The 3-Pointer Problem or the Shooting Revolution?

Dileep Kishore[1*]

[1]Department of Bio-informatics, Boston University

E-mail: dkishore@bu.edu.

September 19, 2017

The basketball of today is a vastly different game from that of a decade ago. Who would have expected that the NBA that was once dominated by big men would now become the domain of smaller, quicker players? That's not all that's changed; the league has transitioned from shooting around 2.8 3-pointers per game in the 1980 season (when the 3-pointer first made its appearance) to more than 25 in the last season. The Golden State Warriors who made history last season by winning the most games ever in a single season in NBA history did so with their small men line-up, their 3-pointer shooting and their star player Stephen Curry. Amid suggestions from all over the NBA that they move the 3-point line backward just to compensate for one player or team, the questions addressed in this study are:

1. **Did this 3-pointer shooting trend start with Stephen Curry and the current Warriors or did they just make the best use of it? Is the trend statistically significant?**
2. **How do things look in the future? Is the 3-pointer trend going to die**

down or is it going to increase?

3. **How does taking more 3-pointers affect the winrate of a team and how accurately do 3-pointers predict winrate over the years when compared to the "4 factors" as an indicator?**

Introduction

In the 2016 basketball season, the Golden State Warriors scored a staggering 1,025 3-pointers (Cohen, 2016), of which one man, Stephen Curry, set a record by attempting more 3-pointers by himself than any average NBA team had ever attempted from 1980 to 1994 (Rudy, 2016). To add to this, Stephen Curry is scoring them at an average rate of 45.6 percent, which is higher than the NBA average for all attempted shots (Cohen, 2016).

The 3-pointer has crept into basketball, and with it have come legends, records, and unexpected last-minute comebacks. But its acceptance and incorporation into modern basketball has been a long and controversial process.

Anyone under the age of thirty might hardly remember a time without the 3-point line, but the NBA only adopted the 3-pointer in 1979 (Wood, 2016), and with it came waves of criticism. Boston Celtics president Red Auerbach dismissed the 3-pointer, believing it was just a gimmick intended to deal with poor television ratings. "I say leave our game alone", he said to the New York Times. John MacLeod, the coach of Phoenix Suns, famously commented "I'm not going to set up plays for guys to bomb from 23 feet. I think that's very boring basketball." (Mather, 2016)

That has not changed. Resentment of the 3-pointer exists even today, with many veteran players holding it in contempt for the kind of gameplay it encourages. Charles Barkley called the modern NBA "watered down" and "the worst I've seen it", while Tracy McGrady wondered aloud whether Stephen Curry could have won his MVP titles so easily in the past (Eger, 2016).

One thing that has changed over the years, though, is the teams' incorporation of the shot into their actual gameplay. Although the 3-pointer was introduced nearly four decades ago, most teams shied away from using it, with 3-pointers making up only 3 percent of total attempted shots in the year it was introduced (Cohen, 2016). This could have been, in part, due to the high success rate necessary to make a 3-pointer "worth it" (Rudy, 2016). However, the shot's usage has steadily increased with each passing season, seeming to plateau recently at 22 percent of all attempted shots (Cohen, 2016). This may be in part due to the increasing popularity of mathematics in basketball (Eger, 2016). Where coaches would once pick players based on their "gut feeling" after watching them play, they began to instead spend hours poring over play statistics. An overall trend emerged, with a focus on "points per possession", with the assumption that possession of the ball alternates between teams roughly equally, and so 3-pointers (which are worth 50 percent more than their 2-pointer counterparts) would pay off in the long run, if one could hit a minimum success rate (Eger, 2016).

As the fraction of 3-pointers attempted increased over the years, so too did the successful 3-pointer attempts. Teams are not just shooting them; they're making them too! While the successful 2-pointer percentage plateaued around 49 percent decades ago (Eger, 2016), the successful 3-pointer attempts have been steadily increasing since it was first introduced.

Franchise changes

The data used for the study spanned the 1980-2016 seasons, during which multiple franchises were renamed or relocated. Certain assumptions were made for the data to account for this:

1. The same team played under the names Brooklyn Nets and New Jersey Nets for a period. The data for these two teams were combined.

2. The San Diego Clippers were re-branded as the Los Angeles Clippers upon their relocation, and their data were combined.

3. The Vancouver Grizzlies relocated and were re-branded as the Memphis Grizzlies, and their data were also combined.

4. The Charlotte Hornets team relocated to New Orleans and became the New Orleans Hornets, which then moved to Oklahoma City and was temporarily named the New Orleans/Oklahoma City Hornets. The franchise then renamed itself the New Orleans Pelicans and returned the "Hornets" name to the original city of Charlotte. Concurrently, the Charlotte Bobcats team, which had established itself in Charlotte, renamed itself the Charlotte Hornets. For ease of data processing, the data for the Charlotte Bobcats and Charlotte Hornets were combined, and the data for the New Orleans Hornets, the New Orleans/Oklahoma City Hornets, and the Oklahoma City Pelicans were combined.

5. The Washington Bullets were renamed the Washington Wizards, and their data were combined.

6. The Kansas City Kings renamed themselves to the Sacramento Kings, and their data were combined.

7. The Seattle SuperSonics were re-branded the Oklahoma City Thunder post-relocation, and their data were combined.

The total number of teams after data merging was 30.

