

# NBA Players Visualization

Stephen Curry vs Kyrie Irving and LeBron James vs Carmelo Anthony

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## ABSTRACT

Data visualization is a powerful tool that allows users to quickly and effectively analyze large amounts of data. In the context of NBA player statistics, data visualization can be used to evaluate a player's performance based on various metrics, such as scoring, rebounding, and assists. This can be helpful for managers and scouts who are looking to make decisions about which players to sign or trade.

One example of a data visualization technique that could be used in this context is the radial chart. This type of chart is useful for comparing multiple variables for a single player. For example, a radial chart could be used to compare a player's scoring, rebounding, and assist numbers, with each variable represented by a different spoke on the chart. This allows managers and scouts to quickly see how a player is performing across multiple dimensions, and can help them make more informed decisions about the player's value to their team.

Another example of a data visualization technique that could be useful for analyzing NBA player stats is the use of 1D and 2D visualization techniques. These techniques, such as scatter plots and bar graphs, can be used to show the relationship between two variables, such as a player's scoring and rebounding numbers, or a team's wins and losses. These visualizations can help managers and scouts identify trends and patterns in the data, and can provide valuable insights into how a player or team is performing.

Also, comparing player's is very helpful in determining their ability to play in all the conditions and the scout can decide with which player to draft for next season according to their requirements. Moreover, the coaches can identify the player's strengths and weaknesses and train them accordingly so that their performance improves in the future games.

Overall, data visualization is a valuable tool for analyzing NBA player stats. By using various visualization techniques, managers and scouts can gain a better understanding of a player's performance, and can make more informed decisions about which players to sign or trade.

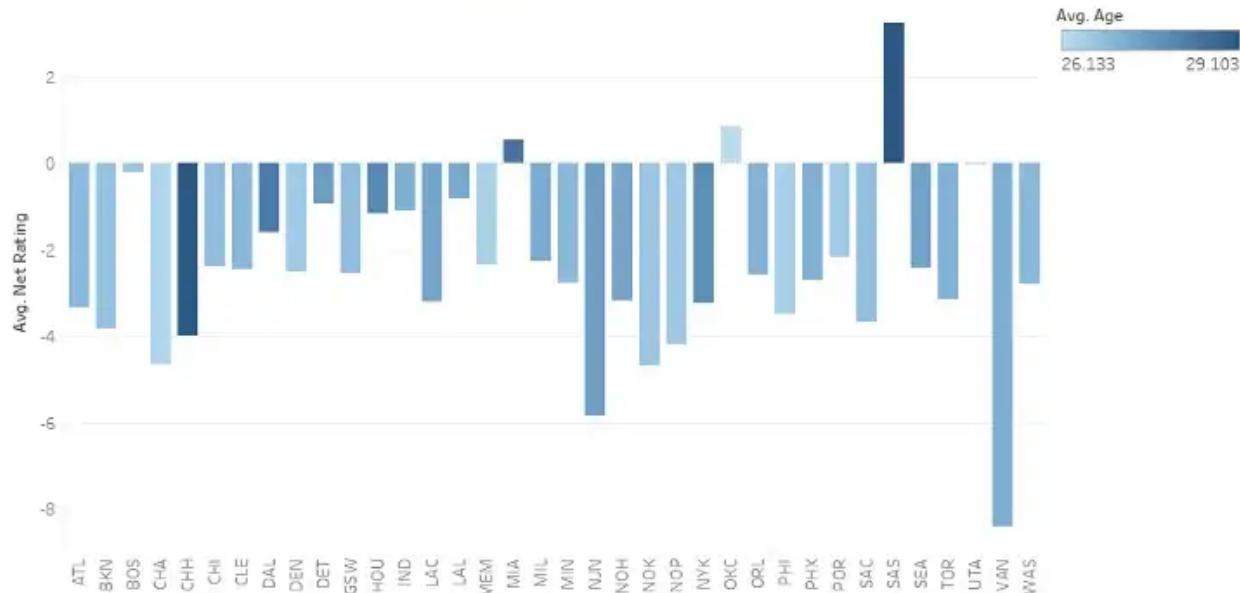
## INTRODUCTION

Visualization is incredibly important in today's society for engaging the audience. The majority of the players, such as the Presidents, Board members, Managers, Scouts, etc., have non-technical backgrounds. Therefore, it would be ideal for the Sports analytics team to design a visualization that offers significant insights utilizing the player numbers rather than merely exhibiting these stats in order to impress the management, get their attention, and aid in better understanding the stats. As visualizations may be understood better and aid the team in making better decisions, doing so would have a far more substantial influence. The team management, for example, can use these numbers to assess a player's performance at the conclusion of the season. On the plus side, managers may be able to pinpoint areas of the team that require strengthening through the transfer market by seeing the visualization. Furthermore, scouts can use these visualizations to identify players based on their stats and make recommendations to the club sporting directors or managers by presenting compelling visualizations (player-wise comparison) to back up their claim that a particular player could add value to a particular area of the game. Players may also assess their performance using these visualizations by contrasting it with that of other players who occupy the same position; this serves as additional incentive for the players to raise their game and please the management.

## EXISTING WORK

Average Net Rating by Team

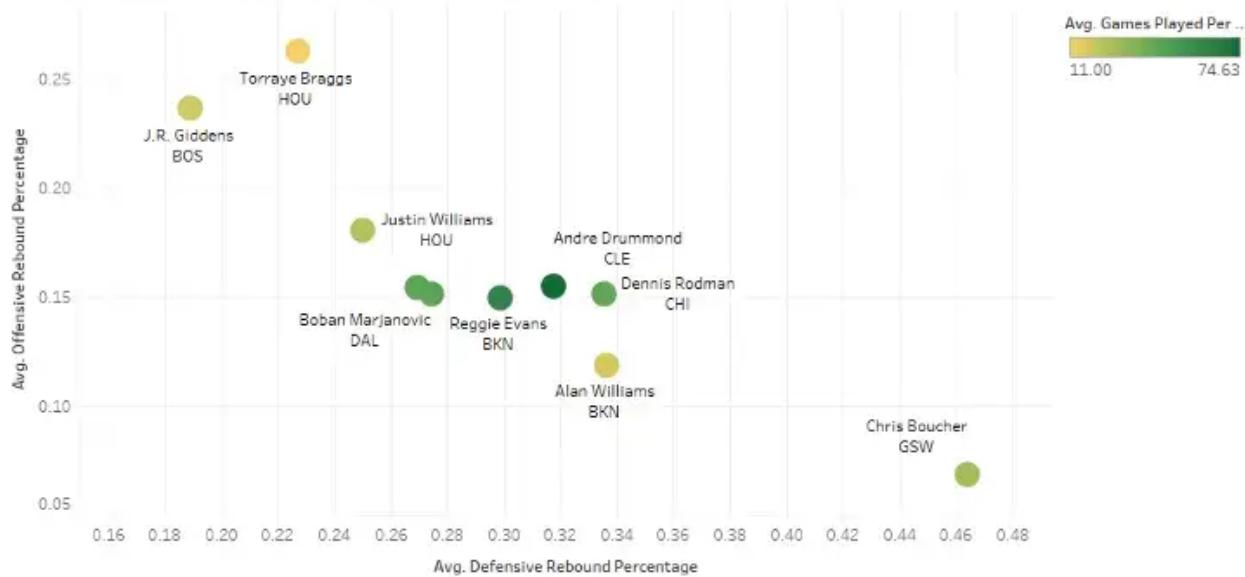
Net rating is the difference in points between the two teams in a game.



The above visualization gives the information about the team which has best and worst net rating which is calculated by considering all the parameters of the game such as points, assists,

rebounds, blocks etc. The average net rating by team is the difference in points between two teams in a game. They used a bar plot, where each bar represents the average net rating and the X-axis represents the team. They also used a color palette based on the average age of the team. It is interesting to see that the San Antonio Spurs have had the best Net Rating, on average, since 1996. This suggests that they have consistently been one of the best teams in the league over this time period. The fact that they are also the oldest team, on average, raises the question of whether experience in the form of having an older team is a factor in their success. It would be interesting to conduct further analysis to see if there is a correlation between a team's average age and their Net Rating. This could provide valuable insights for managers and coaches looking to build a successful team. I found this visualization to be interesting, but they could have used better color encoding since the blue color shades that they have used can mislead the viewer and make it difficult to differentiate between the teams since all the blue shades have differences which are difficult to notice with a human eye.

Top 10 Defensive Players by Rebounds  
At least 10 games played per season on average (Minimum 2 seasons)



Defensive players are often overlooked, but they are crucial to the success of a team. A great defensive player can shut down the opposition's best offensive players, making it difficult for them to score. This can help a team win games and make a deep run in the playoffs.

One metric that can be used to evaluate the effectiveness of a defensive player is rebounds. A rebound is when a player retrieves the ball after a missed field goal or free throw. There are two types of rebounds: offensive and defensive. A superstar defensive player should have a high number of both types of rebounds. This indicates that they are active on the court and are able to grab the ball on both ends of the court, helping their team to score on offense and preventing their opponent from scoring on defense.

The above visualization represents top 10 players in terms of rebounds. And the criteria they chose is that the player should have played at least 10 games per season on an average.

Based on the criteria provided, the top 10 defensive players in terms of rebounds are Chris Boucher, J.R Giddens, Torraye Braggs, Dennis Rodman, Andre Drummond, Jerome Jordan, Al Horford, Rafael Araujo, Antonio Burks, and Brandan Wright. Of these players, Chris Boucher and J.R Giddens are the best at offensive rebounds, while Dennis Rodman and Andre Drummond are the best at both offensive and defensive rebounds. These players have demonstrated their ability to grab the ball on both ends of the court, making them valuable assets to their teams.

They used a Scatter plot to visualize the top players in terms of number of rebounds and the color palette is based on the average games played by the player in that season. The X-axis represents the average defensive rebound percentage and the Y-axis represents the average offensive rebound percentage. Although the visualization is interesting, they could have taken more seasons into consideration instead of taking only 2 seasons. It is because, a player performs well in one season and the other season might not be so good for him. Only 2 seasons cannot judge a player's performance. Suppose, if at least 10 season's performance is taken into consideration, the visualization could have been more reasonable and useful to extract good information. Also, the color palette used is not differentiable because for a viewer, the colors should be distinguishable according to visual encoding techniques. But, here only green shade is visible which is difficult to differentiate if there is a large amount of data.

## **CONTRIBUTION:**

We need a thorough examination since our data, which is made up of player information from well-known NBA games, can provide us with numerous insightful conclusions. We want to investigate players in various categories, such as, for instance: shot range on court, shot map on court, hit and miss shot, Competitiveness between the games, best player between the two players across all the games based on their positions, comparing individual player's performance based on the selected parameters, 3 point shooting, Field goals made, Field goals attempted, shot made flag, rebounds, assists, usage percentage, rebound percentage, free throw percentage etc., to name a few. From our data, we expect that Stephen Curry mostly plays outside the 3 point ring, Kyrie Irving usually plays more inside the ring, and LeBron James plays offensive and defensive since he is an allrounder. Usually, NBA teams have a large proportion of different styles of players. Certain managers have a specific style of play, so we expect to see whether the players can adapt to the coaches' ideas. We expected Stephen Curry to have a 3 point percentage compared to Kyrie Irving, as Stephen Curry suits the Point Guard shooting role, whereas Kyrie Irving is a playmaker, so he should have more inside the ring points. Our project's objective is to develop visualizations producing meaningful insights to represent the stats of individual players from multiple NBA season matches. As it makes no sense to conceptualize a defensive player based on the quantity of goals scored, we want to analyze individuals based on their style of

play. As a result, rather than rating them on all factors, we generated a variety of 1D and 2D graphics dependent on the individual gameplay style. We used relevant visuals whenever feasible to preserve perception, taking into account all the benefits and drawbacks of such an approach. Additionally, we justified the use of specific visualization strategies in our research.

## DATA AND METHODS

### Data Description:

We have imported our dataset from `nba_api` which is an API client package to access the api's of NBA.com website. This package intends to make the APIs of NBA.com easily accessible and provide extensive documentation about them. We can get the data of any player with the help of this code from `nba_api.stats.endpoints import playercareerstats` and a specific player's data can be selected by simply giving the player id of that particular player by executing the following command:

```
career = playercareerstats.PlayerCareerStats(player_id='203999')
```

By executing the above command, we get the data of that particular player. A significant purpose of this package is to continuously map and analyze as many endpoints on NBA.com as possible. The documentation and analysis of the endpoints and parameters in this package are some of the most extensive information available. Using this api, we can import many statistics such as player career statistics, per year statistics, player's shot statistics etc.

An overview of our dataset is as follows,

	GRID_TYPE	GAME_ID	GAME_EVENT_ID	PLAYER_ID	PLAYER_NAME	TEAM_ID	TEAM_NAME	PERIOD	MINUTES_REMAINING	SECONDS_REMAINING
0	Shot Chart Detail	0021500405	3	202681	Kyrie Irving	1610612739	Cleveland Cavaliers	1	11	20
1	Shot Chart Detail	0021500405	22	202681	Kyrie Irving	1610612739	Cleveland Cavaliers	1	8	23
2	Shot Chart Detail	0021500405	132	202681	Kyrie Irving	1610612739	Cleveland Cavaliers	2	11	41
3	Shot Chart Detail	0021500405	151	202681	Kyrie Irving	1610612739	Cleveland Cavaliers	2	10	35
4	Shot Chart Detail	0021500405	171	202681	Kyrie Irving	1610612739	Cleveland Cavaliers	2	9	5

	GRID_TYPE	SHOT_ZONE_BASIC	SHOT_ZONE_AREA	SHOT_ZONE_RANGE	FGA	FGM	FG_PCT
0	League Averages	Above the Break 3	Back Court(BC)	Back Court Shot	59	4	0.068
1	League Averages	Above the Break 3	Center(C)	24+ ft.	10885	3746	0.344
2	League Averages	Above the Break 3	Left Side Center(LC)	24+ ft.	16648	5802	0.349
3	League Averages	Above the Break 3	Right Side Center(RC)	24+ ft.	15837	5597	0.353
4	League Averages	Backcourt	Back Court(BC)	Back Court Shot	440	17	0.039
5	League Averages	In The Paint (Non-RA)	Center(C)	8-16 ft.	6851	2889	0.422

PLAYER_ID	SEASON_ID	LEAGUE_ID	TEAM_ID	TEAM_ABBREVIATION	PLAYER_AGE	GP	GS	MIN	FGM	FGA	FG_PCT	FG3M	FG3A	FG3_PCT	F
0	202681	2011-12	00	1610612739	CLE	20.0	51	51	1558.0	350	747	0.469	73	183	0.399
1	202681	2012-13	00	1610612739	CLE	21.0	59	59	2048.0	484	1070	0.452	109	279	0.391
2	202681	2013-14	00	1610612739	CLE	22.0	71	71	2496.0	532	1237	0.430	123	344	0.358
3	202681	2014-15	00	1610612739	CLE	23.0	75	75	2730.0	578	1235	0.468	157	378	0.415
4	202681	2015-16	00	1610612739	CLE	24.0	53	53	1667.0	394	879	0.448	84	262	0.321
5	202681	2016-17	00	1610612739	CLE	25.0	72	72	2525.0	671	1420	0.473	177	441	0.401

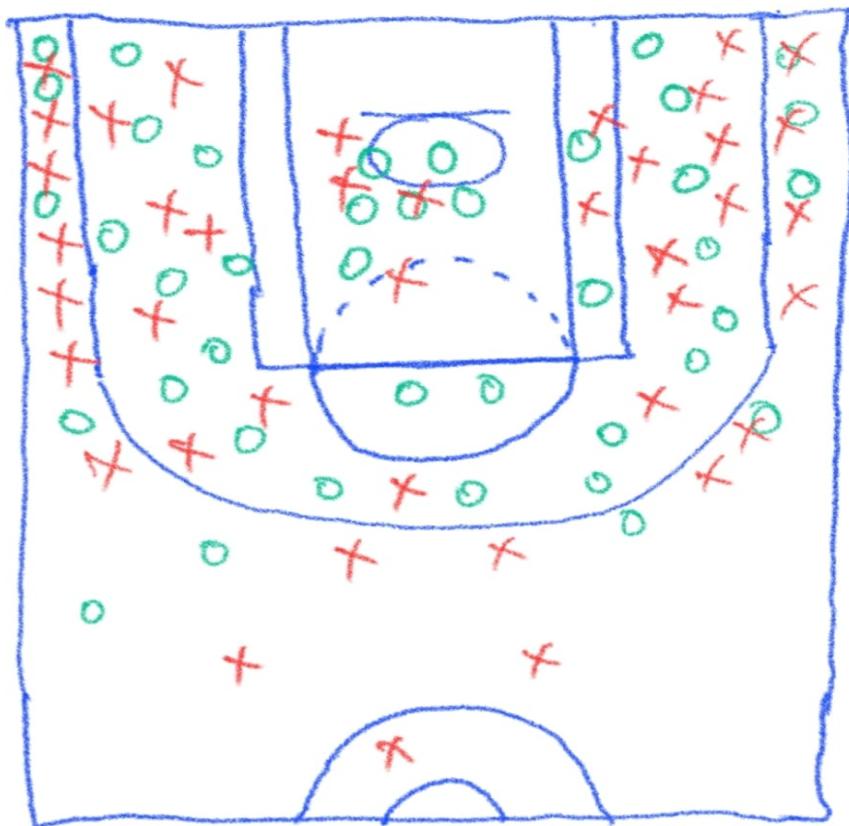
FG3M	FG3A	FG3_PCT	FTM	FTA	FT_PCT	OREB	DREB	REB	AST	STL	BLK	TOV	PF	PTS
73	183	0.399	171	196	0.872	44	147	191	275	54	20	160	110	944
109	279	0.391	248	290	0.855	34	182	216	350	89	21	191	146	1325
123	344	0.358	291	338	0.861	52	207	259	433	108	23	190	163	1478
157	378	0.415	315	365	0.863	55	182	237	389	114	20	186	146	1628
84	262	0.321	169	191	0.885	44	113	157	250	56	18	124	107	1041
177	441	0.401	297	328	0.905	52	178	230	418	83	24	180	157	1816
166	407	0.408	232	261	0.889	33	194	227	306	65	17	139	122	1466
174	434	0.401	214	245	0.873	71	264	335	464	103	34	172	167	1596
56	142	0.394	94	102	0.922	22	81	103	128	27	10	52	53	548

EVENT_TYPE	ACTION_TYPE	SHOT_TYPE	SHOT_ZONE_BASIC	SHOT_ZONE_AREA	SHOT_ZONE_RANGE	SHOT_DISTANCE	LOC_X	LOC_Y
Missed Shot	Driving Layup Shot	2PT Field Goal	Restricted Area	Center(C)	Less Than 8 ft.		1	-11
Missed Shot	Step Back Jump shot	2PT Field Goal	Mid-Range	Left Side(L)	16-24 ft.		16	-147
Missed Shot	Driving Layup Shot	2PT Field Goal	Restricted Area	Center(C)	Less Than 8 ft.		2	-2
Missed Shot	Step Back Jump shot	2PT Field Goal	In The Paint (Non-RA)	Right Side(R)	8-16 ft.		8	66
Missed Shot	Driving Layup Shot	2PT Field Goal	Restricted Area	Center(C)	Less Than 8 ft.		3	-32
...	...	...	...	...	...		...	...
Made Shot	Jump Shot	2PT Field Goal	Mid-Range	Right Side(R)	8-16 ft.		11	84
Made Shot	Fadeaway Jump Shot	2PT Field Goal	Mid-Range	Right Side(R)	8-16 ft.		9	94

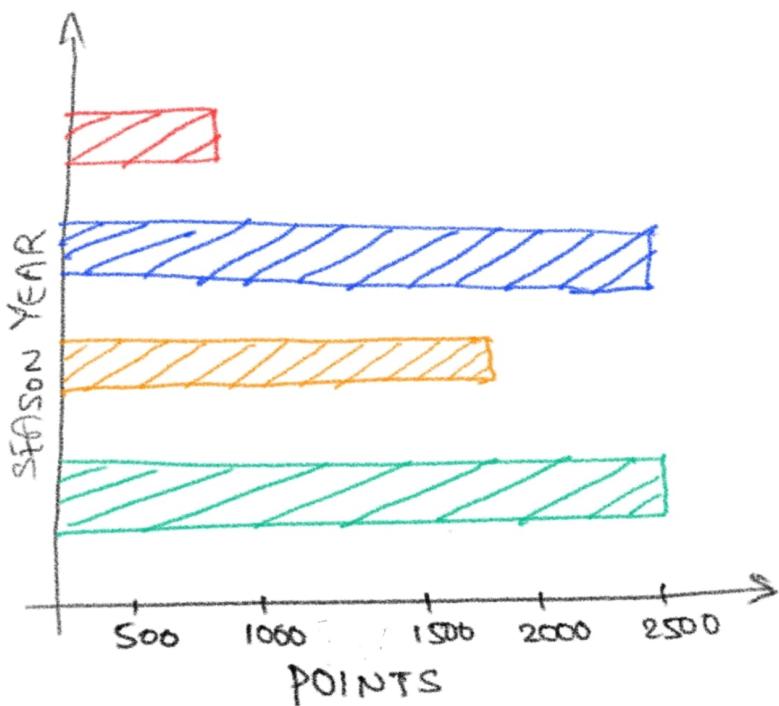
Note: Please do not get misled as in most of the visualizations the values are scaled based on the number of matches played by the player.

### Ideas, Sketches & prototypes

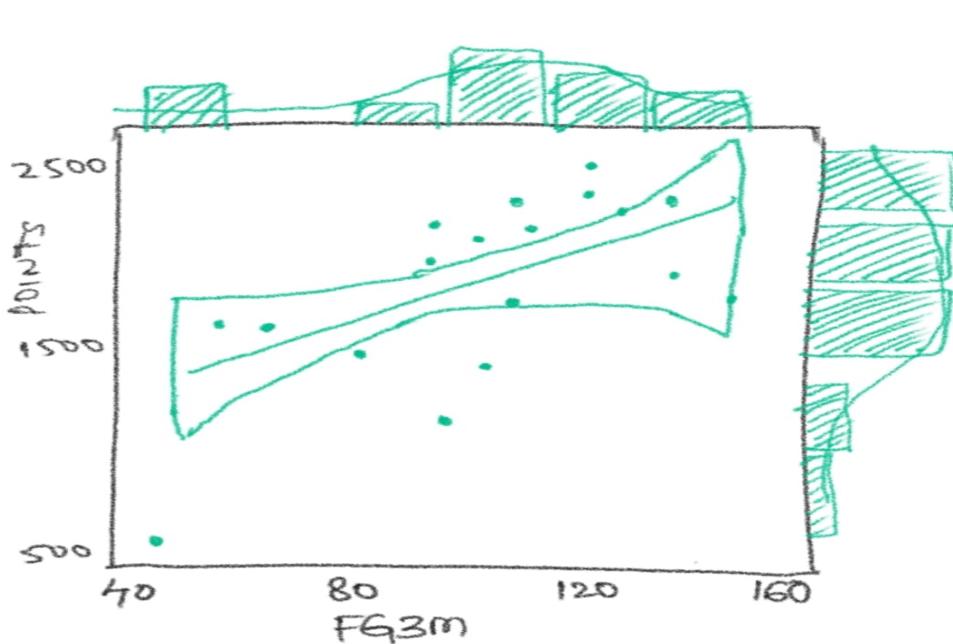
Visualization of NBA charts based on shot hit and shot miss of a player is a great way to analyze the player performance in terms of shooting from various zones on the court. Hence, we sketched a shot chart on an NBA court prototype. We have implemented the exact sketch in our work.



A player's total number of points can be displayed using a bar plot. The NBA season is represented by the vertical axis, while the player's point total is represented by the horizontal axis. It is simple to compare the number of points scored by various players during that season using this type of graphic. The following is a basic example of a bar plot that displays the number of points scored by NBA players with strong records



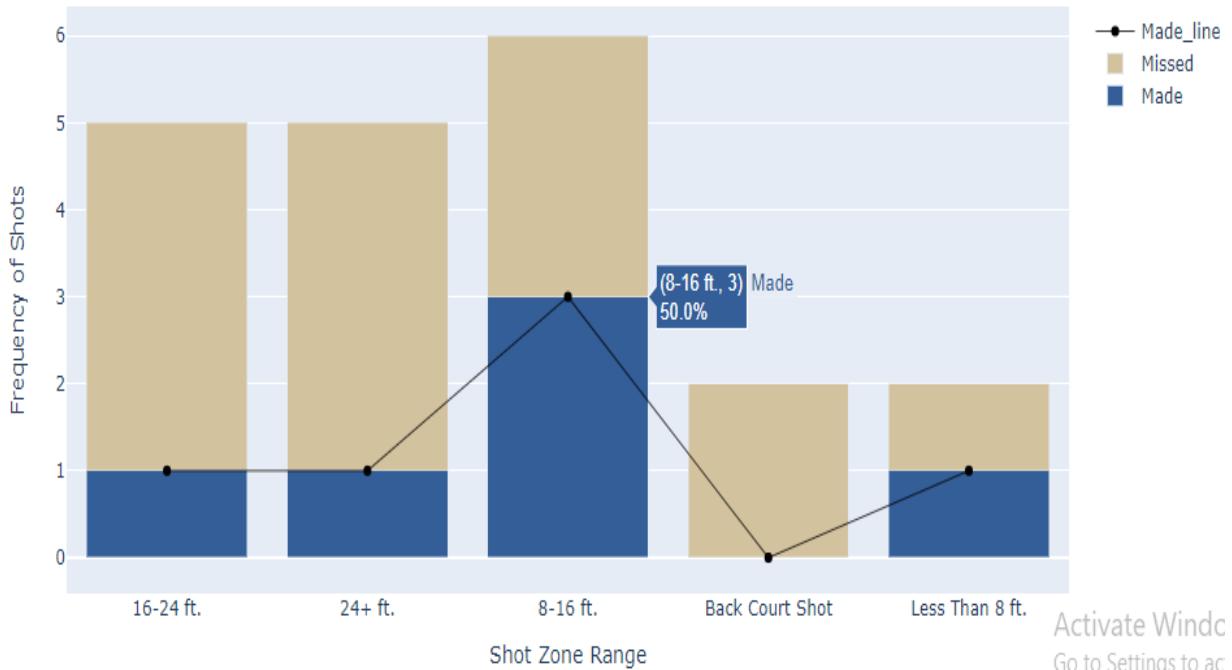
Also, we have an idea of implementing the below visualization that represents a joint plot of Correlation between number of 3 pointers made and total points of both the players and marginal histograms with linear regression model fit.



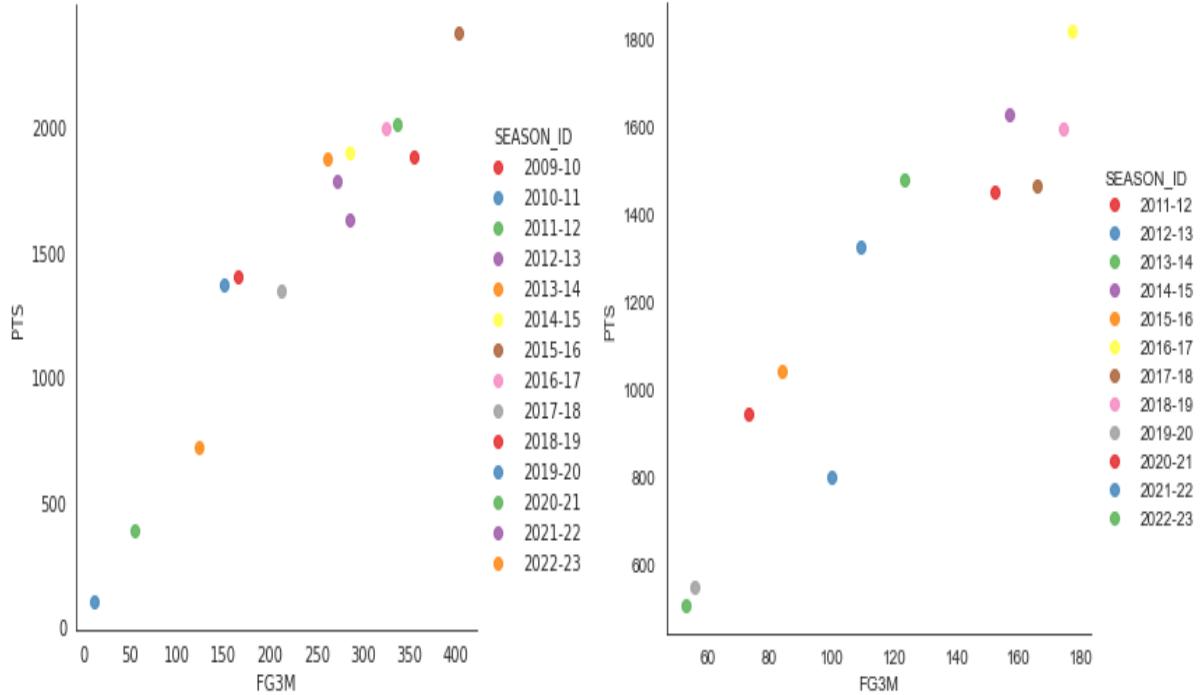
## Visualization methods selection

Depending on the objective and taking into account the benefits and drawbacks of each approach in the study, we employed a variety of visualization techniques throughout the project, such as line plots, bar plots, scatter plots, radial charts, etc. When a player's stat values are close together, for example, utilizing a bar plot to visualize that statistic might not be the best option since it lacks the precision needed to accurately depict the minute variances. As seen in the image below, the plot will appear to be flat since the little variances in values won't be seen.

