INTRODUCTION

National Basketball Association is a men's professional basketball league in North America. It is one of the widely followed sports and is considered to be a premier men's professional basketball throughout the world. NBA was founded in 1946 as Basketball Association of America. One of the lesser known facts about Basketball is that unlike other sports such as soccer or cricket, Basketball has a relatively shorter history even though these 3 games are relatively user friendly and comprehensive. While other sports were invented centuries or even millenniums ago, Basketball was invented just over a century ago, to provide warm ups for athletes Thus the game exploded in its popularity as it went from being a substitute sport to being one of the widely popular sports in a relatively short period of time. Perhaps, the single greatest reason behind the meteoric rise in Basketball's popularity as a sport can be credited to National Basketball Association.

And owing to its popularity, journalists and reporters throughout the world claim to find new insights into basketball and NBA every single day. Claims regarding success factors of a team, critical parameters of a game, allocation of a team's budget are made every season. The objective of this paper is to understand the validity of such claims and to visualise the various aspects of the National Basketball Association to gain insights into the team and players. This paper aims to first of all understand the 2 main success factors: a Team's Offense and a Team's Defense. Spider Charts were used to pit 2 teams and visualise their offense and defense status through a game and/or season. Next, we used parallel plots to understand a player's various characteristics. Finally, we took a look at the relevance between a team's budget & superstars with a team's performance.

DATA

The data for this source was mainly extracted from Basketball Reference (www.basketball-reference.com). Basketball Reference is a premier website developed to keep track of current and historical NBA and ABA (American Basketball Association) data. The website is designed to structure the data and intuitively locate it. But despite that, it's designed hierarchically, which meant that to source any required data we had to access it upon several clicks and then come back to the root page to access another piece of data. In short, there was no compiled (legitimate) data available for us to simply extract from. Thus we had to use a web crawler to access all the data and transform into a csv file so as to analyse. The datasets found for teams' performance had several variables such as the season, the 3 pointers percentage, the 2 pointers percentage, the four popular offense and defence factors and opponent's

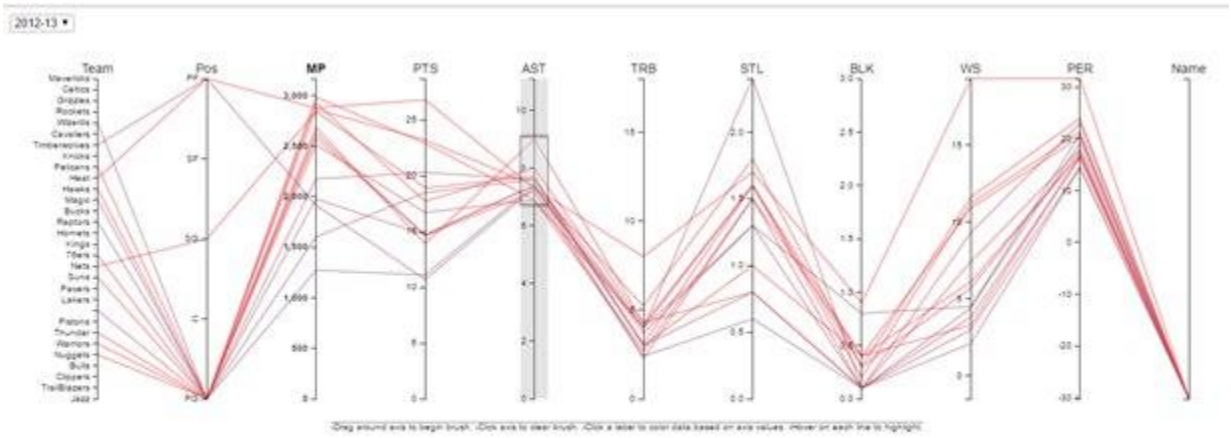
statistics. This dataset also had the team status of whether they were selected into Playoffs, Conference and final NBA championship. Similarly, the dataset for the players were selected such as the points scored, the points stopped and so on. The dataset compiled for the team's budget consisted of The Team's Name, the years they played in, the overall salary of the team, and their win percentage.

One structural change occurred in the early 1998-1999 and 2011-20112 season when the total number games played by a team decreased from 82 to 60 and 66 games respectively. Although this change was reverted back after a season, the point to note is that absolute value of the wins shouldn't be directly considered so as to avoid underestimating the points scored in such seasons. Thus throughout the analysis we have taken win percentages instead of absolute value of wins.