Data Collection

The data collection was undoubtedly the most difficult aspect of this project. The project proposal indicated two possible data sources which could be leveraged and these sources were proposed after validating that data could be retrieved through them.

- The first source that was proposed was the nbastats api that could be used to get data directly from NBA stats site using a python package.

- The other source was Basketball Reference. The proposal was to parse the tables on this site using python.

The problem encountered when using the first method was that although the NBA stats website was updated, the nbastats api was not updated accordingly and hence a large portion of the data on the site could not be accessed through this api. The data that was extracted in order to test this before it was proposed as a potential data source was straightforward and hence this problem was not identified at that stage.

The fallback data-source was Basketball Reference, but accessing data from this source was more involved and required the use of the "BeautifulSoup" python package to parse the html source of the various pages on Basketball Reference in order to extract data from the tables on the website. This was rendered more complicated by the different formats of the various pages on the website.

The various types of data that were extracted from Basketball Reference were:

1. The win-loss data for all the teams for every season from 1980 to 2016. This included the number of wins/losses, the win-loss percentage and other winrate metrics like goal difference.

2. The average performance statistics for all the teams for every season from 1980 to 2016. The performance statistics included statistics like field goal and 3-pointer data, rebounding data, etc.

3. The miscellaneous statistics for all the teams for every season from 1981 to 2016. These miscellaneous statistics included data like effective field goal percentage, turnover percentage, offensive rebound percentage and free throws per field goal attempt, which made up the offensive four factors that were used in the later winrate analysis.

4. The player performance data for every player for every season from 1980 to 2016. This

data included metrics similar to the average team performance statistics but were given for individual players instead.

Data Analysis

The main goals of this study were:

- To determine whether the rise in the 3-pointer shot has been a long time trend or a more recent fancy.
- To determine the effect of the 3-point shot on the winrate of a team.

The 3-pointer shooting trend

The first thing that I look to analyze is whether the increase in 3-pointer shooting is a recent phenomenon or a long-term trend. When I say "3-pointer shooting" this involves two components, the first being the percentage of made 3-pointers, which is the ratio of number of 3-pointers made to the number of 3-pointers attempted. However, this metric on its own only quantifies the efficiency of the shooting but fails to quantify the raw number of 3-point shots taken. Hence, the second component that can be looked at is the number of 3-pointer attempts.

To look at the trends in these two components, we can plot the average (across all teams) of these metrics for every year. As discussed in the introduction there were multiple franchise changes and relocations over the years and some franchises didn't even exist back in the 80's. All of these unavailable data points were removed before plotting.

We first look to visualize the season average 3-pointer percentage for every team from 1980 to 2016.

We observe that the data has a high variance but we can smoothen the data in order to visualize the underlying trend. We use a simple moving average function of order 3 to smoothen

Figure 1: 3-pointer percentage

the data represented in .

Visually, we can see that the 3-pointer shooting percentage was steadily increasing up until the mid-90's and after that it mostly saturated and remained around 35% except for an outlier or two. From the unsmoothened curve we can see that the Golden State Warriors' last season recorded the highest 3-pointer percentage ever (excluding the time-frame between 1995-1997 which will be talked about later in this section).

But as discussed earlier, it is very important to characterize 3-pointer attempts as well, since, a team could have 100% 3-pointer shooting on only one one 3-pointer attempt or 20 3-pointer attempts, and there is a clear difference between the two. Hence, next we take a look at the season average 3-pointer attempts for every team from 1980 to 2016.

We observe that the data again has a high variance and we smoothen the data using a simple moving average of order 3 and this is visualized below.

Visually we can see that the number of 3-pointer attempts has been increasing steadily right

