Mid-Season and Off-Season NBA Coaching Changes Effect on Team and Player Success

Jack Dolitsky

I. Abstract

The following paper will take a look at the impact of changing a coach in the NBA has on team success, and player performance. I will take a look a look at both mid-season and off-season coaching changes. The visualizations suggest that coaches are heavily blamed for underperforming teams. The regression models suggest that there is no significant impact that coaching changes have on team success.

II. Introduction

In the National Basketball Association, every season, many front offices make changes to a team in order to maximize the given team's potential. This may include drafting a rookie, trading a current player for a new one, signing a player, or even looking to the management side and deciding to go in a new direction with their head coach. Every season, teams are expected to perform in a certain way, and if a team underperforms expectations, changes are bound to be made. Coaches are the leader of the team, who not only develop the strategies, but are also responsible for keeping the morale of the team up and keeping their players, especially their star players, happy. A coach is often blamed for a team underperforming, since they are the leader of the team, so this paper aims to test whether that was it was the right decision to change the coach. This is important for a plethora of reasons. If it is found that there is a significant change in team performance, then it can lead teams to change their coach, rather than dismantle the team roster. It is also important to measure how it affects the star player on the team. If the star player is underperforming or is unhappy, it can lead to the entire team be derailed. A good relationship between a star player and coach is crucial, so looking at how they play before and after a coach change is crucial. In order to measure who the star player is in a given season; we can use a metric called Win Shares (WS). Win Shares is a way to credit individuals for team success with the amount of wins they have contributed for that season. When we take a look at how player metrics change before and after a coach firing, we can determine if there is any significant effect. I will look at Box-Plus Minus (BPM), WS, and Value Over Replacement Player (VORP). BPM is an all-encompassing metric that takes into account all the players stats and adjusts for possessions. VORP looks at how much a player contributes over a player that contributes nothing (a typical development league call-up). I will also look at a couple of regression models to see if there a significant way to predict how team performance will change based on experience factors of a coach. In other words, does hiring a new coach with more playoff experience lead to a hiring win percentage after a coach change. Taking a look at these models, as well as the visualizations, will help us determine if replacing a team's head coach is in the best interest of the team, or if they should look to make changes elsewhere.

III. Literature Review

The first subject that will be delved into is Coach Turnover in Basketball. The articles discussed in this section will talk about the effect that changing a coach has on the success of a basketball team. The next section will discuss the impact of coaches in sports. It will take a glance at how much a coach actually matter relative to other factors in a sports team. Following this aforementioned topic, the research discussed will talk about different ways to predict outcomes in the NBA. Continuing with the research done on the NBA, the articles will then discuss how superstars impact the teams that they are. The research will be concluded with studies on the relationship between a coach and athlete.

A. Coach Turnover Impact in Basketball

An article published in the Journal of Sport Management[4] looks into the effects that changing a coach midseason has on team performance. It found very varied results, but overall there was an increase in winning percentage for the teams that made the change (61%). The coaches were more likely to increase win percentage if they played in the NBA or coached many

games prior to their new team, and furthermore the new coach is less likely to improve performance the greater the difference in number of games coached by the former and current coaches.

Additional evidence was found in a study published by J.A. Martinez and S.B. Caudill[3] that looked at the short-term effects of a coaching change, rather than overall. They find that a mid-season coaching change rarely has significant impact in the same season. Only about 15% of coaches outperformed their predecessors significantly. There were 3 factors that contributed to more success in a coaching change: being highly experienced (which was found in the earlier article), having a long NBA career, and making the change before the season begins, rather than in the midst of an ongoing season.

An article in the Sport Management Review[2] looked at what goes into the decision to dismiss a coach. The article concluded that team performance is not the only factor that goes into the firing of a coach. The coach's power within the organization also plays a big factor. It was found that there is a non-linear relationship performance and the probability of coach dismissal. This suggests that win percentage does not have a big influence on the probability of the coach being dismissed, which means that there may be other driving factors that cause a team to hire a specific coach.

Another study by Karg, McDonald, and Schoenberg[1], looked at the behavior of season ticket holders for two different professional sports teams directly following a coaching change. This data shows another side of the coaching impact that affects the team in a way other that direct wins or losses. The data showed that when hiring a new coach, there was a positive reaction from season ticket holders. The data also showed that when a coach was removed, there was no significant impact. The article found that a coaching change should not be the end all be all for a change in attitude among the fanbase, and on-field success is not the only determinant of whether season ticket holders will be satisfied with the change.

