

ALL-TIME NBA INFOGRAPHIC

Data Visualization report

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1 Introduction

The National Basketball Association (NBA) holds a prominent position as one of the most captivating and prestigious professional sports leagues worldwide. Renowned for its breathtaking games and the thrilling playoff format that crowns a new champion each year, the NBA has secured its status as the most-watched basketball league globally.

Since its establishment in 1946, the NBA has undergone a remarkable evolution, shaping the landscape of American basketball. The league has experienced critical changes, ranging from modifications in game rules to advancements in players' training, shifts in teams' playing styles and the emphasis on three-point shooting, which has emerged as a defining characteristic of modern NBA playing style as we are going to see later in this infographic.

Furthermore, the NBA has gathered immense significance through its prestigious awards, which recognize and celebrate the individual excellence displayed by players across various aspects of the game. Among these awards, the Most Valuable Player (MVP) award and the Defensive Player of the Year (DPOY) award stand out as the most important ones.

The MVP award represents the pinnacle of achievement, acknowledging the player who has been most valuable in his team's success. Beyond statistical performance, the MVP takes into account leadership qualities, impact on team chemistry, and the ability to elevate the play of teammates, therefore bringing the team to achieve greatness.

The DPOY award pays homage to outstanding defensive ability and impact throughout a season. This award honors players who excel in disrupting offenses, protecting the rim, and influencing the game through their defensive skills and instincts.

In this report, we are going to analyze these important statistics, aiming to understand how the NBA's evolutionary changes have impacted the entire game. By examining the trends in MVP and DPOY awards, we gain insights into the league's evolution and the evolving criteria that define excellence in the league.

1.1 History

The Basketball Association of America (BAA) was founded in 1946 by owners of the major ice hockey arenas in the Northeastern and Midwestern United States and Canada. Although there had been earlier attempts at professional basketball leagues, including the American Basketball League (ABL) and the NBL, the BAA was the first league to attempt to play primarily in large arenas in major cities.

In 1949, the remaining NBL teams—Syracuse, Anderson, Tri-Cities, Sheboygan, Denver, and Waterloo—merged into the BAA. In deference to the merger and to avoid possible legal complications, the league name was changed to the present National Basketball Association, even though the merged league retained the BAA's governing body, including Maurice Podoloff as president. To this day, the NBA claims the BAA's history as its own. It now reckons the arrival of the NBL teams as an expansion, not a merger, and does not recognize NBL records and statistics.

In 1950, the NBA consolidated to eleven franchises, a process that continued until 1954–55, when the league reached its smallest size of eight franchises: the New York Knicks, Boston Celtics, Philadelphia Warriors, Minneapolis Lakers, Rochester Royals, Fort Wayne Pistons, Milwaukee Hawks, and Syracuse Nationals, all of which remain in the league today, although the latter six all did eventually relocate. The process of contraction saw the league's smaller-city franchises move to larger cities. During this period, the Minneapolis Lakers, led by center George Mikan, won five NBA Championships and established themselves as the league's first dynasty. To encourage shooting and discourage stalling, the league introduced the 24-second shot clock in 1954: if a team does not attempt to score a field goal (or the ball

fails to make contact with the rim) within 24 seconds of obtaining the ball, play is stopped and the ball given to its opponent.

In 1957, rookie center Bill Russell joined the Boston Celtics, which already featured guard Bob Cousy and coach Red Auerbach, and went on to lead the franchise to eleven NBA titles in thirteen seasons. Center Wilt Chamberlain entered the league with the Warriors in 1959 and became a dominant individual star of the 1960s, setting new single-game records in scoring (100) and rebounding (55). Russell's rivalry with Chamberlain became one of the greatest rivalries in the history of American team sports.

The 1960s were dominated by the Celtics. Led by Russell, Cousy, and Auerbach, Boston won eight straight championships in the NBA from 1959 to 1966. This championship streak is the longest in NBA history. They did not win the title in 1966–67, but regained it in the 1967–68 season and repeated in 1969. The domination totaled nine of the ten championship banners of the 1960s. By the end of the decade, the NBA had expanded its playoff format to eight teams and christened its Finals MVP trophy, which was renamed in Russell's honor in 2009.

The NBA matured in the 1970s, both in terms of competitiveness and credibility. Boston's utter dominance throughout the previous decade couldn't last forever, and it was better for the league that it didn't. Eight different franchises won a title in the 1970s, including the Washington Bullets, who claimed the franchise's only championship in 1978. Meanwhile, the NBA was formalizing in important ways, including a 1976 merger with the rival American Basketball Association (ABA) that brought top talents like Julius Erving under the big tent. In 1977, the NBA expanded its playoff format to 12 teams and began handing out the trophy that would eventually be named for Larry O'Brien, the golden ball on a pedestal that teams vie for to this day.

The 1980s are generally regarded as the beginning of the modern era. The league added a three-point line in 1979, instituted its 16-team postseason in 1984 and expanded from 18 teams in the mid-1970s to 27 by 1989. Meanwhile, the NBA expanded its television presence and influence on pop culture, as stars like Magic Johnson, Larry Bird and Michael Jordan established themselves as coveted pitchmen. The decade continued to be dominated by Johnson's Los Angeles Lakers and Bird's Boston Celtics, combined to win eight titles during the decade, and the two longtime rivals and friends combined to win six MVPs over a seven-year span from 1984 to 1990.

Basketball relevance took over in the 1990s, thanks to the legendary "Dream Team" that took gold at the 1992 Barcelona Olympics and to its signature star, Michael Jordan, who took the baton from Magic Johnson and Larry Bird to become the face of the game. The addition of numerous expansion franchises also altered the competitive landscape, bringing the NBA to Canada with the addition of Toronto and Vancouver (which later became Memphis) franchises in 1995. That brought the league to 29 teams, one shy of its current mark, and it took an influx of foreign players over the next 20 years to fill out the enlarged talent pool.

The NBA struggled to find its footing after Michael Jordan's second retirement, enduring a lockout that delayed the start of the 1998-99 season before entering a relatively low-scoring era dominated by defense. Commissioner David Stern pursued several fixes with varying degrees of success: outlawing hand-checking to enhance offensive creativity, shortening contracts to aid team-building efforts and instituting a controversial dress code in an attempt to increase the sport's marketability. Kobe Bryant and Tim Duncan shared dominance throughout the 2000s: Bryant teamed with Shaquille O'Neal and, later, Pau Gasol to help the Los Angeles Lakers win five titles between 2000 and 2010, while Duncan's San Antonio Spurs claimed five titles between 1999 and 2014. With Jordan gone and the Lakers and Spurs entrenched as powerhouses, the Western Conference won 10 of the 13 championships from 1999 to 2011.

Two major forces shaped the NBA in the 2010s: The rise of the player empowerment era and the three-point revolution. As top players like LeBron James and Kevin Durant became more aggressive about forming superteams, they set off an arms race of dueling dynasties. In one corner, there was James, who reached the Finals every year from 2011 to 2018 with the Miami Heat and Cleveland Cavaliers. In the other, there were the Golden State Warriors, led by Stephen Curry and bolstered by Durant's 2016 arrival. James's Cavaliers and the Warriors faced off in every Finals from 2015 to 2019, becoming the first set of opponents to play each other for the championship in four straight years. Curry's rapid ascension as the greatest shooter in league history prompted a widespread strategic overhaul. Over the course of the decade, the game got faster, higher-scoring and more reliant upon the outside shot: Skill and versatility now trumped size and power.

An extended era of growth and prosperity came to an abrupt halt in March 2020, when the coronavirus pandemic shut down the NBA for more than four months during the 2019-20 season. Facing both a public health crisis and a financial crisis that would cost the sport billions of dollars, the NBA and the National Basketball Players Association reached agreements to continue playing during the pandemic. Those adjustments included: playing the 2020 playoffs inside a restricted bubble at Disney World and delaying and shortening the 2020-21 season as well as instituting strict health protocols for players and teams and drastically limiting fan attendance at games.