Field Goal percentage by Shot Zone Range



When a player's specific metrics have similar values, utilizing a line graph or scatter plot might be a better representation. These plots enable a more accurate depiction of the data and are better able to highlight minute variances in the values. In this instance, a scatter plot, like the one below, might be a superior method of displaying a player's statistics.



When the difference between the variables we are attempting to depict is considerable, a bar plot might be acceptable. However, a scatter plot rather than a bar plot would be more appropriate to employ given that we need to depict the ratings of the top 10 players and given that the ratings gap between the players is rather modest.

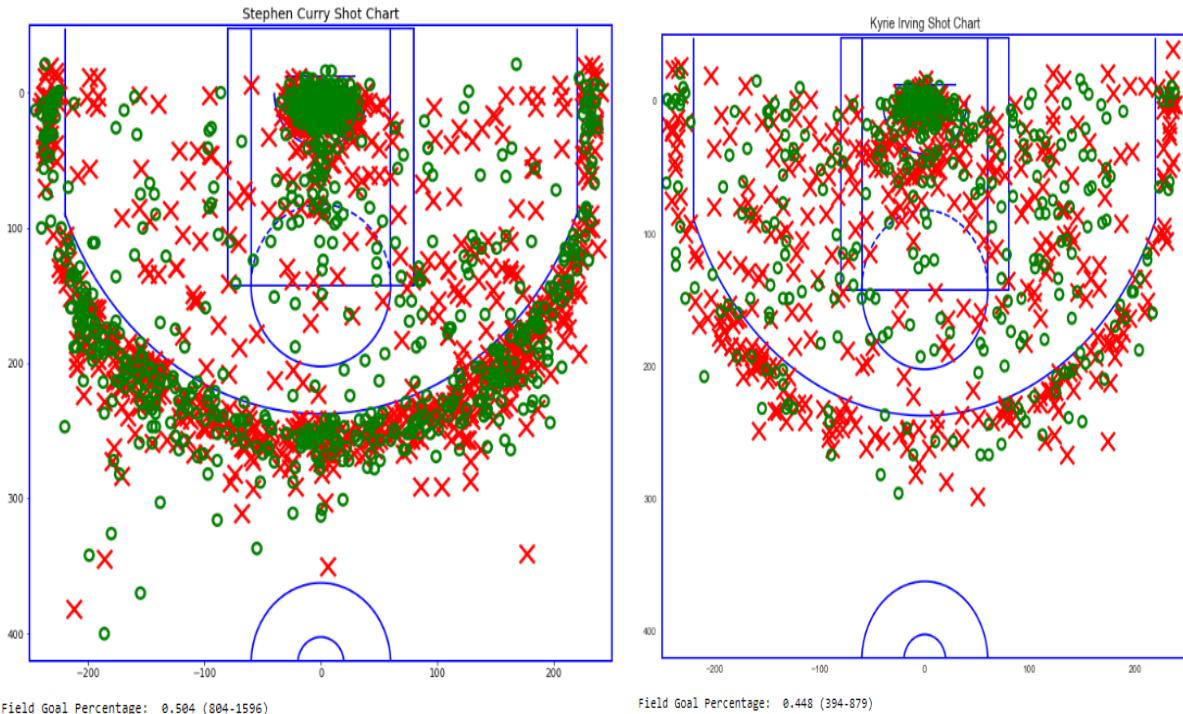
We have employed a variety of graphs, including 3D interactive plots, box plots, histograms, hex charts, etc., to compare different player qualities. These plots may provide a player's performance in every facet of the game a visual representation, which makes it simpler to pinpoint strengths and flaws. Additionally, it is simpler to compare players' stats because of the visual nature of these charts. These plots can also assist coaches in deciding which players should be chosen for particular roles and pinpointing player weaknesses.

The aforementioned plots have a few drawbacks, such as the fact that if the data points are too many or complicated, it may be challenging to read the plot. Additionally, alternative techniques, such bar graphs or line graphs, are best used to examine particular basketball statistics, including passing accuracy or shots on target. The aforementioned charts only show a player's performance at a certain point in time, hence they are not the ideal approach for examining data over time.

## VISUALIZATION AND INSIGHTS:

### Stephen Curry vs Kyrie Irving

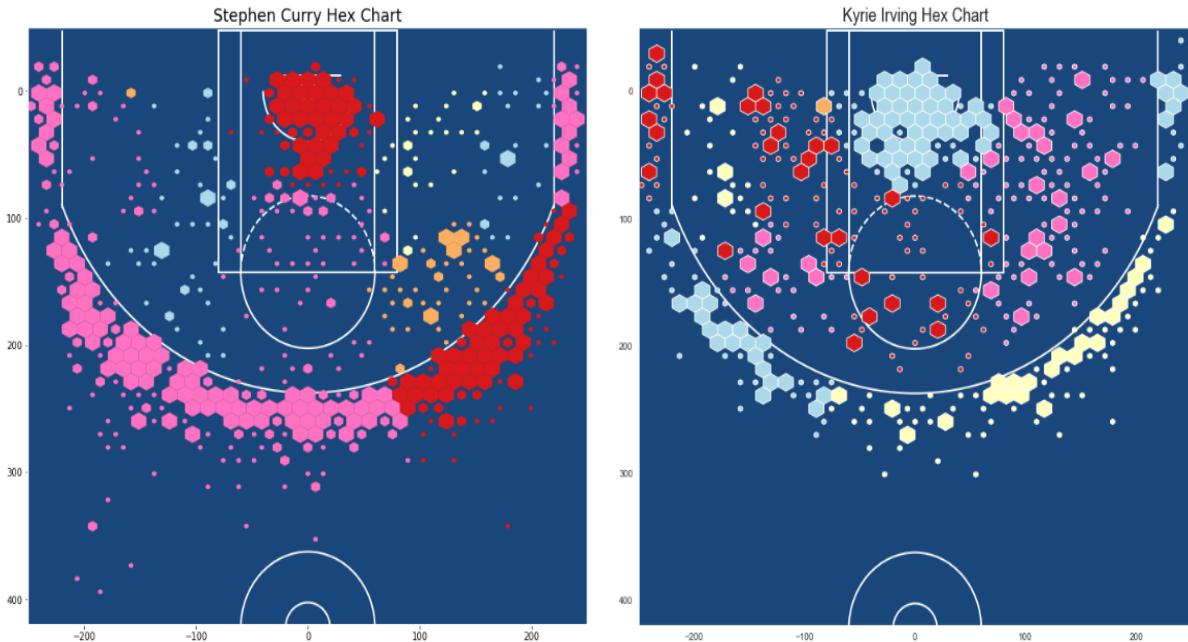
- Player shot hit and shot miss on the court



The above visualizations represent the hit and miss shot chart of Stephen Curry and Kyrie Irving. We have used a scatter plot to represent the shot hit and miss for both the players. Where the green circle represents the shot hit of the player, whereas the red cross represents the shot miss of the player. Initially, to obtain this visualization, we drew the basketball court with original dimensions using the draw\_court function in our code with the help of circle, rectangle and arc functions in python. From the above visualizations, we can notice that Stephen Curry has attempted more 3 point shots since there are more green circles outside the bigger arc. He was successful in making most of the 3 point shots that he attempted as we can see from the visualization. That is the reason he is the best 3 point shooter of all time the game of basketball has ever witnessed. Also, his inside shooting is good with an impeccable Free Throw percentage record. Whereas when we see Kyrie Irving's shot chart visualization, we can clearly notice that his 3 point shooting is not up to the mark as compared to Curry's because there are very few green circles outside the bigger arc. While his inside the arc shooting is very good when compared to Curry. It is because we can see more green circles inside the bigger arc in Kyrie's shot chart visualization. That is the reason, Kyrie is considered as a playmaker with his remarkable athletic and shot completion skills. He is one such player who can complete the shot at any cost even with multiple opponents guarding him. So, the main aim of this visualization is

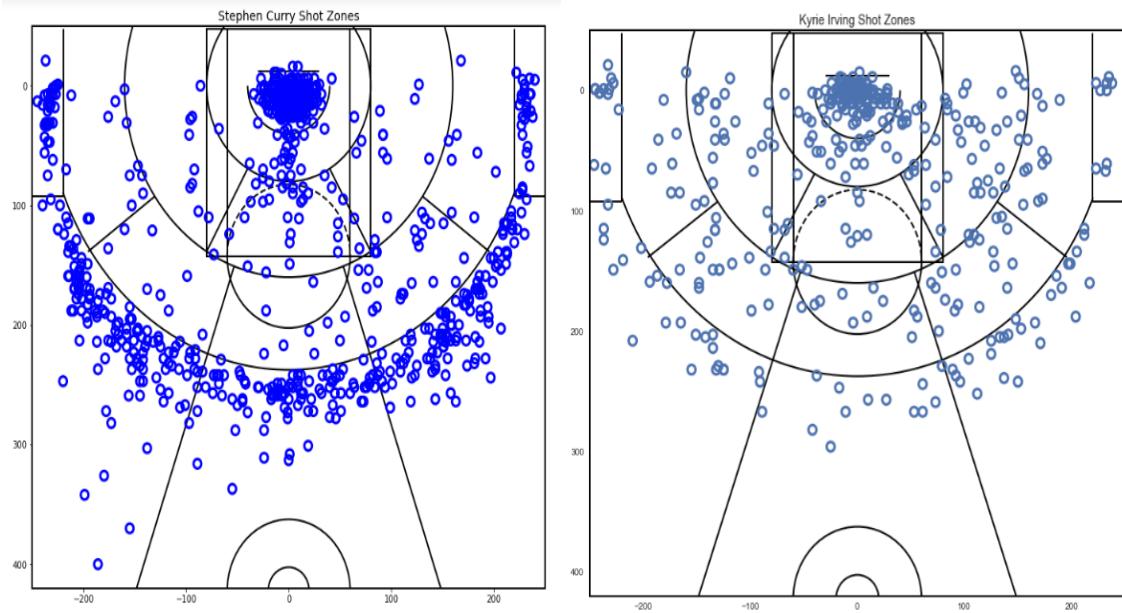
to identify the player's strong and weak zones on court. Also, we calculated the Field Goal percentage of both the players and found that Curry has a FG% of 50.4% and Kyrie has a FG% of 44.8%. We can draw an inference that Kyrie should improve with his 3 point shooting since it is the game changing statistic in basketball. Whereas, Curry should improve his playmaking and inside shooting skills, since it is not always possible to make a 3 point shot with multiple opponents guarding.

- **Players shot analysis in Hex chart**



Hex maps, hex boards, and hex grids are all typical game board designs for wargames of various sizes. The map is split into tiny, regular hexagons that are all the same size. The main benefit of a hex map over a conventional square grid map is that every pair of neighboring hex cells (or hex) have the same distance between their centers. In contrast, on a map with a square grid, the distance between the centers of each square cell and the four diagonally adjacent cells with which it shares a corner is roughly twice as much as the distance between the centers of the four adjacent cells with which it shares an edge. For games where movement measurement is important, it is ideal that all neighboring hexes have this equidistant feature. The other benefit is that adjacent cells always share edges, thus there are never two cells in close proximity. Also, Hexagon covers most of the area for a given space. Hence, we used Hex maps to visualize the player's shot chart. We can clearly infer from the above visualizations that Curry's 3 point shooting is better when compared to Kyrie's and Kyrie's inside the arc shooting is remarkable when compared to Curry's. Curry has a good record in Buzzer beaters as we can observe from the visualization. Also, Hex charts are easy and clear to understand for a viewer and covers most of the data.

- **Player's shot chart according to various zones**

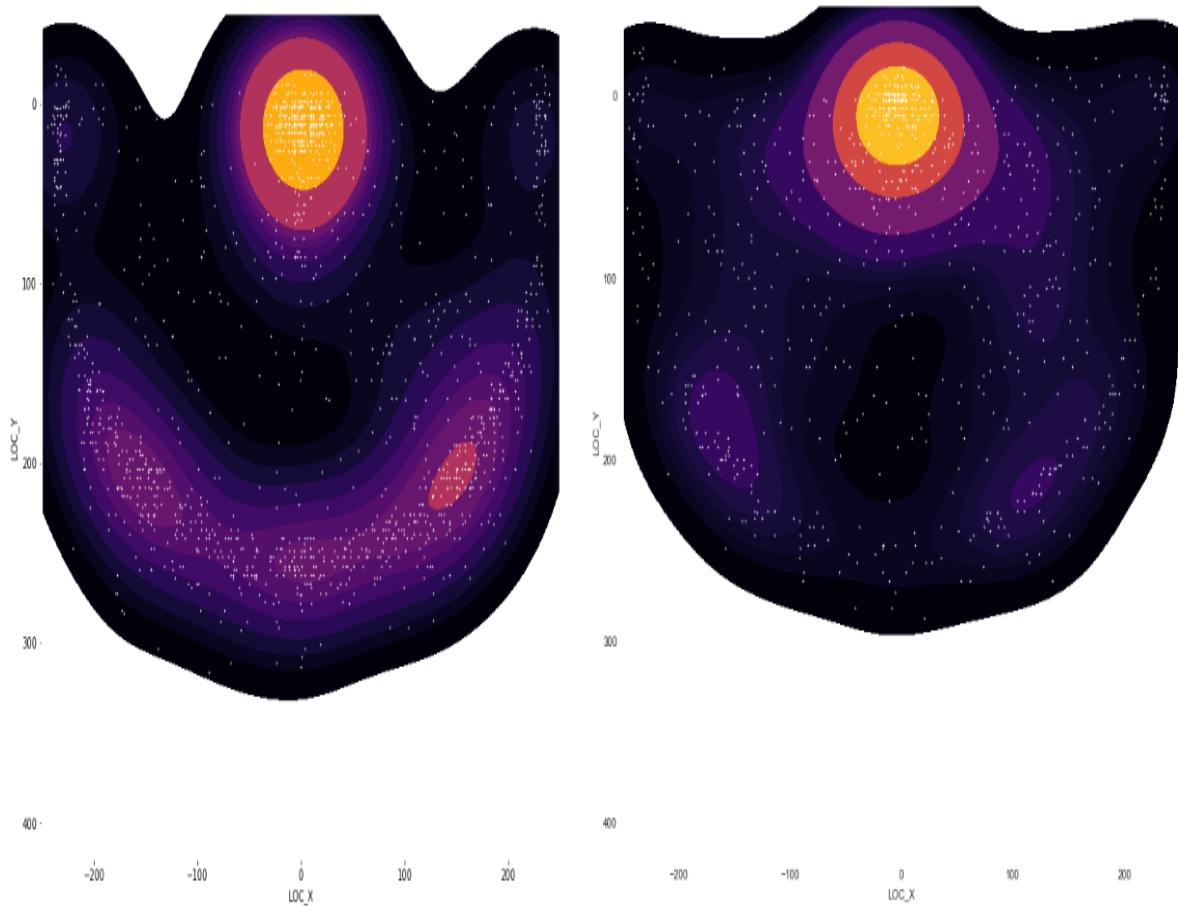


A basketball court has several different sections and areas that can be categorized .Certain spots are better to take high percentage shots. Other spots of the court are the sections that the defense hopes to keep the ball handler to because it's hard to shoot from them. Different areas on a basketball court include corners, wings, top of the key, high post and low post, elbows, midcourt, front court and back court. The above visualization represents the shot chart from different zones and distances on the basketball court. Since we know that a basketball court has multiple zones such as Back court, Centre, left side center, Left side, Right side center and Right side and various distances such as less than 8 ft, 8-16 ft, 16-24 ft and 24+ ft. From the above visualization, we can observe that Stephen Curry has taken a few more shots on the left side and center of the court and he is very strong in that zone. Whereas Kyrie is strong in all the zones on the court since we can see from the visualization that all zones have almost equal number of shots. This visualization is very helpful because the team can plan their defensive strategies according to the opponent's strong and weak zones on the court.

- **Heatmap of shot chart data**

A data visualization approach known as a heat map (or heatmap) displays a phenomenon's magnitude as color in two dimensions. The reader receives clear visual clues about how the phenomena is clustered or fluctuates across space as a result of the color variation, which can be determined by hue or intensity. Heat maps may be divided into two groups that are essentially distinct from one another: cluster heat maps and spatial heat maps. In a cluster heat map, magnitudes are arranged into a matrix with fixed cell size whose rows and columns are discrete phenomena and categories. Rows and columns are intentionally and somewhat arbitrarily sorted

with the aim of suggesting clusters or representing them as discovered through statistical analysis. Although the cell's size is random, it is large enough to be easily seen. In contrast, there are no cells in a spatial heat map; instead, the position of a magnitude is determined by its location in that space, and the phenomena is thought to change continuously.



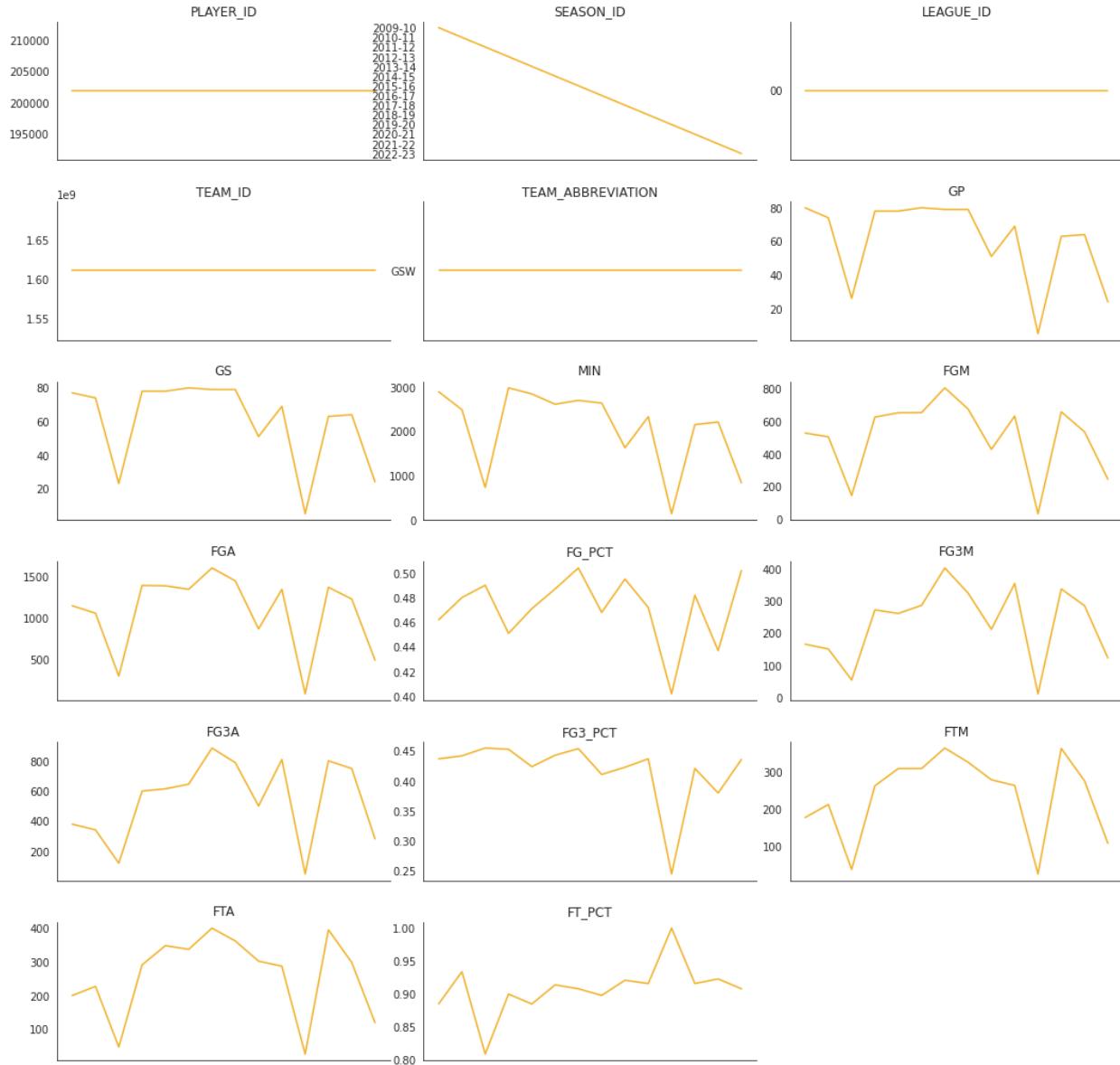
From the above visualizations, we can see that Curry's heat map is more concentrated outer bigger arc because of his 3 point shooting efficiency. Whereas, Kyrie's heatmap is more concentrated on inside the arc. The colormap that we used is inferno since that gives a clear visualization since the background is black.

- Interactive visualization with dashboard to chose player

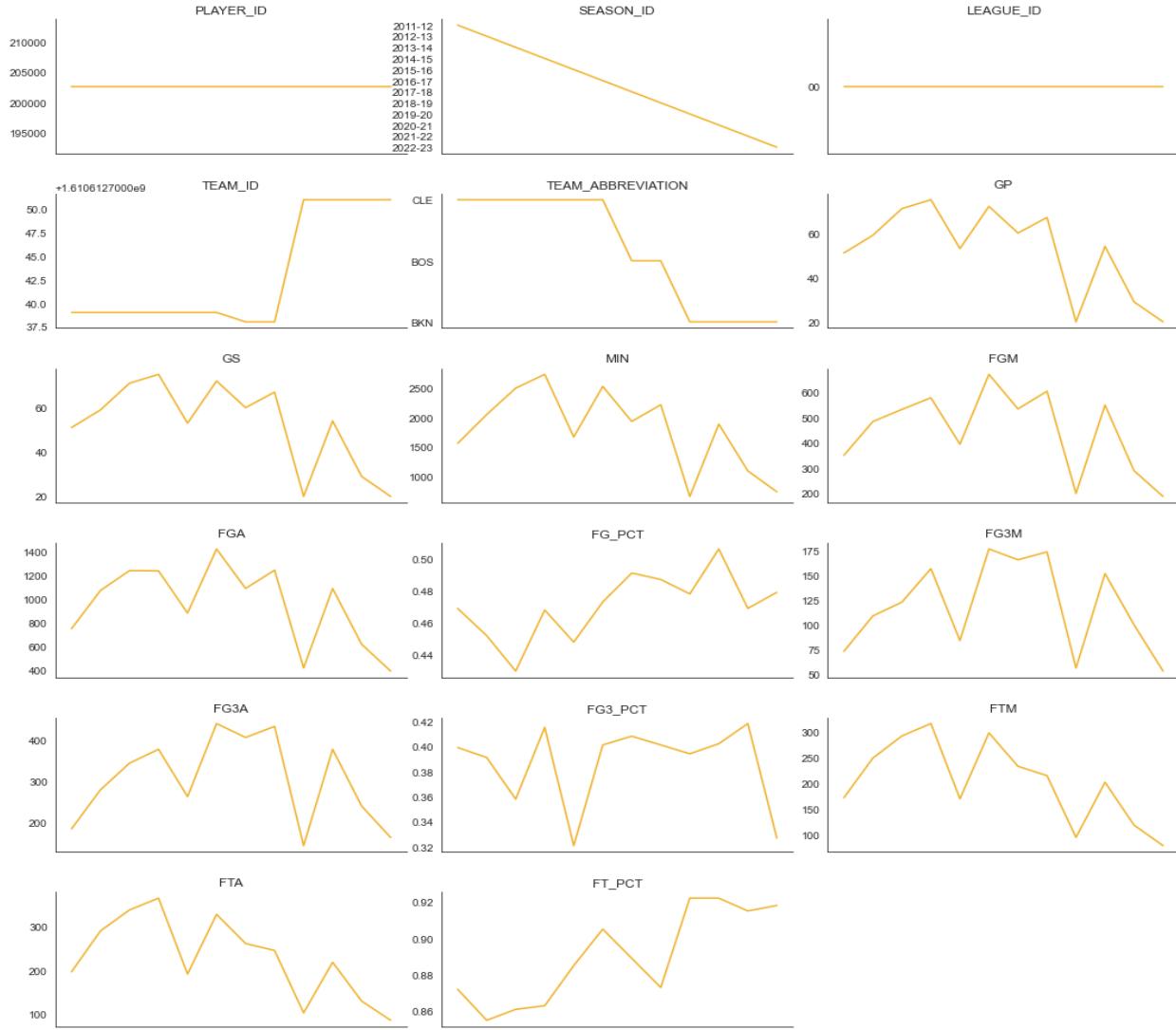


We created a dashboard to visualize players shot hit and miss interactively. Also, the zone on the court is also visualized like mid range, above the break 3, inside the break 3, inside the paint(near hoop). Data visualization technologies that enable direct change of components on a graphical plot are used to create interactive visualizations. The goal is to design graphs and charts that the end user may actively examine and modify as opposed to passively reading. In essence, interactive data visualization has an advantage over static representations of data in that it provides tools for interacting with the data displayed in real time, enabling the end user to see more details, produce new insights and questions, and squeeze more juice out of the available data sets.

- Player's attribute visualization

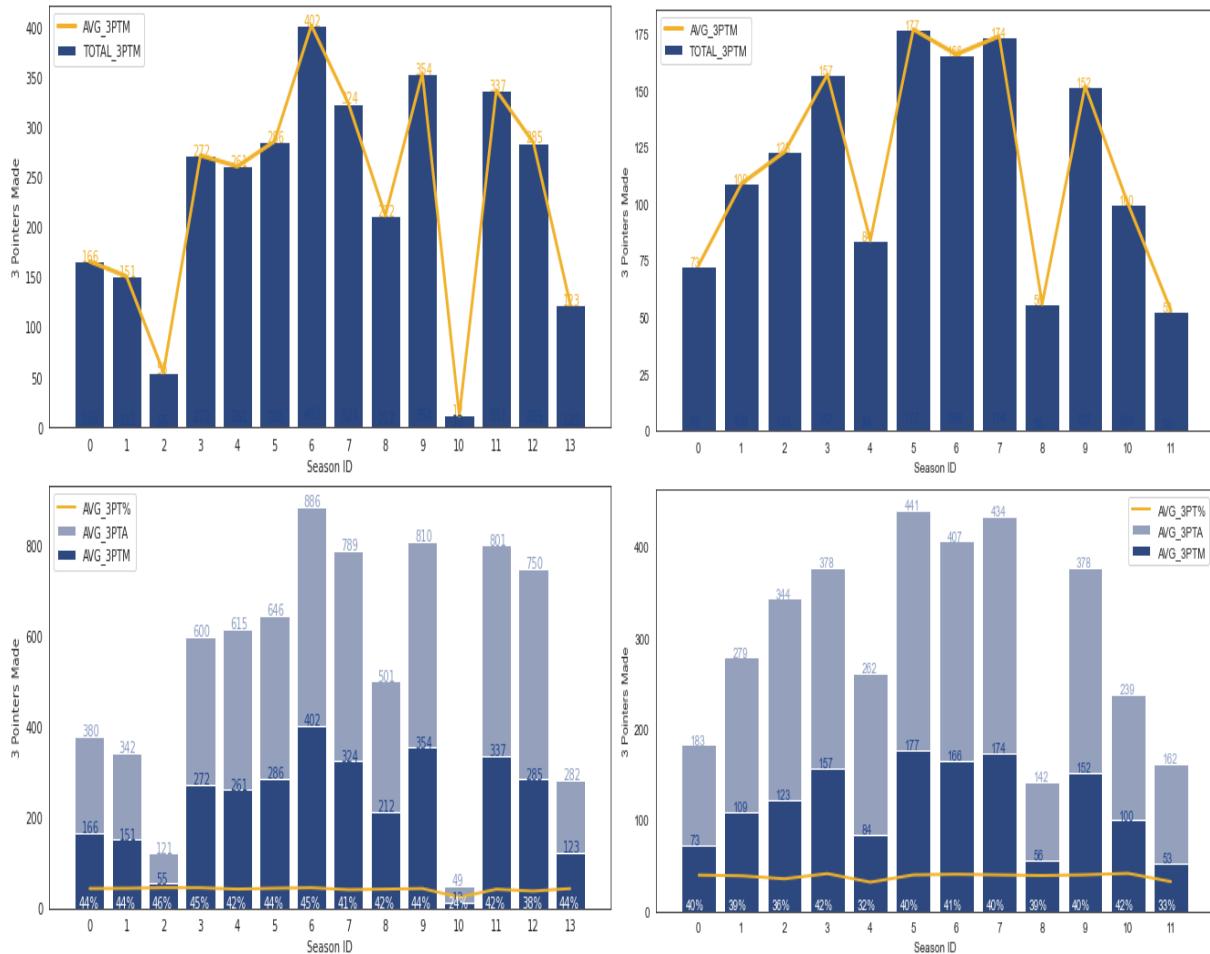


The above visualization represents the line plot visualizations of various statistical attributes of Stephen Curry. Line graphs are helpful in that they clearly display data factors and patterns and can aid in forecasting the outcomes of yet-to-be-recorded data. Additionally, they may be used to contrast many dependent variables with a single independent variable. For the sport of basketball, several statistics are recorded. Statistics are a useful tool for evaluating your performance in sports and identifying your strongest areas. They may also assist in identifying areas for improvement for both you and your group. Of course, one of the most significant game statistics is scoring. From the above visualizations, we can interpret that Stephen Curry shooting statistics have constantly improved from season to season.