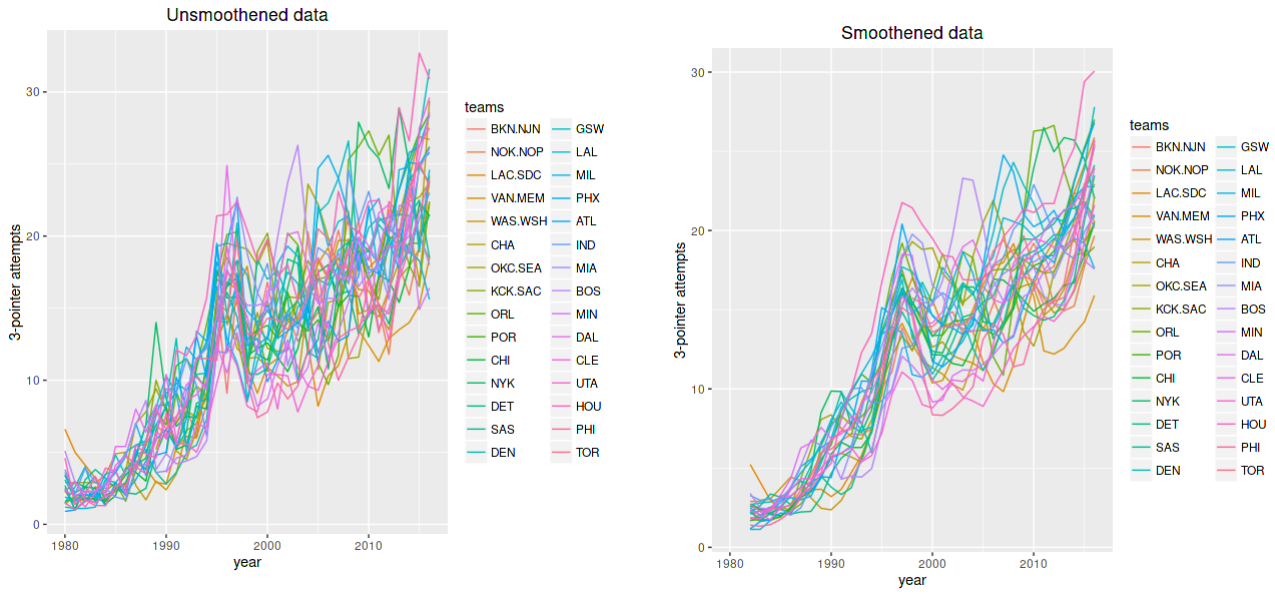

Figure 2: 3-pointer attempts

from when it was first introduced, but unlike the 3-pointer percentage which seemed to have saturated over the last decade the 3-pointer attempts have continued to increase. This implies that the teams have managed to keep the same efficiency over the last decade but have been gradually increasing the number of 3-pointers they make on average. From the unsmoothed data we can see that the Houston Rockets in their 2015 season recorded the highest number of 3-pointer attempts made.

Note:
The 3-pointer line was moved closer during the '95, '96 and '97 seasons and then moved back to its original position for the '98 season. Hence the abnormally high 3-pointer percentages and attempts during this period can be attributed to the fact that the NBA had made it easier to score a 3-pointer during this period of time.

Next, we can look at the average of these metrics across all teams over the various seasons (1980-2016).

The average 3-pointer percentage vs. time clearly shows what we suspected upon looking at : the average 3-pointer percentage increases and then saturates as we approach the current sea-

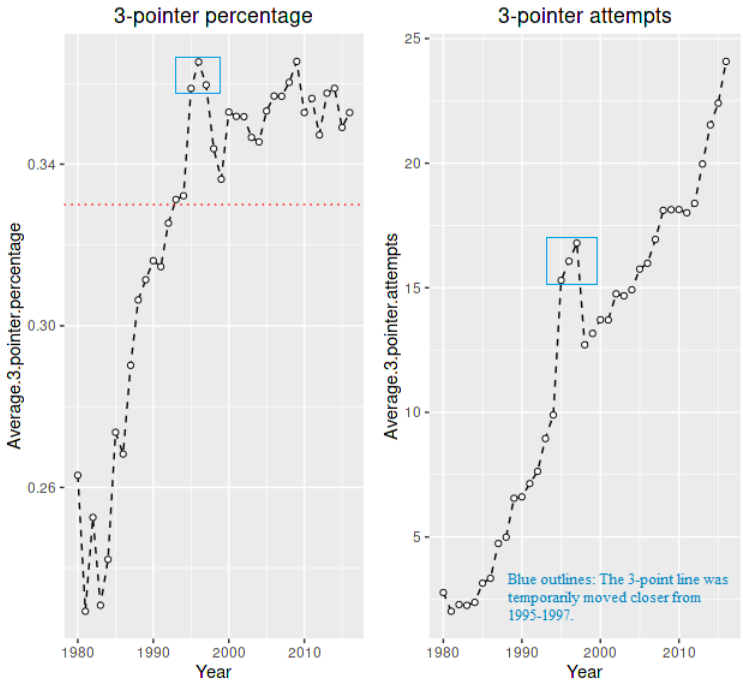

Figure 3: Overall trends in 3-pointer shooting

son. The 3-pointer is a harder shot to make compared to a 2-pointer and has more risk involved. The percentage of made 2-pointers has long been stagnant at around 50%. Hence, on average you get 1 point for every 2-pointer attempted. For the same to hold true for a 3-pointer, the percentage of made shots has to be 33%. Above this efficiency, the 3-pointer will always yield more points per attempt. But what might be the reason for this stagnant 3-pointer percentage? Could it be some sort of optimization on the part of coaches where they try to maximize the gains they get out of 3-pointer shooting while still minimizing their risks? Could it be that it is just not possible to shoot at a higher percentage from beyond this range?

The plot of the average 3-pointer attempts vs. time might help us answer these questions. The trend indicates that the number of attempts have continued to increase at a steady rate. Given that the trend is such, this definitely implies that gradually the fraction of total shots (all

field goals) that are 3-pointers is increasing. If this is the situation, it would be more probable that saturation in 3-pointer efficiency could be due to the fact that it is very difficult to shoot at a higher percentage from beyond 23 feet (the current 3-pointer line). The big jump in the percentage when the 3-pointer line was moved closer (1995-1997) also suggests this scenario.

The next thing we looked at was the distribution of these metrics among the various teams for the last season (2016) vs. the distribution a decade ago (2006).