An article by Alex Kennedy[24] talked about a study published that looked at 20 years of data for NBA coaches. During that 20-year span, the NBA had the highest coaching turnover rate among the four leagues. The study found that a new head coach is hired every 2.4 seasons on average in the NBA, while the NHL is every 2.6 seasons, the MLB is every 3.1 seasons, and the NFL is every 3.4 seasons. The study also shows a graph that shows there is strong correlation between win percentage and coaching tenure for teams (although this does not imply causation). The one big outlier was the Lakers, who had 8 coaches at the time of the study, but over a .500 winning percentage.

Entering the 2019-20 season, the average head coach has been with the same team for 303.5 games, which is nearly four seasons[23]. That is the highest average in any season ever, and the next highest was back in the 50's. Gregg Popovich has a major effect on the research, as he has been coach for 23 seasons. Even without Popovich, the average would still be relatively high. Although there has been recent stability, the NBA *still* has the highest turnover rate for coaches in any sport.

B. Coaching Impact in All Sports

An analysis[8] of all NBA head coaches since the ABA/NBA merger in 1976 revealed that longer-tenured head coaches have won approximately six more regular season games each year than the 41-win league average. This article also talks about a created metric called CWS, which means Coaching Win Shares. The findings showed that longer tenured head coaches historically

outperformed shorter tenured ones, but the tendency to change a coach has remained relatively stable throughout history.

In this study presented at MIT Sloan, Berry and Fowler[7] took a look at the coaching impact in professional and college sports. They found that coaches impacted outcomes significantly in every sport they studied. Coaches are highly significant for team outcomes in the NBA and Division 1 college basketball. They influence points scored, points allowed, the point margin, and the number of victories. In college basketball, coaches also affect the total number of points scored in a game. They used a method called RIFLE to see if coaches have an outcome on specific aspects of the game.

An article by Joseph Price[5] discussed the luck that can happen in basketball game, but people will still point fingers at the coach after a close loss. There are factors like, opponent free throw percentage that is completely outside of the coach's control, yet they still are more likely to make lineup changes following a close loss. They found that if an opponent makes 80 percent of their free throws instead of 70 percent, the coach is about half a percentage point more likely to change the starters in the next game.

Brian Burke[6] went into detail about how he believes NFL coaches are, for the most part, interchangeable. He went into detail about 4 different aspects to back up his claim - mathematical, statistical, psychological, and philosophical. For the statistical aspect, Burke looks at the variance in team performance attributable to randomness. He concluded there is very little variance that can be attributed to coaching, and NFL outcomes are driven by player talent and luck. He claimed that NFL coaches are interchangeable, but they are interchangeable with each other rather than anybody on the planet.

An article published in the Wall Street Journal[22] looked at the impact of NBA coaches. A study suggested that fewer than a quarter of NBA coaches between 1977 and 2008 had any significant effect on their players' performance. They looked at a wins-produced metric and compared a player's performance with a without a coach to see the impact of the coach. Phil Jackson had the most impact with about 17 wins per season. Matt Guokas is the only coach to make his players significantly worse. There are some hall of fame coaches who have no serious effect, like Pat Riley.

A Freakonomics article[21] talked about a study that found that most NBA coaches across a sample covering 30 years did not have a statistically significant impact on player productivity. And in other sports, there is evidence that coaches cannot systematically change outcomes. This article also gave an example from a former NBA coach, Jeff Van Gundy, who argued for this point. When the Pistons were successful (in 2007-2008), according to a wins produced metric, most of the wins were produced by a minority of the team's roster. An average player produced 0.100 wins per 48 minutes (WP48). Of the players who played at least 1,000 minutes in 2007-08, five players were above average. And these five produced 46.2 of Detroit's wins.

A study from the University of Chicago[27] concluded that coaches account for 20 percent to 30 percent of the variation in team outcomes in sports. In terms of basketball, the article found that coaches are highly significant in both NBA and Division I college basketball outcomes, influencing points scored, points allowed, point differential, and victories. The study was conducted with a method called randomization inference for leadership effects, which takes into account player quality and the strength of schedule.

Research by Brian Freilich[8] looked at how much coaching tenure affects team success. An analysis of all NBA head coaches since the ABA/NBA merger, showed that the longer-tenured head coaches won about six more regular season games each year than league average.

About 4 wins are unrelated to coaching performance and, instead, the result of longer-tenured head coaches historically being endowed with superior talent and more stable rosters. But about 2 wins are a result of head coaching performance.

C. Predicting outcomes in the NBA

Wheeler[12]used machine learning in order to predict NBA player stat lines, and then see if that could be translated into a prediction for the win or loss of the team. He used linear regression to predict a variety of different stats for the players. He found that predicting player-level statistics using linear regression was better than using player averages, and it did not translate well to win loss which had a 53% error rate. It can be improved in the future by using social media and weighted regressions (i.e. weighting a player's recent games more than older ones.