The above visualization represents the line plot visualizations of various statistical attributes of Kyrie Irving. From the above visualizations, we can infer that Kyrie's Free throw percentage and Field Goal percentage have been constantly improved from season to season which is very important since free throws shooting is an easy way to generate points for the team.

- Average 3 pointers made vs Total 3 pointers made

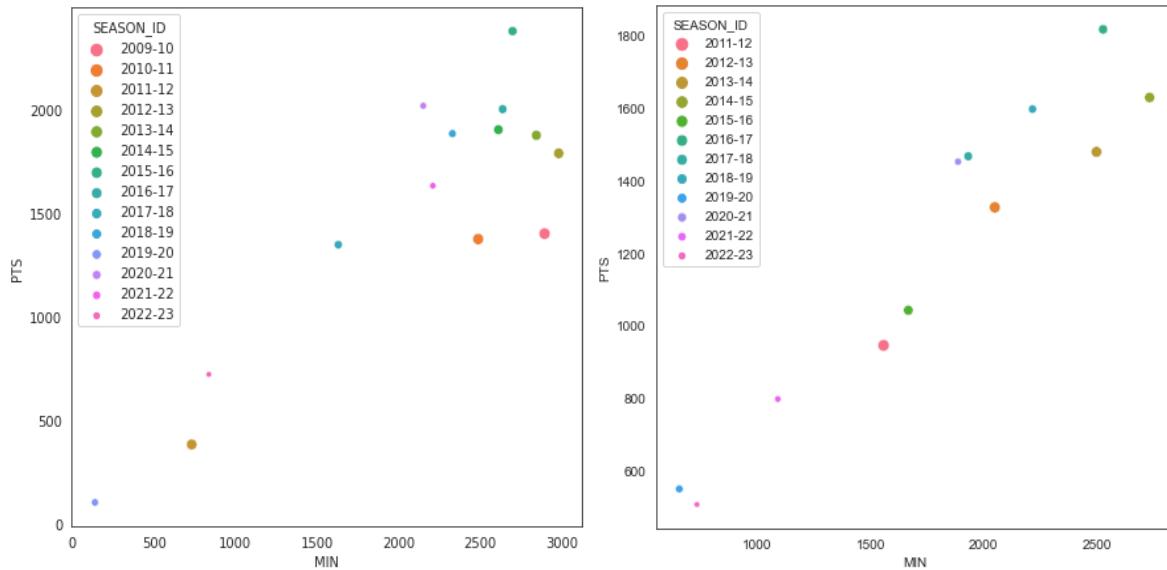


We visualized this with the combination of line plot and stacked bar plot. A stacked chart is a type of bar chart that displays the comparison and composition of a small number of variables through time, whether they be relative or absolute. These charts, sometimes known as stacked bars or columns, have the appearance of a number of columns or bars that have been layered on top of one another. When used properly, stacked charts are a really powerful tool for comparisons. They are made to compare sum values between different groups.

The graph in the top represents a combination of bar plot and line plot. Where the bar represents the total 3 pointers made and the line graph in yellow color represents the average 3 pointers made. Whereas the graph in the bottom represents average 3 pointers percentage, average 3 pointers made and average 3 pointer attempts. From the above visualizations we can clearly interpret that Stephen Curry has more average 3 point percentage when compared with Kyrie

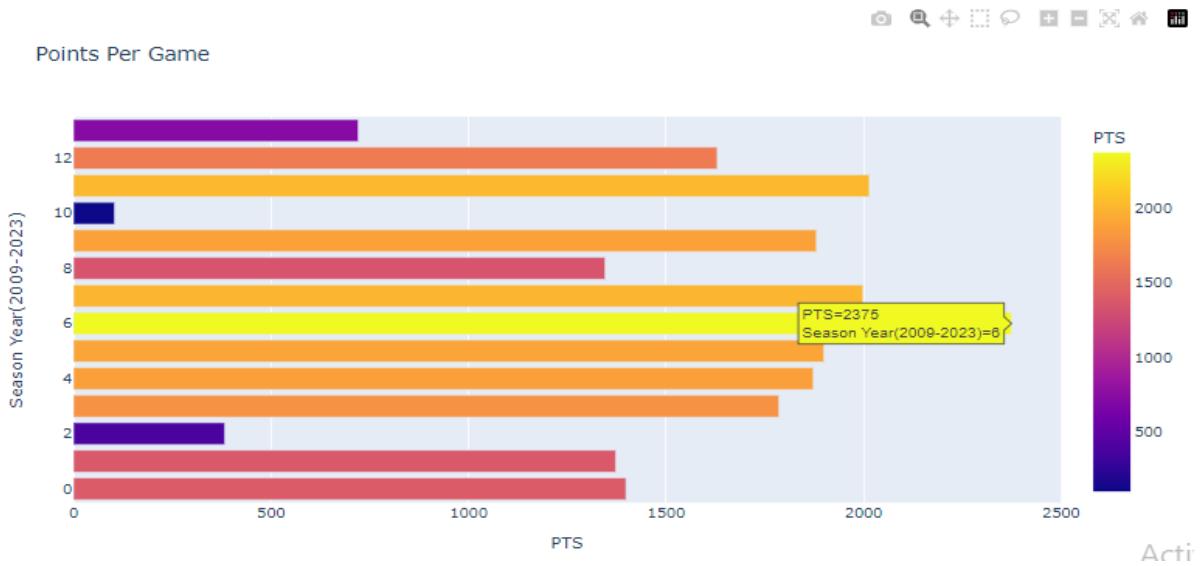
Irving and Kyrie Irving's 3PA to 3PM ratio is very less which is a drawback in terms of scoring ability.

- Minutes played vs Points scored

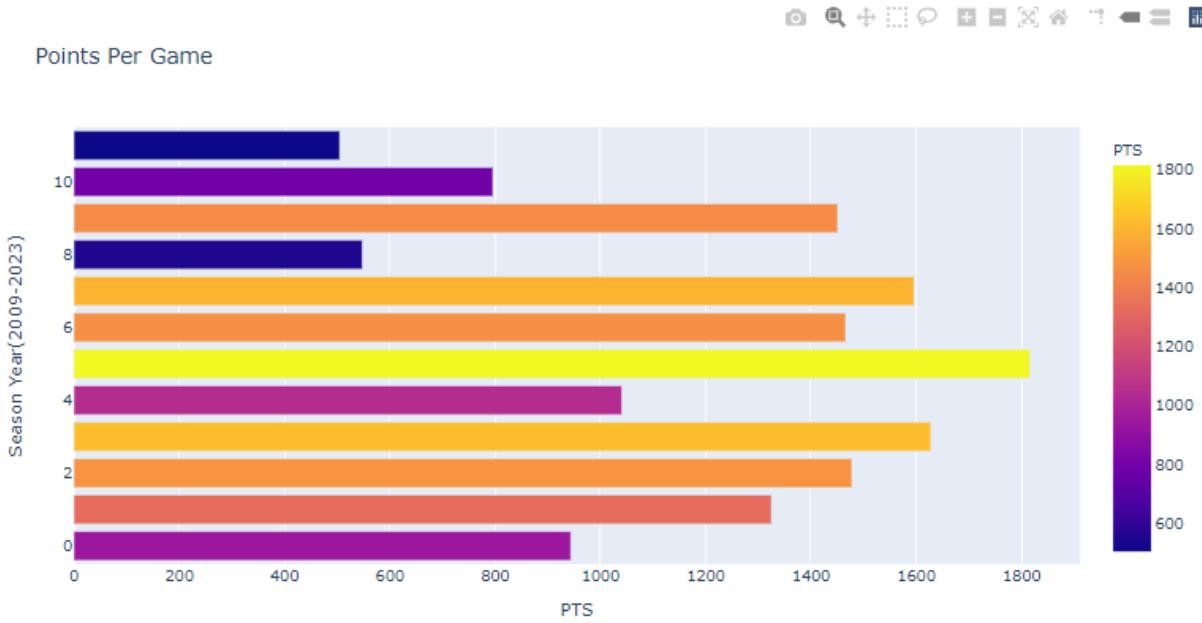


This above visualization represents a Scatter plot between number of minutes played and the points scored done using Seaborn. This is a very useful visualization because the player's usage percentage is dependent on this attribute. It is always good to contribute more points even if the minutes played is less. In this field, both the players performed well and Curry has a slight advantage since the number of points scored by him is more as we can see in the scale of y-axis on the left chart.

- Points per game



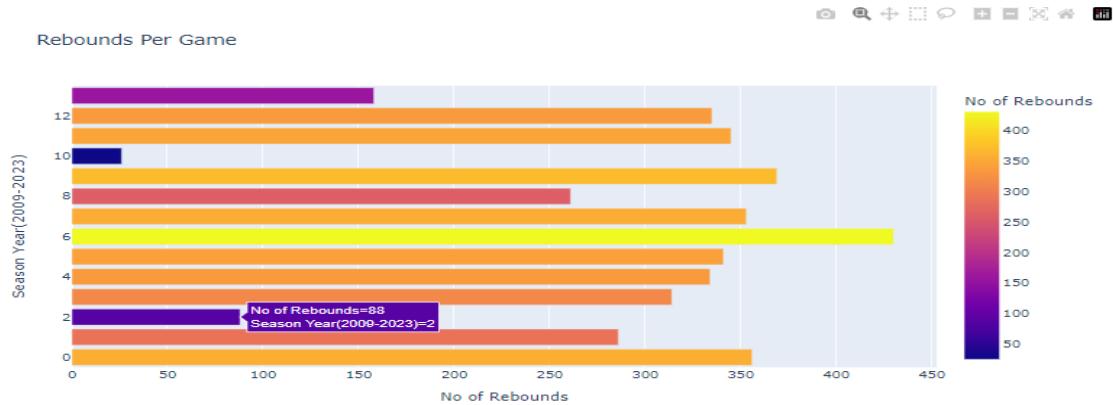
The above visualization represents an interactive horizontal bar plot of the number of points scored per game by Stephen Curry.



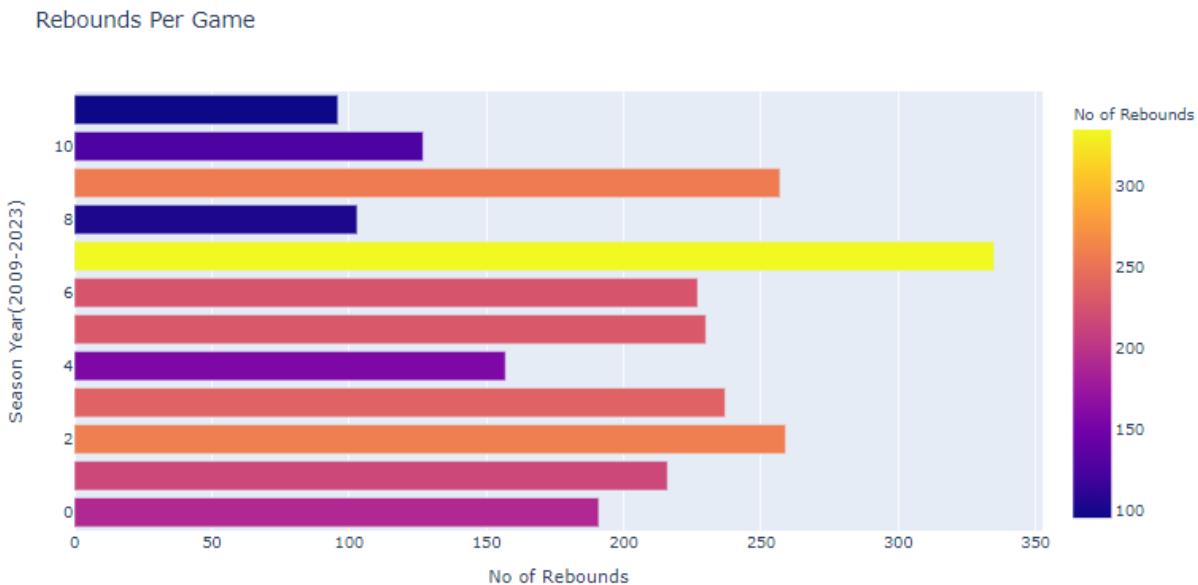
The above visualization represents an interactive horizontal bar plot of the number of points scored per game by Kyrie Irving. Points scored per game is a very important factor in determining the player's contribution to the team score and also the player's performance in that season. The more the number of points scored per game, the better is the player's performance in that season. This attribute helps to find the weak zones of the player and train them accordingly.

Here, in our case, Stephen Curry scored more points for a given season. His contribution to the team scoring is great and it motivates other players to perform well.

- **Rebounds per game**



The above visualization represents an interactive horizontal bar plot of the number of rebounds per game by Stephen Curry.



The above visualization represents an interactive horizontal bar plot of the number of rebounds per game by Kyrie Irving.

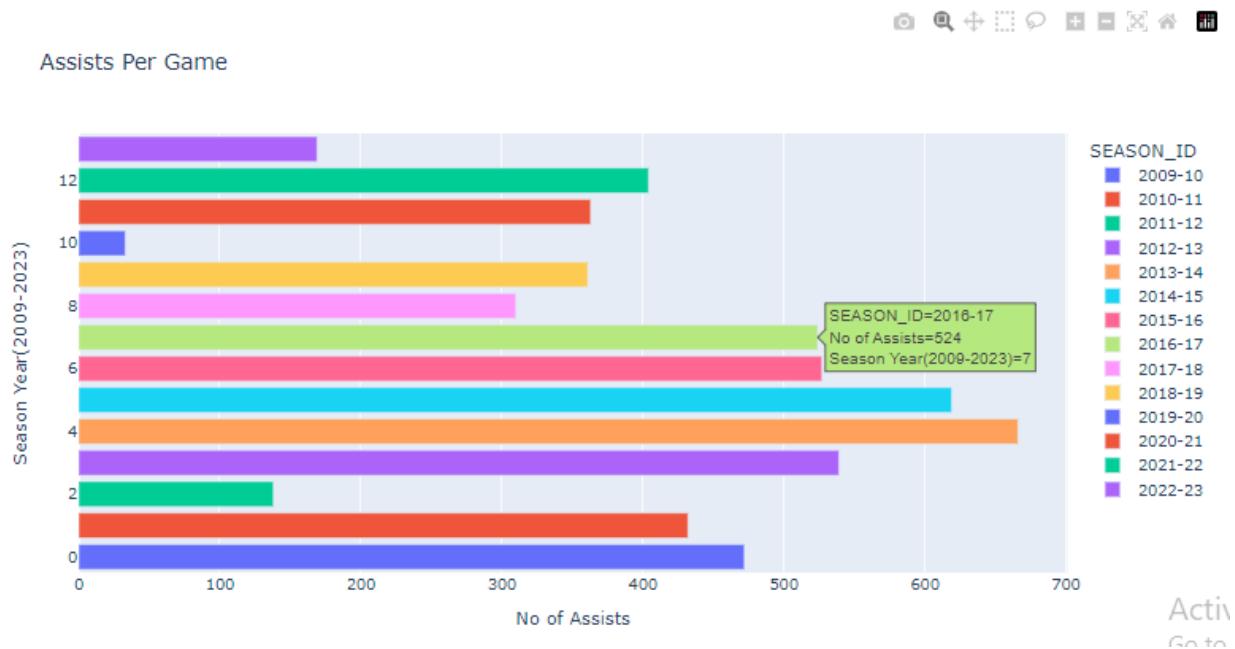
Any missed shot that is not cleared by a single player results in a rebound for the team that receives it. One of the most crucial aspects of the game of basketball is rebounding. Each time a team gains control of the ball through rebounding, its offense, defense, and overall ability to win

basketball games are all aided. There are two types of rebounding. Offensive rebounding and Defensive Rebounding. Offensive rebounding is considered when a player grabs the ball after a missed shot by his teammate. Whereas, a defensive rebounding is taken into account when a player grabs the ball after a missed shot by his opponent team player. Total rebounds is a combination of both offensive rebounds and defensive rebounds. It is a very important scoring factor for the team because the player can immediately attempt for a shot and add score to the team. There are many scenarios in which a match has been won due to rebounds.

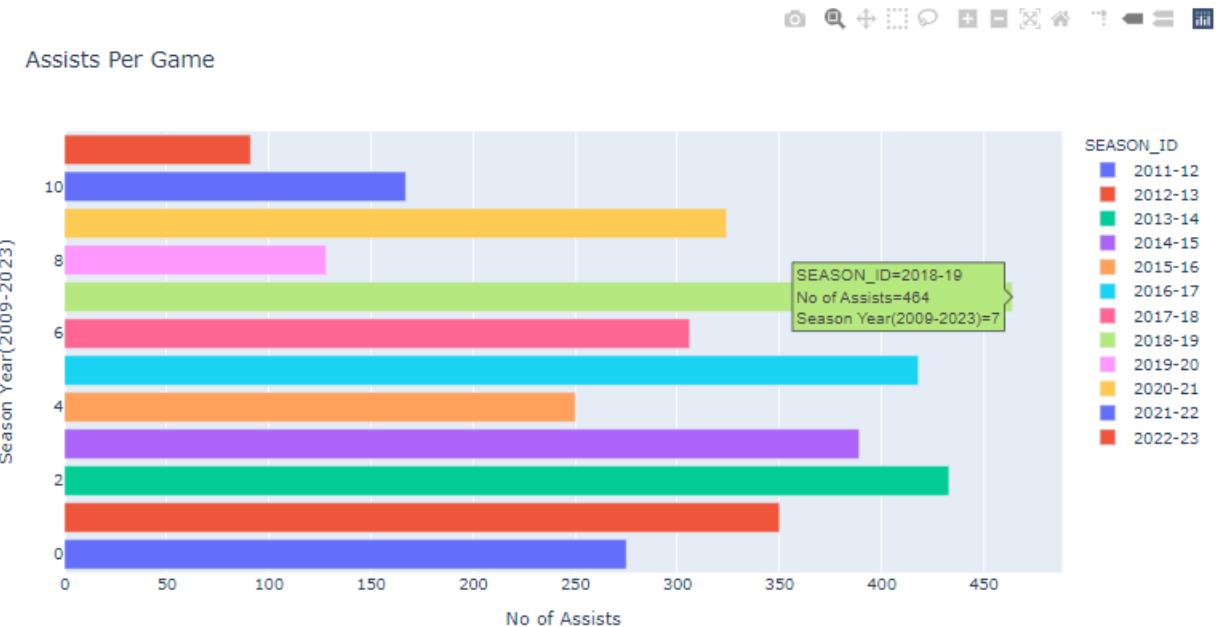
From the above two visualizations, we can interpret that Curry has taken more rebounds for most of the seasons when compared to Kyrie Irving.

- **Assists per game**

A player receives an assist in the NBA when he passes the ball to another player who subsequently makes a basket. Basketball assists are a crucial metric that appear in the box score throughout a game. Any fantasy basketball owner must also grasp what an assist is.



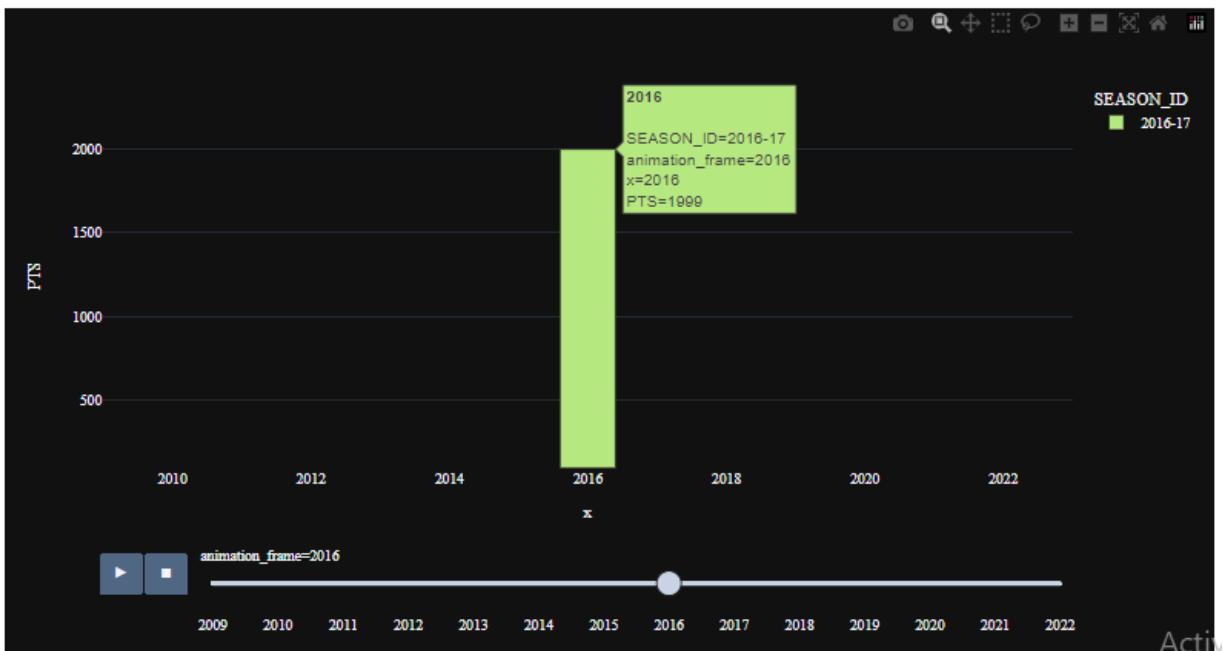
The above visualization represents an interactive horizontal bar plot of the number of assists per game by Stephen Curry.



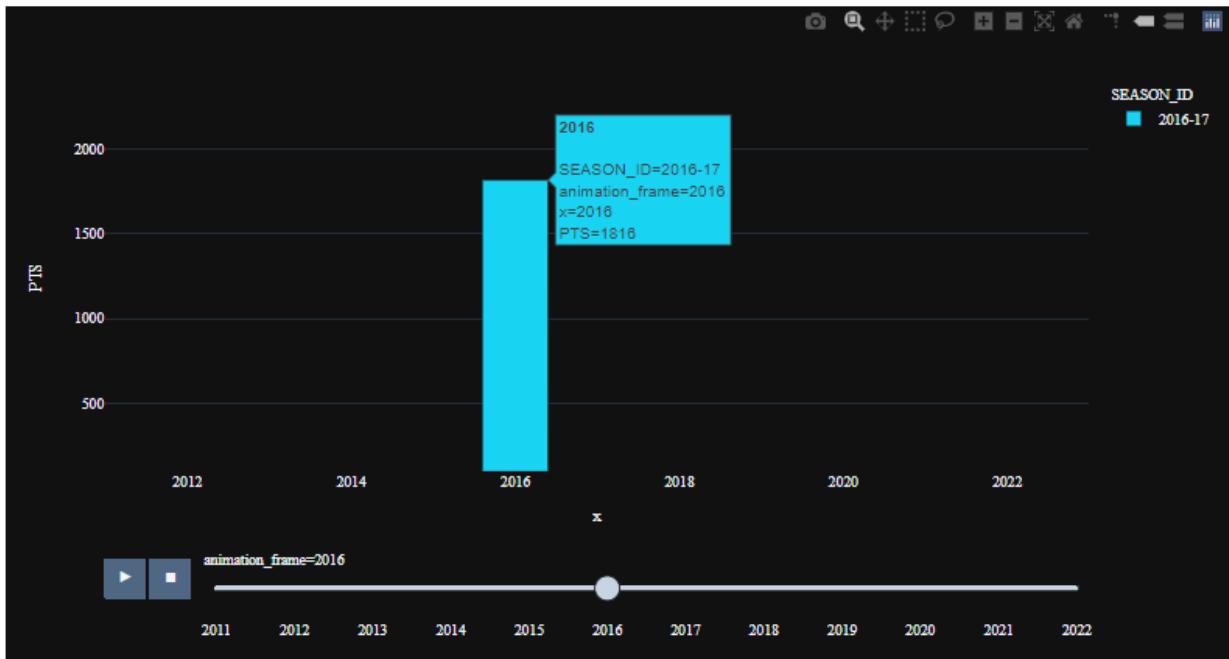
The above visualization represents an interactive horizontal bar plot of the number of assists per game by Kyrie Irving.

From the above two visualizations, we can interpret that Stephen Curry has more assists per game for the majority of the season when compared to Kyrie Irving. The important question here is “Is it possible for a player to assist and score on the same play?” No, according to the official definition, the pass must be made to a teammate. Even if you can hurl the ball against the wall and score, you won't get a goal and an assist on that play.

- **Animated and Interactive visualization**



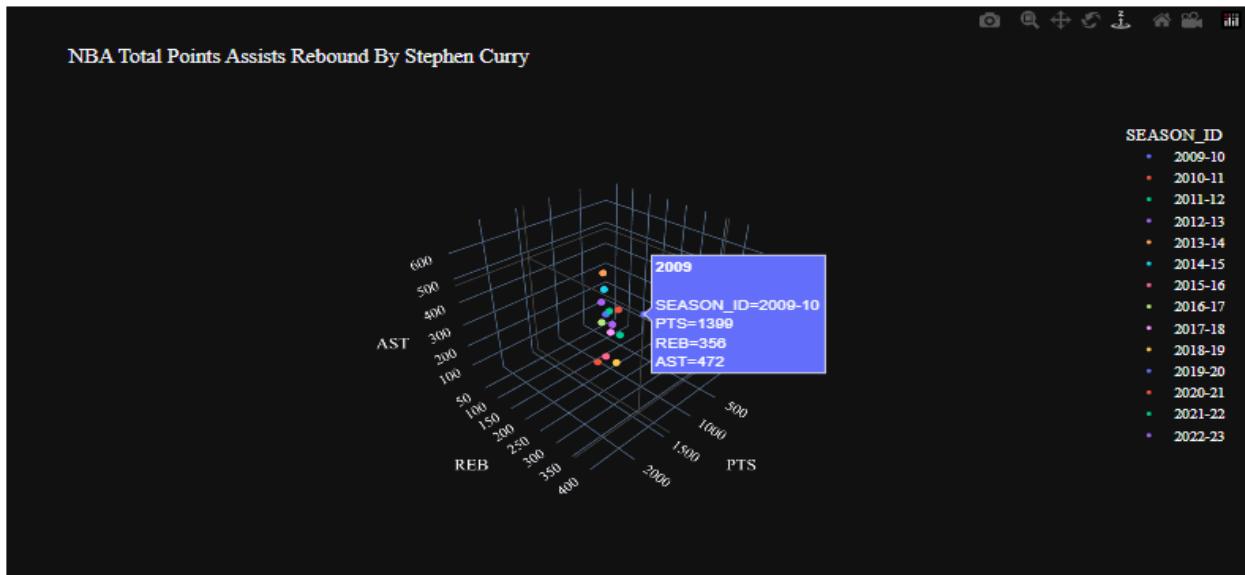
The above visualization is an animated and interactive visualization for points scored in a particular season by Stephen Curry.



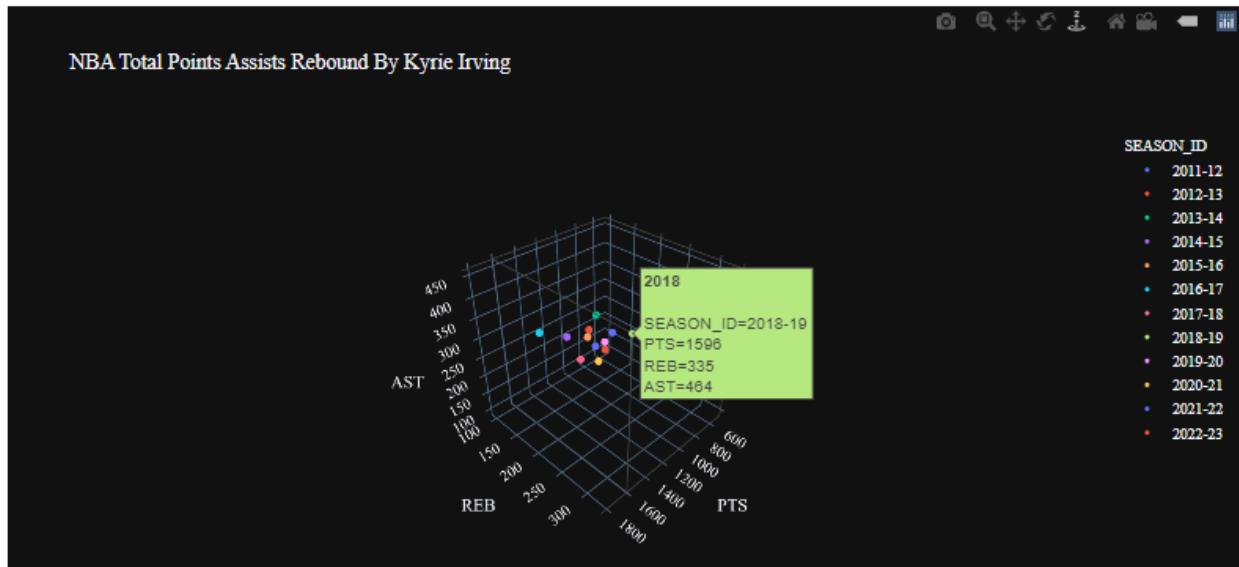
The above visualization is an animated and interactive visualization for points scored in a particular season by Kyrie Irving.

The slide bar for hovering used here is the season(year) in which the game is played. Animated visualizations give us a clear picture of individual season's statistics.