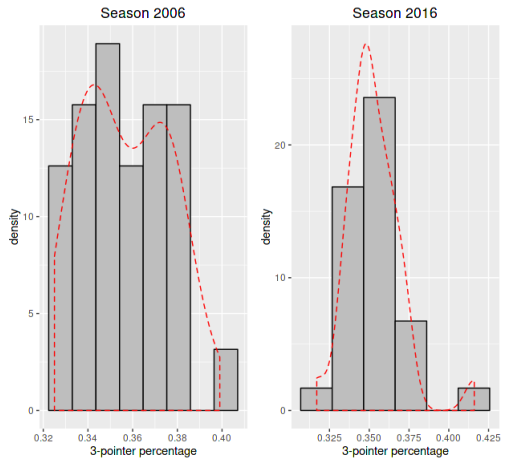

Figure 4: Comparing distribution of 3-pointer percentages among the teams

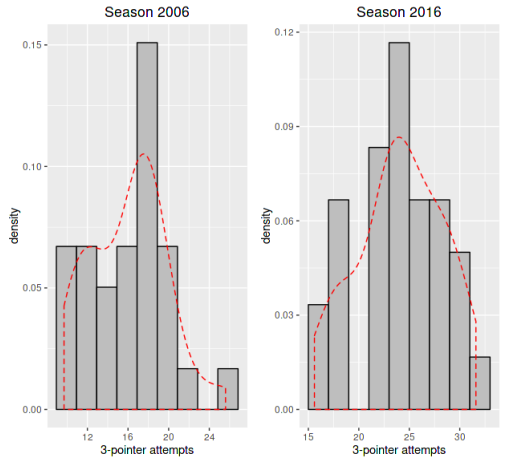

Figure 5: Comparing distribution of 3-pointer attempts among the teams

The 2006 season was chosen as a suitable dataset point for comparison because this was the

earliest season for which data was not missing or unavailable for any of the teams. Visually, the distributions in Figure (4) do not look similar; the data for the 2016 season looks normally distributed with a smaller variance compared to that of the 2006 season. We can perform a t-test (p-value=0.4014) as well as a ks-test (p-value=0.3877) in order to determine whether these data points could have the same underlying distribution. These p-values indicate that the null-hypothesis that these data points might be sampled from the same data points cannot be rejected.

However, in the case of Figure (5) the distributions look very different: it looks like all of the data points from the 2006 season are shifted by a good margin. We can perform a t-test (p-value=$1.8x10^{-10}$) and a ks-test (p-value=$1.97x10^{-}07$) in order to determine whether these data points are from different distributions, and these p-values indicate that the null-hypothesis can be rejected and that these data points are not from the same underlying distributions.

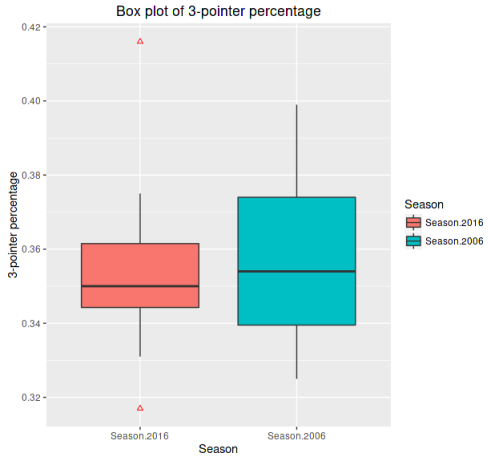

Figure 6: Boxplot of 3-pointer percentages

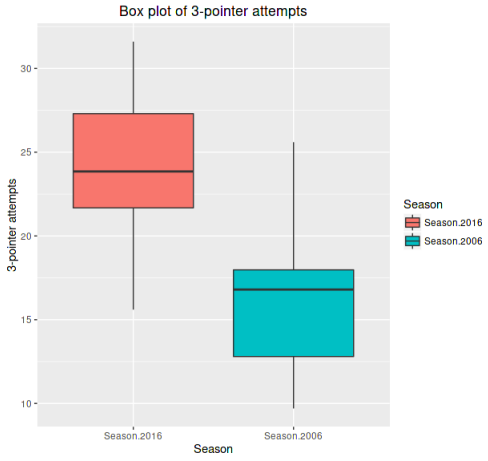

Figure 7: Boxplot of 3-pointer attempts

The boxplots in Figure (6) show us that the variances of the two seasons are different but the means are quite close. One interesting thing to note would be that the outliers in the 2016 season with 41.6% 3-point shooting are the Golden State Warriors and with 31.6% 3-pointer shooting are the Los Angeles Lakers.

The more interesting box-plot to look at would be the one in Figure (7), where the shift in the data points for different seasons can be clearly visualized (the shift shows an increase in the 3-pointer attempts in the 2016 season vs. the 2006 season), but there are no outliers in this case.

The two observations we made in the previous two box-plots leads us to one important conclusion, which is that while the Golden State Warriors did take more 3-pointer shots per game than any other team last season (31.6), this value was not an outlier (was not beyond 1.5xIQR) but was actually very close to that of other teams - Houston Rockets (30.9) and Cleveland Cavaliers (29.6). Hence, what actually contributed towards the Warriors' incredible performance was not their volume shooting but their efficiency from beyond the arc (3-pointer). The Warriors' 3-pointer shooting percentage is a significant outlier and the closest were the San Antonio Spurs (37.5%). The fact that the Warriors were 6% more efficient in 3-point shooting compared to the league average coupled with the fact that the entire league was unable to increase its 3-point efficiency for the last decade made the Warriors the dominant force that they were last season. Many people (including me) and many articles (Golliver, 2016; Harper, 2016; Morris, 2016) attributed importance to the Golden State Warriors' "volume" shooting from the 3-point line, but we've proven that statistically what contributed to this was

1. The Warriors were able to raise their 3-pointer efficiency to an unprecedented level when the entire league was unable to do so significantly for the last decade or so.