1.2 Salary Cap

The NBA salary cap is the limit to the total amount of money that National Basketball Association teams are allowed to pay their players. It is necessary to control costs and benefit parity, defined by the league's collective bargaining agreement (CBA). This limit is subject to a complex system of rules and exceptions and is calculated as a percentage of the league's revenue from the previous season.

The NBA features a so-called soft cap, meaning that there are several significant exceptions that allow teams to exceed the salary cap to sign players. This is done to allow teams to keep their own players, which, in theory, fosters fan support in each individual city.

There are consequences for exceeding the cap by large amounts. A luxury tax payment is required of teams whose payroll exceeds a certain "tax level" and teams exceeding it are punished by being forced to pay bracket-based amounts for each dollar by which their payroll exceeds the tax level.

1.3 Statistics

Statistics serve a wide range of purposes in the NBA. They offer an objective means of evaluating player and team performance, guiding decisions on acquisitions, trades, and contracts. By analyzing shooting percentages, turnovers, and other metrics, teams gain insights into effective strategies, allowing for better game planning and optimization. Statistics also help the player development by identifying areas for improvement. Additionally, they make the fan experience much better by providing deeper insights and fueling discussions. Advanced analytics and statistical models have become prominent, impacting decision-making on lineup optimization and in-game strategies.

The NBA has a rich history of statistics that dates back to its early years. In the 1950s, the league started to officially track basic statistics like points, rebounds, and assists, although advanced metrics were not yet developed. The introduction of the three-point line in 1979 expanded the range of statistics used to evaluate player performance, and over time, more advanced metrics emerged to provide a comprehensive understanding of player and team contributions.

Only in recent years the NBA has seen a surge in the use of analytics and advanced statistics. Teams now have access to vast amounts of data, including player tracking information and shot charts, thanks to advancements in technology. This has led to the development of advanced metrics such as player efficiency rating (PER), true shooting percentage (TS percentage), and offensive and defensive ratings.

We can thus say that statistics play a vital role in the NBA by providing an objective evaluation of performance, facilitating strategic decision-making, supporting player development, creating an interesting fan experience, and evolving over time to become more advanced and influential.

1.4 Award

The awards in the NBA's world are very important. Each player inside his contract have some bonus if they win a determined award. The most important award is the MVP aka the Most Valuable Player: it is the prize to the best player in the regular season. A jury of journalist give 5 preferences for the best player and at each position of the journalist rank has be given an amount of points, then the player with most points win the MVP.

Another important prize is the DPOY aka the Defensive Player Of the Year. This award goes to the player who most shine in his half-field, by stopping the other team to make basket. The assignement process is the same to the MVP, but instead of five preferences, the journalist and expert have three preferences.

The player with the most MVP award is Kareem Abdul-Jabbar (Lew Alcindor) that from the 69' and the 89' have won this trophy 5 times, he is also the second best scorer in the history of NBA, behind LeBron James, but at his time the three-point shot didn't exist. The players that have won the DPOY most times are Ben Wallace and Dikembe Mutombo, each with 4 wins.

2 Dataset description

2.1 DPOY.csv:

This dataset contains the data about the Defensive Player of the Year votes, from 2014 to 2022. The features of the dataset that we are gonna use are:

- **year:** year of the season
- **player:** name of the player
- **award:** name of the award take in consideration, in this case we consider only the subset composed by DPOY award, but also in the original data there are the MVP award, the ROY award, and so on
- **points given:** number of votes taken by one single player for the DPOY in specific year

2.2 statnbatot2.xlsx:

This dataset contains the basic statistics for each player since 1982 and we are going to use this statistics for MVP's award and DPOY's award. *statnbatot2* covers the main stats related to the game, like how many points or assists the player had in a season. Those are the features that we are going to use:

- **year:** year of the season
- **pos:** position of the player
- **player :** name and surname of the player
- **TRB per g:** total number of rebounds (defensive and offensive) captured by the player per game in a specific season
- **AST per g:** assists per game of a player in a determined season
- **STL per g:** number of times per game a player stole the ball from the opposite team in a determined season
- **BLK per g:** number of times per game a player blocked the ball in a determined season
- **RANK PT:** player's ranking based by points, for a specific season
- **RANK AST:** player's ranking based by assists, for a specific season
- **RANK REB:** player's ranking based by rebounds, for a specific season
- **RANK ST:** player's ranking based by steals, for a specific season
- **RANK BK:** player's ranking based by blocks, for a specific season
- **DBPM:** Defensive Box Plus/Minus estimates the points per 100 possessions that a player contributes defensively above or below the league average. A positive DBPM indicates that a player is better than the average defender, while a negative DBPM suggests that a player is below average defensively.

- **DWS:** Defensive win shares (DWS) takes into account a player's defensive performance relative to their teammates and the league average to ultimately provide an estimate of the player's defensive contributions to the team's wins.
- **WS:** Win shares is an estimation the number of wins a player contributes to his team through his offense, defense, and overall play.
- **PER:** Player Efficiency Rating, statistic that attempts to measure a player's overall performance by taking into account his positive contributions on offense, such as scoring, shooting efficiency, and assists, as well as negative contributions, such as turnovers and missed shots.
- **MP per g:** Mean of the minutes played by a player in a specific season
- **Award share:** percentage that measures how much of the total award points a player has received in a given season for a particular award, such as the Most Valuable Player (MVP)

2.3 statbase.csv:

This dataset has the base statistic for the player in the season 2022-2023

- **player:** Name of the player
- **MP per g:** mean of the minutes played per game
- **AST:** Total assist made in the season
- **TRB:** Total rebound made in the season
- **PTS:** Total points made in the season

2.4 TTEAM202220231.xlsx:

This dataset contains the team statistic for every NBA's team in the 2022-2023 season

- **W/L:** Percentage of games won by the team

2.5 STATPLA202220231.xlsx:

This dataset contains the advanced stats, calculated with articulated formulas.

- **PER:** calculated by dividing a player total contribution across various statistical categories by the number of minutes he played, and then adjusting the result to account for the pace of play and the league average. The result is a single number that represents a player's overall efficiency on the court
- **OWS:** Offensive Win Shares, which is a statistic used in basketball to estimate the number of wins a player contributes to their team through their offensive performance. Players who have a high OWS are typically considered to be strong offensive contributors to their team and may be relied upon to score points and create scoring opportunities for their teammates.

2.6 NBAfranchises.xlsx:

This dataset contains information about each franchise, from their accolades to their geographical position

- **Franchise:** name of the franchise
- **Lg:** league membership
- **Plyfs:** number of times the franchise made the playoffs
- **Div:** number of times the franchise won the division
- **Conf:** number of time the franchise won the conference title
- **Champ:** number of campioships won by the franchise
- **Location:** city and state where the franchise is located
- **Country:** country where the franchise is located
- **Years:** time interval in years in which the number of teams in the league was constant
- **No. of teams:** number of teams in the league correlated to the Years column

2.7 NBAsalarycap.xlsx:

This dataset contains the values of the salary cap in millions of dollars through the seasons

- **Year:** NBA season
- **Salary Cap:** NBA Salary Cap in USD
- **2022 Dollars:** NBA Salary Cap in 2022 USD (Salaries converted using Consumer Price Index (CPI) [5])

2.8 NBALeagueAvergaes.xlsx:

This dataset contains the main league averages statistics for each season

- **Season:** NBA season
- **Lg:** league membership
- **Age:** player's age on February 1 of the season
- **FG:** field goals per game
- **FGA:** field goal attempts per game
- **3P:** 3-point field goals per game
- **3PA:** 3-point field goal attempts per game
- **FT:** free throws per game
- **FTA:** free throws attempts per game
- **ORB:** offensive rebounds per game

- **DRB:** defensive rebounds per game
- **TRB:** total rebounds per game
- **AST:** assists per game
- **STL:** steals per game
- **BLK:** blocks per game
- **TOV:** turnovers per game
- **PF:** personal fouls per game
- **PTS:** points per game
- **FG%:** field goal percentage
- **3P%:** 3-point field goal percentage
- **Pace:** an estimate of possessions per 48 minutes
- **eFG%:** this statistic adjust the field goal percentage considering the fact that a 3-point field goal is worth one more point than a 2-point field goal

2.9 Player-Stats.csv

This dataset contains the information concerning all the players in the NBA history from 1947 to 2018.