- **3D visualization**



The above 3 dimensional visualization is done by taking 3 parameters which are Points, Rebounds and Assists for a particular season by Stephen Curry.

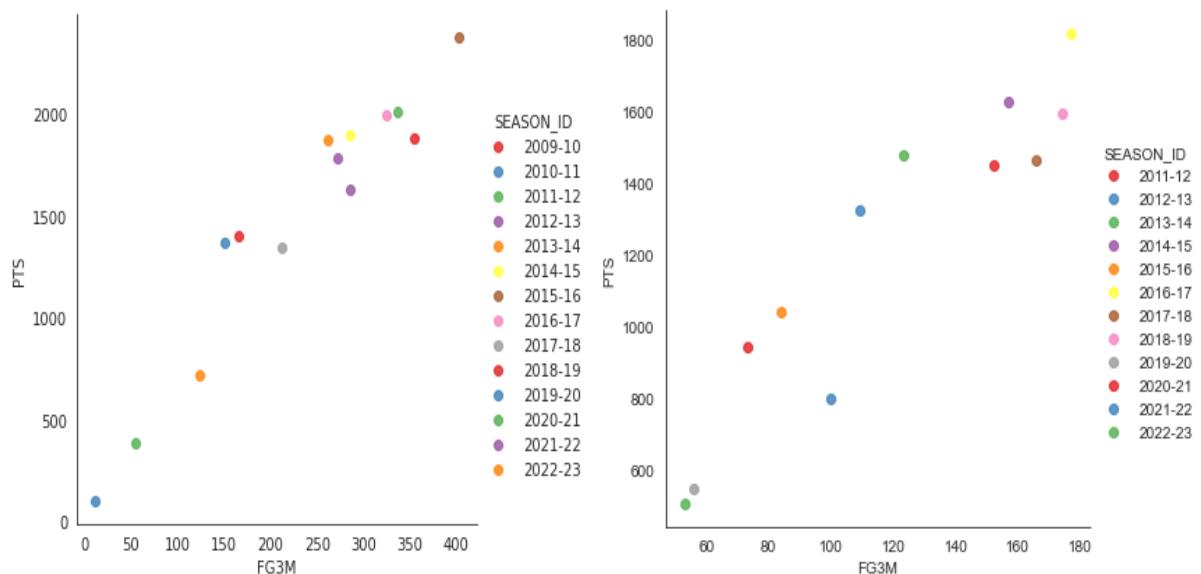


The above 3 dimensional visualization is done by taking 3 parameters which are Points, Rebounds and Assists for a particular season by Kyrie Irving.

The main advantage of these kinds of visualizations is that the manager, scout or coach can just analyze the player's performance in that season by just looking at all the three important attributes at a single glance.

- **Correlation between Points and 3 points scored**

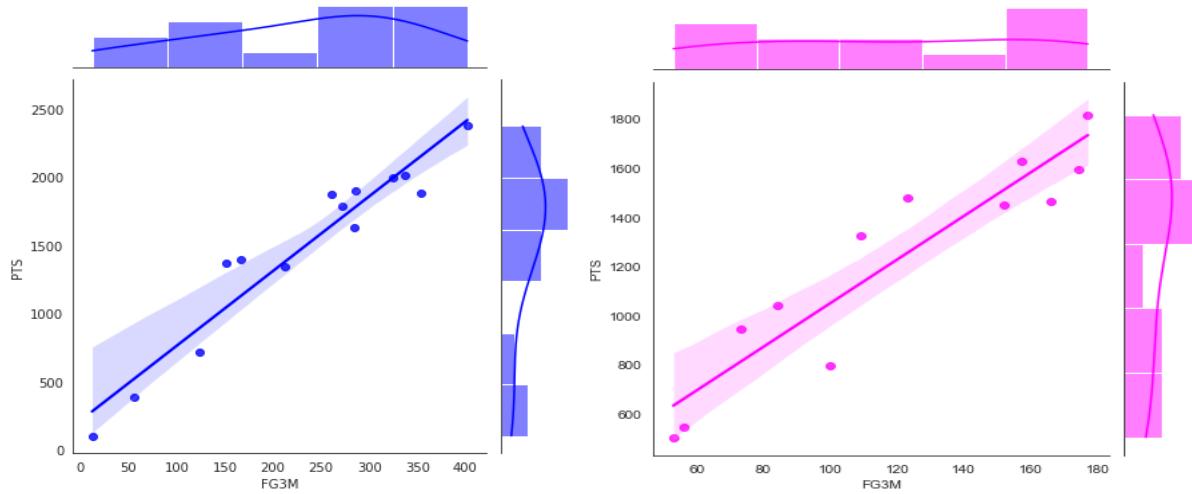
A statistical metric known as correlation describes how closely two variables are connected linearly (meaning they change together at a constant rate). It's a typical technique for expressing straightforward connections without explicitly stating cause and consequence.



The graph on the left side is the correlation plot between the number of 3 pointers scored against total points for Stephen Curry and the graph on the right side is the correlation plot between the number of 3 pointers scored against total points for Kyrie Irving.

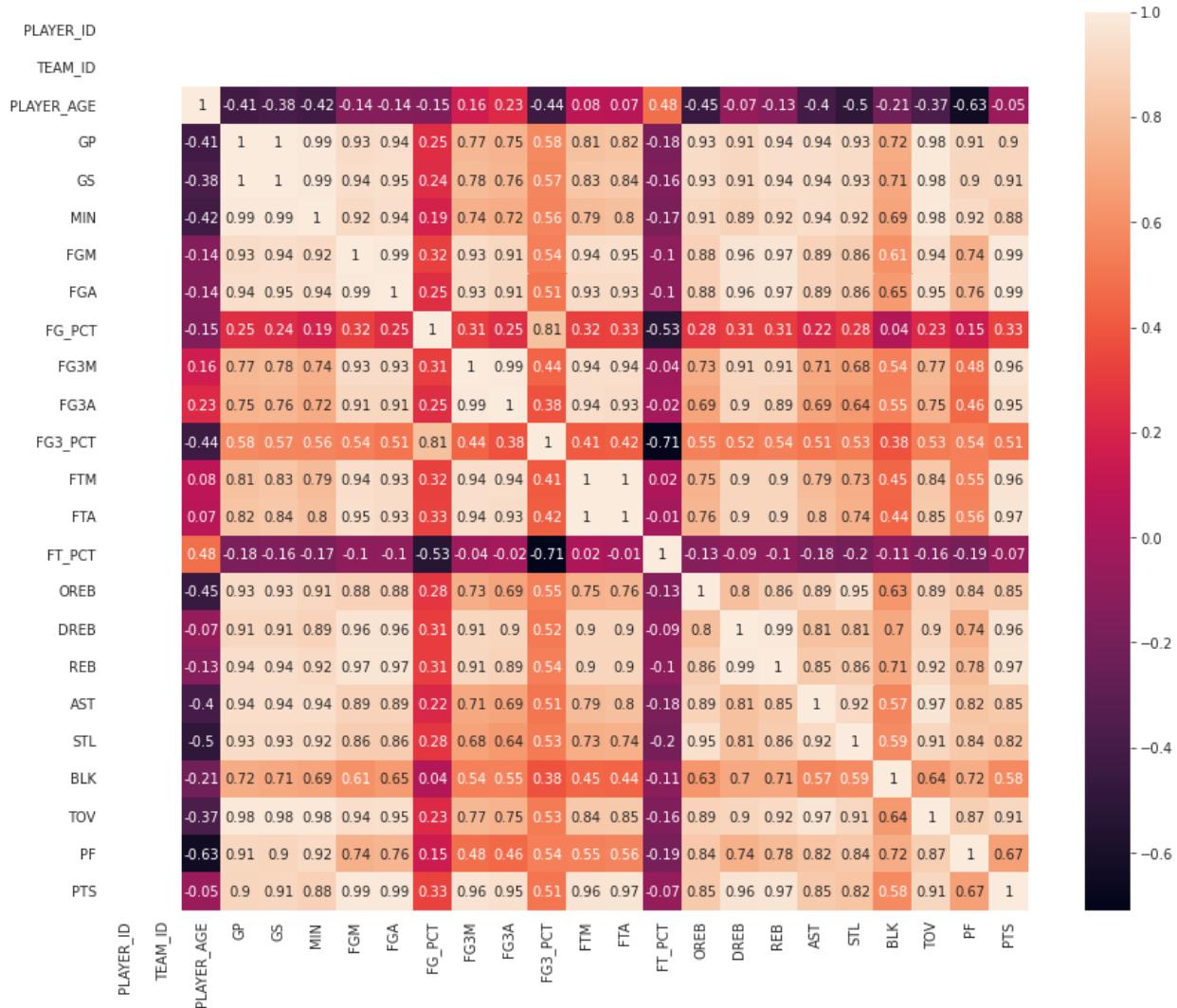
From the above two graphs, we can interpret that out of the total number of points scored by Stephen Curry, majority of the points are from 3 pointers made. Whereas, on the other hand, out of the total points scored by Kyrie Irving, only a few points are from 3 pointers made.

- **Join plot**



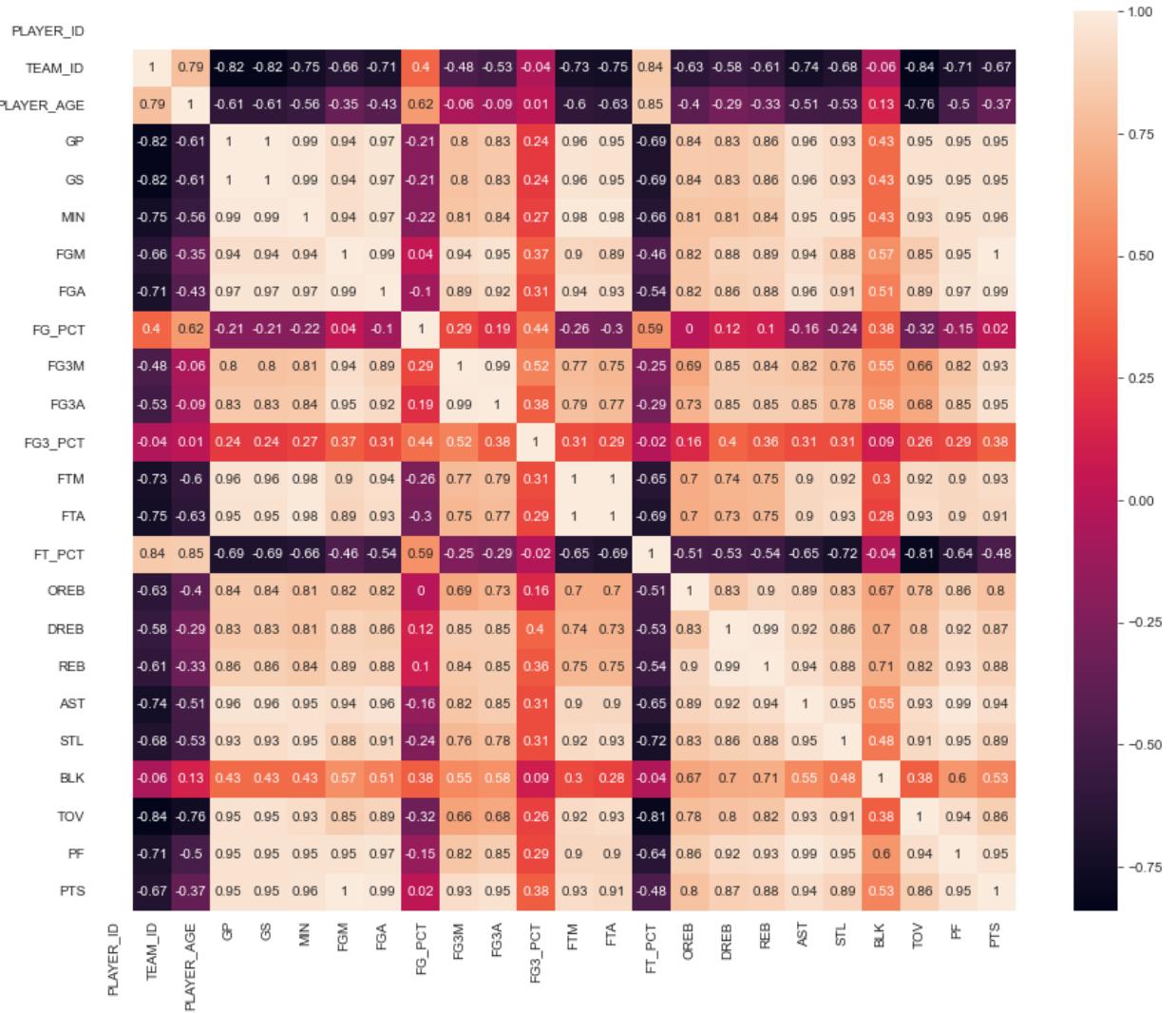
The above visualization represents a joint plot of Correlation between number of 3 pointers made and total points of both the players and marginal histograms with linear regression model fit.

- **Heatmap of correlation matrix**



The above visualization is a heatmap of correlation matrix for all the parameters taken into consideration for Stephen Curry.

A correlation matrix is a table that shows the correlation coefficients for various variables. The correlation between all potential pairings of values in a table is shown in the matrix. It is an effective tool for compiling a sizable dataset and for locating and displaying data patterns.



The above visualization is a heatmap of correlation matrix for all the parameters taken into consideration for Kyrie Irving.

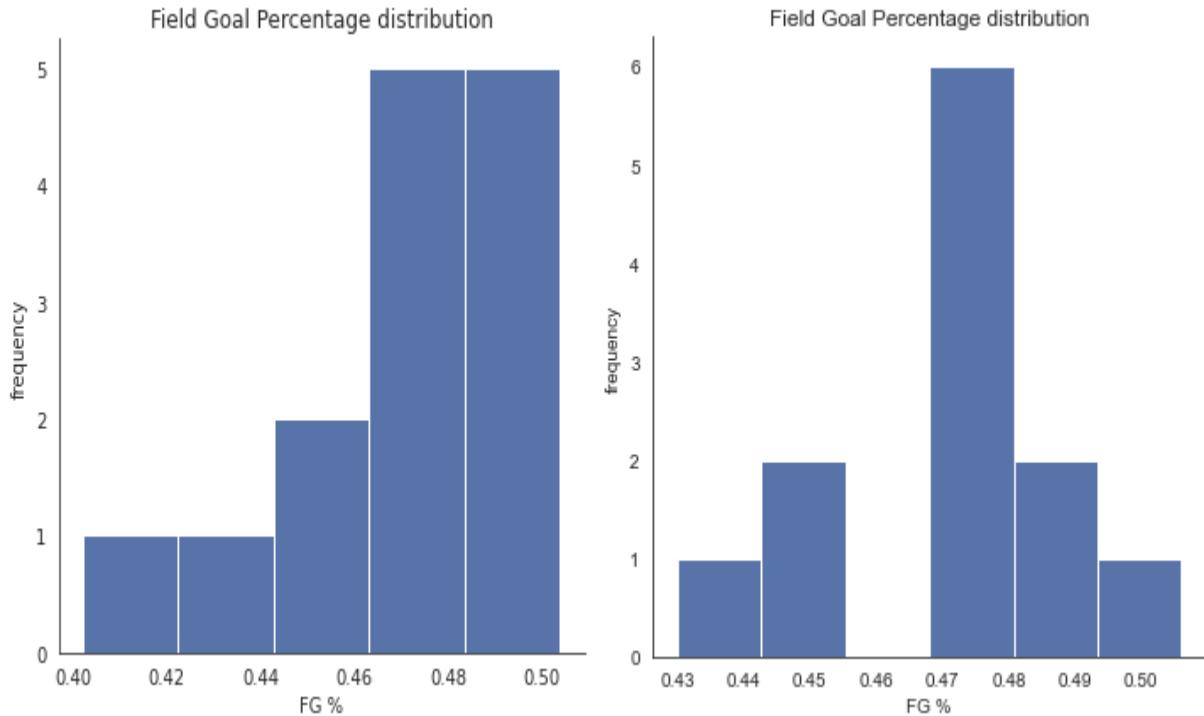
A correlation matrix should be computed for the following three general reasons:

To compile a lot of data with the intention of finding patterns. The observable pattern in the aforementioned example is that all the variables have a strong correlation with one another.

To include in additional analysis. For instance, when removing missing values pairwise in linear regression, structural equation models, and exploratory and confirmatory component analyses, correlation matrices are frequently used as inputs.

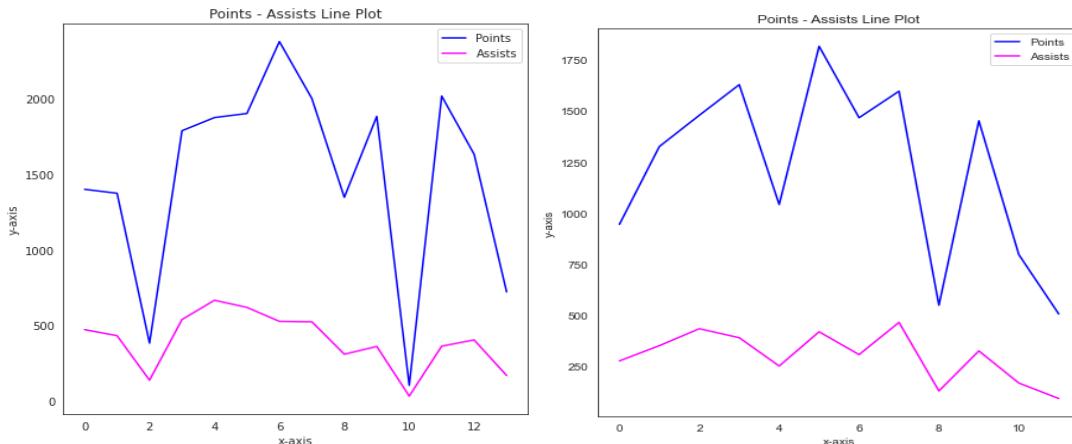
For diagnostic purposes while examining other analyses. If there are many correlations, for instance, it is likely that the linear regression estimations will not be accurate.

- **Field Goal percentage distribution**



The above two visualizations represent the field goal percentage distribution across various seasons of the game. Field goal percentage is a ratio of field goal made and field goal attempts. This is a very important factor in analyzing a player's scoring ability. The more the percentage, the better is the player's performance in the game. From the above visualizations, we can interpret that Field goal percentage is almost similar for both the players which is a positive sign for the player as well as the team.

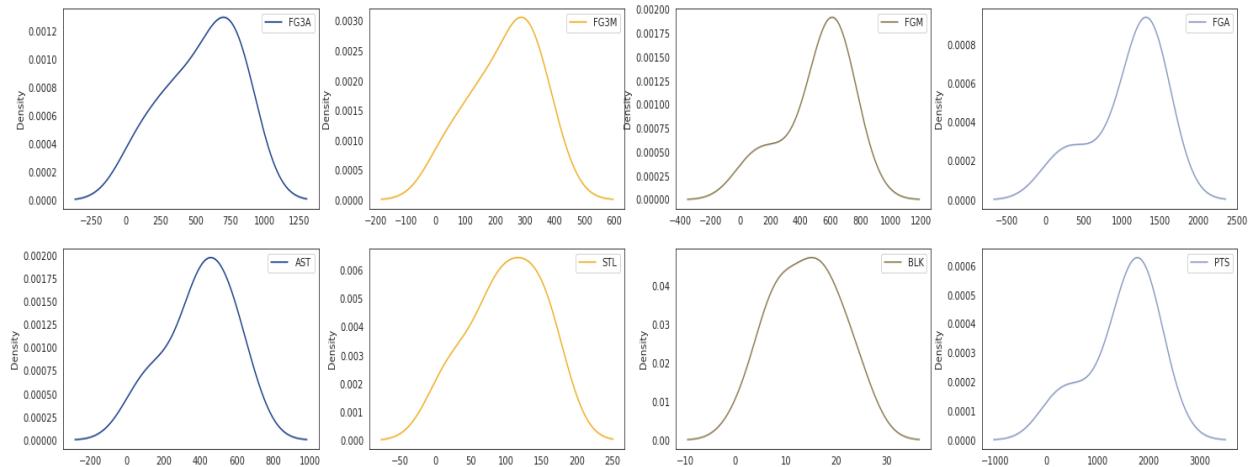
- **Points and Assists Line plot**



The above two visualizations represent a combined line plot of assists and points where blue line represents the total points in that season and magenta line represents the number of assists.

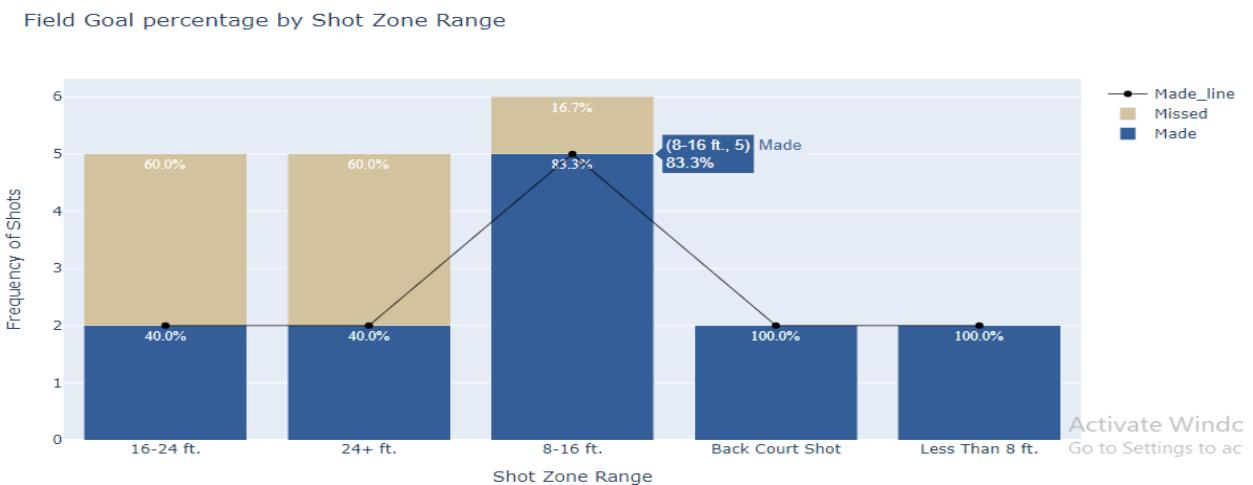
This visualization helps us to identify the relation between number of points and assists which has to be more for a player in order for the team to score better.

- **Density plot**



The above visualization represents the density plot of a few statistics of the players. A density plot can be seen as an extension of the histogram. The density plot can smooth out the distribution of values and reduce the noise. It visualizes the distribution of data over a given period, and the peaks show where values are concentrated.

- **Field Goal percentage by shot zone range**



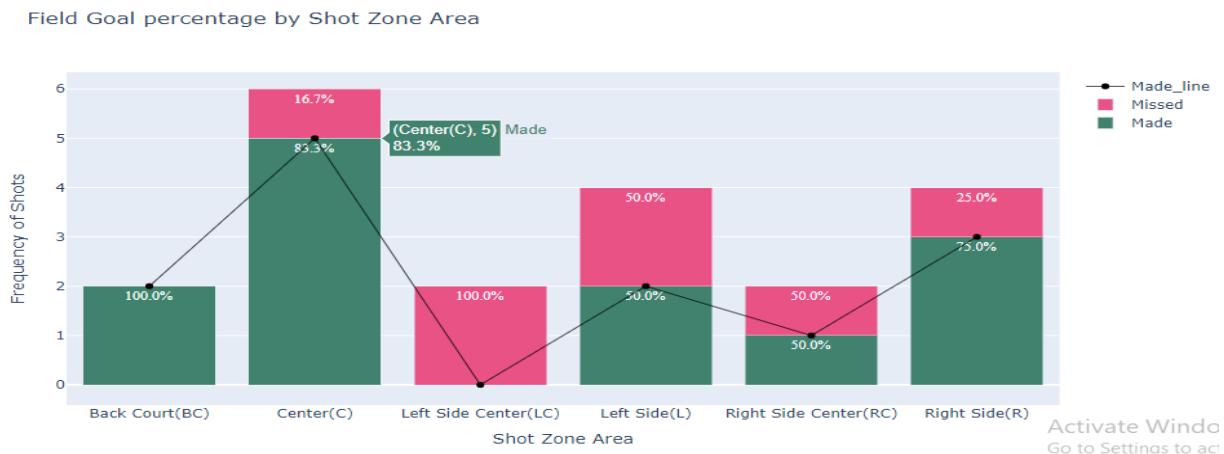
The above visualization represents the Field goal percentage by shot zone range of Stephen Curry.



The above visualization represents the Field goal percentage by shot zone range of Kyrie Irving.

We implemented a stacked bar graph to show the frequency of shots taken from different ranges on the court and their field goal percentage. This is very useful to determine players' strengths and weaknesses of different distances on the court. We can interpret from the above visualizations that Stephen Curry has a good success rate from various distances on the court. This could be helpful to identify the success rate of buzzer beater shots attempted by players since they can change the fate of the game.

- **Field Goal percentage by shot zone area**



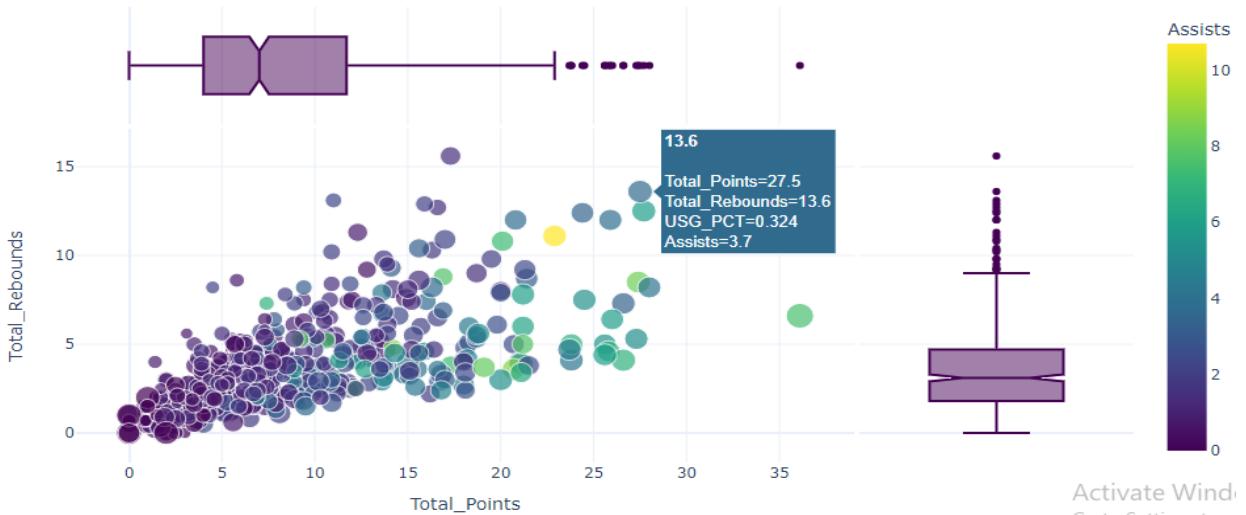
The above visualization represents the Field goal percentage by shot zone area of Stephen Curry.



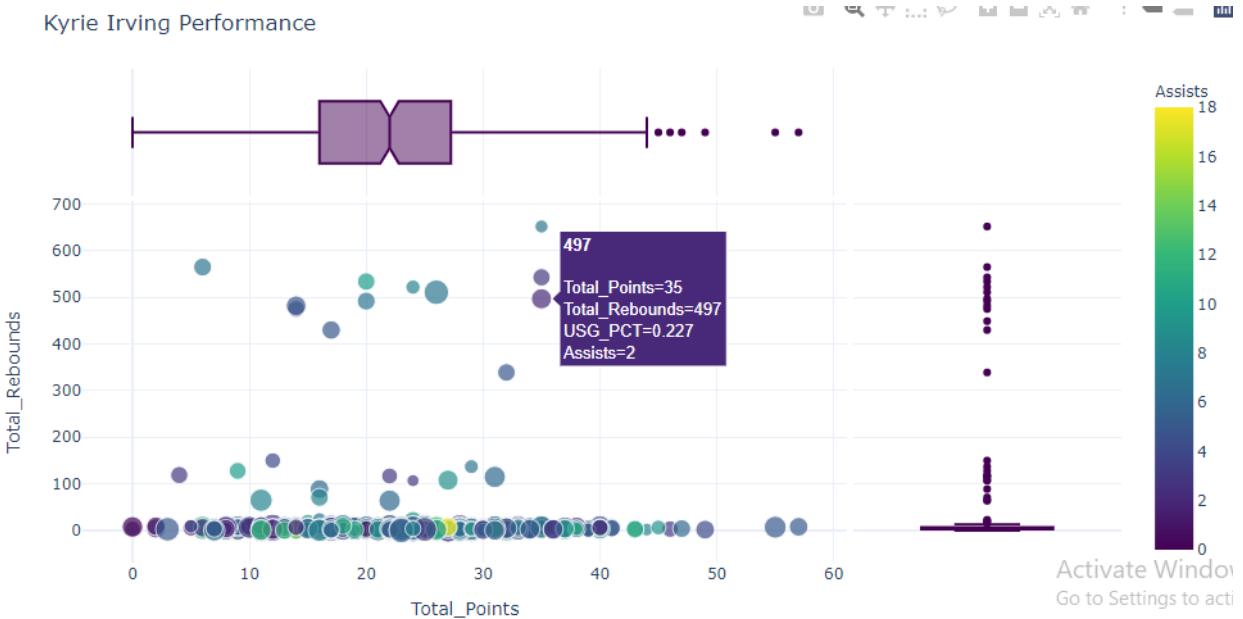
The above visualization represents the Field goal percentage by shot zone area of Kyrie Irving.