Between 2008-2011, Eric Scot Jones[11] looked at a random sample of 144 NBA games. Models were developed to predict point spread and to estimate the chance of a certain team winning based on many different game statistics. Three different methods were used to predict in-game statistics of future games so that the models could be used to predict who wins. The three methods were 3-game moving median, 3-game moving weighted average, and seasonal averages. Seasonal averages were found to be the most accurate for predicting games. Putting weights within the model can help to improve it for the future, as discussed earlier.

An article by Alexander Fayad[10] is very useful for figuring out how to use machine learning to make predictions. In this prediction model, Fayad uses monthly averages to make his predictions. He used the seasons from 2008-2009 and upwards and scraped from basketball reference. He then merged two CSV files (one with game scores, and the other with statistics), to then make a predictor variable. Out of all the models attempted, the one with the highest accuracy was the support vector machine SVC classifier, with a 72.5 percent success rate. There was one weakness in the model, and that was that it predicted upsets too often.

Elan Rotenberg[9] created a model to predict NBA games that are right on par with FiveThirtyEight and NBA minor, while being way less complicated. The two most important stats they used were Elo rating and Location. Elo is a team's winning percentage while being adjusted for opponent strength. Location is whether the team is home or away. With just two variables, Rotenberg was able to build a successful model, and with more variables it could get even better.

D. Impact of superstars in the NBA

Brendan Marks[16] and Gavin Off looked at 28 years of data to determine what makes an NBA player a star. Of the 20 NBA teams since 1991 whose All-Stars accounted for the most cap space, 10 teams, including the 2017-2018 Golden State Warriors, won the NBA Finals that season. Another four advanced to the Finals but lost. The article went on to describe other typical attributes that make up and NBA all-star, but what the most important takeaway is that teams that spend more to get more all-stars, tend to be way more successful.

Zhou Li[15] looked at attendance data for NBA games for two seasons. The purpose of his research was to show the impact of star power and team quality on NBA attendance, as well as to determine whether superstar presence or a championship caliber team drives NBA attendance. Teams were separated into four groups. The groups were the high-level team (playoff team) with at least one superstar, the high-level team with no superstars, the low-level team (non-playoff team) with at least one superstar, and the low-level team with no superstars. The research

determined that a single visiting superstar will increase attendance, and it is a larger attendance increase for low level teams, and teams with high attendance variability. When the home teams are high-level, then a high-level team with a superstar will drive attendance, but a high-level team without a superstar will not have much of an effect.

When an NBA team trades away their superstar player, fans may be disgruntled and frustrated, since this may be seen as an act of tanking. It would be fair to assume that attendance would drop when trading away a superstar. However, this article by Joseph Volpe[14] used linear regression using common variables on fan attendance to see if that is the case. The effect of trading away their superstar player was not significant enough to have any effect on attendance, which would suggest the drop-in attendance after a team trades away their superstar does not have to do with the trade.

Research presented at the Sloan Conference[13] looked NBA superstar missing a game, for any reason, can have a major impact on the quality of an NBA game. The article looked at the economic effects of when a superstar misses a game. The article gathered data from secondary ticket markets to see how much the willingness to pay changes when a star sits out. The most popular superstars do have a statistically significant and economically meaningful impact ranging from a 7-25% ($9-$25) reduction in the average ticket price in the games that they sit out. Some players, such as Curry and Kevin Durant had way bigger effects when they were the road team, compared to guys like Kristaps Porzingis who had a bigger effect at home. The negative impact of the absence of superstars is much less significant in bigger markets.

E. The Coach-Athlete Relationship

A study by Sophia Jowett and Victoria Chaundy[20] looked at athlete's perception of their relationship with their coach and how that affects group cohesion. Four self-report instruments that measure perceptions of group cohesion, coach leadership, and the nature of coach-athlete relationships were completed by 111 university athletes. Through regressions, the results showed the results revealed that leadership variables predicted more variance in task and social cohesion when relationship variables were included.

An article written by the Head of Research and Writing at athleteassessments.com[19] talked about how important it is to have a strong relationship between an athlete and coach. One study of athlete performance was conducted by Penny Wurthner on the 2008 Canadian Olympic team. The study consisted of interviews with 27 Olympic and Paralympic athletes and 30 coaches which were then analyzed. The study found the most significant contributor to a medal winning performance or personal best was a productive coach athlete relationship. The article then goes on to discuss the "how" of developing a good coach-athlete relationship.

A journal from humankinetics.com[18] looked at collegiate athletes and coaches and what coaching attributes effect winning. Overall, looking at many variables, it was seen that leader behaviors were related to team outcomes. Coaches who engaged in more rewarding behavior, social support behavior, and a more democratic decision-making process resulted in more satisfied athlete, as well as younger coaches and previously successful coaches.