The features of this dataset that we are going to use are:

- **Height-cm:** this contains the height in centimeters of the NBA players. This data has been obtained by converting the original *Height* data, which contains the height of the players in feet;
- **Weight-kg:** this contains the weight in kilograms of the NBA players. This data has been obtained by converting the original *Weight* data, which contains the weight of the players in pounds;
- **Position:** this contains the position taken by the player in NBA.

2.10 NBA-Dataset

This dataset includes all the statistics about the NBA players that are extremely popular and, more importantly, helpful in order to understand better how players and teams are good and can improve.

The features of this dataset that we are going to use are:

- **Season:** this data contains the years taken into consideration inside this dataset, in particular from 1982 to 2022.
- **Blk Per G:** Blocks per game is a statistic defined as the average number of blocks a player makes per game.
- **Blk Pct:** Block percentage is a statistic used to estimate how many of an opponent's two-point field goal attempts are blocked over the course of a game.

- **Stl Per G:** Steals per Game is a statistic which measures the average number of steals per game of any given player.
- **Stl Pct:** Steal Percentage measures the number of steals made by the player out of total team during the game.
- **Position:** this contains the position taken by the player in NBA.
- **Fg2 Pct:** This Field Goal Percentage measures the number of 2-points shots made by the player in the game.
- **Fg2 Per G:** Two field goals per game are any shot — other than a free throw — taken on or inside the three-point line.
- **Fg3 Pct:** This Field Goal Percentage measures the number of 3-points shots made by the player in the game.
- **Fg3 Per G:** Three-point field goals per game, which are any shot taken outside the three-point line.

3 Infographics realization

In this chapter we will analyze in detail each infographic we have realized, the process that led to their creation and what we propose to communicate through such graphics.

3.1 Number of teams

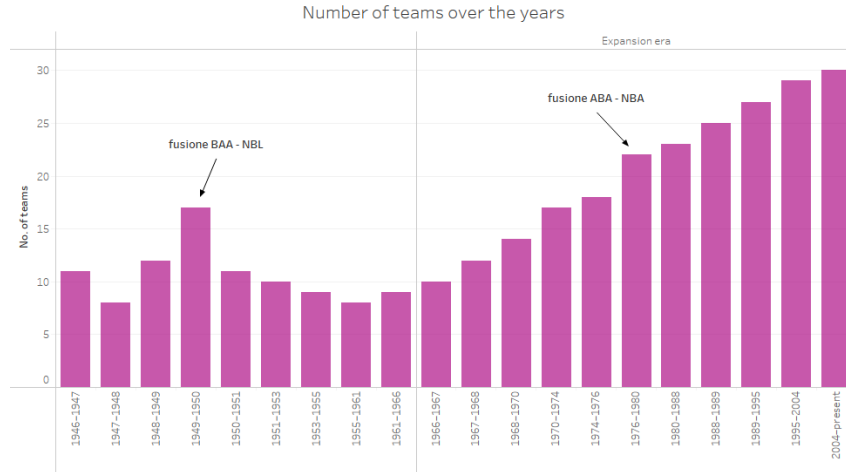


Figure 1: number of teams in the NBA since its foundation

The graphic above proposes to show the expansion of the National Basketball Association through the decades, in terms of number of teams that play in the league. The NBA originated in 1946 with 11 teams, and through a sequence of team expansions, contractions, and re-locations currently consists of 30 teams. The United States is home to 29 teams and one is located in Canada. Specifically the most relevant changes are the following:

- **Early years:** in 1949, the ten surviving BAA teams merge with the seven remaining teams from the NBL to form the NBA. The league experienced its first substantial growth, although it was short-lived, as the league was back down to nine teams by 1961.
- **Expansion era:** During a span of 15 years, 14 of the 30 current teams were brought into the league, beginning with the Chicago Bulls in 1966. Following the 1975–76 season, the NBA merged with the American Basketball Association, in particular four ABA teams became members of the NBA: the Denver Nuggets, Indiana Pacers, Brooklyn Nets and the San Antonio Spurs. In 1980, the Dallas Mavericks were created as the league's 23rd member. The NBA has added seven more franchises from 1988 to present, the latest in 2004: the Charlotte Hornets and Miami Heat in 1988, Minnesota Timberwolves and Orlando Magic in 1989, Toronto Raptors and Vancouver Grizzlies in 1995 (who relocated to Memphis in 2001), and New Orleans Hornets in 2002.

3.2 Salary cap

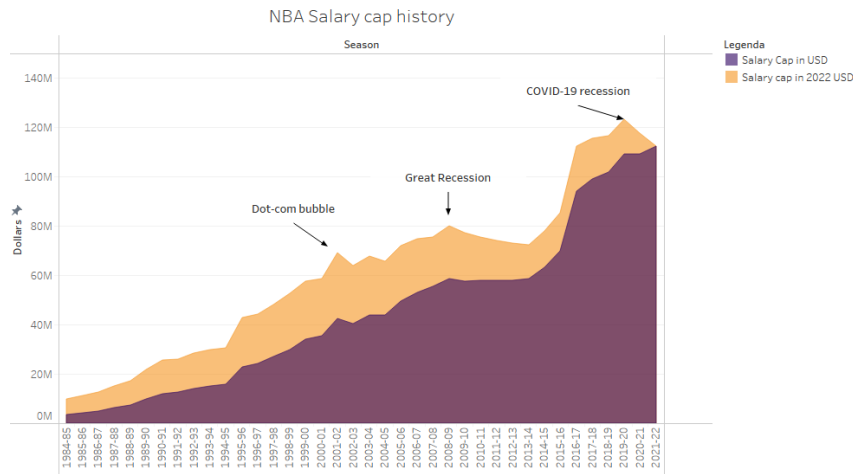


Figure 2: NBA Salary cap through the seasons

The league introduced a salary cap in the 1984–85 season, as an attempt to level the playing field among all of the NBA’s teams and ensure competitive balance for the League in the future. Before the cap was reinstated, teams could spend whatever amount of money they wanted on players, but in the first season under the new cap, they were each limited to 3.6 million USD in total payroll (which updated with the 2022 allocation rate would be approximately 9.8 million).

From 1985 the limit steadily increased by 1-2 million a year until 1995-1996, the year when it went from just under 16 million a year to 23 million in total, growing with consistency and even greater effectiveness. The big jump came in 2001-02 when the cap shot up from 35.5 million the previous season to 42.5 million the following year, as a result of the dot-com bubble, a stock market bubble coincided with massive growth in Internet adoption. After this burst, the following season had the first cap drop to around 40 million.

The salary cap was subject of a consistent growth of over 2 million dollars a year until 2013-14. From 2014 to 2016 the payroll had a substantial leap from 58 to 70 million and the following season it jumped to 94 million dollars thanks to a new contract on television rights. The evolution went along until the today’s 112 million total cap, which was expected to rise to 117 million in the next years.

Even though the Great Recession and the Coronavirus pandemic devalued the USD, as a result of the decreased inflation rate respectively in 2008 and 2019, the salary cap was not affected in a relevant way, maintaining approximately the same payroll level.