2. It was not because they just took way more 3-pointers than the rest of the league (this was not an outlier).

Modeling the Trend and Future Predictions

We now look at modeling this 3-point shooting trend using time-series based modeling methods. The two forecasting methods we use are Holt-Winters exponential smoothing and ARIMA

models (though smoothing can be considered a special case of ARIMA models). The data we work with in this section are the league average of the two metrics from the 1980 season to the 2016 season.

NOTE:
The 3-pointer line was moved closer in the years 1995 to 1997; hence this data would be abnormal and would generally not follow the trend of the entire time-series. Hence I chose to replace these values with interpolated values in order to minimize the influence of external factors. The modified data is shown below.

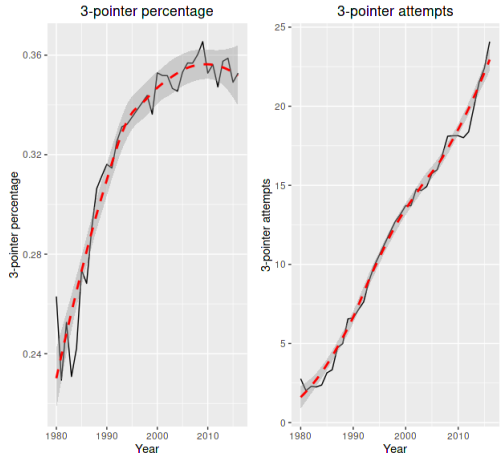

Figure 8: Overall trends in 3-pointer shooting after modifying the data

We can clearly see that the interpolated data now fits the trend much more closely.

The first thing we observe is that upon decomposition we observe that our data does not have seasonal trends. This is as expected since we are using yearly averages and not game averages across seasons. Given that the data is not seasonal, the easiest and most straightforward forecasting method we can apply is exponential smoothing. In this study the exponential forecasting method we use is the Holt-Winters method. The Holt-Winters method also supports examination of seasonality in data but we do not look at this aspect.

The plot below shows the exponential smoothing of the data using Holt-Winters filtering. The mean SSE for the fit for the 3-pointer percentage was 0.0062 and the mean SSE for the fit for the 3-pointer attempts was 12.3362.

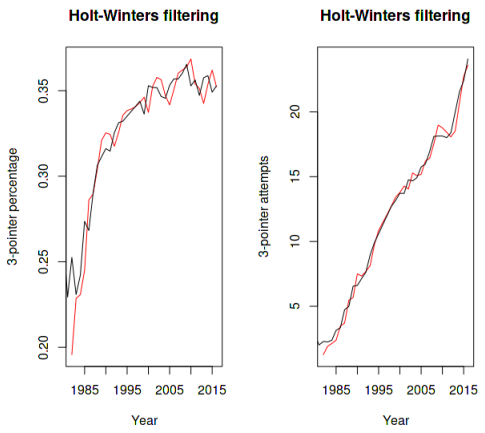

Figure 9: Holt-Winters Filtering

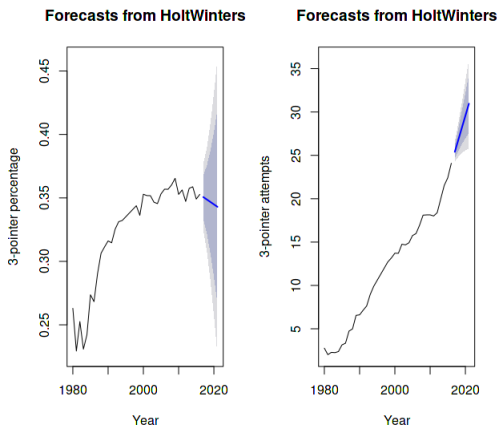

Figure 10: Holt-Winters Forecasting

The Holt-Winters model can then be used to forecast predictions for the next five seasons. The plot below represents the predictions from the Holt-Winters model.

The forecast for the 3-pointer attempts seems to be as expected and still continues to increase in the coming seasons. But the forecast for the 3-pointer percentage seems to indicate that there might be a drop in the 3-pointer percentages in the future. We cannot come to any conclusions just based on these predictions and we might have to compare these predictions to another forecasting model to check whether the forecasts tally – hence we look at ARIMA models.

The disadvantages of ARIMA models are that we would need sufficient data (at least 40 data points suggested on Stack-Overflow whereas we have only 37 data-points). The other disadvantage is that we need to determine the ARIMA model that best fits our data. The latter problem can be overcome by using an automatic fitting algorithm to determine the best ARIMA model that fits the data (auto.arima function in R).