An article by Joshua Brown, Dr. George Davis, Dr. Gerald Granderson[17] argued that playoff data is superior to regular season data, so it looks exclusively at playoff data. It looks at data about team success, and how to construct the roster. In terms of coaching, they found that when hiring a coach, team owners should consider length of a coach's tenure and the number of playoffs wins he has accrued as the factors that will most likely increase how efficiently the team will perform in the playoffs.

One study[28] looked at the impact head coaching changes have on intercollegiate student-athletes. This was a qualitative study, utilizing interviews. Three themes were identified: (1) Student-athletes seem to accept head coaching changes, (2) Head coaches are essential to team success, and (3) The student-athlete-coach relationship is the core factor of the intercollegiate experience. These themes indicated a need for additional research to determine the ways in which to better support student-athletes and the new head coach to achieve a positive environment.

Coach turnover is very frequent in college sports[26]. There is limited research, to date, on what the effects are. One qualitative study, based off interviews, looked at how coach turnover might influence student-athletes' psychosocial states and team dynamics in college sports. The analysis suggested that, depending on their gender and coaching style, coaches might have a positive or negative impact on athletes' affective states, team dynamics, and the program culture. The results also suggest that the gender of the coach likely has an effect on the success of the turnover process, especially in sports, where there are gender stereotypes.

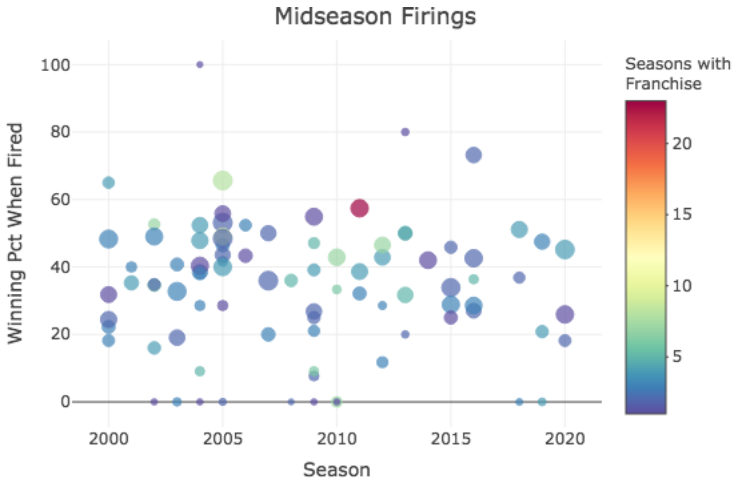
III. Body

A. Data Summary

All of the data that I used in this study came from Basketball-Reference. I scraped coaching data from to 2000-2020 seasons. The coach data had variables for team, name, seasons with the current franchise, seasons overall, regular seasons games coached and one for the given season, their career, and their time with the franchise. It also included variables for the similar factors but replacing regular season with playoffs. I created two of my own variables that designated that in a given offseason or midseason, was a coach hired or replaced. I also scraped a table for all players' advanced statistics in the seasons 2000-2020, and I filtered for the top player on each team based on win shares. I included the top player on each team's WS (Win Shares), BPM (Box Plus-Minus), and VORP (Value Over Replacement Player). I used Win Shares to determine each team's star player because it accounts for how much of the season they played. If a player was the best player on the team but only played three games for the team, they would not have had the highest positive impact on the team. Win Shares estimates how many wins a player contributed to a given team in a given season.

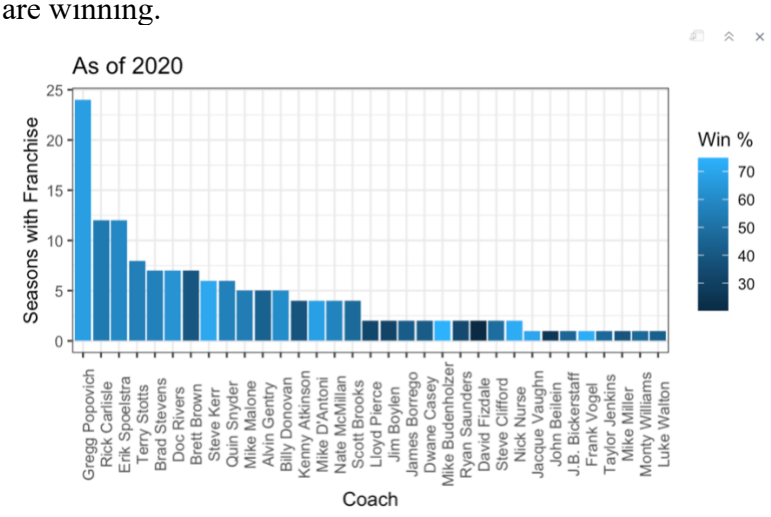
B. Visualizations

The following graph shows mid-season firings by season. It shows what the winning percentage was when the coach was replaced, and the color represents how many seasons they have been with the franchise. The size represents how many games they coached. This graph paints a great picture of the trends that lead teams to replace their coach.



