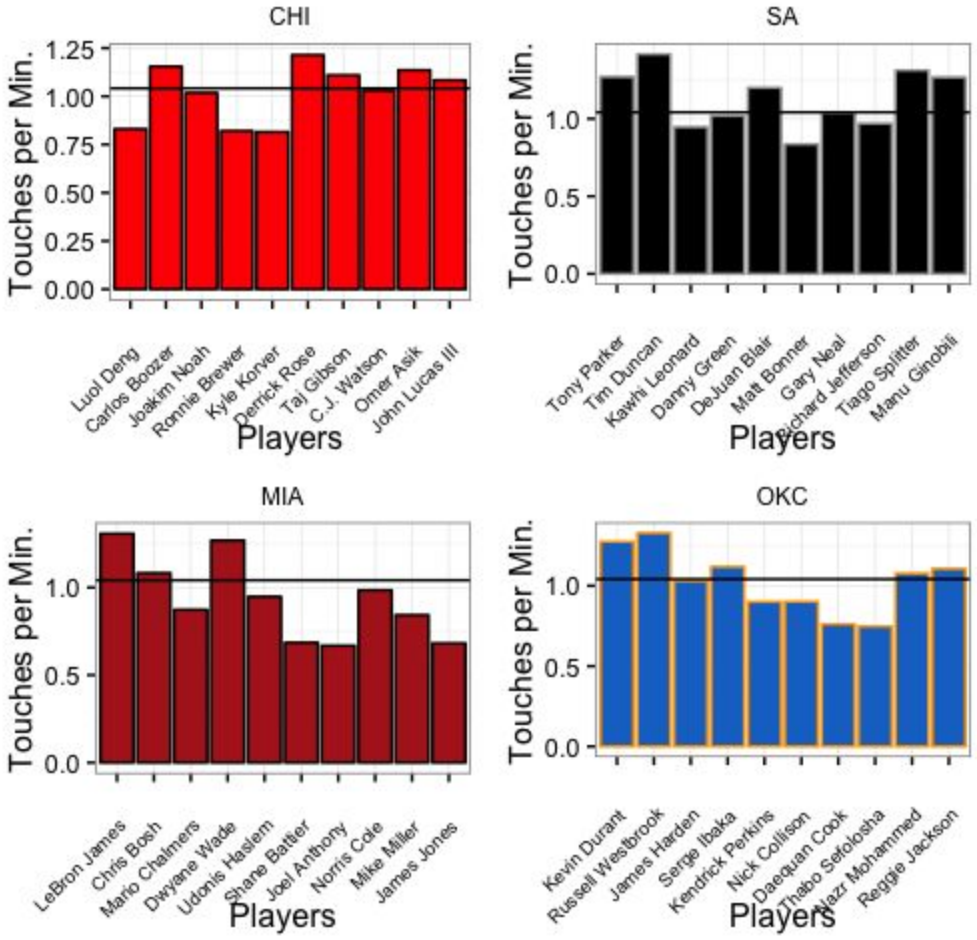
Figure 6. The below plot shows the team overall player rank by touches for the Heat and Oklahoma.



Looking at the graph that shows overall player rank against touches for Miami and Oklahoma, we can see that both teams have a composition with 3-4 top players. In contrast, San Antonio and Chicago appear to have more variety within their team player compositions.

Total Team Touches by Minute. To assess how total team touches influence team framework, we evaluated the Touches per Minute (TPM) for each of the top Eastern and Western conference teams. Exploring the distributions and touches per minute of the top teams provides information on how team composition is related to winning percentage. The plots below show the frequencies of touches per minute for the top four teams in the NBA during the 2011-12 season. The players are sorted in ascending order by team ranking.

Figure 7. The top 4 seed teams in the East (left) and Western (right) conferences touches per minute distributions along with the average touches per minute in the NBA(black line).