Before we fit an ARIMA model it would first help to check whether or not our data is stationary and also look at the autocorrelations in our data. Looking at the trend plots in Figure (8) we can clearly say that the data is not stationary; hence, we try to convert the data to a stationary form using differencing. The results are as shown below: The first order differences

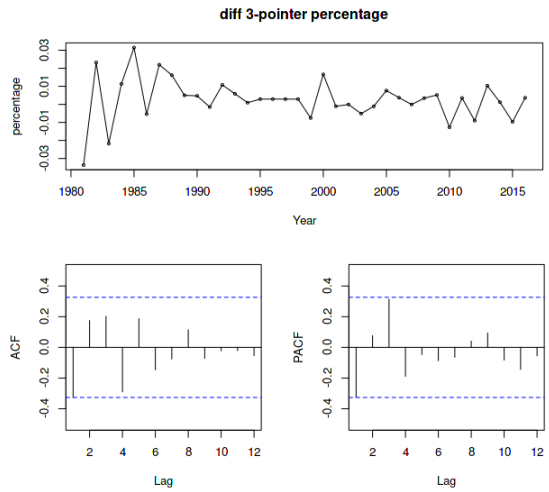

Figure 11: Diff of the 3-pointer percentages

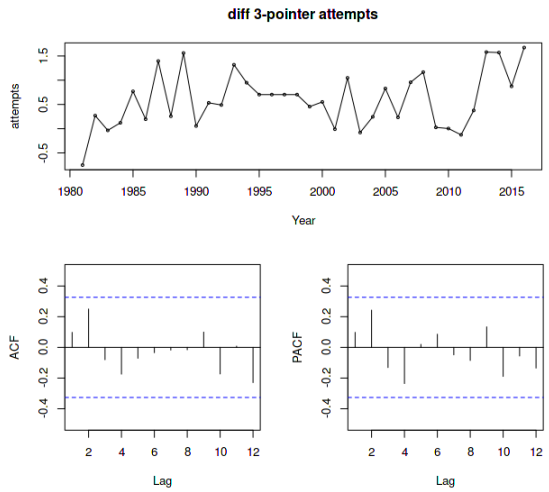

Figure 12: Diff of the 3-pointer attempts

for the 3-pointer percentage look stationary. The pacf curve for the 3-pointer percentage shows that lags of 1 and 3 have higher auto-correlations after differencing but they are very close to the threshold; hence, the ARIMA model might be either arima(1,1,0) or arima(3,1,0).
Similarly the first order differences for the 3-pointer attempts also look stationary. The pacf curve on the other hand does not show any significant auto-correlations for any amount of lag; hence the ARIMA model might be arima(0,1,0).

We use the auto.arima function in R to automatically calculate the ARIMA model that gives the lowest AIC for the given data. The results we obtain were close to what was estimated previously using the auto-correlation plots of the first order difference - arima(1,1,0) with drift (AIC=-217.1) to model the 3-pointer percentages and arima(0,1,0) with drift to model the 3-pointer attempts (AIC=65.5).

Next we used the ARIMA models to forecast the 3-pointer shooting trend in the coming seasons and the results are shown below:

It is interesting to note that the forecasts given by both the forecasting methods (Holt-

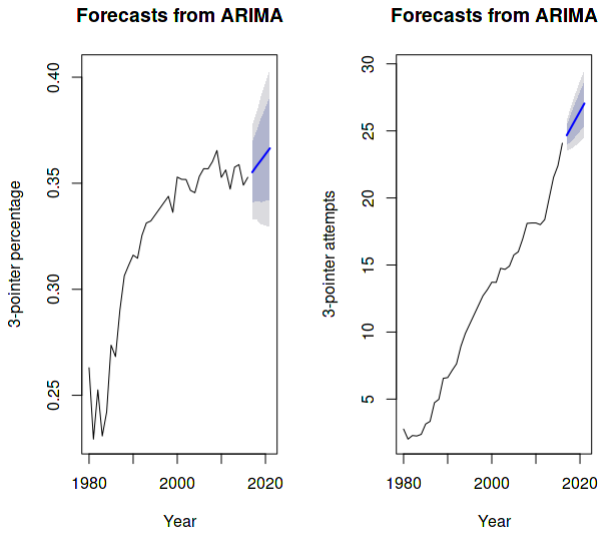

Figure 13: Arima Forecasting

Winters and ARIMA) in case of the 3-pointer attempts are similar. But when it comes to forecasting the 3-pointer percentage entirely opposite trends were forecasted. From our analysis of the stationarity of the data as well as the auto-correlations in the data, we can definitely conclude that the ARIMA(1,1,0) model better fits our model. The Holt's smoothing model is actually a special case of an ARIMA model. It is an ARIMA(0,2,2) model and hence does not fit our data appropriately. ARIMA is usually superior to exponential smoothing techniques when the data is reasonably long and the correlation between past observations is stable. If the data is short or highly volatile, then some smoothing method may perform better (Morrison, 2016).

Hence our predictions state that the 3-pointer attempt rate would keep on increasing and the 3-pointer percentage is also expected to go up slightly.

Winrate modeling

The last part of our analysis looks at the effect of 3-pointer shooting on the winrate (win percentage) of a team.

First we look at winrate vs. 3-pointer percentage, winrate vs. 3-pointer attempts and winrate

vs. 3-pointers made for various seasons.