During the midseason, one coach sticks out in the color red. That coach is Jerry Sloan who was fired after 17 seasons with the Utah Jazz. Some of the outliers who were fired after having a very high win percentage only coached a few games, so they could have been interim or had an issue with a star player early on. Most of the coaches fired midseason hover under 50% which suggests that winning percentage is a major factor going into firing a coach which is to be expected, and it remains pretty consistent from season to season.

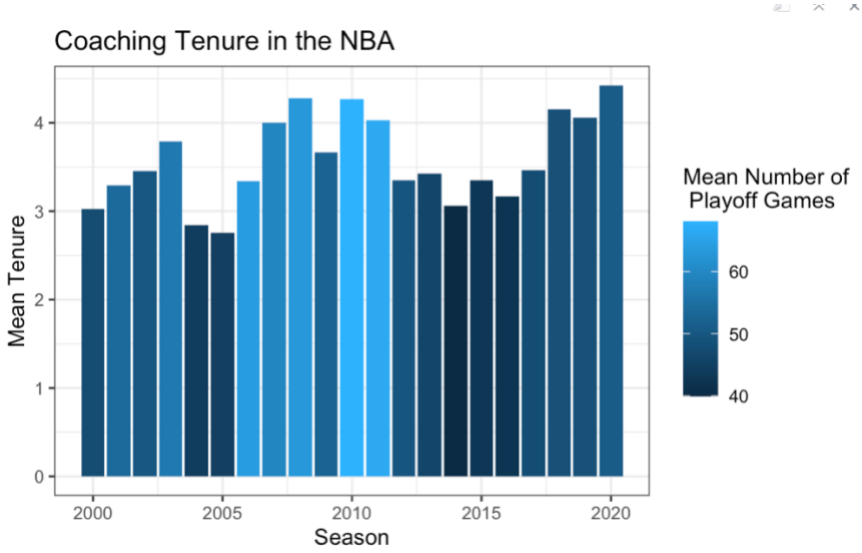
The next graph suggests the same. It depicts all the coaches in the season 2020, how long they have been tenured with their franchise, and the color represents their win percentage. This helps to visualize just how rare it is that a coach lasts more than a few seasons with a team, unless they are winning.



All of the coaches towards the left (that have more years tenured) tend to have lighter colors meaning higher win percentages, and the darker colors are towards the right. As mentioned earlier, this suggests that coaches are often a main factor blamed for a team underperforming.

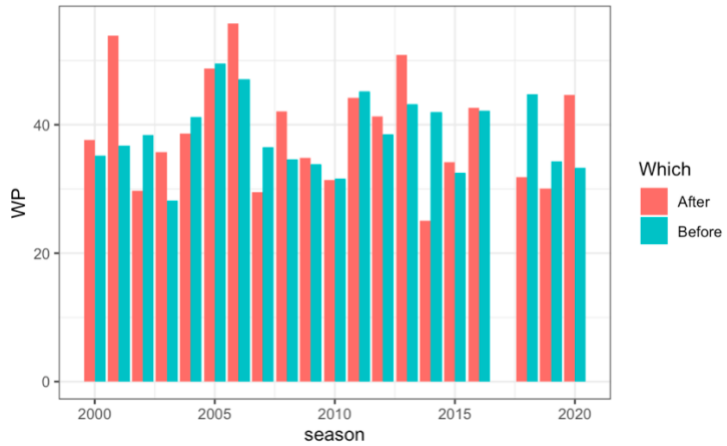
The next visualization looks at something similar, except now looks more at playoff success. This is important because it can show whether there is relationship with historical playoff success, as opposed to regular season and coaching tenure. The darker bars represent more

playoff games coached, on averaged, over a coach's career in the given season. The height represents the mean tenure of coaches with their current franchise in that season.



The graph suggests that playoff experience does not have as much of effect on team's decision to replace a coach, as regular season success in the given season. There is no clear relationship between the mean number of playoff games, and mean tenure. For example, from 2018-2020, the mean tenure was about the highest it's been, but the bars are darker, suggesting less playoff games coached. Alex Kennedy published research that concluded that of the four major sports leagues, the NBA had the shortest coaching tenures, on average.

The following graph shows the win percentage before and after a midseason coach replacement. This is a useful visualization because it can help envision if there is a consistent trend. If the red bar is consistently higher than the blue bar, then that would suggest that replacing a coach midseason is helpful to team success.