We implemented a stacked bar graph to show the frequency of shots taken from different areas on the court and their field goal percentage. This is very useful to determine players' strengths and weaknesses of different zones on the court. We can interpret from the above visualizations that Stephen Curry has a good success rate from Center and Right side zones on the court. Whereas, Kyrie Irving has a good success rate from Center and Left side of the court.

- Interactive Box and Scatter plot



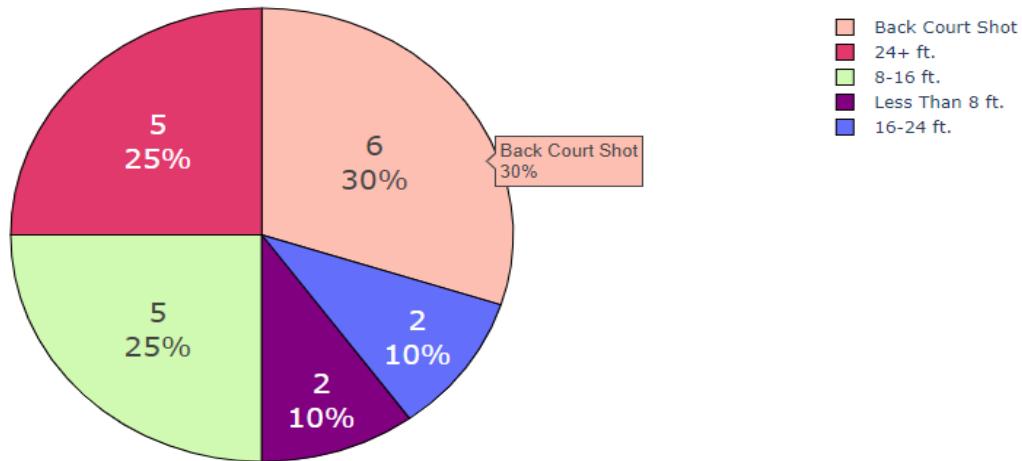
The above visualization is an interactive combination of scatter and box plot of Total points, rebounds, usage percentage and total assists of Stephen Curry.



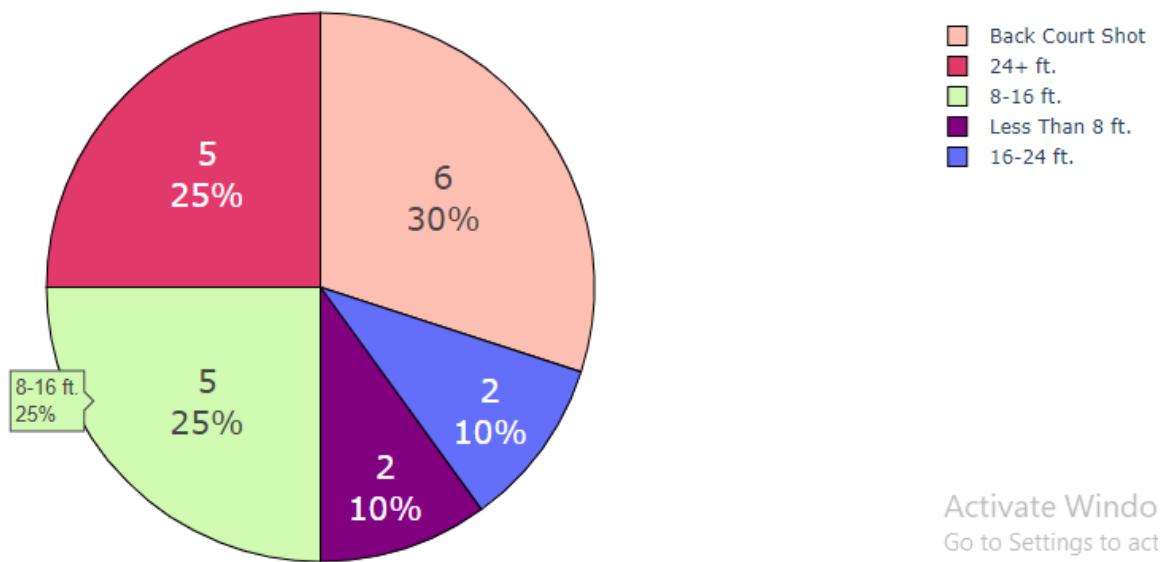
The above visualization is an interactive combination of scatter and box plot of Total points, rebounds, usage percentage and total assists of Kyrie Irving.

In the above visualizations, the scatter plot gives the information about a player's total points, rebounds, usage percentage and assists for a particular game. The box plot gives us the information about the parameter's mean, interquartile range(Q3-Q1).

- **Pie chart of percentage of shot zone distances**



The above visualization represents the pie chart of percentage of shots taken from various distances on the court by Stephen Curry.

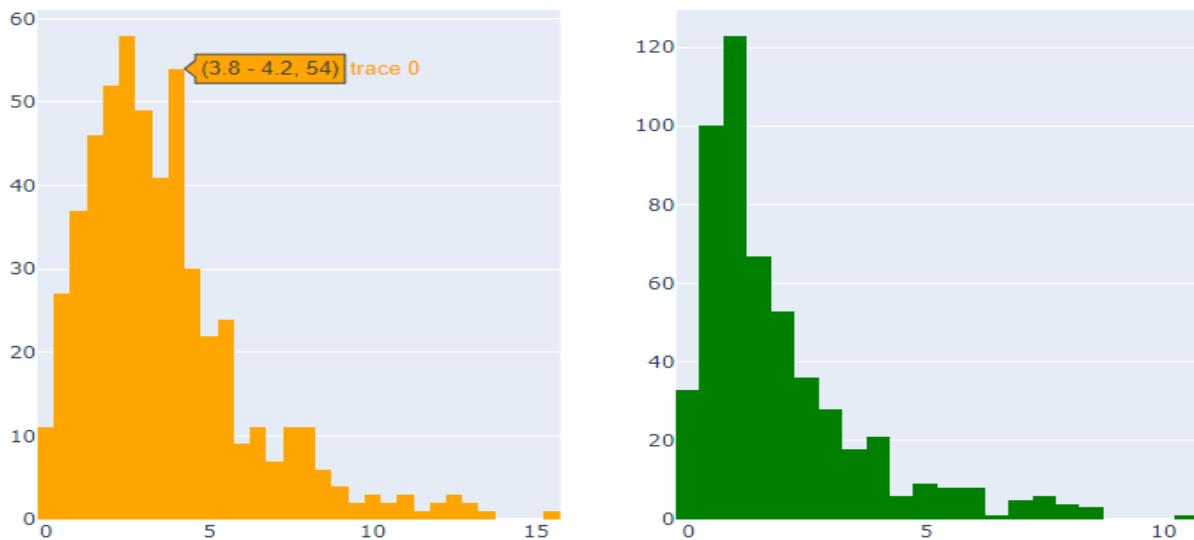


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The above visualization represents the pie chart of percentage of shots taken from various distances on the court by Kyrie Irving.

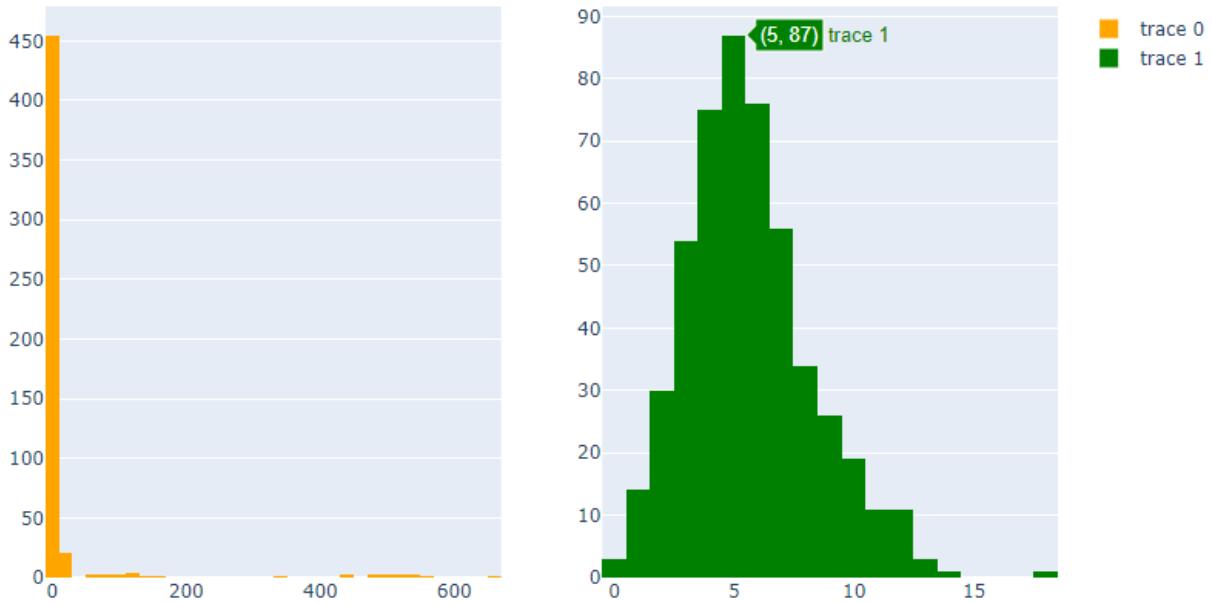
- **Rebounds and points Histogram plot (failed experiment)**

Rebound and Points Histogram plots



The above histograms represent the total points and rebounds of Stephen Curry for a particular game.

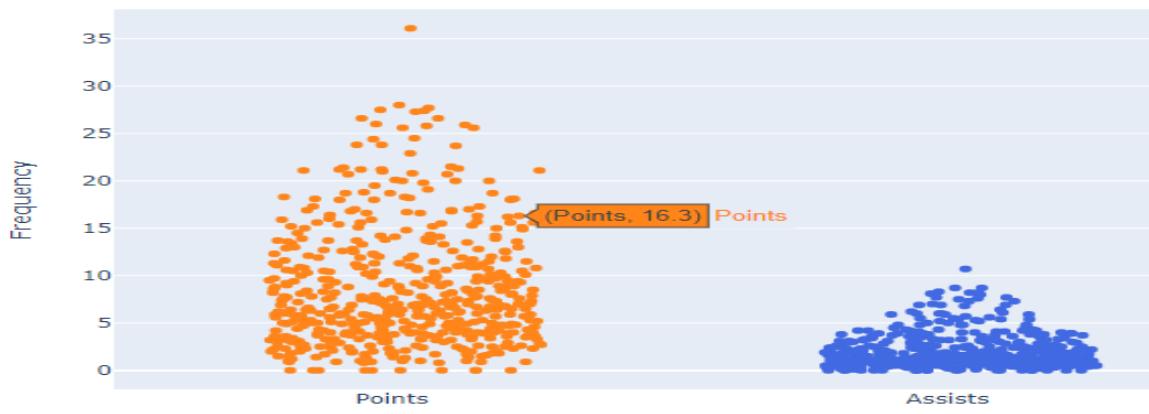
### Rebound and Points Histogram plots



The above histograms represent the total points and rebounds of Stephen Curry for a particular game.

We tried to experiment with a histogram plot against rebounds and points. But, we realized that there is no correlation between both rebounds and points which could be plotted using a histogram. So, we consider this visualization as a failed experiment.

- **Beeswarm plot of points and assists**



The above visualization is a beeswarm plot of total points and assists for each game played by Stephen Curry.

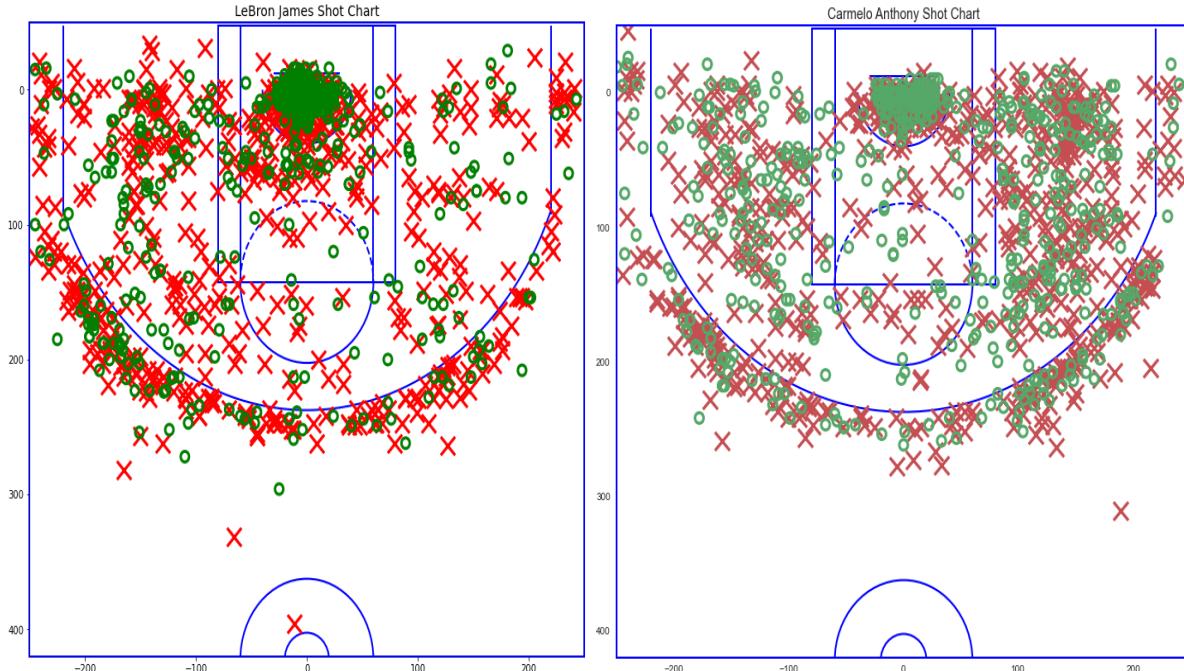


The above visualization is a beeswarm plot of total points and assists for each game played by Kyrie Irving.

The beeswarm plot is made to show a summary of the top characteristics in a dataset and how they affect the model's output in a way that is both information-dense and easy to understand. A single dot is used to indicate each instance of the explanation in each aspect of the figure. Other than the alignment of the data points, the main distinction between a unit histogram and a bee swarm is that a bee swarm usually does not bin the data as I have done here. They often display the data point's real value. As a result, the output of a beeswarm often consists of lines that gradually bend as they approach the ends rather than a group of horizontal lines.

## LeBron James vs Carmelo Anthony

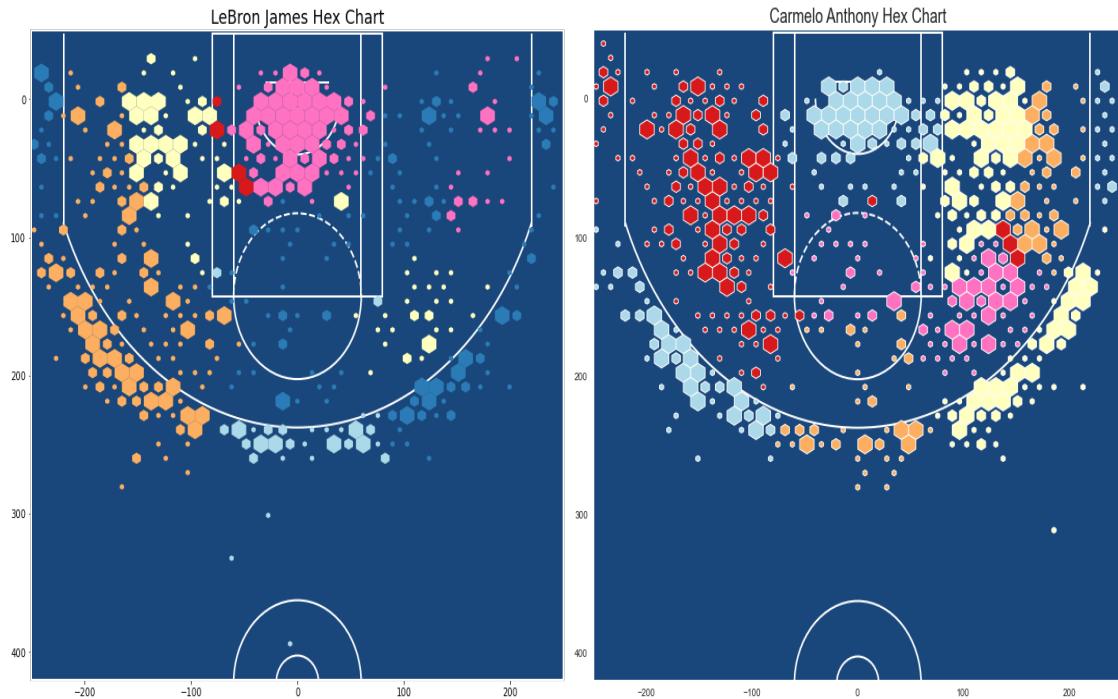
- Player shot hit and shot miss on the court



The above visualizations represent the hit and miss shot chart of LeBron James and Carmelo Anthony . We have used a scatter plot to represent the shot hit and miss for both the players. Where the green circle represents the shot hit of the player, whereas the red cross represents the shot miss of the player. Initially, to obtain this visualization, we drew the basketball court with original dimensions using the draw\_court function in our code with the help of circle, rectangle and arc functions in python. From the above visualizations, we can notice that Carmelo Anthony has attempted more 3 point shots since there are more green circles outside the bigger arc. He was successful in making most of the 3 point shots that he attempted as we can see from the visualization. That is the reason he is one of the best 3 point shooters of all time the game of basketball has ever witnessed. Whereas when we see LeBron James's shot chart visualization, we can clearly notice that his 3 point shooting is not up to the mark as compared to Carmelo's because there are very few green circles outside the bigger arc. While his inside the arc shooting is very good when compared to Carmelo. It is because we can see more green circles inside the bigger arc in LeBron's shot chart visualization. That is the reason, LeBron is considered as a GOAT(greatest of all time) with his remarkable athletic and shot completion skills. He is one such player who can complete the shot from anywhere near the court even with multiple opponents guarding him. So, the main aim of this visualization is to identify the player's strong and weak zones on court. Also, we calculated the Field Goal percentage of both the players and found that LeBron has a FG% of 52.1% and Carmelo has a FG% of 43.4%. We can draw an

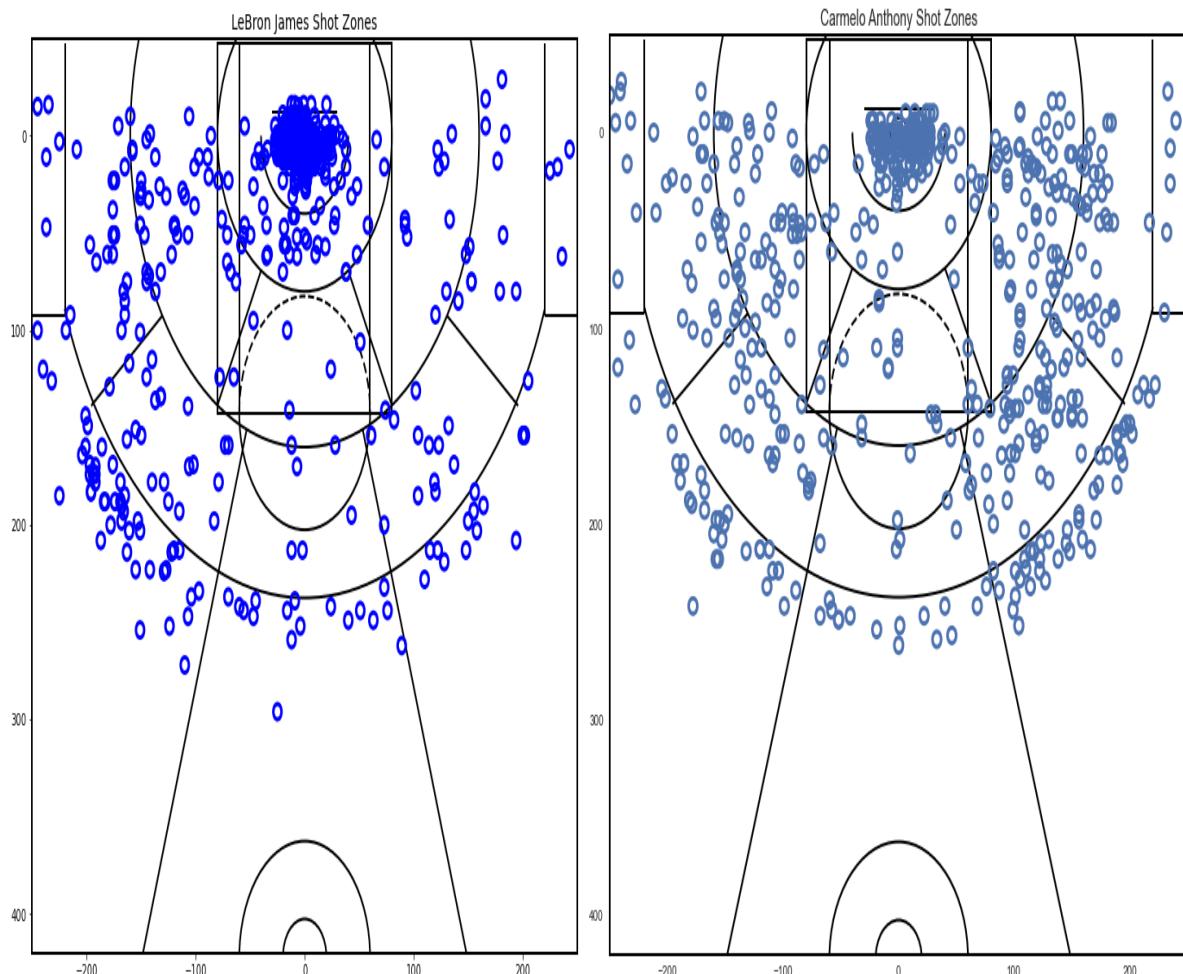
inference that LeBron should improve with his 3 point shooting since it is the game changing statistic in basketball. Whereas, Carmelo should improve his playmaking, defensive and inside shooting skills, since it is not always possible to make a 3 point shot with multiple opponents guarding.

- **Players shot analysis in Hex chart**



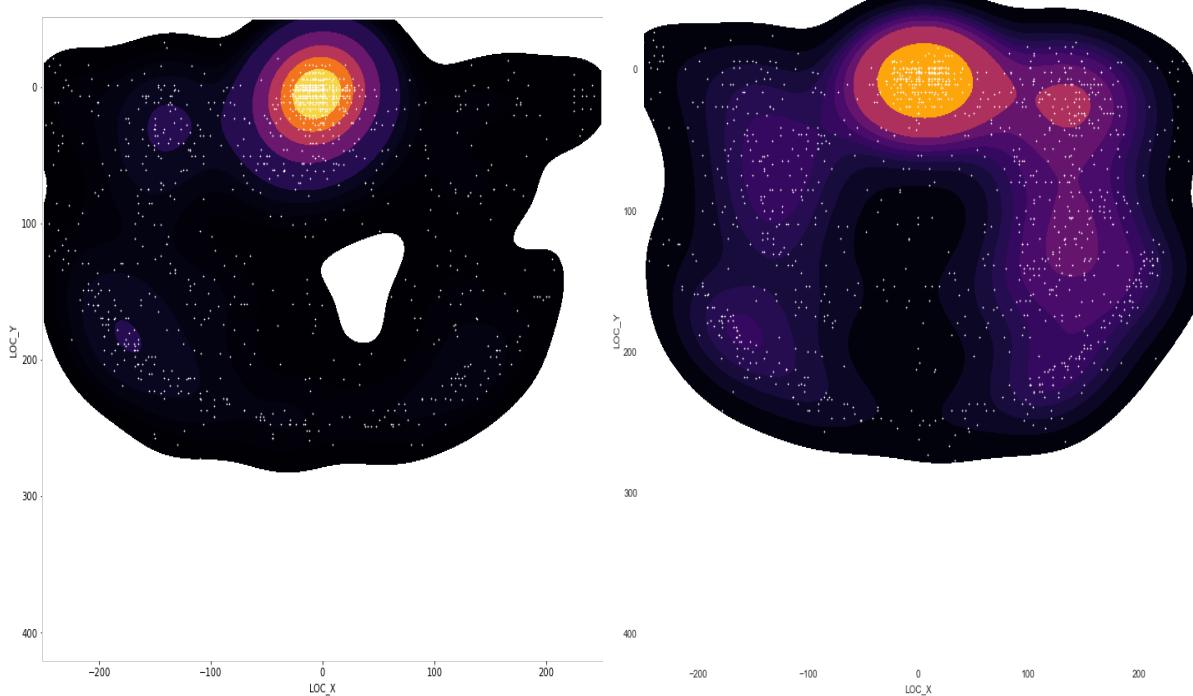
Hex maps, hex boards, and hex grids are all typical game board designs for wargames of various sizes. The map is split into tiny, regular hexagons that are all the same size. The main benefit of a hex map over a conventional square grid map is that every pair of neighboring hex cells (or hex) have the same distance between their centers. In contrast, on a map with a square grid, the distance between the centers of each square cell and the four diagonally adjacent cells with which it shares a corner is roughly twice as much as the distance between the centers of the four adjacent cells with which it shares an edge. For games where movement measurement is important, it is ideal that all neighboring hexes have this equidistant feature. The other benefit is that adjacent cells always share edges, thus there are never two cells in close proximity. Also, Hexagon covers most of the area for a given space. Hence, we used Hex maps to visualize the player's shot chart. We can clearly infer from the above visualizations that Carmelo's 3 point shooting is better when compared to LeBron's and LeBron's inside the arc shooting and Free throw shooting is remarkable when compared to Carmelo's. LeBron has a good record in Buzzer beaters as we can observe from the visualization. Also, Hex charts are easy and clear to understand for a viewer and covers most of the data.

- Player's shot chart according to various zones



A basketball court has several different sections and areas that can be categorized .Certain spots are better to take high percentage shots. Other spots of the court are the sections that the defense hopes to keep the ball handler to because it's hard to shoot from them. Different areas on a basketball court include corners, wings, top of the key, high post and low post, elbows, midcourt, front court and back court. The above visualization represents the shot chart from different zones and distances on the basketball court. Since we know that a basketball court has multiple zones such as Back court, Centre, left side center, Left side, Right side center and Right side and various distances such as less than 8 ft, 8-16 ft, 16-24 ft and 24+ ft. From the above visualization, we can observe that LeBron James has taken a few more shots on the left side and center of the court and he is very strong in that zone. Whereas Carmelo Anthony is strong in all the right court zones on the court since we can see from the visualization that all right zones have almost equal number of shots. This visualization is very helpful because the team can plan their defensive strategies according to the opponent's strong and weak zones on the court.

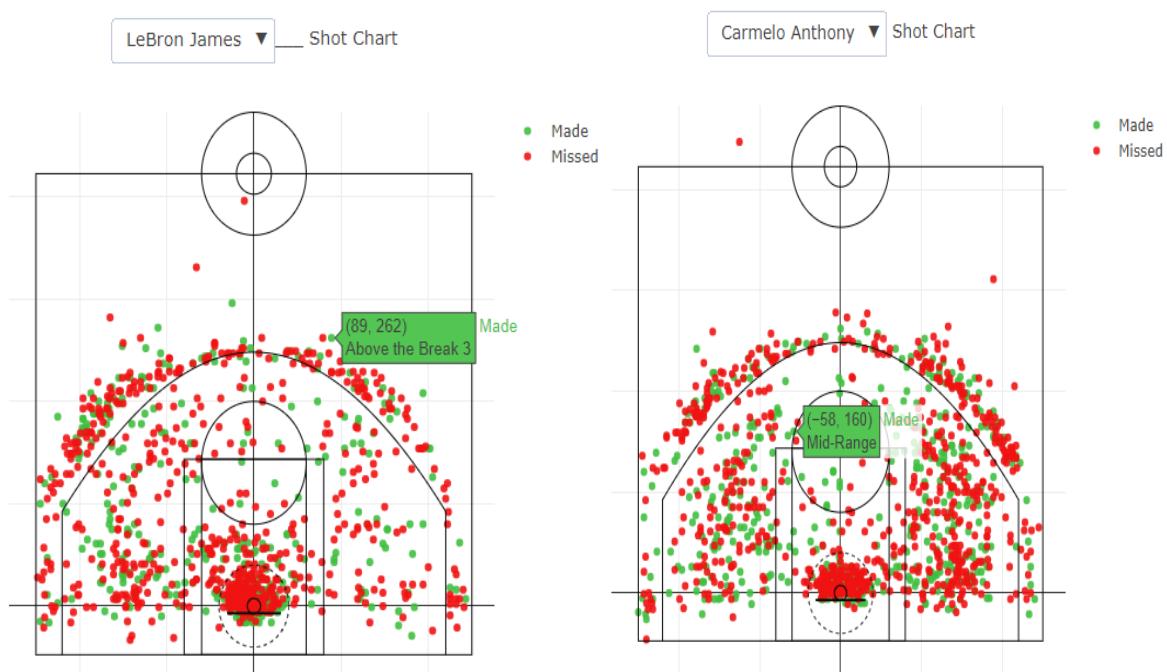
- **Heatmap of shot chart data**



A data visualization approach known as a heat map (or heatmap) displays a phenomenon's magnitude as color in two dimensions. The reader receives clear visual clues about how the phenomena is clustered or fluctuates across space as a result of the color variation, which can be determined by hue or intensity. Heat maps may be divided into two groups that are essentially distinct from one another: cluster heat maps and spatial heat maps. In a cluster heat map, magnitudes are arranged into a matrix with fixed cell size whose rows and columns are discrete phenomena and categories. Rows and columns are intentionally and somewhat arbitrarily sorted with the aim of suggesting clusters or representing them as discovered through statistical analysis. Although the cell's size is random, it is large enough to be easily seen. In contrast, there are no cells in a spatial heat map; instead, the position of a magnitude is determined by its location in that space, and the phenomena is thought to change continuously.