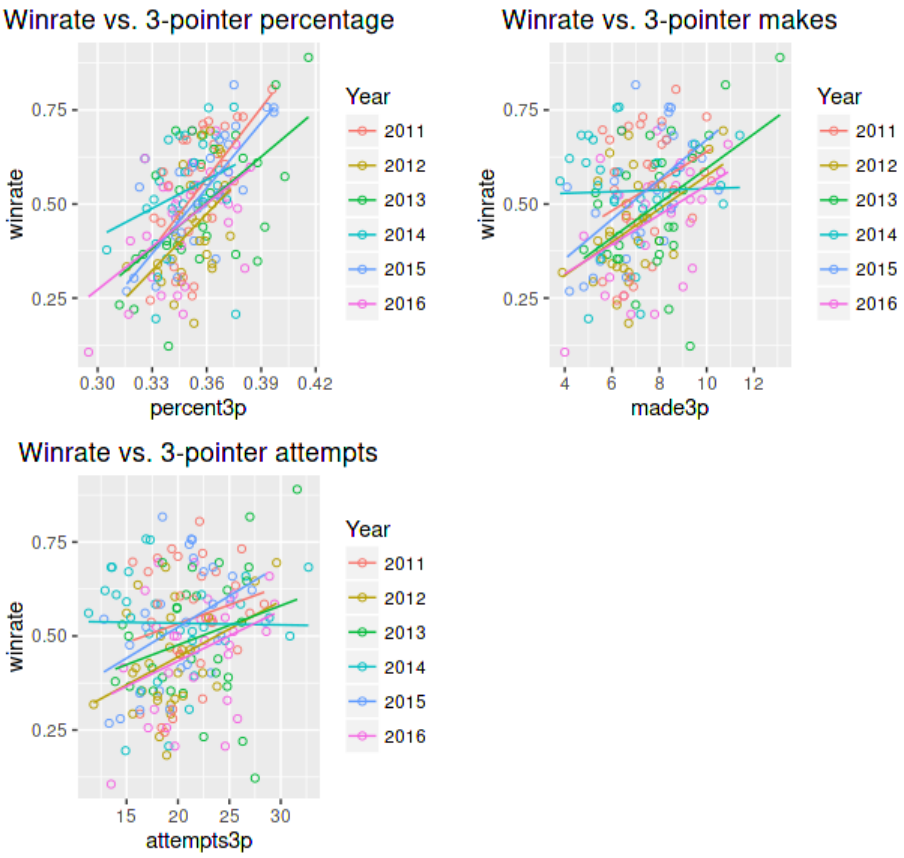

Figure 14: Winrate vs. 3-pointer shooting statistics

We can observe that the 3-pointer attempts and the 3-pointers made do not look like they are correlated with the winrate. The 3-pointer percentage however looks to be relatively more correlated to winrate. We next build linear models for winrate vs. various factors and analyze the capability of these factors in predicting the winrate. But the positive correlation in all three cases indicates that the 3-point shot has had a positive effect on the winrate and was not detrimental to a team's performance on average.

We constructed individual models for winrate vs. 3-pointer percentage, 3-pointer makes and 3-pointer attempts. While the p-value was found to be significant in all these cases the R-squared value for the $winrate\ 3-point.percentage$ model was 0.297, $winrate\ 3-point.made$

model was 0.12 and the $winrate\ 3 - point.attempts$ was 0.0512. These are very low R-squared values especially for the 3-pointer attempts and makes and indicate that these are not good indicators of winrate.

One of the most widely used parameters for winrate prediction and analysis are called the "four-factors" (Honkasolo, 2016; Lawhorn, 2016; Oliver, 2016). Let us see how winrate prediction using 3-pointer shooting compares to the prediction using the "four-factors". The four-factors are basically eight-factors - four for offense and four for defense but in this study we will only consider the four offensive factors (Effective Fields Goal Percentage, Free Throws Per Field Goal, Offensive Rebound Percentage, Turnover Percentage). Building a linear model with these four factors we observe that we obtain an R-squared of around 0.622, we also see that the most significant factor was the Effective Fields Goal Percentage which is the total shoot percentage taking into account the value of each shot. This would be highly correlated with the 3-pointer percentage. The equation of the linear regression can be given by: $winrate = 6.06255 * eff\_fg\_per + 0.62854 * ft\_per\_fg + 0.01426 * off\_reb + -0.04250 * turn\_per$

The residuals were found to be normally distributed.

When the 3-pointer percentage statistic was added as another feature to this model, ANOVA analysis showed that this did not result in any significant performance boost. Hence, this line of work was put to a halt.

In order to gauge the relative importance of all of our features in the regression model we can implement a Random Forest regression with all of our features including the four factors and all the 3-point shooting metrics. In general random forests handle correlated data very well; hence the different metrics of 3-pointer shooting would not affect the regression as much. A random forest with 1000 trees can be trained on the data and a relative feature importance bar graph

can be plotted, as shown below.