There is no clear trend in this graph as every season, a different bar is higher. This shows that it may not be a useful move to replace a coach midseason, as according to visualization, there is no way to predict if it will help or hurt the team. There is one blank space in 2017 as there was no midseason coach changes in that season.

C. Models

```
        One Sample t-test

data:  Player_change$BPM
t = 1.9609, df = 69, p-value = 0.05393
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 -0.007143837  0.830000980
sample estimates:
mean of x
0.4114286


        One Sample t-test

data:  Player_change$WS
t = 0.78296, df = 69, p-value = 0.4363
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 -0.3648726  0.8363012
sample estimates:
mean of x
0.2357143


        One Sample t-test

data:  Player_change$VORP
t = 1.2539, df = 69, p-value = 0.2141
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 -0.1215701  0.5329987
sample estimates:
mean of x
0.2057143
```

The first model is a one sample t-test. I chose this model because I was comparing the mean of two groups. This model takes a look at the effect that coaching changes in the offseason have on the star player of the team from one season to the next. The three tests look at Box Plus-Minus (BPM), Win Shares (WS), and Value Over Replacement Player (VORP). BPM is a variable that looks at all of a player's box score statistics and creates a single number that represents a player's contributions per possession. Win Shares is statistic that estimates the amount of wins a player has contributed to their team in a given season. VORP is a metric that estimates how much value a player brings in compared to a player who has minimal impact.

The only significant change was in BPM. There is expected to be a slight positive change in the star player's BPM when there is a coach change. This supports the notion that having a good relationship between the star player and the coach is important. The other two variables were not significant which suggests that coaches have minimal impact on player performance. This is

consistent with the Freakonomics article that discussed a study that found that most NBA coaches statistically insignificant impact on player productivity.

```
Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)       -3.690e-02  4.672e-02  -0.790   0.4323
reg.previous.aft.G  9.179e-05  4.430e-05   2.072   0.0420 *
seasons.overall.bef  4.318e-02  2.495e-02   1.730   0.0879 .
reg.previous.W    -1.530e-03  8.313e-04  -1.841   0.0699 .
playoff.previous.G  9.829e-03  6.196e-03   1.586   0.1172
playoff.previous.W -1.317e-02  8.884e-03  -1.482   0.1428
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1438 on 70 degrees of freedom
Multiple R-squared:  0.1201,    Adjusted R-squared:  0.05723
F-statistic: 1.911 on 5 and 70 DF,  p-value: 0.1035
```

The next model is a best fit model. It is a linear model with a variety of variables measuring coaches from before a midseason replacement and afterwards, and the dependent variable is the change in win percentage. The reg.previous.aft.G variable looks at how many regular season games the new coach has coached in his career. Seasons.overall.bef looks at how many seasons the first coach has coached. The reg.previous.W looks at how many regular season wins the first coach had (prior to the given season). The playoff.previous.G and playoff.previous.W variables look at how many games the first coach has coached and won, respectively, in the playoffs. The first variable that is significant is the number of games that the new coach being brought in has coached. There is a positive coefficient, which means that bringing in a coach with regular season experience is beneficial to win percentage. The variable for how many games the previous coach has coached has a negative coefficient, which suggests that replacing a coach with experience has a negative impact on win percentage. In interesting to see that the number of seasons that were coached before is significant but has a positive coefficient. This means that firing a coach with many seasons of experience is beneficial to the team according to the model. Keep in mind, this model does not account for changes in the team roster

```
Call:
lm(formula = wp.change ~ seasons.overall + reg.career.W + reg.career.G +
    playoff.career.G + playoff.career.W, data = offseason_coach_changes)

Residuals:
     Min       1Q   Median       3Q      Max
-0.32346 -0.09346 -0.01219  0.08268  0.42624

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)      -0.0746491  0.0229477  -3.253  0.00156 **
seasons.overall   0.0114202  0.0260939   0.438  0.66259
reg.career.W     -0.0018839  0.0006760  -2.787  0.00638 **
reg.career.G      0.0007885  0.0005124   1.539  0.12702
playoff.career.G  0.0005923  0.0030645   0.193  0.84714
playoff.career.W  0.0023637  0.0037490   0.630  0.52983
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1405 on 99 degrees of freedom
  (143 observations deleted due to missingness)
Multiple R-squared:  0.1317,    Adjusted R-squared:  0.08779
F-statistic: 3.002 on 5 and 99 DF,  p-value: 0.01449
```

Looking at the data for only coaches that were changed in the offseason, the data was checked for normality. A linear model is a great model to use here because the data was normally distributed. These five variables were chosen because they represent the experience as well as the success of the new coach. The only variable of significance is regular season games coached prior. It is surprising to see a negative coefficient, which means that with more experience, we expect there to be a drop off in win percentage the following season after a coach change. A possible explanation is that if a coach, coached many games (leading to more wins) it could mean that he was replaced multiple times for certain factors that did not work out in the team's favor. The fact that none of the other variables were statistically significant supports the notion that changing a coach in the offseason does not have an impact on team success. Keep in mind, this model does not account for changes in the team roster.