3.3 Stats evolution

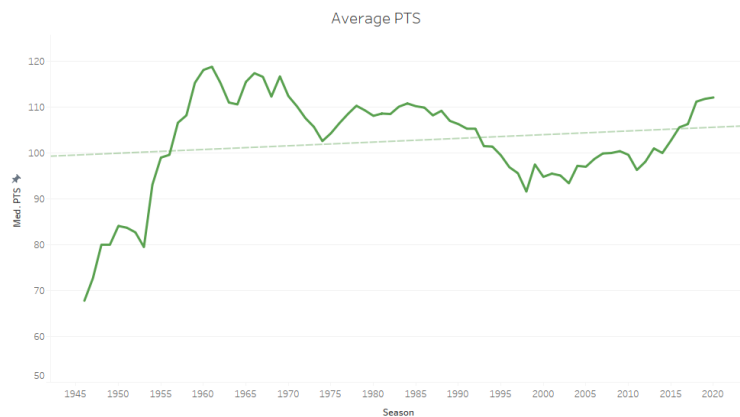


Figure 3: Average points per game through the seasons

The highest scoring season in NBA history was the 1961-62 season, in which the league averaged 118.8 points. Unsurprisingly, the lowest scoring year was the first season (1946-47), with an average of 67.8 points.

The 13 season stretch from 1995-96 through 2007-08 is the longest stretch in NBA history in which the league averaged under 100 points. The NBA seasons that have seen the most field goal attempts are also some of the highest scoring years in league history, which all came before the advent of the three-point line.

Anyway, the rise of the three-pointer has revitalized scoring in the NBA to levels it has not seen in over two decades. If this rise in three-pointers continues at its current pace, it is possible the NBA could see 1960s levels of scoring.

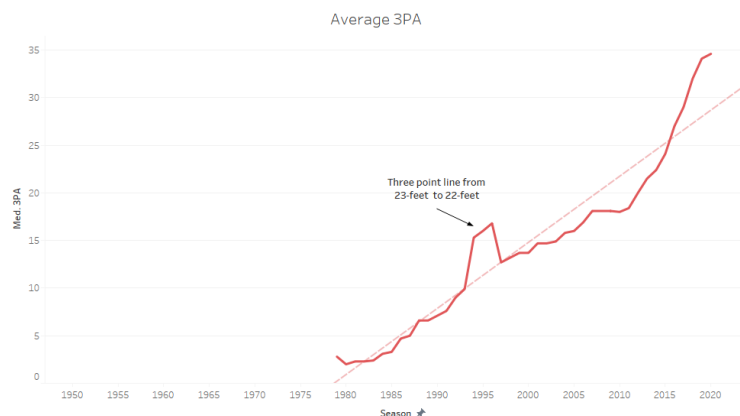


Figure 4: Average 3-point field goal attempts per game through the seasons

The addition of the three-pointer changed the way the NBA was played. During the early years of its existence, the three-pointer did not have much of an impact on games. For this reason the league reduced its 3-point line distance from 23-feet and nine inches to 22-feet between 1994 and 1997 as an attempt to combat the decreased scoring.

The total points per game were still dropping which prompted the change to push the line back to its original distance of 23-feet and nine inches at its longest.

Since 1997, that distance has remained the same while NBA Commissioner Adam Silver has had discussions with his competition committee regarding the possibility of pushing the current line back instead of adding a four-point line.

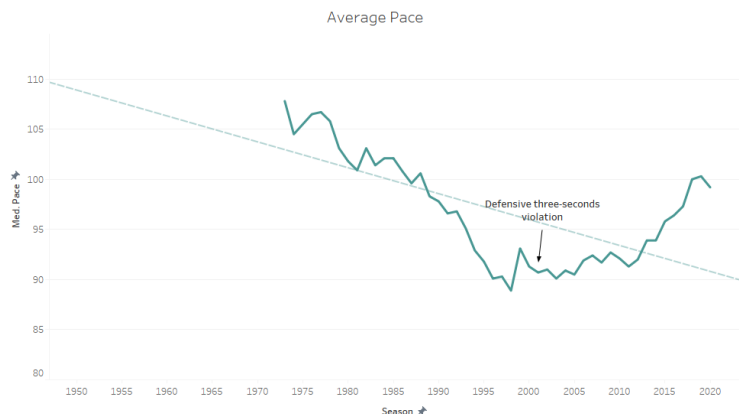


Figure 5: Average Pace per game through the seasons

The huge increase in 3-point attempts over the last decade has led to more rebounds and far more possessions per team per game, which has dramatically increased the speed of play. Over the last 10 years, league-wide possessions per game jumped from fewer than 96 to about 101.

A mutation on defensive rules also played a role on increasing the number of possessions, specifically the Defensive three-second violation, which means when a player spends more than three seconds in the free throw lane (also called "the paint") while not actively guarding an opponent, his team is assessed a team technical foul. The offense receives one free throw and retains possession of the ball.

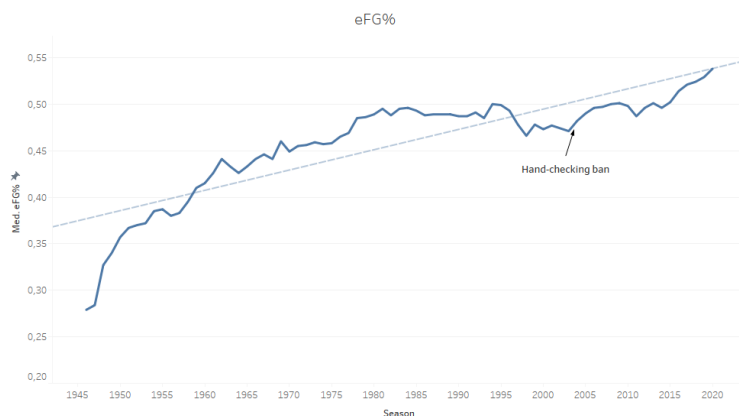


Figure 6: Effective field goal percentage per game through the seasons

The greatest change in the past decades that affected the scoring percentage is the banishing of hand-checking from basketball, a rule introduced in the 2004-2005 season that greatly influenced teams such as the Phoenix Suns who first began experimenting with a run-and-gun style of offensive play that forced them to attempt to score in seven seconds or less. Hand-checking, or the use of the hands and arms by a defensive player from preventing an offensive player from moving forwards, allowed smaller players to shine and use their lateral

quickness to score. This change was perhaps the most impactful, as a smoother offense and freer passing movements were now all more possible, helping create the Warriors, along with the rest of the NBA, as we know it today.