VISUAL ANALYSIS

PLAYERS

There are 5 players in each team and their performance is measured on several characteristics such as points scored, the rebounds, the steals and so on. We used d3 library to develop the parallel coordinates for displaying all NBA players' statistics through 5 years.

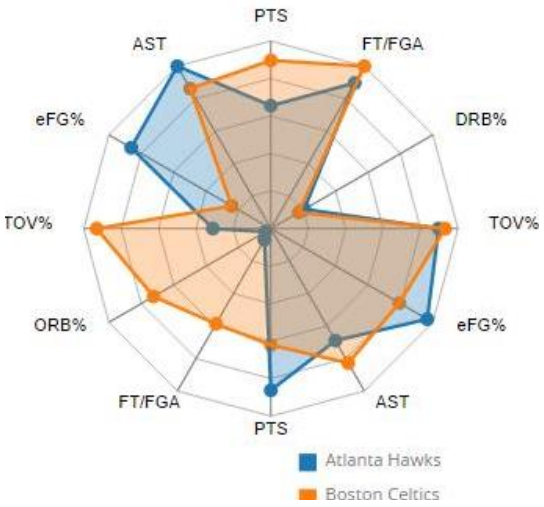


As we know that team managers sometimes want to see whether there are some relations between each kind of data or they just want to see a player's ranking of all kinds of data in the league. But in traditional way using excel, team manager cannot see the data intuitively or get an overview of the whole thing.

Using parallel coordinates, we can clearly see the ranking for all data of one player. Then we can know what are things this player did good and what they did bad. Besides, parallel coordinates have a filter function. We can choose a range of one kind of data and see how players in this range of data perform in other fields. Also, we may choose range for several kinds of data to filter players who have depending on the required quality. This is really helpful as a managerial tool.

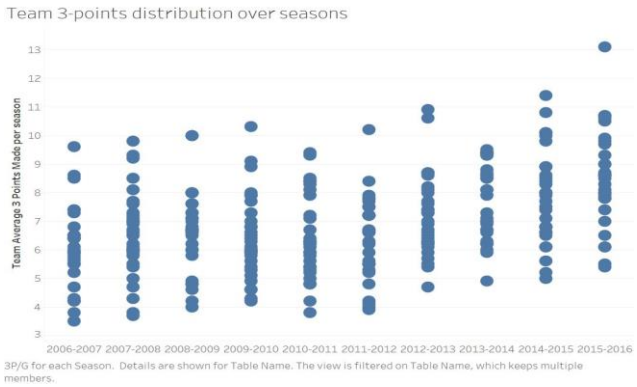
TEAMS

There are 30 teams in the NBA, although over time this value has changed and one of the key parameters is to take a look at the overall team's performance. For this the team's performance is summarised for a given season. And then we applied d3 for radar chart in order to show comparisons between different teams' performance or a team's performance in multiple seasons. This would allow users to draw comparisons and find interesting observations based on the radar chart to implement. The left circle shows a team's average points per game, average assists per game and the other four offensive factors. Thus, left half of the radar chart measures a team's offensive ability. The right half shows a team's opponent performance against their plays. We use a formula to calculate the metrics and it reflects a team's defensive performance. On the right hand side, there is a configuration tool bar. It includes several functions which enables users to vary the shape of radar chart or change the comparison chart to separate charts.

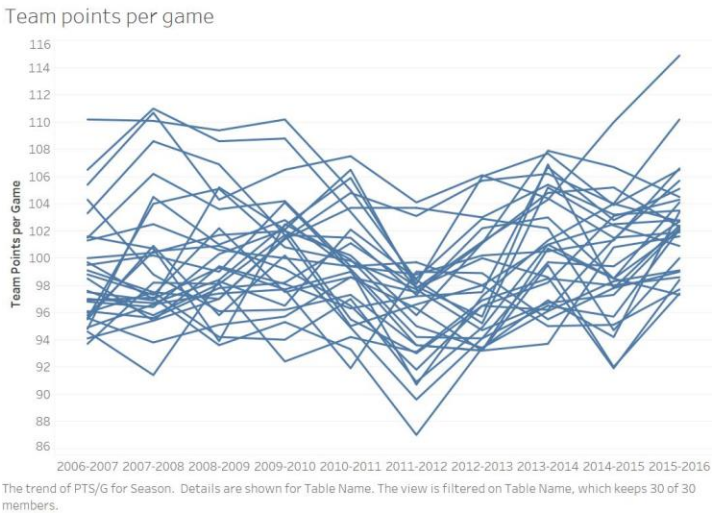


Every point in NBA is made up of either the 3 pointers or 2 pointers. The 3 pointers take place in a special circumstance, where in a team is awarded 3 points if the player successfully attempts to shoot a ball from beyond a designated three-point line. Otherwise, any other valid successful attempt awards the team 2 points. 2 pointers can be attributed to multiple sources (most of which weren't documented for a long time), but since 3 pointers is a unique case, we decided to analyse the data regarding 3 pointers.