IV. Conclusion

Overall, we see that that changing a coach has some impact on team success, but in totality, that effect is not large enough to justify how often coaches are changed. While taking a look at the visualizations, we saw that there really was not much job security among any coach in the NBA with the exception of a few. This is consistent with Alex Kennedys research that the NBA has the highest coach turnover in the league.

When looking at how star player performance was affected, we saw that there was positive increase after an offseason coaching change, but only the change in BPM was significant. This can tell us that when a team is underperforming, and the coach is changed, the star player is expected to see an increase in his overall statistical impact. This may mean that if a team has their star player entering his contract year, and the team has just not played up to expectations beforehand, it may be a good strategy to change the coach to help boost that player's morale. There are not many other instances where it would seem to be a significant positive strategy considering the other metrics were not statistically significant. This agrees with the Freakonomics article that discussed a study that found that most NBA coaches statistically insignificant impact on player productivity.

The best fit model for midseason coach changes, that in the midseason it is beneficial to the team to bring in a coach that has a lot regular season coaching experience. It was also expected that team win percentage would decline if the coach that was replaced had a lot of experience in the regular season, and also if the coach had a lot of playoff experience. This is intuitive, but it shows that coach experience does matter, and should be taken account when a team is contemplating changing their coach midseason.

When it comes to offseason changes, the OLS regression model looked at the new coach, and a few variables regarding the new coach's experience. The only variable that was significant was the regular season career wins variable, and interestingly enough it was negative. No other variable was significant, which implies it usually would not be a good idea to change the coach in the offseason (it is possible to justify it, if the star player is entering a contract year, as mentioned earlier) and the team should look to other areas in the offseason to improve the team.

There were some limitations with this research. The first limitation was it being extremely difficult to gather the player data for the mid-season coach changes, so I was only able to look at the offseason effect. The data also does not account for roster turnover, which could be a major factor in how teams perform, so this would be a good area for future research. Another area for future research is to compare coach changes with other ways to change the team, such as comparing changing the coach with drafting in the lottery (top 14 picks in the NBA draft) or trading away a player from the starting five. This would help further understand whether other team changes actually have a significantly larger effect than changing the coach.

V. References

1. Karg, A., McDonald, H., & Schoenberg, G. (2015, March 01). The Immediate Impact of Coach Succession Events on Season Ticket Holder Attitudes. Retrieved December 07, 2020, from https://www.questia.com/read/1P3-3619076091/the-immediate-impact-of-coach-succession-events-on
2. Wangrow, D., Schepker, D., & Barker, V. (2017, August 31). Power, performance, and expectations in the dismissal of NBA coaches: A survival analysis study. Retrieved December 07, 2020, from https://www.sciencedirect.com/science/article/abs/pii/S1441352317300888
3. Martinez, J. (2010, December 20). Does mid-season change of coach improve team performance? Evidence from the history of the NBA. Retrieved December 07, 2020, from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.961.645&rep=rep1&type=pdf
4. Martinez, Jose & Caudill, Steven. (2013). Does Midseason Change of Coach Improve Team Performance? Evidence From the NBA. Journal of Sport Management. 27. 108-113. 10.1123/jsm.27.2.108.
5. Price, J., & Price, J. (2017, November 17). The Blame Game: How Outcome Bias Fools NBA Coaches (and Their Bosses). Retrieved December 07, 2020, from https://behavioralscientist.org/blame-game-outcome-bias-fools-nba-coaches-bosses/
6. Burke, B. (2013, October 18). On the Effect of Coaching. Retrieved December 07, 2020, from http://archive.advancedfootballanalytics.com/2013/10/on-effect-of-coaching.html
7. Berry, C., & Fowler, A. (2019). How Much Do Coaches Matter. Retrieved December 06, 2020, from https://www.sloansportsconference.com/research-papers/how-much-do-coaches-matter
8. Freilich, B. (2016). The Value of Coaching Tenure in the NBA. Retrieved December 07, 2020, from https://chance.amstat.org/2016/11/coaching-tenure/
9. Rotenberg, E. (2019). [WSS19] Using Machine Learning to Predict NBA Games. Retrieved December 07, 2020, from https://community.wolfram.com/groups/-/m/t/1730466
10. Fayad, A. (2020, July 12). Building My First Machine Learning Model: NBA Prediction Algorithm. Retrieved December 07, 2020, from https://towardsdatascience.com/building-my-first-machine-learning-model-nba-prediction-algorithm-dee5c5bc4cc1
11. Jones, E. S. (2016, April). PREDICTING OUTCOMES OF NBA BASKETBALL GAMES A Thesis. Retrieved December 7, 2020, from https://library.ndsu.edu/ir/bitstream/handle/10365/28084/Predicting%20Outcomes%20of%20NBA%20Basketball%20Games.pdf
12. Wheeler, K. (n.d.). Predicting NBA Player Performance. Retrieved December 07, 2020, from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.278.4919&rep=rep1&type=pdf
13. Kaplan, S., Ramamoorthly, V., Gupte, C., Sagar, A., Premkumar, D., Wilbur, J., & Zilberman, D. (2019). The Economic Impact of NBA Superstars: Evidence from Missed Games using Ticket Microdata from a Secondary Marketplace. Retrieved December 07, 2020, from https://www.sloansportsconference.com/research-papers/the-economic-impact-of-nba-superstars-evidence-from-missed-games-using-ticket-microdata-from-a-secondary-marketplace