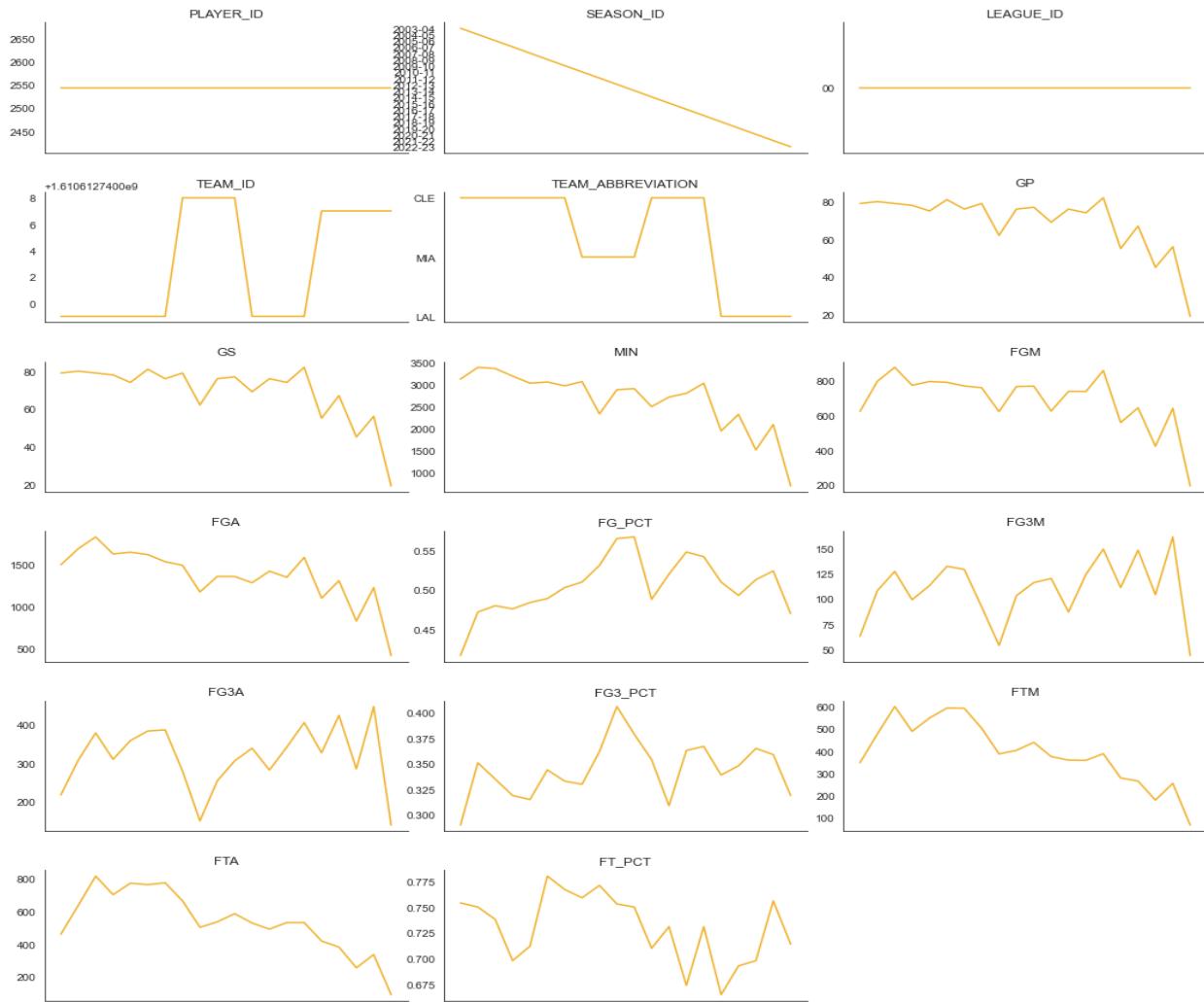
From the above visualizations, we can see that Carmelo's heat map is more concentrated outer bigger arc because of his 3 point shooting efficiency. Whereas, LeBron's heatmap is concentrated on inside the arc. The colormap that we used is inferno since that gives a clear visualization since the background is black.

- Interactive visualization with dashboard to chose player

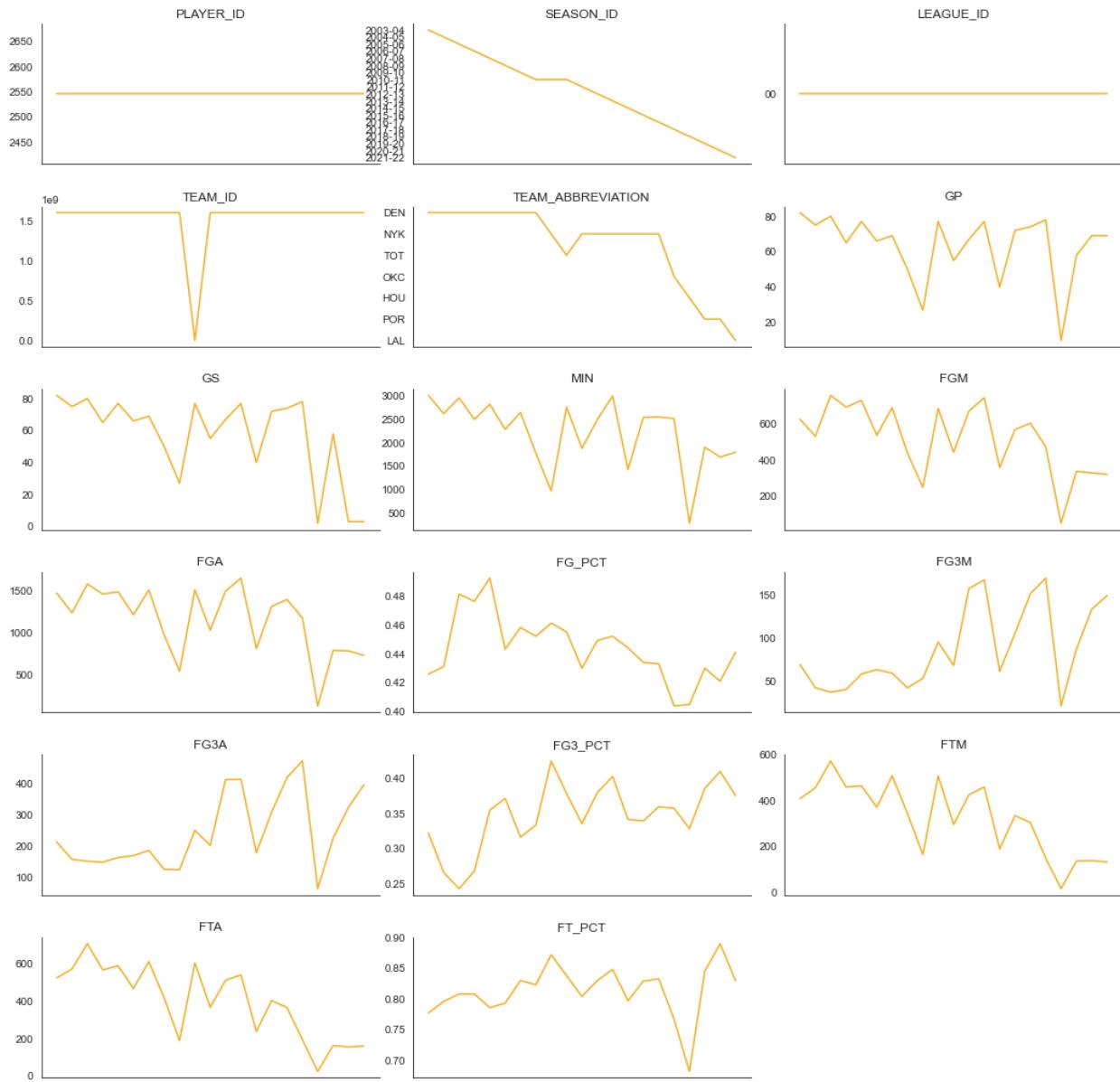


We created a dashboard to visualize players shot hit and miss interactively. Also, the zone on the court is also visualized like mid range, above the break 3, inside the break 3, inside the paint(near hoop). Data visualization technologies that enable direct change of components on a graphical plot are used to create interactive visualizations. The goal is to design graphs and charts that the end user may actively examine and modify as opposed to passively reading. In essence, interactive data visualization has an advantage over static representations of data in that it provides tools for interacting with the data displayed in real time, enabling the end user to see more details, produce new insights and questions, and squeeze more juice out of the available data sets.

- Player's attribute visualization

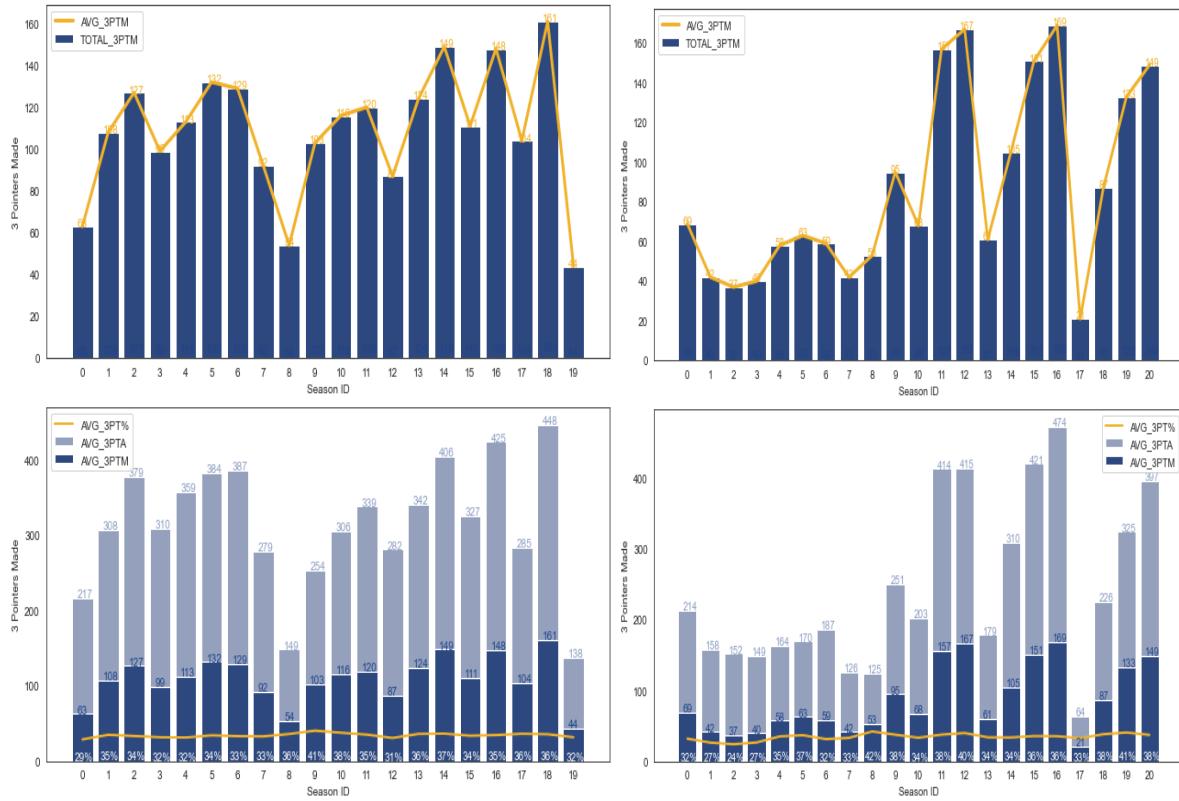


The above visualization represents the line plot visualizations of various statistical attributes of LeBron James. Line graphs are helpful in that they clearly display data factors and patterns and can aid in forecasting the outcomes of yet-to-be-recorded data. Additionally, they may be used to contrast many dependent variables with a single independent variable. For the sport of basketball, several statistics are recorded. Statistics are a useful tool for evaluating your performance in sports and identifying your strongest areas. They may also assist in identifying areas for improvement for both you and your group. Of course, one of the most significant game statistics is scoring. From the above visualizations, we can interpret that LeBron James's shooting statistics have constantly improved from season to season.



The above visualization represents the line plot visualizations of various statistical attributes of Carmelo Anthony. From the above visualizations, we can infer that Carmelo's 3 point Field goal percentage and Field Goal percentage have been constantly improved from season to season which is a very important way to generate points for the team.

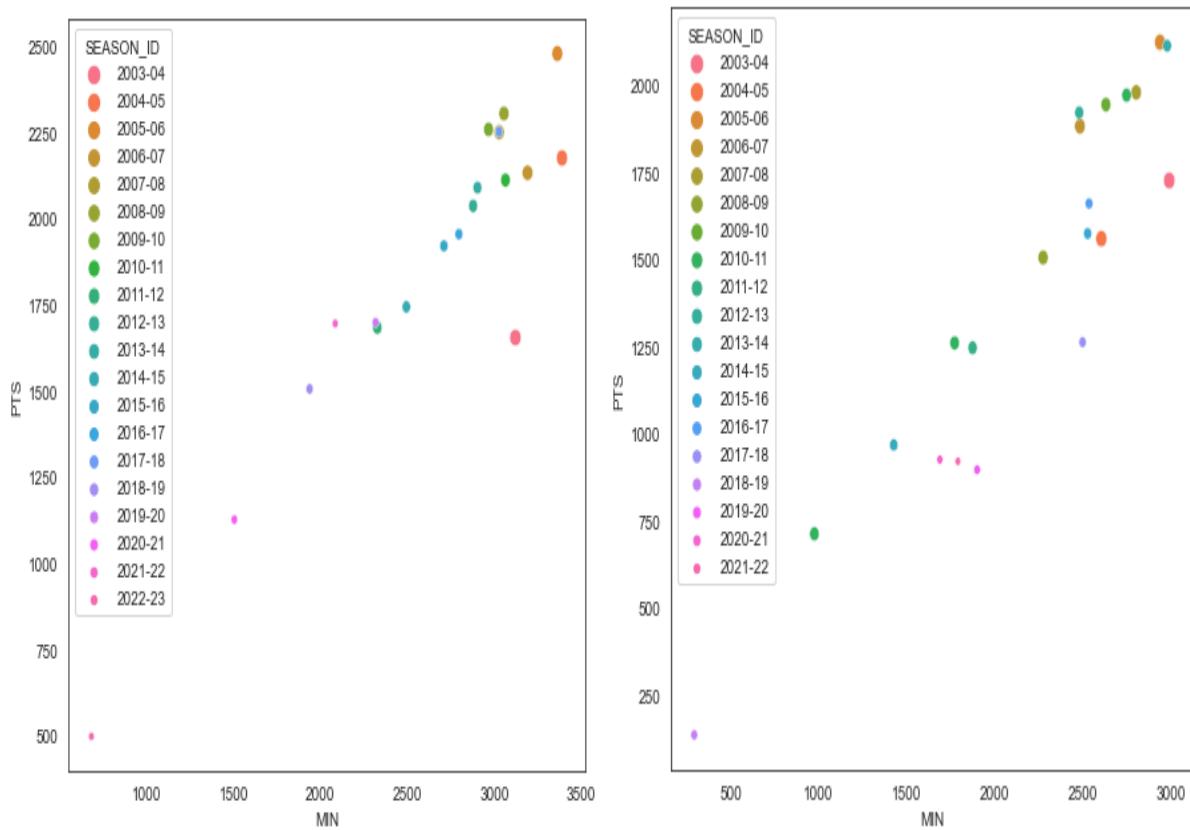
- Average 3 pointers made vs Total 3 pointers made



The visualization this with the combination of line plot and stacked bar plot. A stacked chart is a type of bar chart that displays the comparison and composition of a small number of variables through time, whether they be relative or absolute. These charts, sometimes known as stacked bars or columns, have the appearance of a number of columns or bars that have been layered on top of one another. When used properly, stacked charts are a really powerful tool for comparisons. They are made to compare sum values between different groups.

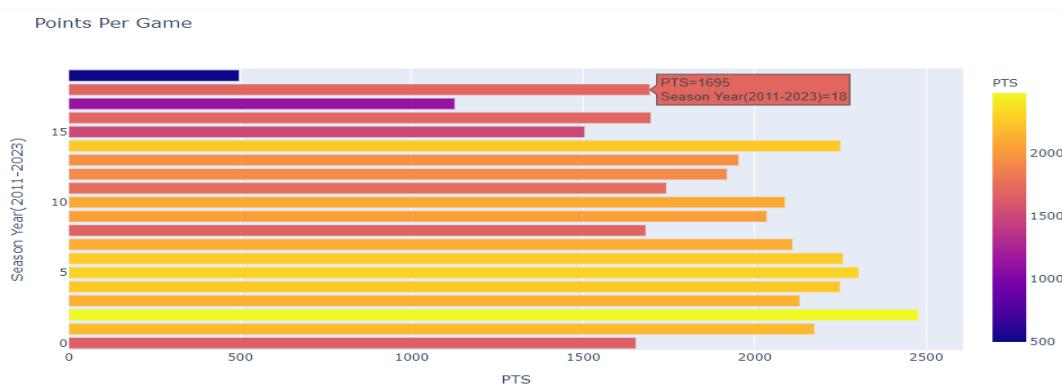
The graph in the top represents a combination of bar plot and line plot. Where the bar represents the total 3 pointers made and the line graph in yellow color represents the average 3 pointers made. Whereas the graph in the bottom represents average 3 pointers percentage, average 3 pointers made and average 3 pointer attempts. From the above visualizations we can clearly interpret that both the players have almost similar average 3 point percentage and Carmelo had few good seasons with more 3 point shooting average.

- Minutes played vs Points scored

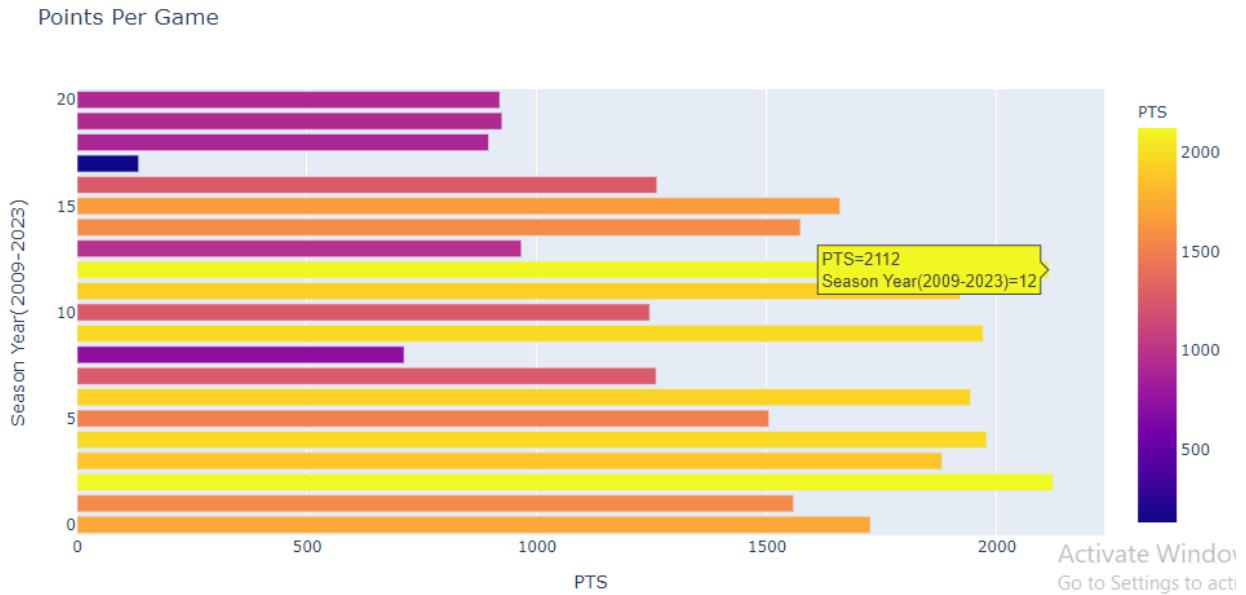


This above visualization represents a Scatter plot between number of minutes played and the points scored done using Seaborn. This is a very useful visualization because the player's usage percentage is dependent on this attribute. It is always good to contribute more points even if the minutes played is less. In this field, both the players performed well and LeBron has a great advantage since the number of points scored by him is more as we can see in the scale of y-axis on the left chart.

### ● Points per game

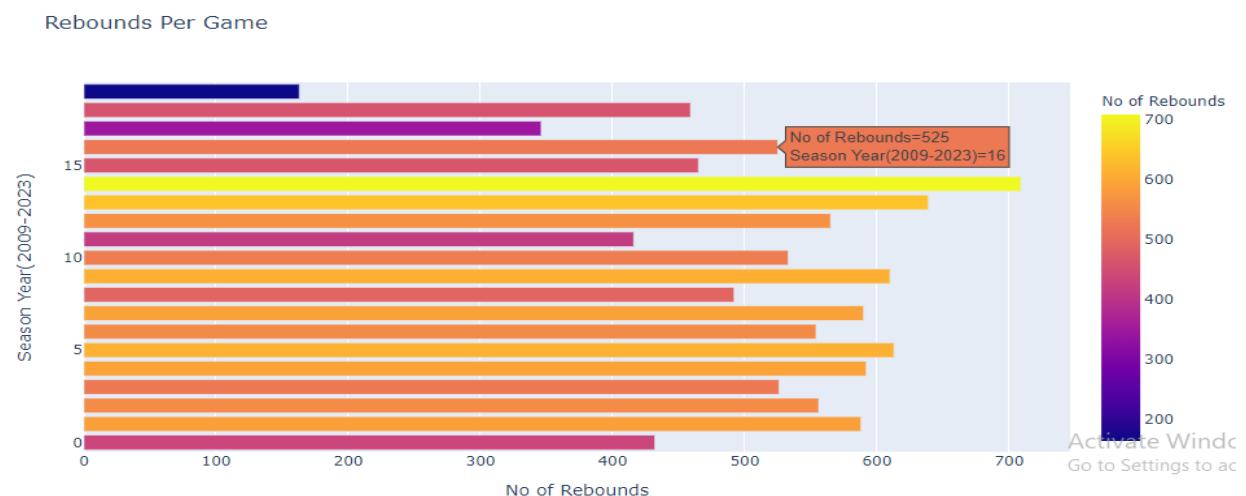


The above visualization represents an interactive horizontal bar plot of the number of points scored per game by LeBron James.

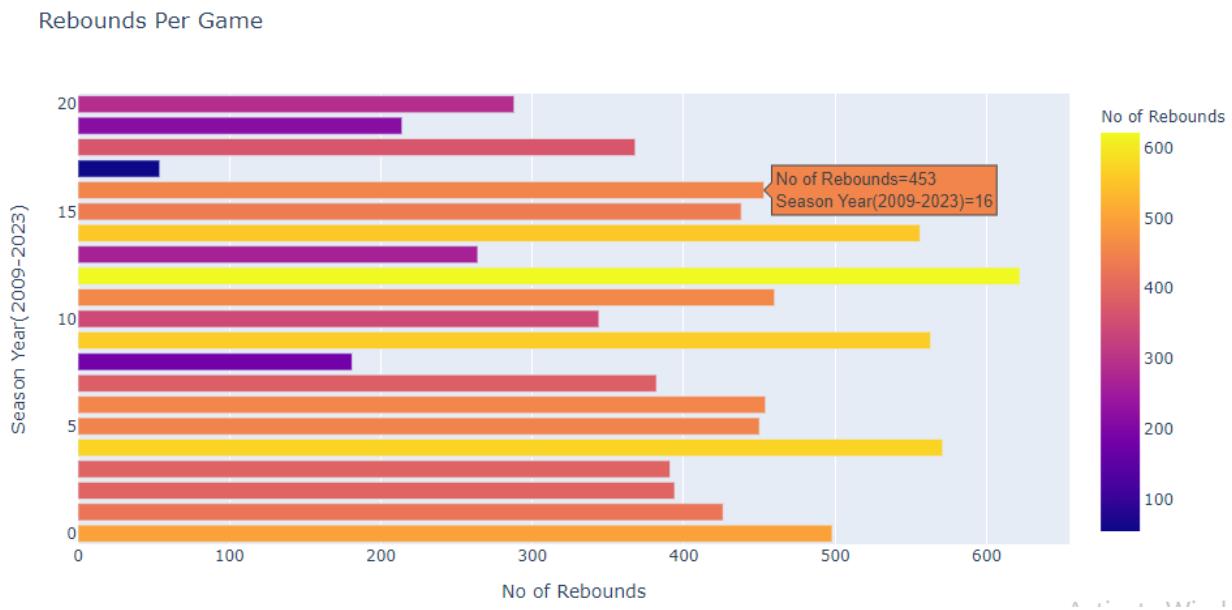


The above visualization represents an interactive horizontal bar plot of the number of points scored per game by Carmelo Anthony. Points scored per game is a very important factor in determining the player's contribution to the team score and also the player's performance in that season. The more the number of points scored per game, the better is the player's performance in that season. This attribute helps to find the weak zones of the player and train them accordingly. Here, in our case, LeBron James scored more points for a given season. His contribution to the team scoring is great and it motivates other players to perform well.

- **Rebounds per game**



The above visualization represents an interactive horizontal bar plot of the number of rebounds per game by LeBron James.



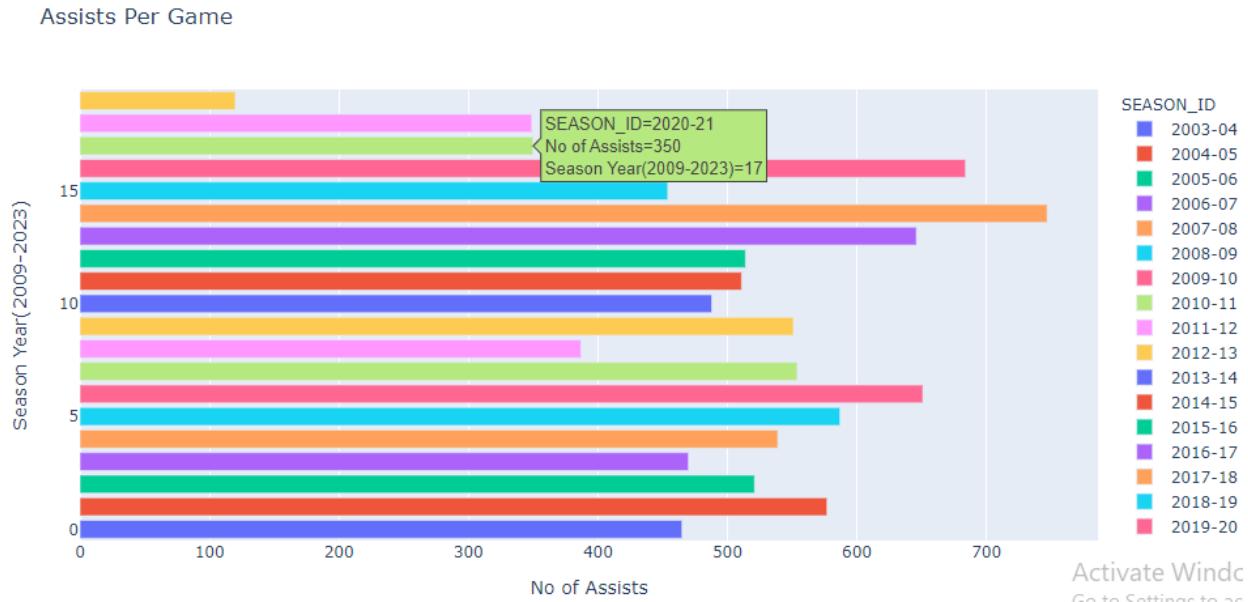
The above visualization represents an interactive horizontal bar plot of the number of rebounds per game by Carmelo Anthony.

Any missed shot that is not cleared by a single player results in a rebound for the team that receives it. One of the most crucial aspects of the game of basketball is rebounding. Each time a team gains control of the ball through rebounding, its offense, defense, and overall ability to win basketball games are all aided. There are two types of rebounding. Offensive rebounding and Defensive Rebounding. Offensive rebounding is considered when a player grabs the ball after a missed shot by his teammate. Whereas, a defensive rebounding is taken into account when a player grabs the ball after a missed shot by his opponent team player. Total rebounds is a combination of both offensive rebounds and defensive rebounds. It is a very important scoring factor for the team because the player can immediately attempt for a shot and add score to the team. There are many scenarios in which a match has been won due to rebounds.