It can be observed from the graph that there is a rising trend towards the importance of 3 pointers. As the number of points are fixed in a game, the increasing number of 3 pointers implies a decreasing number of 2 pointers, (and thus an overall focus on the 3 pointers). This trend has been observed across multiple teams over the seasons from 2006 to 2016.



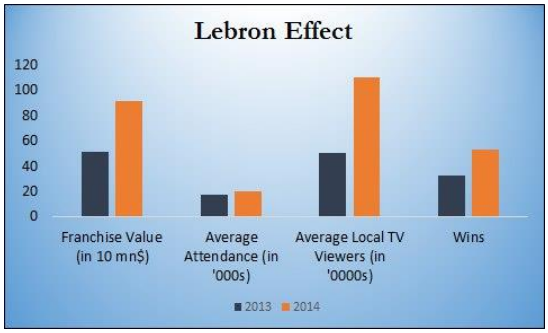
Another interesting observation was to look at the team's performances over the years and for this a parallel plot was employed so as to have a holistic perspective. A key observation from this parallel plot is that the nearly every team's performance in 2011 has dipped down. And this can be attributed to the structural change in NBA. There have been several changes to the structure of the NBA that can potentially affect a team's performance. Our exploratory data analysis revealed that the number of games have been changed over the course of time. A temporary change occurred couple of years ago in 2011, when instead of 82 games, the teams got to play only 66 games. This change was coupled with uncertainties created by collective bargaining agreement (which led to a lockout). Overall this uncertainty decreased team motivation of players and teams.

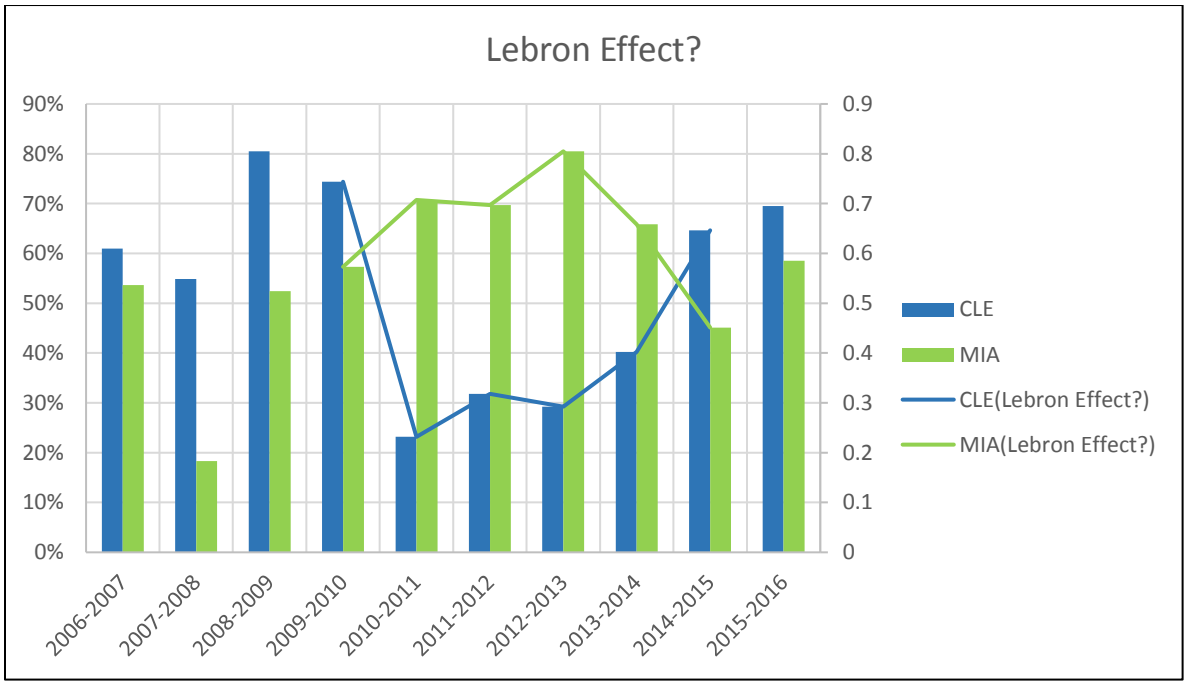


SUPERSTARS & BUDGETS

Superstars are the one of the reasons how NBA was able to popularise the sport commonly played in schools and colleges today. National Basketball Association employed the concept of transcendent stars who were able to inspire people to play this game. These stars are referred to as transcendent because people beyond basketball aficionados were able to identify them. This is the reason behind the popularity of movies and sports. They were able to create transcendent superstars who made themselves a common