14. Volpe, J. (2015, April 15). The Impact of Mid-season Super-Star Trades on NBA Attendance. Retrieved December 07, 2020, from https://scholarsmine.mst.edu/ugrc/2015/full-schedule/22/
15. Li, Z. (2018, May 01). The Impact of Star Power and Team Quality on NBA Attendance. Retrieved December 07, 2020, from https://kb.osu.edu/handle/1811/84911
16. Marks, B., & Off, G. (2019, February 15). The Making of a Modern All-Star: What 28 years of data says about NBA's best players. Retrieved December 07, 2020, from https://www.charlotteobserver.com/sports/charlotte-hornets/article226224515.html
17. Brown, J., Davis, G., & Granderson, G. (2020, March 9). What Makes a Good Coach? A Case for NBA Teams Playing up to Their Potentials. Retrieved December 06, 2020, from https://www.fsb.miamioh.edu/lij14/Thesis_BrownJoshua.pdf
18. Weiss, M. R., & Friedrichs, W. D. (1986, December 01). The Influence of Leader Behaviors, Coach Attributes, and Institutional Variables on Performance and Satisfaction of Collegiate Basketball Teams. Retrieved December 07, 2020, from https://journals.humankinetics.com/view/journals/jsep/8/4/article-p332.xml
19. Pavlovich, L. (n.d.). The Coach Athlete Relationship is a Performance Factor. Retrieved December 07, 2020, from http://www.athleteassessments.com/coach-athlete-relationship-performance-factor/
20. Jowett, S., & Chaundy, V. (2004). An Investigation Into the Impact of Coach Leadership and Coach-Athlete Relationship on Group Cohesion. Retrieved December 07, 2020, from https://psycnet.apa.org/record/2004-21554-006?doi=1
21. Berri, D. (2013, May 30). A Former NBA Coach Argues That Coaches Are Not Responsible for Outcomes. Retrieved December 07, 2020, from https://freakonomics.com/2013/05/30/a-former-nba-coach-argues-that-coaches-are-not-responsible-for-outcomes/
22. Biderman, D. (2010, November 04). Do NBA Coaches Actually Make an Impact? Retrieved December 07, 2020, from https://www.wsj.com/articles/SB10001424052748703506904575592363492225220
23. Kennedy, A. (2019, December 12). NBA head coaching jobs have never been more stable than right now. Retrieved December 07, 2020, from https://hoopshype.com/2019/09/30/nba-coaches-head-stable-stability-same-team-fired-history-coaching/
24. Kennedy, A. (2019, May 11). 20-year study: Coaches in NBA have highest turnover among major leagues. Retrieved December 07, 2020, from https://hoopshype.com/2019/05/05/nba-coaches-fired-hired-20-season-study-spurs-winning-percentage/
25. Shipherd, A. (2020, July 24). Coach Turnover And Its Impact on Student-Athletes And Team Dynamics. Retrieved December 07, 2020, from https://www.athleticdirectoru.com/articles/coach-turnover-and-impact-on-student-athletes-and-team-dynamics/
26. Shipherd, A. M., Wakefield, J., Stokowski, S., & Filho, E. (2018, March). (PDF) The influence of coach turnover on student-athletes ... Retrieved December 7, 2020, from https://www.researchgate.net/publication/324064353_The_influence_of_coach_turnover_on_student-athletes'_affective_states_and_team_dynamics_An_exploratory_study_in_collegiate_sports

27. Coaches really do matter for success in sports. (2019, March 07). Retrieved December 07, 2020, from https://www.futurity.org/coaches-professional-college-sports-2002762/
28. The Impact of a Head Coaching Change on Intercollegiate ... (n.d.). Retrieved December 7, 2020, from https://digitalcommons.wku.edu/cgi/viewcontent.cgi?article=1085&context=diss