3.4 Championships

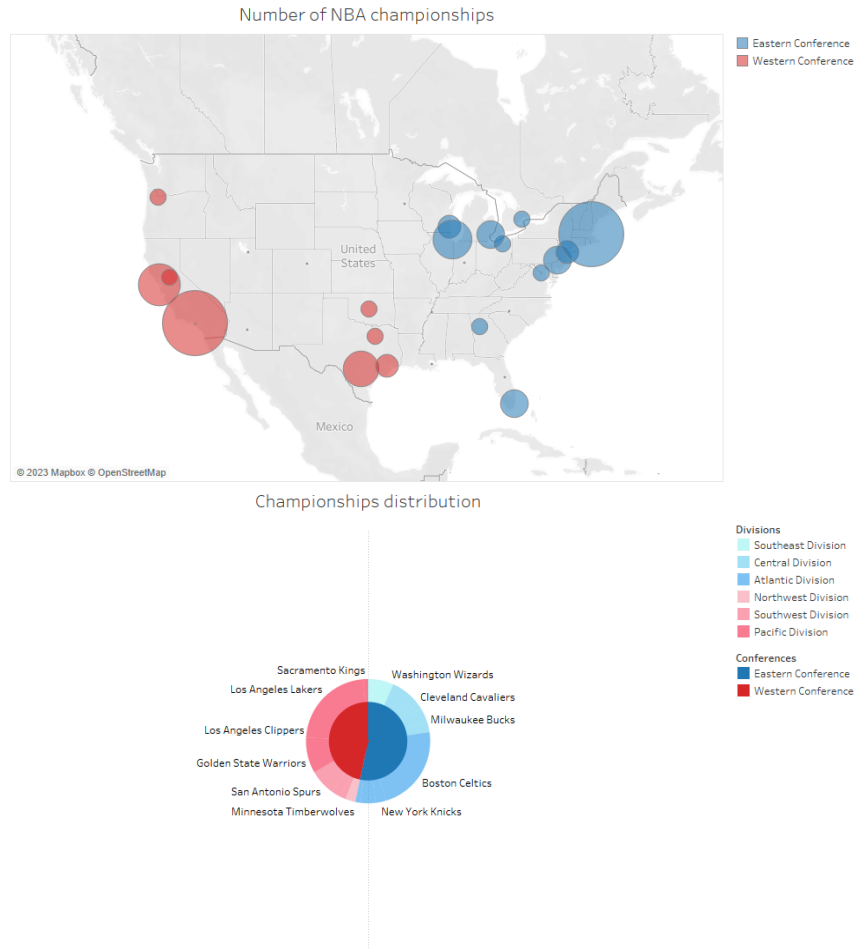


Figure 7: Championships distribution by team, division and conference

The NBA Finals is the championship series for the National Basketball Association held at the conclusion of its postseason. All Finals have been played in a best-of-seven format, and are contested between the winners of the Eastern Conference and the Western Conference.

As of 2022, the Eastern champions have a 40–36 advantage in NBA titles over the Western champions. The Boston Celtics and the Los Angeles Lakers are the most successful teams in terms of championships won, with 17 each in their rivalry.

3.5 Comparison between weight and height

This infographic aims to show the different trends that weight and height seem to have for the NBA players.

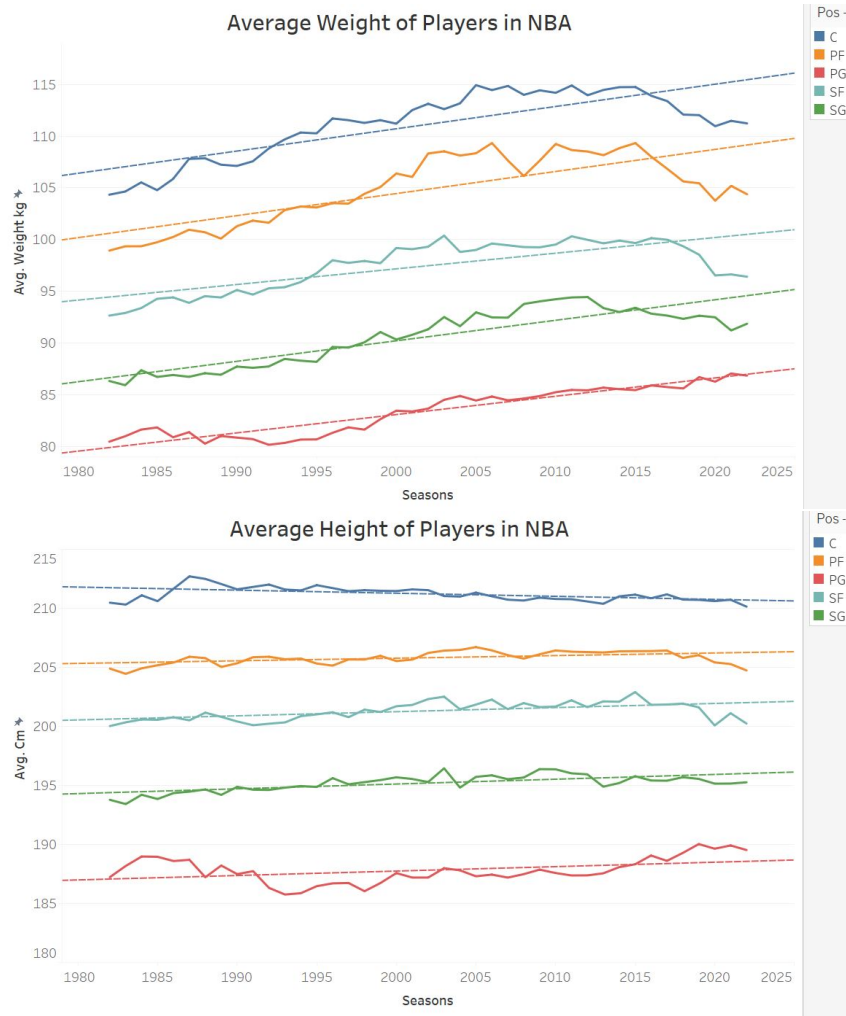


Figure 8: Average weight and height of players

In order to plot the weight, we took the *Season* attribute from the **NBA-Dataset** source and then the *Weight kg* attribute, computed on the original *Weight* data, which is in the **Player-Stats.csv** source and has values in pound measures, exploiting the formula of dividing the values by 2,205.

For the height plot, we took again the *Season* attribute from the **NBA-Dataset** source and then the *Cm* attribute, computed on the original *Height* data, which is in the **Player-Stats.csv** source as well and has values in feet measures, this time by multiplying the values by 30.48.

As it is possible to notice, it doesn't seem for the average height of the players to grow a lot over time: in fact, we can fairly say that the average height is basically steady throughout the years, with a slight growth over time for every player's role but the center one. The same things does not apply to the average height of the players as well: in fact we can say it's

quite the opposite, as it is possible to see that there is a noticeable trend for every players' role in the NBA where we have a steadily increasing average height over time.

Using the Tableau built-in plot possibilities, we can have a look at their boxplots:

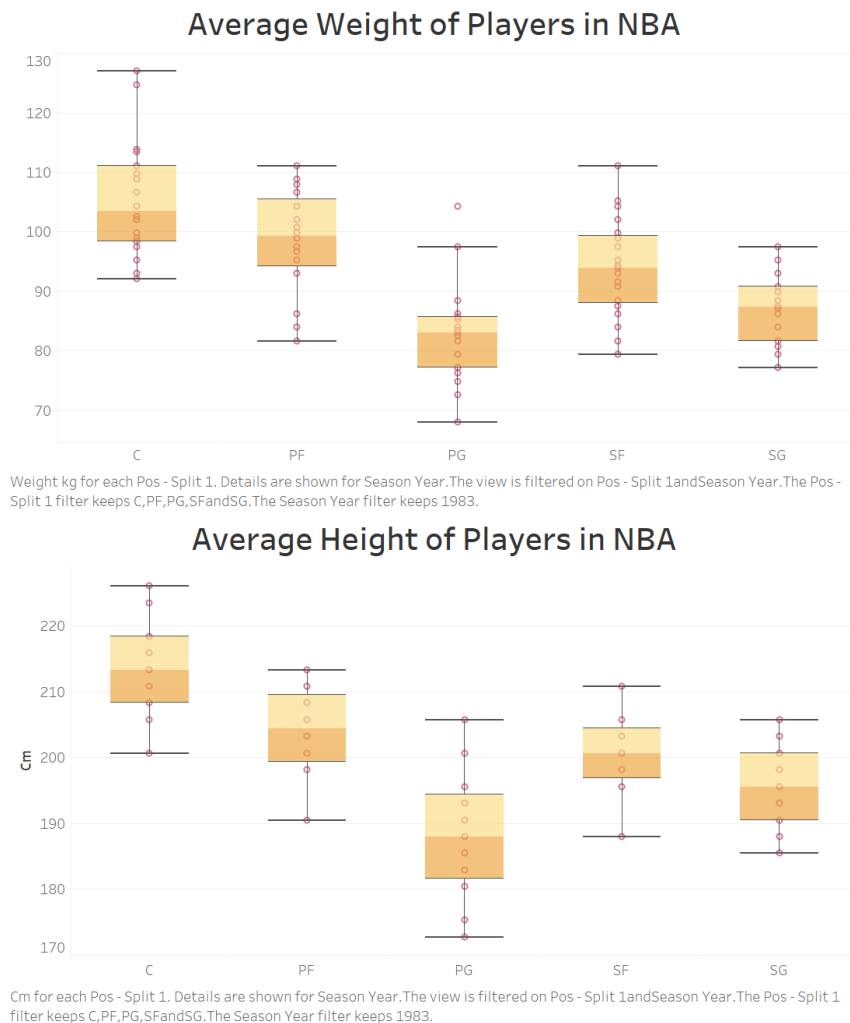


Figure 9: Weight and height boxplots

The lowest weight are in correspondence with the centers, as seen before. In particular, what's really interesting to notice with the centers is their median weight, which is closer to the upper hinge than to the lower hinge, therefore we can say that the centers' distribution is negatively skewed, thus having the mean lower than the median. Moreover, the centers' boxplot have an outlier. This outlier is none other than Shaquille O'Neal, one of the best centers of the entire NBA's history, renowned for his big body stature (2,16 meters and 104 kg).

For the average height's boxplots, we can notice that the distributions of all the NBA roles are basically symmetrically distributed. This is due to the fact that NBA experts measure the height of the players with fixed values, therefore we do not have the real heights of the NBA stars.

The average height of NBA players has been steadily increasing over time, as we can see in the figure 8, and this is due to several factors, like:

- **Strategic advantages:** As basketball has evolved, teams have recognized the strate-

gic advantages of having taller players on the court. Height provides benefits in areas like rebounding, shot-blocking, and defending the basket. Consequently, there has been a greater focus on recruiting and developing taller players who can excel in these aspects of the game.

- **Enhanced player development:** Advances in nutrition, sports science, and training methods have contributed to improved player development. With better knowledge about nutrition and specialized training programs, athletes can optimize their physical growth during adolescence, helping them reach their full height potential.
- **Global talent pool:** The NBA has become more diverse and inclusive, with players from around the world joining the league. Some regions have a higher concentration of taller individuals, and the inclusion of these players has influenced the average height of NBA players.
- **Aspiration and selection bias:** The increasing popularity of basketball has led to more individuals with exceptional height aspiring to become professional players. This aspiration creates a self-reinforcing cycle, where taller individuals are more likely to pursue basketball as a career, leading to a higher average height among NBA players.
- **Rule changes:** Changes in NBA rules have impacted the style of play, favoring taller players. For instance, rules like the three-second violation in the key area and defensive restrictions have made it advantageous to have taller players who can protect the rim and contest shots effectively.

It's important to note that while the average height of NBA players has increased, there is still a wide range of heights in the league. Not all players are exceptionally tall, and skill, athleticism, and basketball IQ remain crucial factors for success in the game.

3.6 Field Goals

Field goal percentage in basketball is the ratio of field goals made to field goals attempted, while field goals per game are the baskets scored on any shot or tap other than a free throw. These field goals are worth two or three points depending on the distance of the attempt from the basket.

By taking the *Season* attribute seen before, the average *Field Goal Pct* attribute and the average *Field Goals per Game* attribute, both present in the *NBA-Dataset* source, we obtain this:

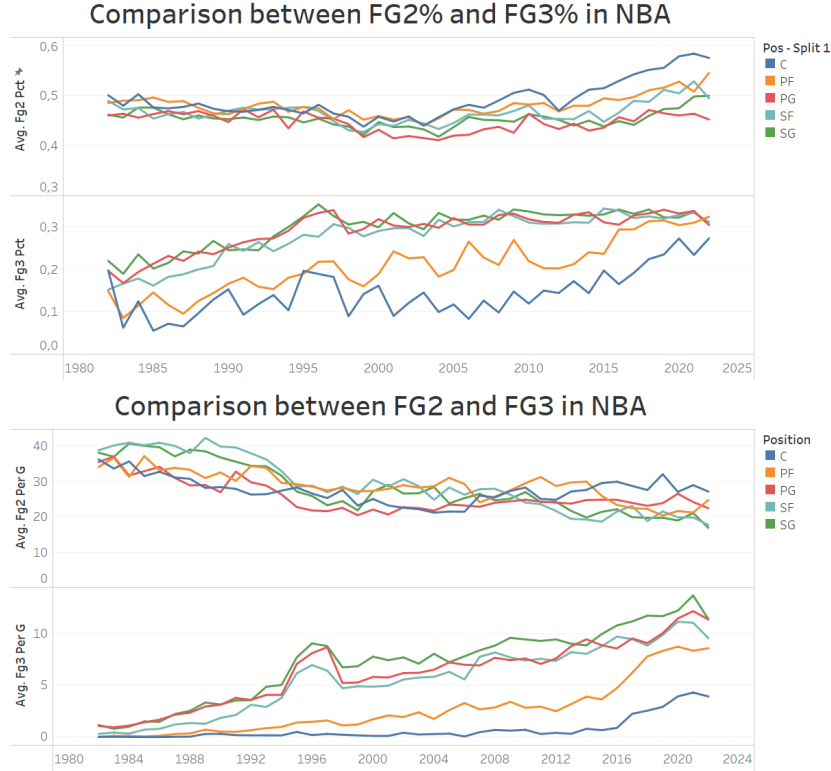


Figure 10: Comparison between FG per game and FG percentage

As we can notice, while the frequency of 2-point field goals has remained consistent over the seasons, there has been a steady rise in the number of 3-point field goals. This observation is particularly interesting as it provides valuable insights into the evolving playing style in the NBA. In fact, players have increasingly favoured shooting 3-pointers beyond the two-point area, gradually moving away from mid-range 2-point shots.

Furthermore, changes in defensive strategies have played a role in the increase of 3-point field goals. Traditionally, teams emphasized protecting the paint and defending close-range shots. However, with the rise of 3-point shooting as a dominant offensive strategy, defenses have had to adapt. This has created more space on the perimeter, providing shooters with better opportunities to attempt and make 3-point shots.

In summary, the steady increase in 3-point field goals can be attributed to the recognition of their statistical advantage, the influence of exceptional long-range shooters, and the evolving defensive strategies employed by teams. Meanwhile, the frequency of 2-point field goals has remained relatively unchanged as teams and players have shifted their focus

towards exploiting the benefits of long-range

In recent years, the average number of assists by centers in the NBA has seen an increase. This can be attributed to various factors that have shaped the game and the role of centers:

One significant factor is the evolution of playing styles in the NBA. Teams now emphasize ball movement, increased pace, and effective spacing on the court. This shift has led to more intricate offensive systems, involving greater collaboration and passing among players. Centers have become integral to these offensive schemes, often acting as facilitators from different areas of the court.

Another factor is the development of centers' skills. Modern centers are now more adept at passing and playmaking. Teams recognize the value of exploiting mismatches and creating scoring opportunities through their big men. As a result, centers have focused on improving their passing abilities, allowing them to make accurate and effective passes to their teammates.

Changes in NBA rules have also played a role. The introduction of the defensive three-second violation and a greater emphasis on defensive rotations have made it more challenging for centers to score in isolation. Consequently, centers have adapted by looking for open teammates and making well-timed passes instead of forcing shots.

Moreover, the increasing use of advanced analytics in basketball has shed light on the value of assists and ball movement in creating efficient scoring opportunities. Teams now prioritize finding centers who can make the right passes and create scoring chances for others. As a result, centers have become more proactive in seeking out open teammates and making high-quality passes.

In summary, the rise in centers' assists average in the NBA can be attributed to the evolution of playing styles, the development of centers' skills, rule changes, the prevalence of small-ball lineups, and the influence of analytics. These factors have collectively elevated the role of centers as facilitators and playmakers on the court.