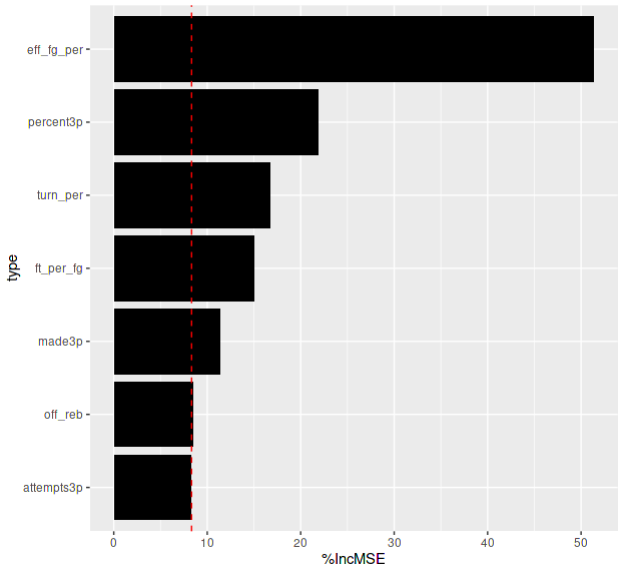

Figure 15: Relative feature importance obtained from the random forest regression model

We observe that in terms of relative importance, the Effective Field Goal Percentage is the most important feature among all the features suggested. This is followed by 3-pointer percentage and the other offensive factors. The feature that least contributed to winrate prediction is the number of 3-pointers attempted, which makes sense since it does not say anything about the efficiency of the conversion.

Conclusions

This study has shown that the 3-pointer shooting trend has been a long-term trend and not just a consequence of the success of the Golden State Warriors (though the average number of 3-pointer attempts did start increasing at a slightly higher rate after their success). We observed that even though the average number of 3-pointer attempts kept increasing with each season, the percentage of 3-pointer shots made was fairly constant over the last decade. We hypothesized that this could be due to player game styles and inefficiencies rather than due to lack of returns

from a good 3-pointer conversion rate. We statistically proved that the Warriors dominated the league last season not because of their volume shooting from the 3-point arc but because of the monstrous efficiency with which they did this.

The next part of this study focused on forecasting models and prediction of the league average 3-pointer percentage and 3-pointer attempts for the next five seasons and we were fairly successful in doing so. We observed that both these metrics are predicted to show an increasing trend in the next few seasons.

The last part of this study looked at modeling winrate as a function of 3-point shooting. We observed that the 3-pointer shooting statistics on their own were not very good measures for estimating the winrate compared to the offensive four factors. Finally we looked at the relative feature importance using a random forest regression model.

References

1. Cohen, B. (2016). The Golden State Warriors Have Revolutionized Basketball. WSJ. Retrieved 16 December 2016, from http://www.wsj.com/articles/the-golden-state-warriors-have-revolutionized-basketball-1459956975

2. Eger, I. (2016). The NBA's love affair with the three pointer: thrilling fans, frustrating big men. Timeline. Retrieved 16 December 2016, from https://timeline.com/the-nbas-love-affair-with-the-three-pointer-thrilling-fans-frustrating-big-men-811a38b8e8ef.ipisvukfj

3. Golliver, B. (2016). Watch: Steph Curry Breaks NBA Three-Point Record. Sports Illustrated. Retrieved 16 December 2016, from http://www.si.com/nba/2016/11/08/stephen-curry-golden-state-warriors-nba-three-point-record

4. Harper, Z. (2016). The Warriors are crushing opponents (and history) with their 3-point attack. CBS Sports. Retrieved 16 December 2016, from http://www.cbssports.com/nba/news/the-warriors-are-crushing-opponents-and-history-with-their-3-point-attack/

5. Honkasolo, M. (2016). NBA Advanced Stats: The Four Factors Of Winning. Hoops Habit. Retrieved 16 December 2016, from http://hoopshabit.com/2014/07/23/nba-advanced-stats-four-factors-winning/

6. Lawhorn, A. (2016). Ultimate Guide to the Four Factors in the NBA. Sportingcharts.com. Retrieved 16 December 2016, from https://www.sportingcharts.com/articles/nba/ultimate-guide-to-the-four-factors-in-the-nba.aspx

7. Mather, V. (2016). How the N.B.A. 3-Point Shot Went From Gimmick to Game Changer. NY Times. Retrieved 16 December 2016, from http://www.nytimes.com/2016/01/21/sports/basketball/how-the-nba-3-point-shot-went-from-gimmick-to-game-changer.html

8. Morris, B. (2016). Can The Warriors Break Basketball Again?. FiveThirtyEight. Retrieved 16 December 2016, from http://fivethirtyeight.com/features/can-the-warriors-break-basketball-again/

9. Morrison, J. (2016). Autoregressive Integrated Moving Average Models (ARIMA). Forecasting Solutions. Retrieved 16 December 2016, from http://www.forecastingsolutions.com/arima.html

10. Oliver, D. (2016). Four Factors — Basketball-Reference.com. Basketball-Reference.com. Retrieved 16 December 2016, from http://www.basketball-reference.com/about/factors.html

11. Ross, T. (2016). This Isn't Your Dad's NBA: Thank Big Data. The Atlantic. Retrieved 16 December 2016, from http://www.theatlantic.com/entertainment/archive/2015/06/nba-data-analytics/396776/

12. Rudy, K. (2016). 3-Point Shooting in the NBA: Long-Term Trend or Fad? — Minitab. Minitab. Retrieved 16 December 2016, from http://blog.minitab.com/blog/the-statistics-game/3-point-shooting-in-the-nba:-long-term-trend-or-fad

13. Wood, R. (2016). The History of the 3-Pointer. USA Basketball. Retrieved 16 December 2016, from https://www.usab.com/youth/news/2011/06/the-history-of-the-3-pointer.aspx