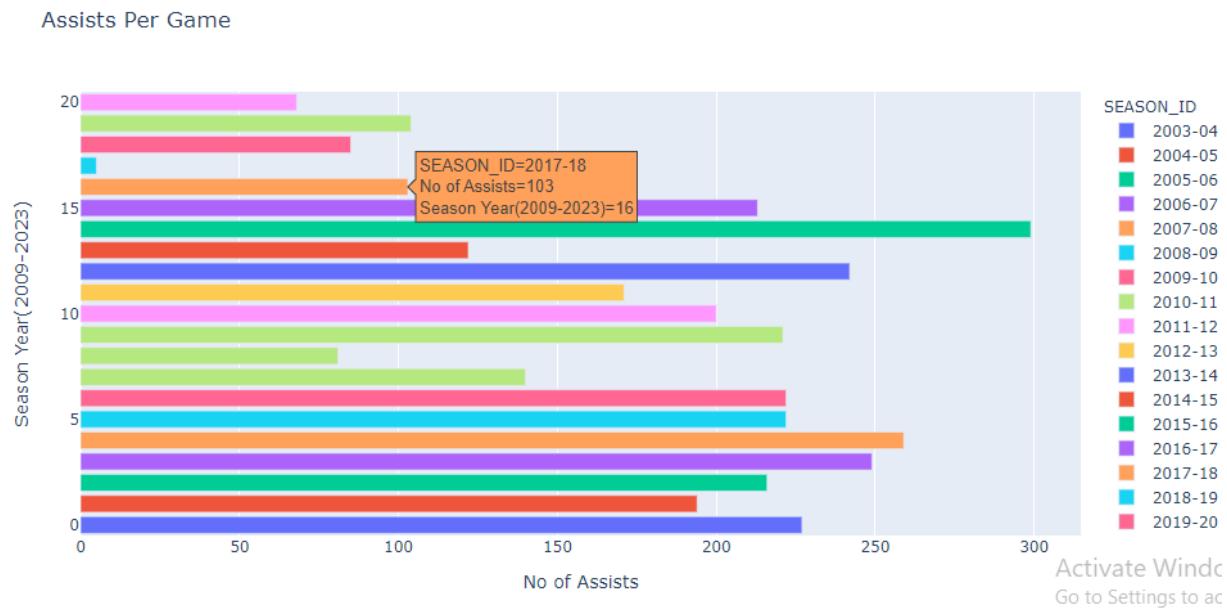
From the above two visualizations, we can interpret that LeBron James has taken more rebounds for most of the seasons when compared to Carmelo Anthony.

- **Assists per game**

A player receives an assist in the NBA when he passes the ball to another player who subsequently makes a basket. Basketball assists are a crucial metric that appear in the box score throughout a game. Any fantasy basketball owner must also grasp what an assist is.



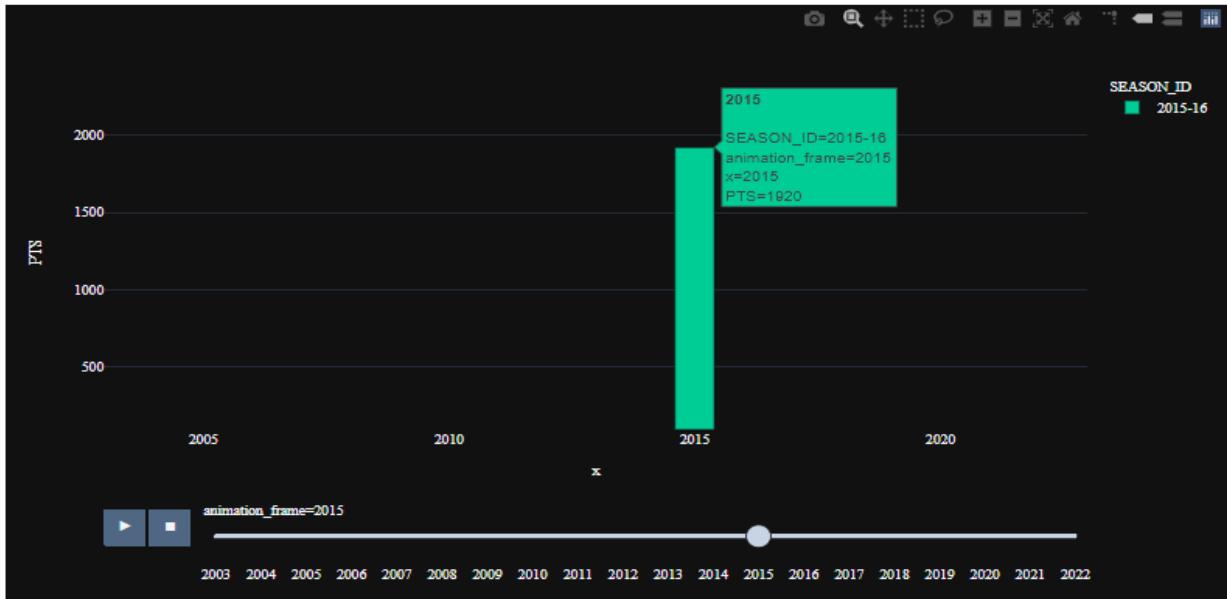
The above visualization represents an interactive horizontal bar plot of the number of assists per game by LeBron James.



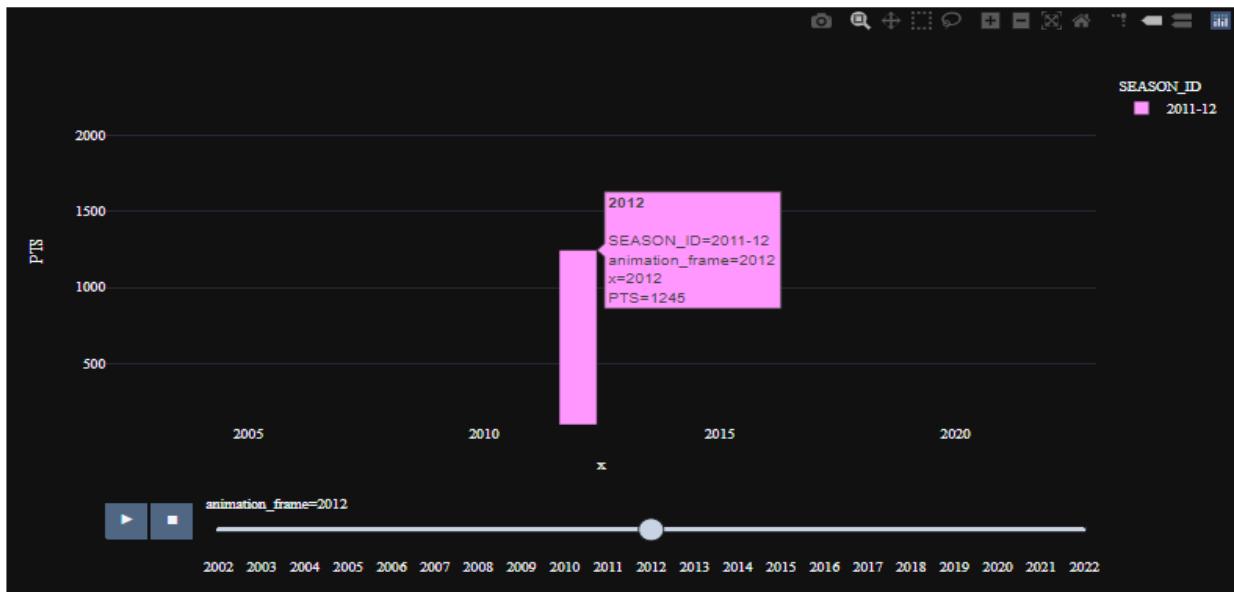
The above visualization represents an interactive horizontal bar plot of the number of assists per game by Carmelo Anthony.

From the above two visualizations, we can interpret that LeBron James has more assists per game for the majority of the season when compared to Carmelo Anthony. The important question here is “Is it possible for a player to assist and score on the same play?” No, according to the official definition, the pass must be made to a teammate. Even if you can hurl the ball against the wall and score, you won't get a goal and an assist on that play

- Animated and Interactive visualization



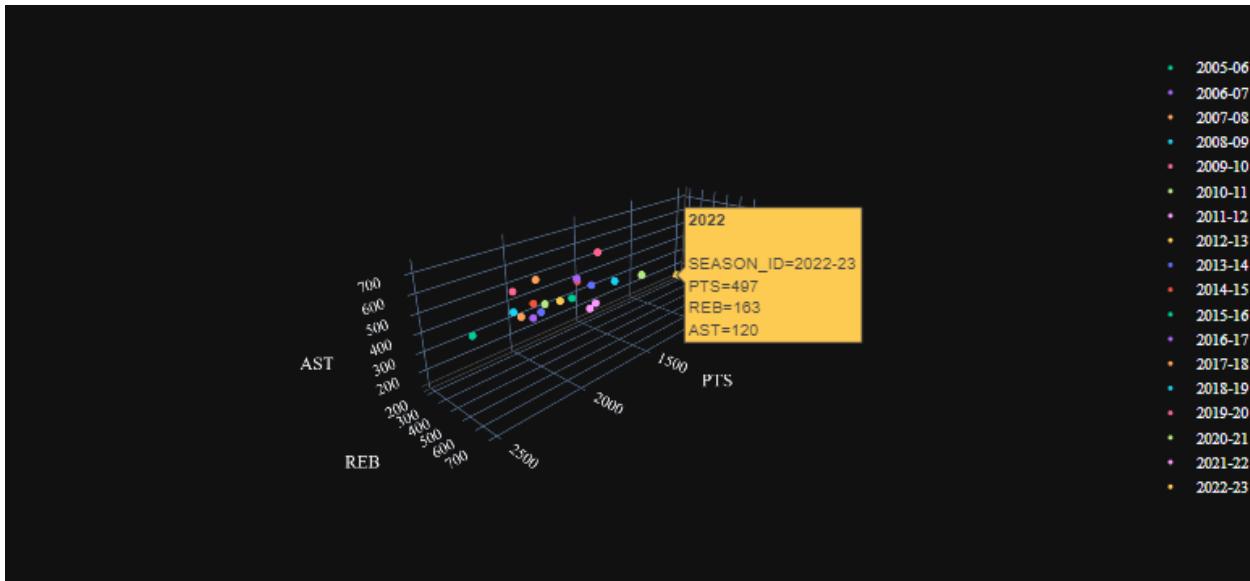
The above visualization is an animated and interactive visualization for points scored in a particular season by LeBron James.



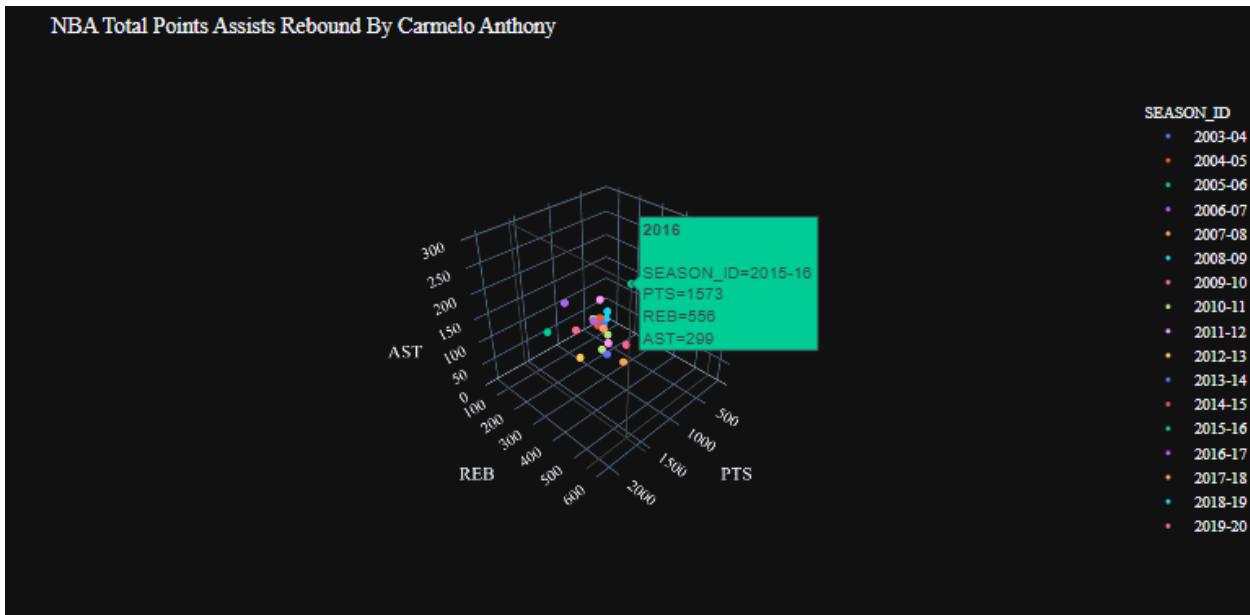
The above visualization is an animated and interactive visualization for points scored in a particular season by Carmelo Anthony.

The slide bar for hovering used here is the season(year) in which the game is played. Animated visualizations give us a clear picture of individual season's statistics.

- 3D visualization



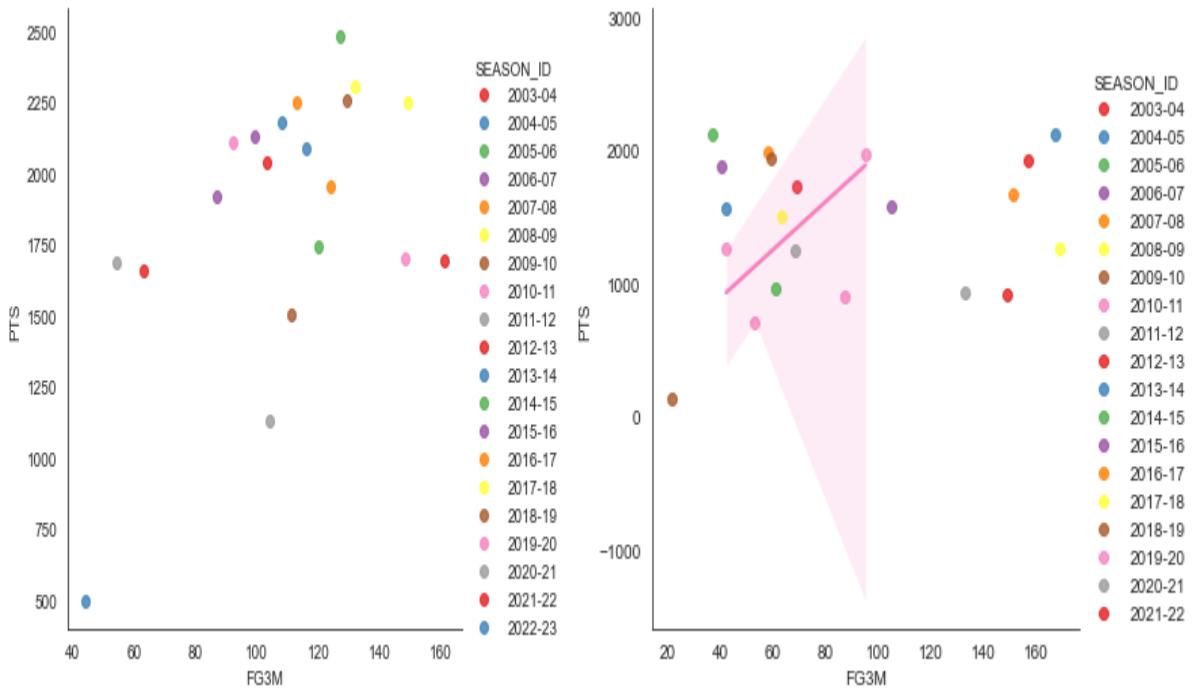
The above 3 dimensional visualization is done by taking 3 parameters which are Points, Rebounds and Assists for a particular season by LeBron James.



The above 3 dimensional visualization is done by taking 3 parameters which are Points, Rebounds and Assists for a particular season by Carmelo Anthony.

The main advantage of these kinds of visualizations is that the manager, scout or coach can just analyze the player's performance in that season by just looking at all the three important attributes at a single glance.

- Correlation between Points and 3 points scored



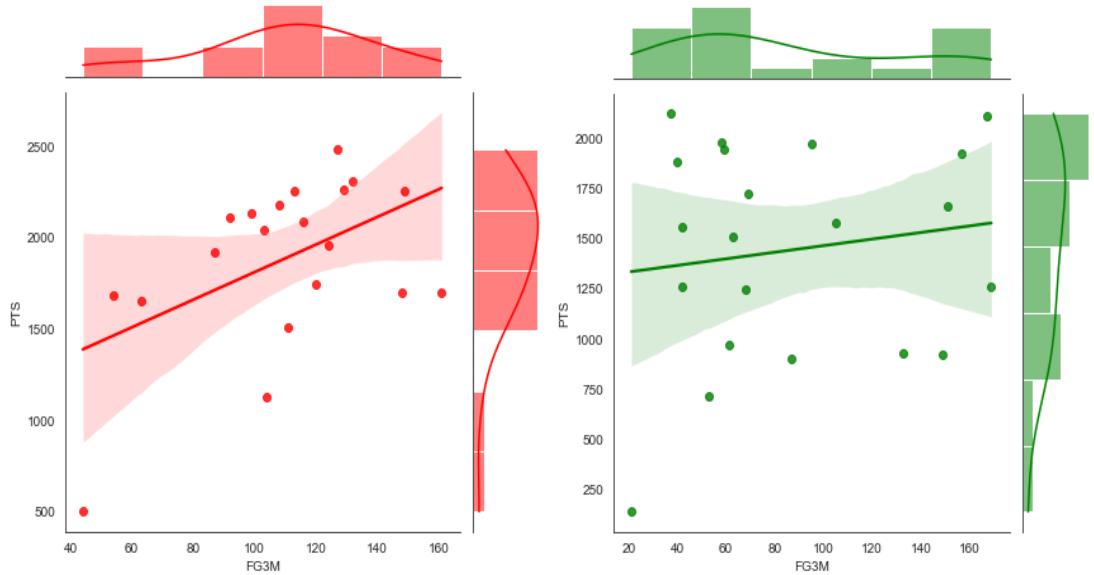
A statistical metric known as correlation describes how closely two variables are connected linearly (meaning they change together at a constant rate). It's a typical technique for expressing straightforward connections without explicitly stating cause and consequence.

The graph on the left side is the correlation plot between the number of 3 pointers scored against total points for LeBron James and the graph on the right side is the correlation plot between the number of 3 pointers scored against total points for Carmelo Anthony.

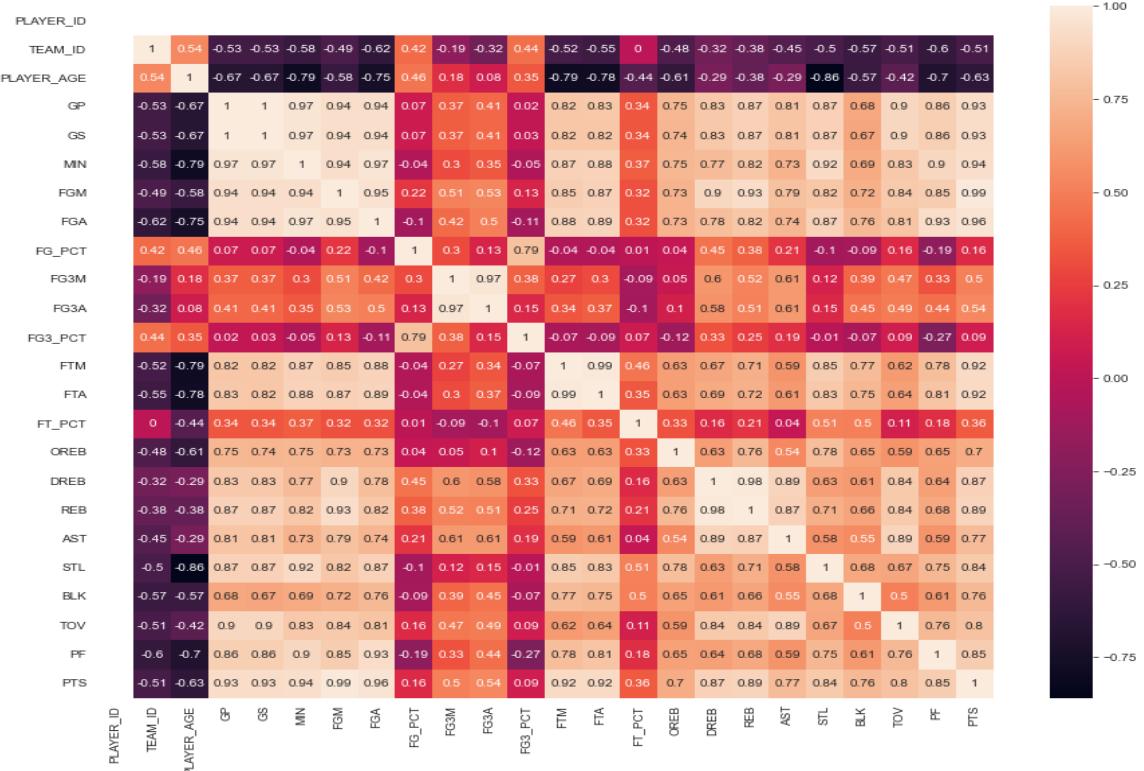
From the above two graphs, we can interpret that out of the total number of points scored by Carmelo Anthony, majority of the points are from 3 pointers made. Whereas, on the other hand, out of the total points scored by LeBron James, few seasons 3 point shooting is good compared to Carmelo Anthony. That is the reason, LeBron James is considered as an allround player.

- Join plot

The below visualizations represent a joint plot of Correlation between number of 3 pointers made and total points of both the players and marginal histograms with linear regression model fit.

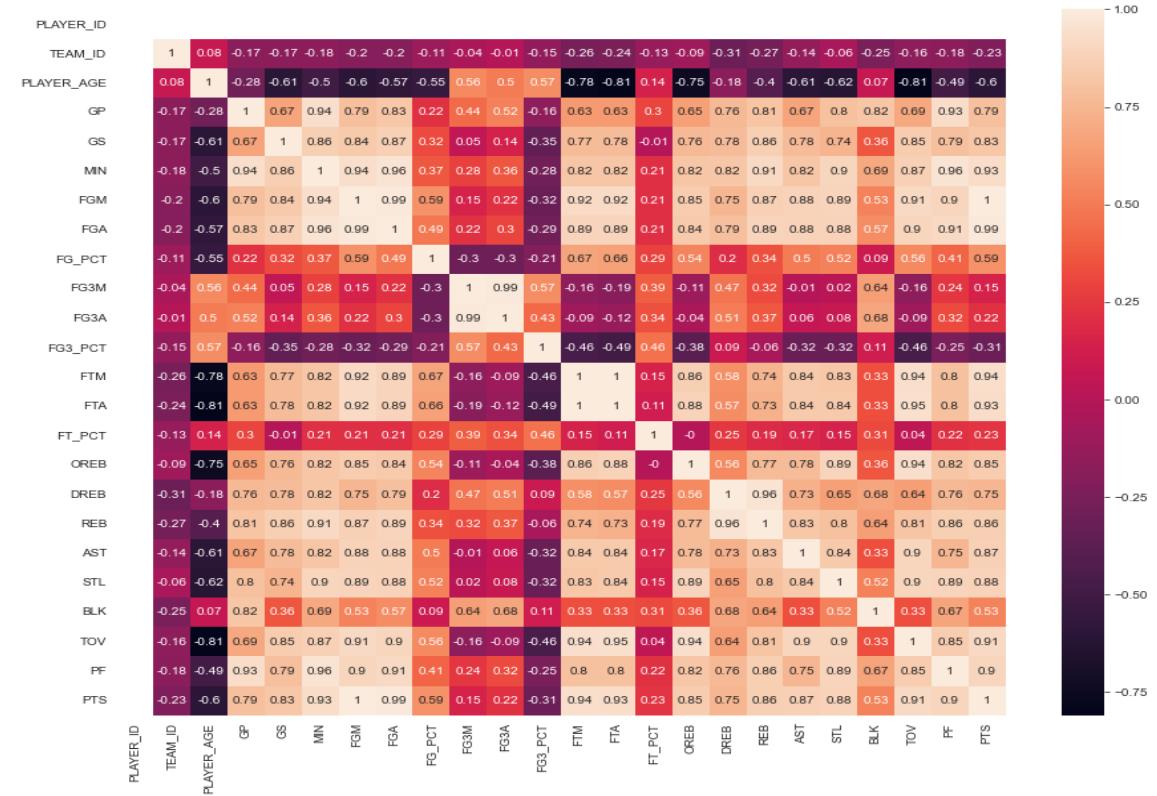


- Heatmap of correlation matrix



The above visualization is a heatmap of correlation matrix for all the parameters taken into consideration for LeBron James.

A correlation matrix is a table that shows the correlation coefficients for various variables. The correlation between all potential pairings of values in a table is shown in the matrix. It is an effective tool for compiling a sizable dataset and for locating and displaying data patterns.



The above visualization is a heatmap of correlation matrix for all the parameters taken into consideration for Kyrie Irving.

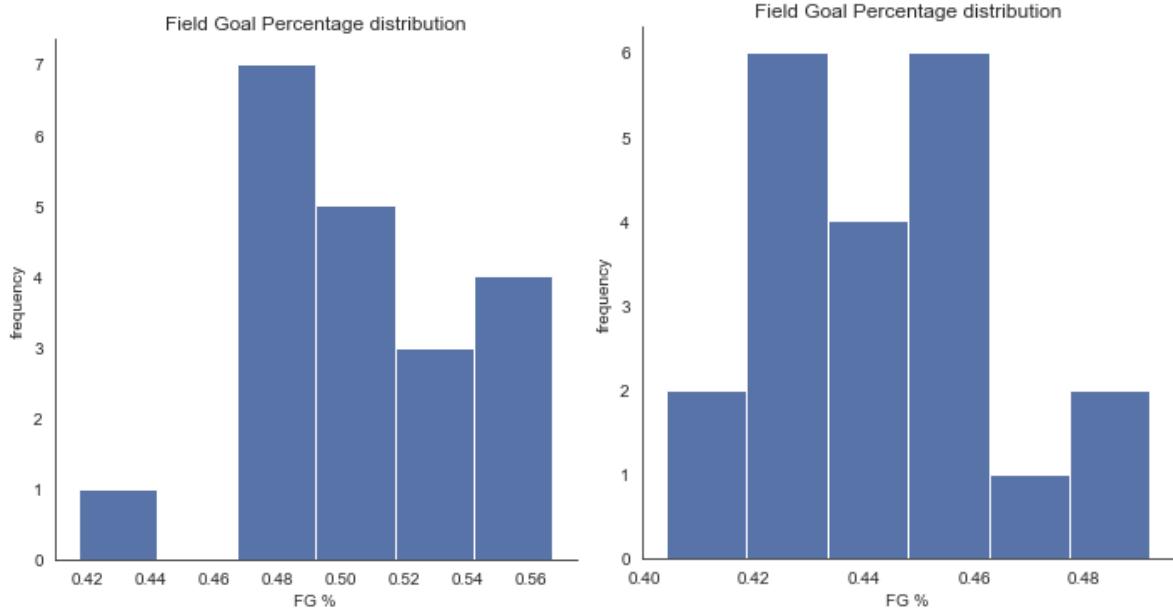
A correlation matrix should be computed for the following three general reasons:

To compile a lot of data with the intention of finding patterns. The observable pattern in the aforementioned example is that all the variables have a strong correlation with one another.

To include in additional analysis. For instance, when removing missing values pairwise in linear regression, structural equation models, and exploratory and confirmatory component analyses, correlation matrices are frequently used as inputs.

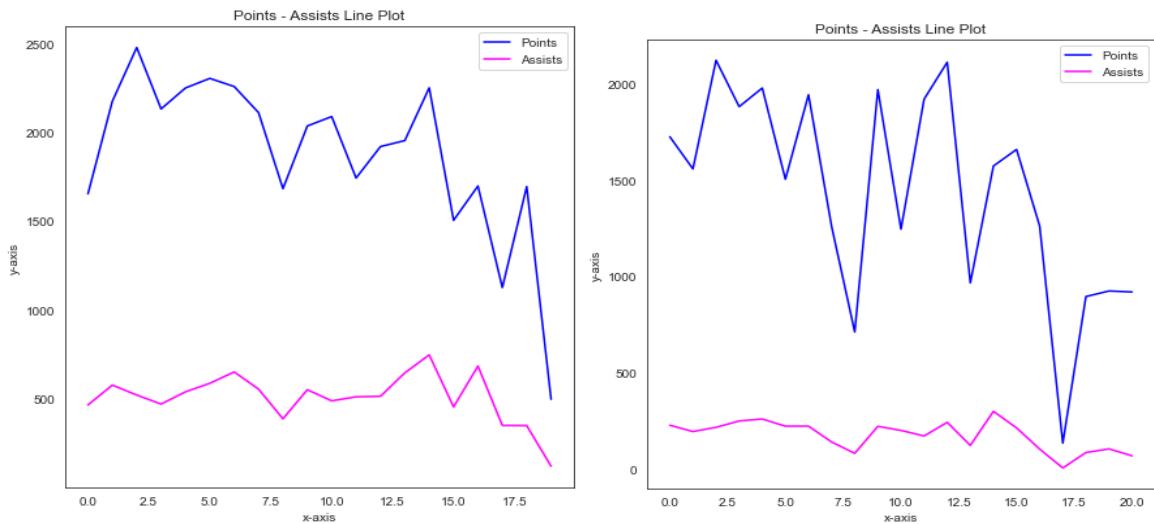
For diagnostic purposes while examining other analyses. If there are many correlations, for instance, it is likely that the linear regression estimations will not be accurate.