3.7 Blocks and assists

The next analysis that we propose is about the blocks and steals averages in the NBA franchise. As we can see in the following figure, which was obtained by picking up the *Season* attribute and the averages of *Blk Per G* and *Stl Per G* attributes, there's an interesting phenomenon:

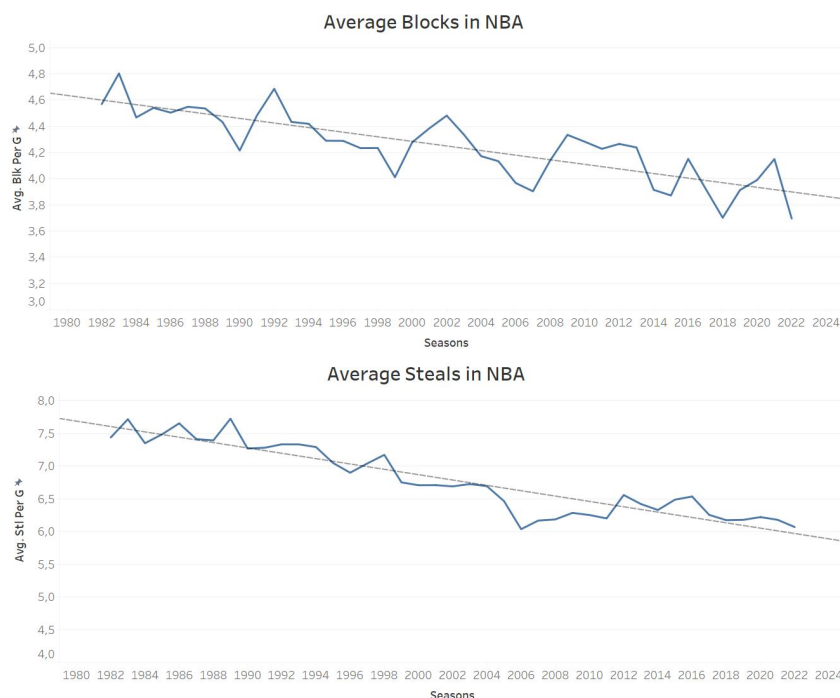


Figure 11: Blocks and steals per game

In recent years, there has been a noticeable trend in the NBA where the average number of steals and block has been decreasing. This can be attributed to several factors that have influenced the defensive dynamics of the game.

It is interesting to notice how the blocks have been decreasing overtime with a strange trend: the game's best rim protectors are blocking fewer shots, while more players are providing marginal help

Changes in NBA rules and officiating have also played a role. The league has implemented measures to reduce physicality and restrict hand-checking, making it more challenging for players to intercept passes and accumulate steals.

Offensive trends have contributed as well. The increased prevalence of three-point shooting and perimeter-oriented play has resulted in fewer opportunities for steals. With players often stationed on the perimeter, the chances of intercepting passes are reduced.

What it is worth to mention is that in basketball there's also an emphasis on blocks over steals. Advanced statistics and analytics have become more prevalent in the NBA, and shot-blocking is often regarded as a more tangible and easily measurable defensive metric compared to steals.

3.8 Defensive heatmap, bar chart and pie chart

The next 3 graph belong to a dashboard that is composed by an heatmap, a pie chart and a histogram. The purpose is to represent year by year the statistic and the distribution by position of the player that have received at least one DPOY's vote for the season selected. For the first 2 graph there is a season filter: with that the user can select what season will be shown on the dashboard.

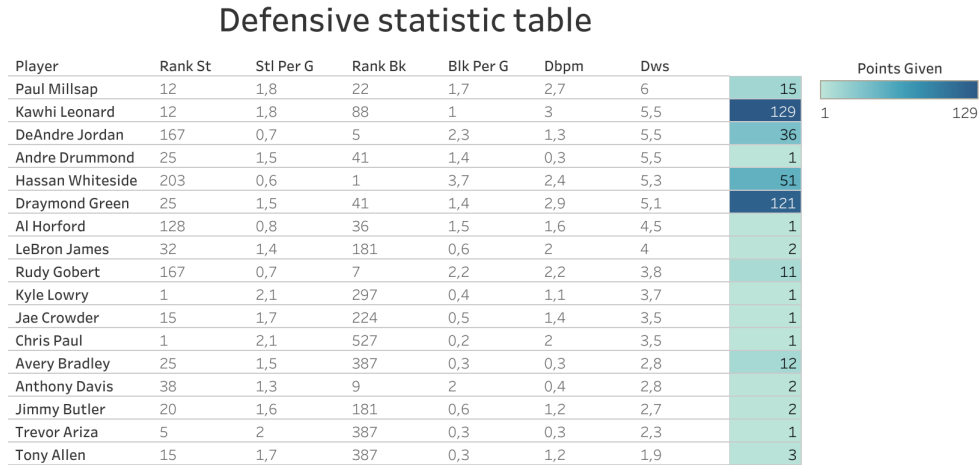


Figure 12: DPOY

The heatmap is been created by using the defensive statistic: we have taken the players that have at least received one vote as a DPOY and we add a filter that show only one year at time. Then we have add the principal defensive statistic: Rank st, Stl Per G, Rank Bk, Blk Per G, DBPM, DWS and points given. (look below, statnbatot2, for more description about these statistic). Rank St and Rank Bk are calculated by adding two new columns to the dataset statnbatot2, and by putting in that column the ranking by st and bk: the rank is calculated on every player by season, so the ranks show in table are not calculated only on the player that are shown on the heatmap. We have a coloured legend that make easier the recognition of the players that have received more votes. Also if you click one of the column's name, the table will be sorted by that column, so you can see what are the most important features for winning the DPOY. We have seen that in majority of the cases, the statistics that have more impact are DPBM and DWS, which are the most advanced statistic to establish how good is a player on his own side of field.

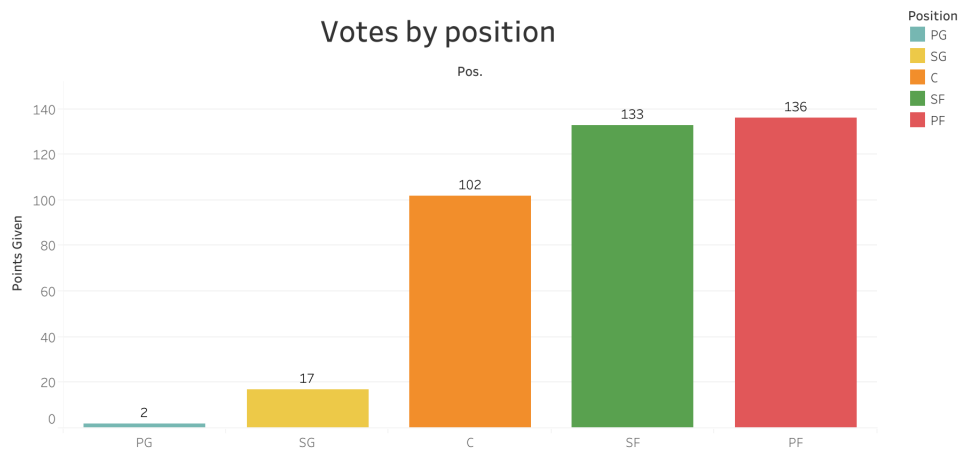


Figure 13: Bar chart for position in DPOY

The bar chart shown above report the sum of votes that each position received for the DPOY, in a determined season. We added a colour legend to make more clear the representation and the value of the sum on top of every bar to make more usable the graph for observing the data.