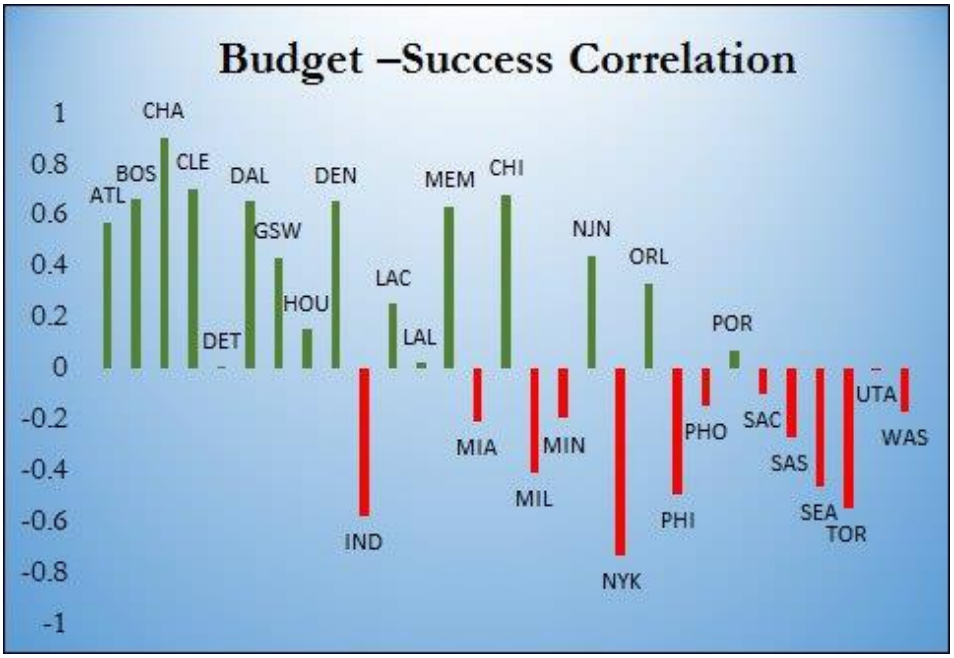
household names. The following bar graph shows the impact that Lebron James, an unanimously agreed upon superstar, has on basketball. Not only is his effect reflected in the wins but it also transcends to the franchise value, average attendance and average local TV viewers. This is often coined as the Lebron Effect. To add perspective to the Lebron effect, we increased the timeline of his potential effect beyond the 2 years mentioned above.





We tracked the effect Lebron James had when he left CHE (Cleveland Chevaliers) in 2010-11 season and joined MIA (Miami Heats). As you can see Cleveland faced a sharp drop in their win percentage. However, this effect cannot be satisfactorily guaranteed without looking at the other end. As you can see, Lebron did not have considerable impact on Miami Heat, as their win percentage did not increase significantly. Neither did his leave from affect Miami Heats considerably. But his comeback to Cleveland Chevaliers skyrocketed their performance again. Thus perhaps, superstar effect is closely connected to culture and compatibility. This effect can be compared and contrasted with other superstars as well, but the reason Lebron James was chosen is because L. James has shifted teams and that to for a considerable period of time, such that a superstar effect can be critically studied.

Having looked at the superstars, we went on to look at the team's budget over success. And as you can see, for as many positive correlations, there are as many negative correlations.



This can be further reinforced by conducting a Pearson correlation analysis of salaries and their performances, conducted for a period of 10 years. As can be seen, the correlation coefficient is quite low at about 0.2 and this correlation can be validated by the fact that the p-value was lower than 0.0001 thus making the finding statistically significant.

Correlations

	Salary	Win%
Salary	1.0000	0.2140
Win%	0.2140	1.0000

Correlation Probability

	Salary	Win%
Salary	<.0001	<.0001
Win%	<.0001	<.0001

CONCLUSION

Thus we undertook a visual exploration into the various aspects of National Basketball Association. First we started off from a player's perspective which used parallel plots to give a glance at the player statistics over the years. Then we moved on to the team's statistics, which delved into the team's performances over the years. Finally, we went to the broader perspective of the Team's Management of Budget and understood if there is any relation to success.

REFERENCES

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