- **Field Goal percentage distribution**



The above two visualizations represent the field goal percentage distribution across various seasons of the game. Field goal percentage is a ratio of field goal made and field goal attempts. This is a very important factor in analyzing a player's scoring ability. The more the percentage, the better is the player's performance in the game. From the above visualizations, we can interpret that Field goal percentage is higher for LeBron James which is a positive sign for the player as well as the team.

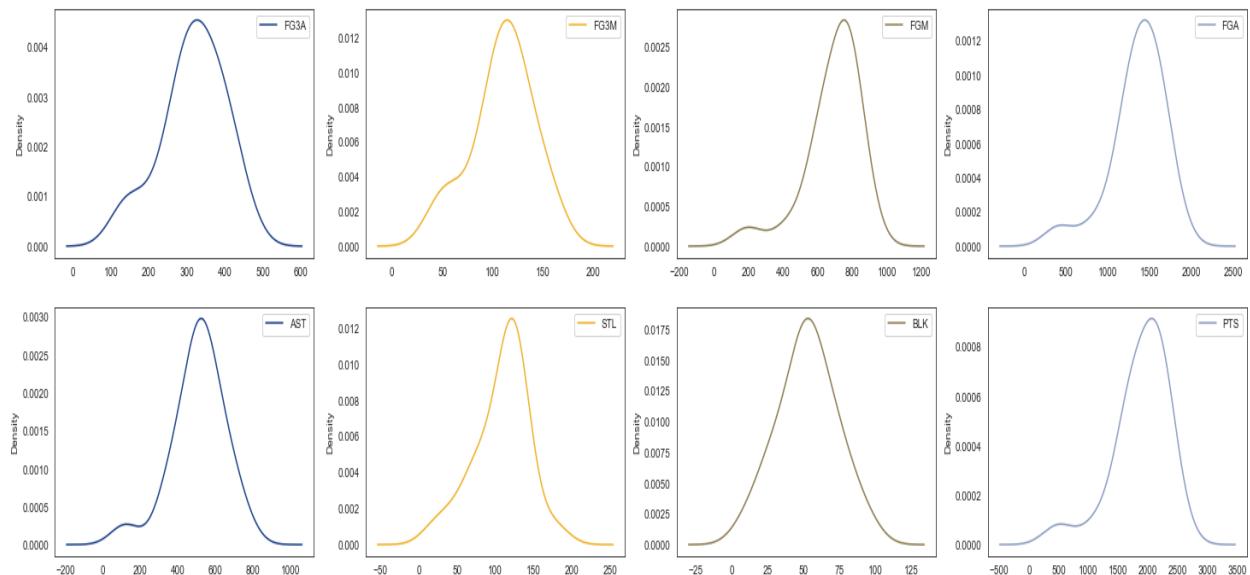
- **Points and Assists Line plot**



The above two visualizations represent a combined line plot of assists and points where blue line represents the total points in that season and magenta line represents the number of assists.

This visualization helps us to identify the relation between number of points and assists which has to be more for a player in order for the team to score better.

- **Density plot**



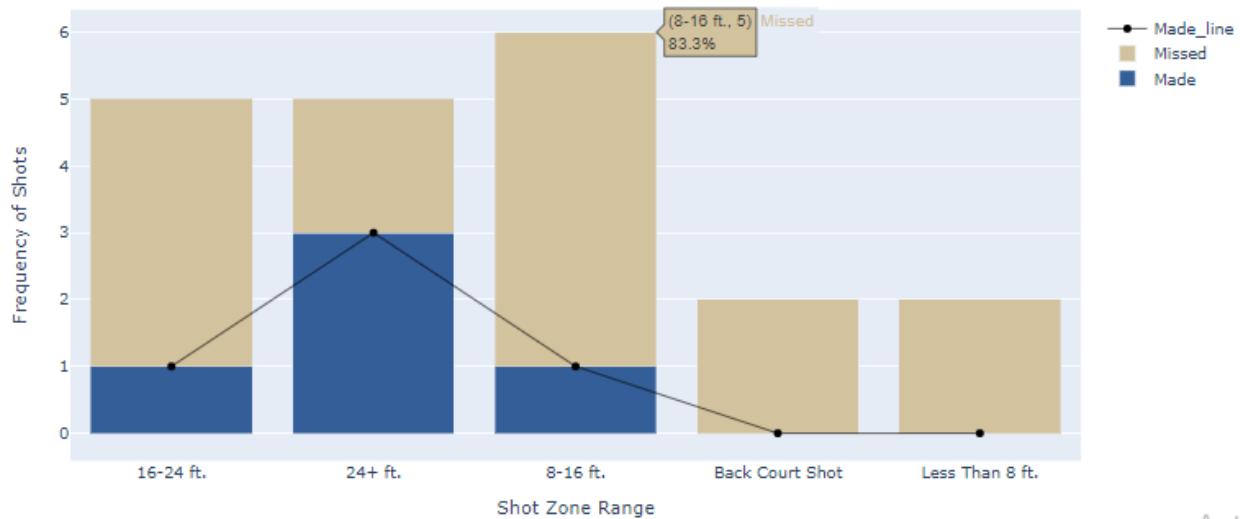
The above visualization represents the density plot of a few statistics of the players. A density plot can be seen as an extension of the histogram. The density plot can smooth out the distribution of values and reduce the noise. It visualizes the distribution of data over a given period, and the peaks show where values are concentrated.

- **Field Goal percentage by shot zone range**



The above visualization represents the Field goal percentage by shot zone range of LeBron James.

Field Goal percentage by Shot Zone Range

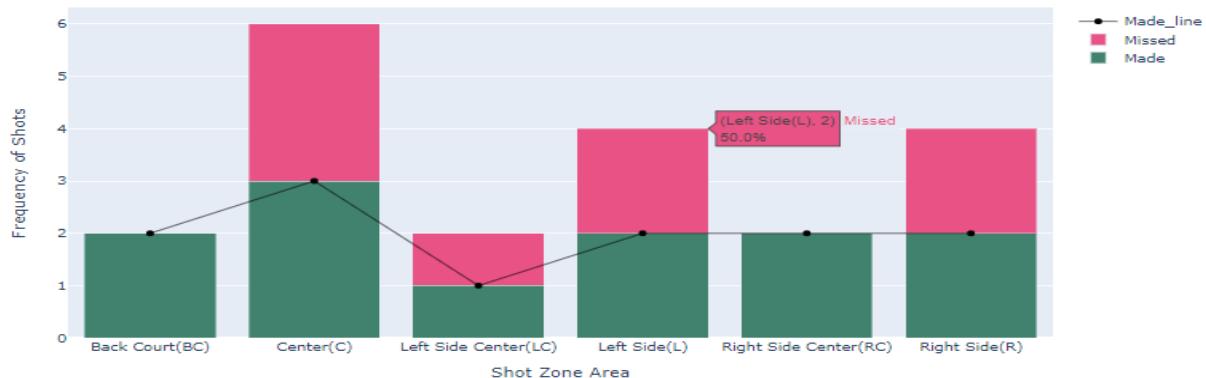


The above visualization represents the Field goal percentage by shot zone range of Carmelo Anthony.

We implemented a stacked bar graph to show the frequency of shots taken from different ranges on the court and their field goal percentage. This is very useful to determine players' strengths and weaknesses of different distances on the court. We can interpret from the above visualizations that LeBron James has a good success rate from various distances on the court. This could be helpful to identify the success rate of buzzer beater shots attempted by players since they can change the fate of the game.

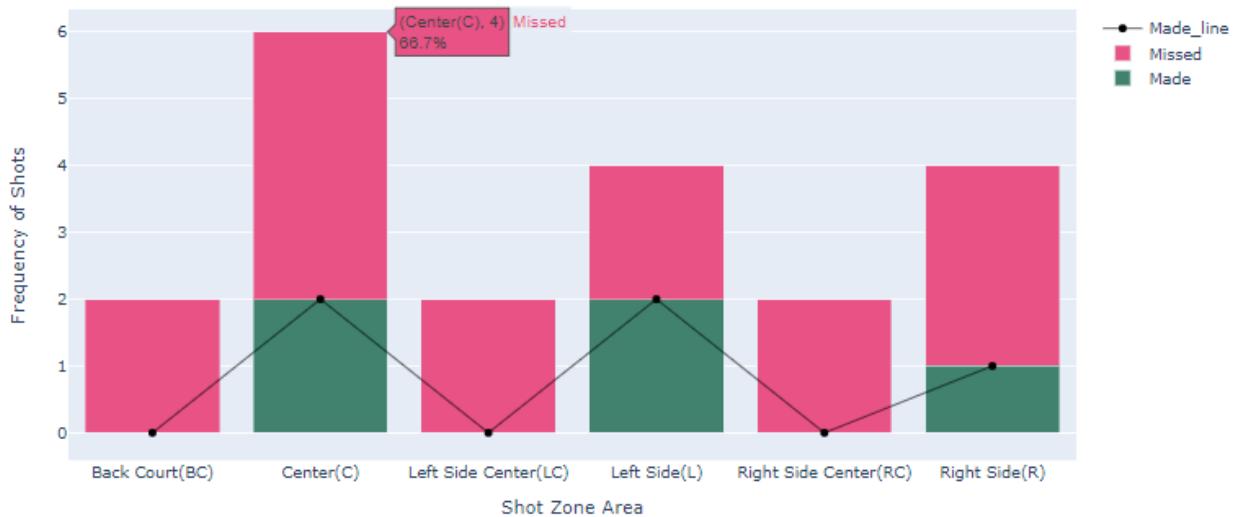
- **Field Goal percentage by shot zone area**

Field Goal percentage by Shot Zone Area



The above visualization represents the Field goal percentage by shot zone area of LeBron James.

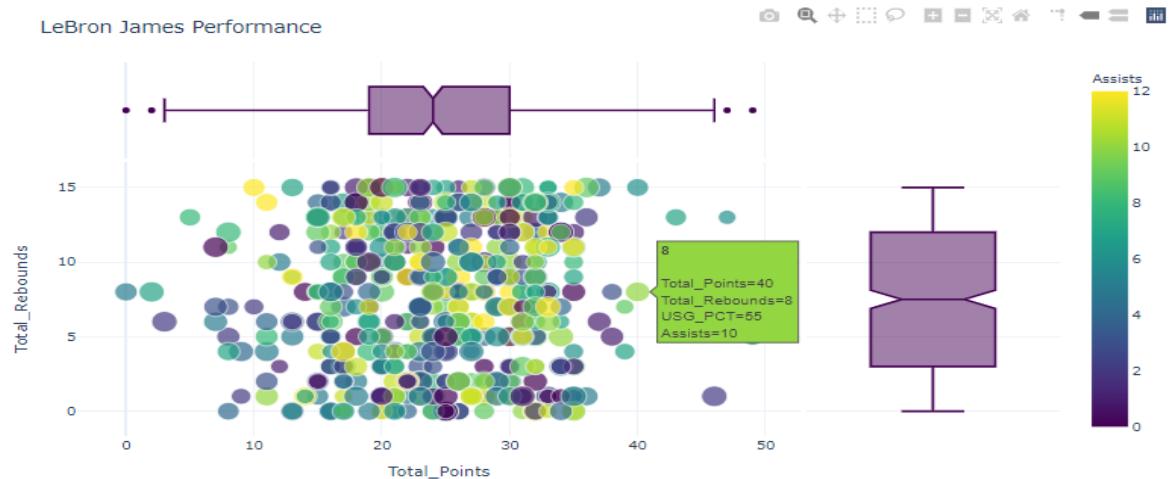
Field Goal percentage by Shot Zone Area



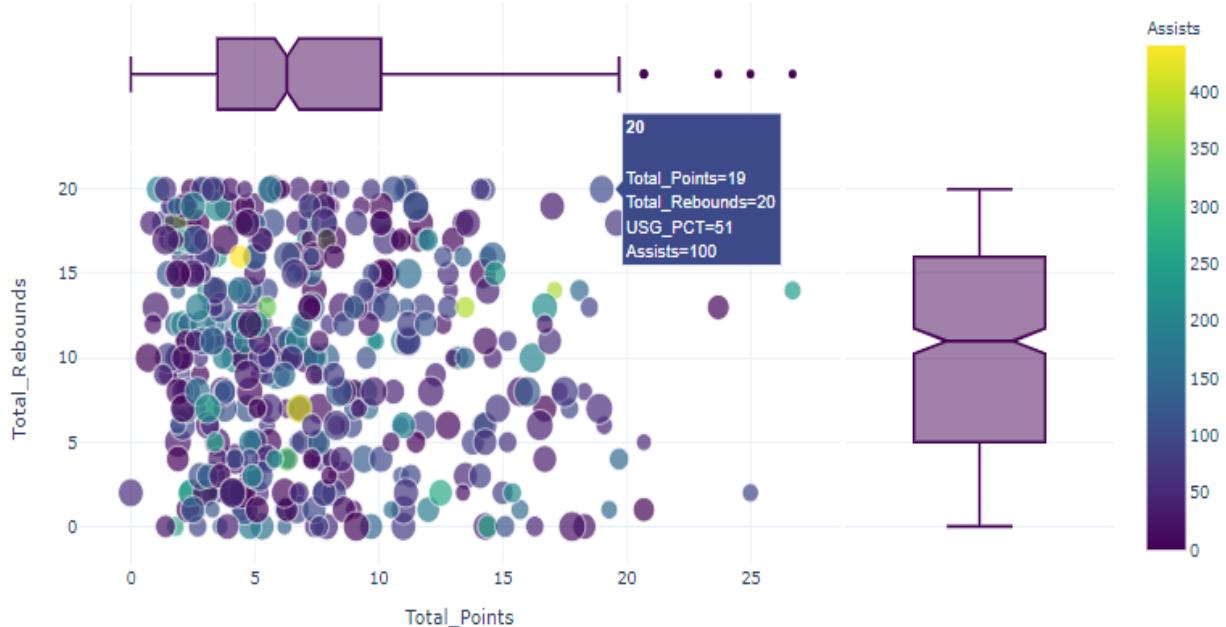
The above visualization represents the FG% by shot zone area of Carmelo Anthony.

We implemented a stacked bar graph to show the frequency of shots taken from different areas on the court and their field goal percentage. This is very useful to determine players' strengths and weaknesses of different zones on the court. We can interpret from the above visualizations that LeBron James has a good success rate from Center, Left side and Right side zones on the court. Whereas, Carmelo Anthony has a decent success rate from Center and Left side of the court.

- Interactive Box and Scatter plot



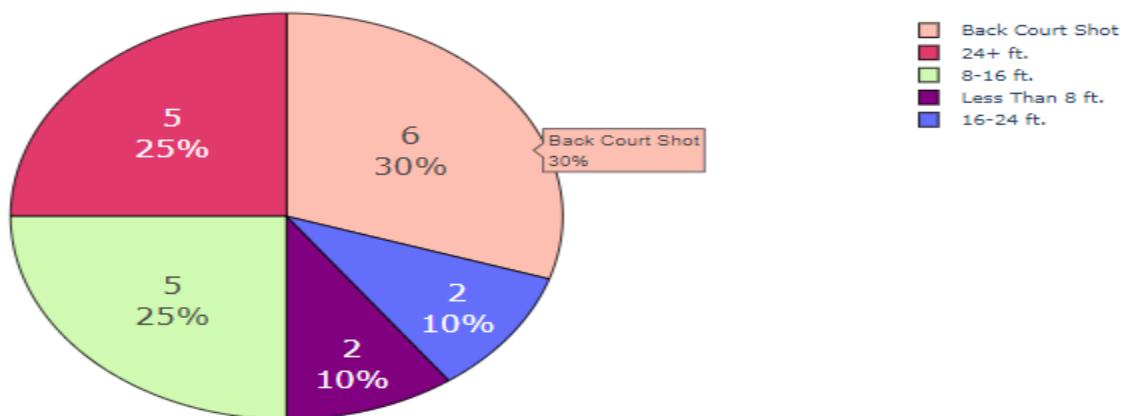
The above visualization is an interactive combination of scatter and box plot of Total points, rebounds, usage percentage and total assists of LeBron James.



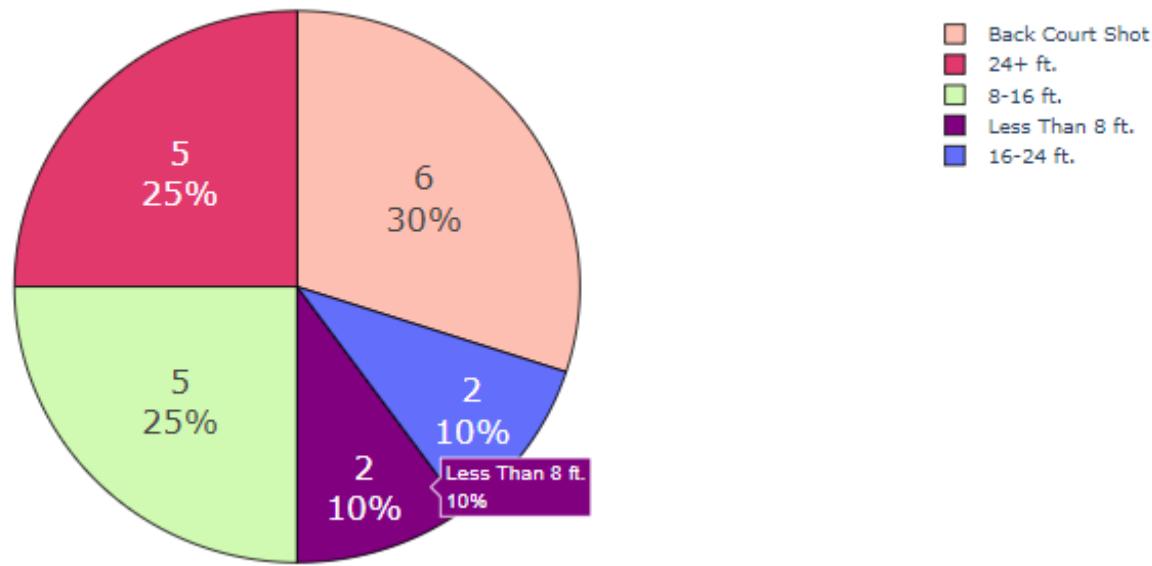
The above visualization is an interactive combination of scatter and box plot of Total points, rebounds, usage percentage and total assists of Carmelo Anthony.

In the above visualizations, the scatter plot gives the information about a player's total points, rebounds, usage percentage and assists for a particular game. The box plot gives us the information about the parameter's mean, interquartile range(Q3-Q1).

- **Pie chart of percentage of shot zone distances**



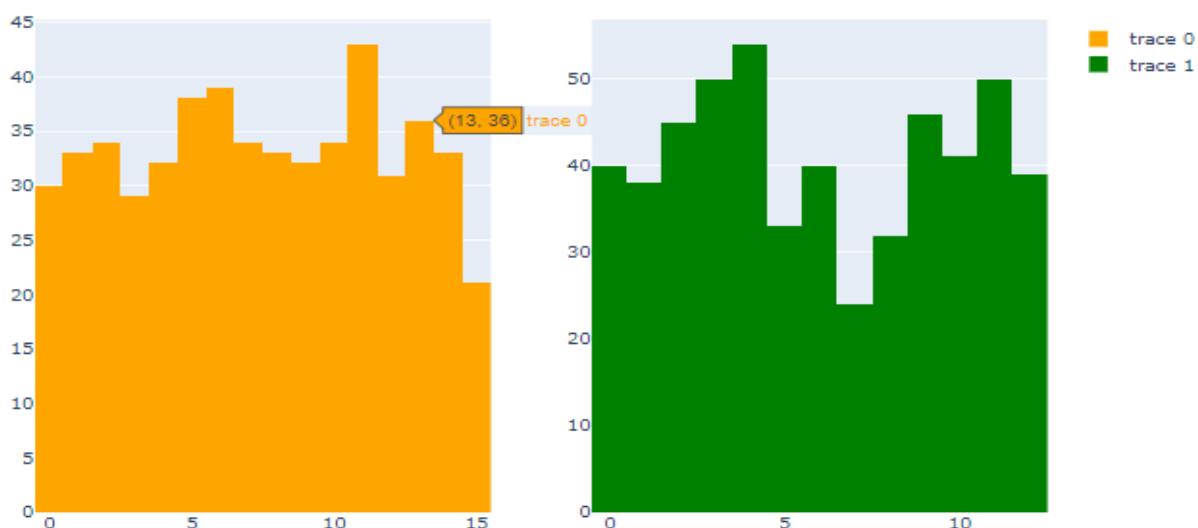
The above visualization represents the pie chart of percentage of shots taken from various distances on the court by LeBron James.



The above visualization represents the pie chart of percentage of shots taken from various distances on the court by Carmelo Anthony.

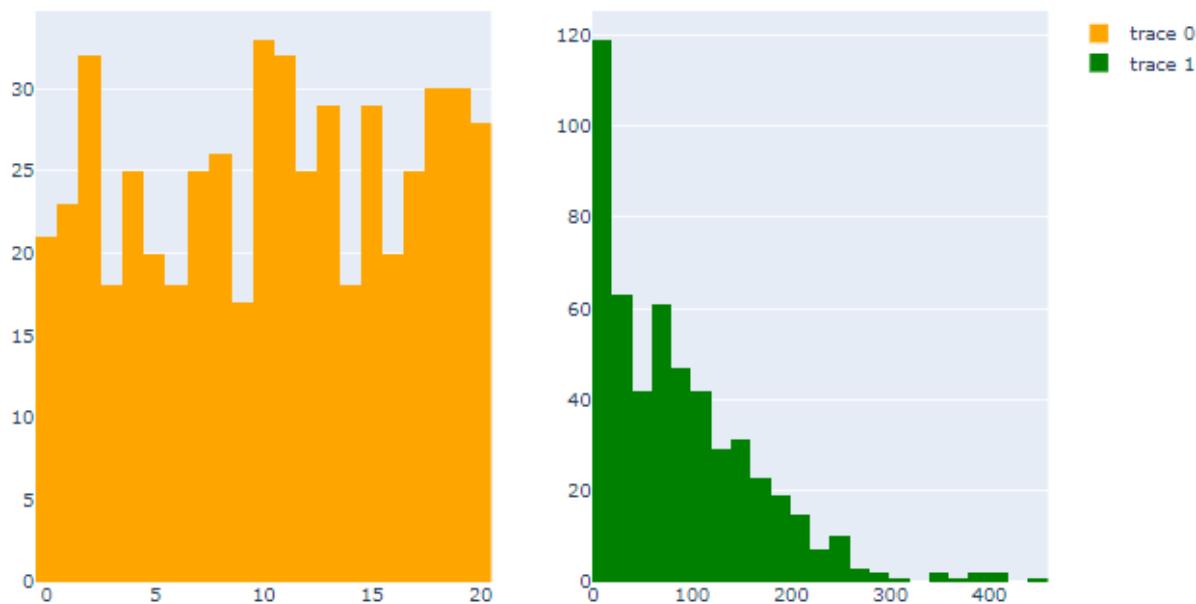
- **Rebounds and points Histogram plot (failed experiment)**

Rebound and Points Histogram plots



The above histograms represent the total points and rebounds of LeBron James for a particular game.

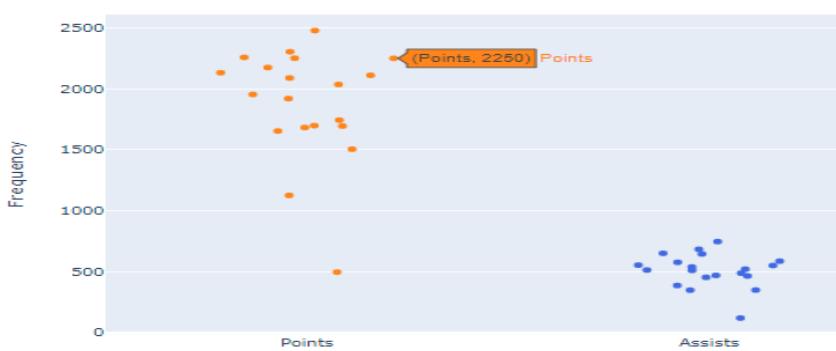
#### Rebound and Points Histogram plots



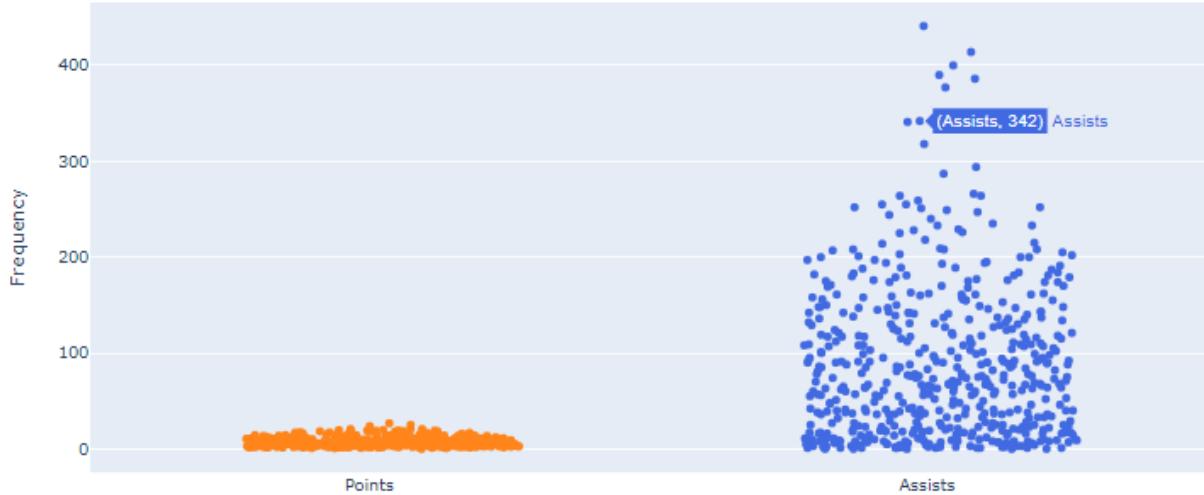
The above histograms represent the total points and rebounds of Carmelo Anthony for a particular game.

We tried to experiment with a histogram plot against rebounds and points. But, we realized that there is no correlation between both rebounds and points which could be plotted using a histogram. So, we consider this visualization as a failed experiment.

- **Beeswarm plot of points**



The above visualization is a beeswarm plot of total points and assists for each game played by LeBron James.



The above visualization is a beeswarm plot of total points and assists for each game played by Carmelo Anthony.

The beeswarm plot is made to show a summary of the top characteristics in a dataset and how they affect the model's output in a way that is both information-dense and easy to understand. A single dot is used to indicate each instance of the explanation in each aspect of the figure. Other than the alignment of the data points, the main distinction between a unit histogram and a bee swarm is that a bee swarm usually does not bin the data as I have done here. They often display the data point's real value. As a result, the output of a beeswarm often consists of lines that gradually bend as they approach the ends rather than a group of horizontal lines.

## CONCLUSION

Interactive visualization charts can be a useful tool for evaluating players' performance in sports. By using different chart types, such as bar charts, line graphs, and scatter plots, we can visualize various aspects of a player's performance, such as their shooting accuracy, pass completion rate, and defensive skills. For a team, interactive charts allow for easy exploration of the data, and can highlight trends and patterns that may not be immediately apparent from looking at raw data. Additionally, by allowing users to filter and sort the data, interactive charts can help coaches and scouts to compare players based on specific criteria, such as position or playing style. Overall, interactive visualization charts can be a valuable tool for evaluating players and making informed decisions about team selection. In order to more easily pinpoint the areas where a player needs to improve, interactive visualization charts may be used to track a player's development over time. Additionally useful for evaluating basketball player performance are line

graphs. To make it simpler to spot any trends or patterns in the data, we utilized line plots to chart changes in a player's performance over time. In order to help coaches and scouts choose players more wisely, we also employed line plots to compare the performance of several players at a certain moment. By giving a visual depiction of a player's performance in many areas, including shooting, assists, rebounds and defensive statistics such as blocks and steals, bar plots can be helpful in studying the performance of basketball players. As can be seen from the analysis above, a bar plot should be used when the difference between the variables we are attempting to demonstrate is large. On the other hand, utilizing a bar plot to show a player's individual stat when the values of those numbers are near might not be the best course of action since they lack the essential accuracy to accurately reflect the slight variations. Pie charts are not aesthetically appealing in showing the quantity due to visual distortion, as indicated by Steven's power law, so when visualizing the number of points based on a season with 7 categories, we used a bar plot rather than a pie chart. The best plots and visualization techniques were used whenever possible, to sum up. In the event that it did not, we were well aware of the drawbacks and made an effort to explain our decision.

## FUTURE DIRECTIONS

- The same visualization techniques can be further implemented for various sports, such as American Soccer, Cricket, FIFA, Baseball etc.
- It is always interesting to analyze the live game. The same visualizations could be generated while the match is going on and can be helpful to improve the performance of players in the second half of the game. This helps in identifying the strong zones and weak zones of opponents and also the mistakes that they have made in the first half of the game.
- Also, player movement tracking visualization on the court would be helpful to know the game style of the player and identify his strength and weakness and do some modifications to his game play style.
- These visualization techniques could also be applied to Olympic and European basketball games in order to improve their playing style and win medals for their nation.

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[6] Existing visualizations (online)

Available: <https://towardsdatascience.com/10-unique-visualizations-of-the-nba-b981cfdb78bf>