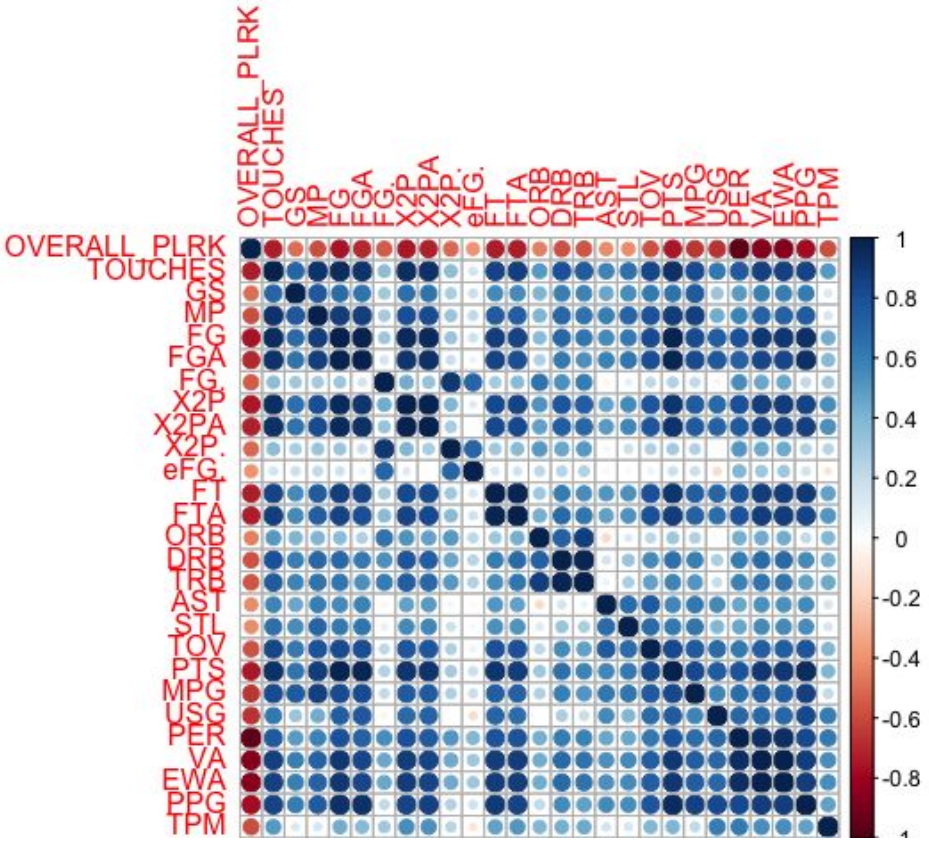


To validate whether or not this finding is significant or statistically valid, we use Welch's Two-Sample t-test to test the difference between Eastern and Western touches per minute.

```
##  Welch Two Sample t-test
## data:  easttpm and westtpm
## t = -2.2024, df = 11.926, p-value = 0.04806
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.42321967  -0.00717937
## sample estimates:
## mean of x mean of y
##  10.05742  10.77262
```

Modeling Player Rank and Determining Significant Predictors. If we know that different distributions of rankings predict team success, then it is useful to know the significant predictors of rank. In order to find the best predictors for overall player rank, we examine the correlations between overall player rank and the other predictors in the data set. Figure 5 below shows which predictors were most highly correlated with overall player rank. Isolation of the most important predictors in the whole dataset reveals which variables should be used in building a model to predict player ranking. A stepwise regression using the set of variables examined in the correlation plot was used to build a multiple regression model for the formula predicting overall player rank.

Figure 8. The plot above shows a correlation heat map with the variables that were used in to building a liner regression model, these variables showed to be highly correlated with overall NBA player rank.



Results

Based on the above stated findings, this study has led to a few conclusions as well as prompted questions that warrant further research.

Outcome 1

As stated before, the results of the t-test comparing the total number of team touches in the east and the west produced significant results. This allows us to conclude that the pace of play as defined by the number of touches a team has, in the west is considerably faster than in the east.

Outcome 2

The graphs comparing overall team player rank and winning percentage suggest that perhaps a team with a composition that consists of a few ‘top’ players is better than a team that has a better overall player ranking. Because there was no test conducted on this result, further examination of team composition in other seasons would need to be done to validate this finding. For now, we can only conclude that in the 2011-2012 season, the two teams who competed in the championship had a worse than average overall player ranking, but had 3-4 very highly ranked players.

Outcome 3

From the stepwise regression results, the predictors that were found to have a significant effect on overall player rank were position of the player, number of assists, number of offensive rebounds, usage Rate - the number of possessions a player uses per 40 minutes, effective field goal percentage, and the number of turnovers. The results from the model show that every position except for power forward was statistically significant. This is interesting because NBA

currently does not even consider the position of the player to be factored in the ranking system. The combined predictors explained about 85%(.85) of the variation in overall player rank. To prove the robustness of the model, we need to test the model for multicollinearity and determine that these predictors are not highly correlated with each other.

Outcome 4

The black horizontal lines show the average touches per minute of the NBA,which was about one. Our findings are consistent with those from the previous analysis, where several teams were composed of 3-4 key players who had many touches per minute--notably above the NBA average--while the other teams distributions were more fairly distributed. The p-value from the Welch's Two Sample t-test above shows that the findings are statistically significant ($P < .05$), thus we can conclude that there is likely a difference between Eastern and Western touches per minute.

Discussion

Our study begins an attempt at defining team synergy in terms of characteristics unique to each team. To validate these findings, we would need to confirm that there are consistent results across all seasons. These results illuminate patterns and factors that possibly determine success in the NBA. We found that there is a different pace of play between the western and eastern divisions, that teams that had a few top players as opposed to a very high overall ranking were more successful, and that several variables are highly predictive of the overall player ranking. From these, we can draw tentative conclusions as well as give recommendations for implementation of a new and improved game strategy. It is recommended that player position be taken into higher consideration because of its significant effect on overall rank and that a coach

not organize his team solely on the basis of overall team ranking. Although our study of basketball team synergy is still in its infancy, we have already found striking results that may have far reaching implication for future games. Awareness of these results could possibly revolutionize the way the game is strategized and played.

Limitations

Due to limited access to recent NBA data, the data source we used to gather the play-by-data from--BasketballValue.com--only provided all play-by-play data up to the 2011-2012 season, which was the season that the NBA had its 4th lockout. The lockout resulted in the cancellation of 16 out of 82 regular-season games. This lack of data limited the scope of our analysis by decreasing the sample size of all teams total games, which was a significant obstacle in finding trends that could be generalized to other seasons.

References

[1] "BasketballValue.com Data Files." *BasketballValue.com Data Files*. N.p., n.d. Web. 09 June 2016.

[2] "NBA & ABA League Index | Basketball-Reference.com." *Basketball-Reference.com*. N.p., n.d. Web. 09 June 2016.

[3] "2011-12 Hollinger NBA Player Statistics - All Players." *ESPN.com*. N.p., n.d. Web. 09 June 2016.

[4] Maymin, Allan Z., Phillip Z. Maymin, and Eugene Shen. "NBA Chemistry: Positive and Negative Synergies in Basketball." *International Journal of Computer Science in Sport*, December 2013.

[5] Lutz, Dwight. "A Cluster Analysis of NBA Players."