We can see that the positions with the most votes are at the frontcourt (C, SF, PF), and tendentially the Center (C) is the position with the most votes, because they are the defensive anchor usually. This pattern is well represented in the following pie chart, where we consider all the seasons from 2014 to collect the sum of votes by position for DPOY: we use the same colour of the bar, and we can see a dominance:

SUM OF VOTES FOR THE DPOY SINCE 2014

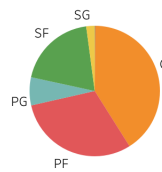


Figure 14: pie chart for all-time DPOY nomination

3.9 Importance of Blocks and Steals

This two scatter plot have the purpose to show if there is a correlation between steal, block and DWS: we have chosen blocks and steals as the more relevant defensive action that a player can do during a game, and DWS as the most important statistic for show how defensively good a player is.

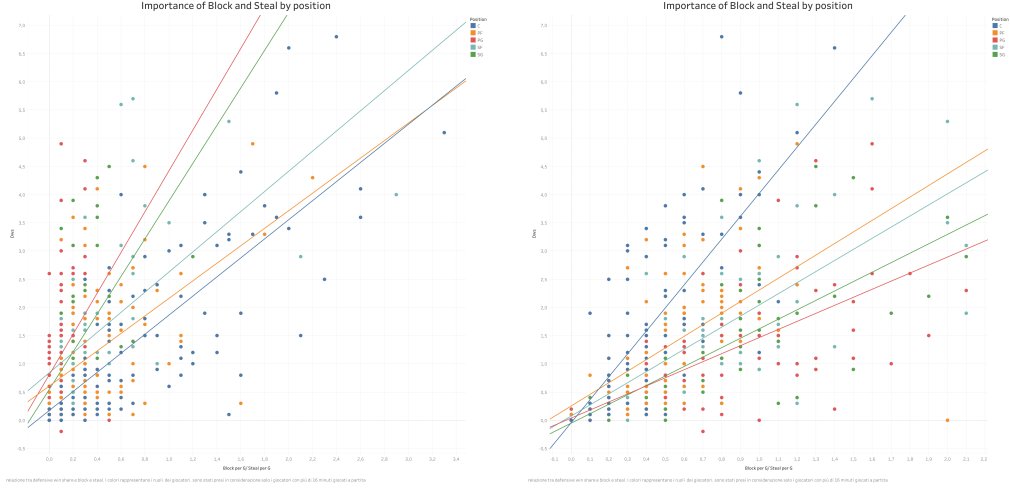


Figure 15: block and steal

We used the color to show the different position and the trend lines to show better how the different role's points are distributed. On y-axis we put DWS, on the x-axis we add a calculate field that the user can use to select if he want to see either blocks or steals.

We observe that the trend lines are very different for the two statistics: when we analyze blocks, we see that the DWS of Point Guards have higher values than Centers, that's because the center have an higher probability to make a block due to his height, so if a PG make the same amount of blocks of a center, he will have an higher DWS. Same thing happens for steals but reversed, that's because a Point Guard is more inclined to do a steal compared to a Center.

3.10 MVP heatmap

Table with statistic of the player that have received votes for MVP's award

Player	Pos.	Pts Per G	Ast Per G	Trb Per G	Ws	Per	Heatmap Award Share
Michael Jordan	SG	32,5	8	8	19,8	31,1	0,7040
Charles Barkley	PF	25,8	4,1	12,5	16,1	27	0,1110
Magic Johnson	PG	22,5	12,8	7,9	16,1	26,9	0,7820
John Stockton	PG	17,1	13,6	3	15,6	22,9	0,0330
Kevin Johnson	PG	20,4	12,2	4,2	12,2	20,5	0,0260
Karl Malone	PF	29,1	2,7	10,7	15,2	24,4	0,4260
Mark Price	PG	18,9	8,4	3	11,3	20,6	0,0210
Chris Mullin	SF	26,5	5,1	5,9	10,6	21,9	0,0040
Robert Parish	C	18,6	2,2	12,5	10,5	21,6	0,0050
Moses Malone	C	20,2	1,4	11,8	10,7	21,2	0,0040
Patrick Ewing	C	22,7	2,4	9,3	10,9	22,1	0,2350
Larry Nance	PF	17,2	2,2	8	10,3	19,9	0,0040
Tom Chambers	PF	25,7	2,9	8,4	9,2	19,3	0,0240
Brad Daugherty	C	18,9	3,7	9,2	9,6	18,5	0,0050
Joe Dumars	SG	17,2	5,7	2,5	7	16,8	0,0010
Hakeem Olajuwon	C	24,8	1,8	13,5	12,4	25,2	0,2110
Terry Cummings	SF	22,9	2,5	8,1	7,7	19,7	0,0010
Isiah Thomas	PG	18,2	8,3	3,4	7	17,1	0,0010
Mark Eaton	C	6,2	1	10,3	6,6	10,6	0,0040

Figure 16: MVP

This heatmap shows the main stats of every player that have received a vote for the MVP. As in DPOY, there is a filter that allow us to choose the season to see. The attributes here represented are: Pos, PTS Per G, Ast per G, Trb Per G, WS, PER and award share (to see more details about this statistics, look at *statnbatot2*). The colour legend is used to show more efficiently who have received more votes in a season.

We can choose a feature, click on the column, and the player could be sorted: using this function, we can see that PER, WS and Pts Per G are the most important characteristic for MVP's award, then whoever have the higher values on these statistics have a higher chance of winning MVP.

3.11 Offensive Scatter Plots

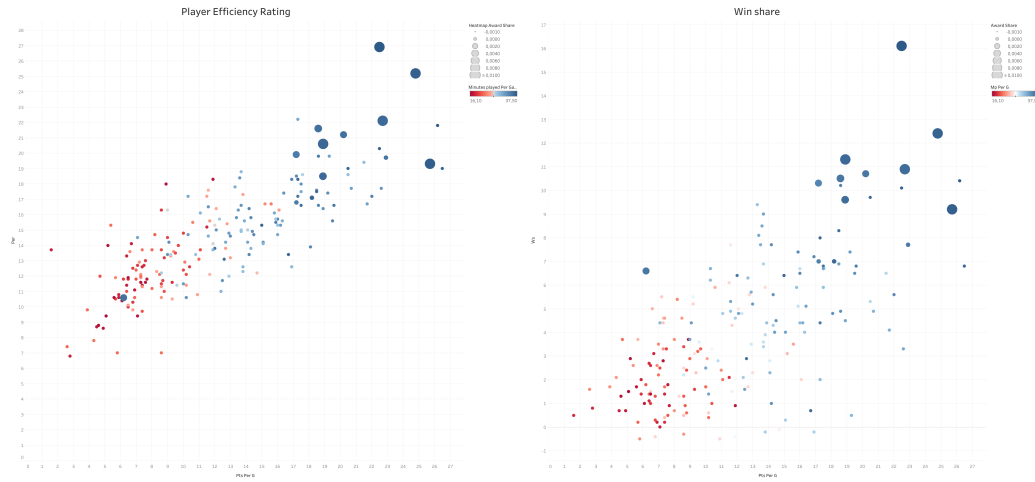


Figure 17: PER and WS

These two scatter plots are in the same dashboard with the MVP heatmap: they were created using the 3 main statistics which influence the MVP award: Points Per G, PER and WS. Every circle constitutes a player that played in a determined season and we add two legend:

- The first filter is for the colour of the circle: if the circle is dark blue, the player have played more minutes and if the circle is red, the player have less minutes per Game. We wanted to show this because advanced statistics sometimes gives an high values to some player that have played less than 1 or 2 minutes (if a player plays the last minute of a game, scores 1 or 2 bucket, the statistic reports the fact that in only 2 minutes he scored 4 points, so in 30 minutes he could score 60 points, which could suggests that he is a great player, but this is completely false), for this reason we added a filter to exclude the player that have less than 16 minutes.
- The second filter is on the size of circle. The bigger the circle is, higher the Award Share the player has.

For both visualizations, the player with higher award share are in the top right corner of the graph, so they have high values for the attribute.

3.12 Season 2022-2023 scatter plot

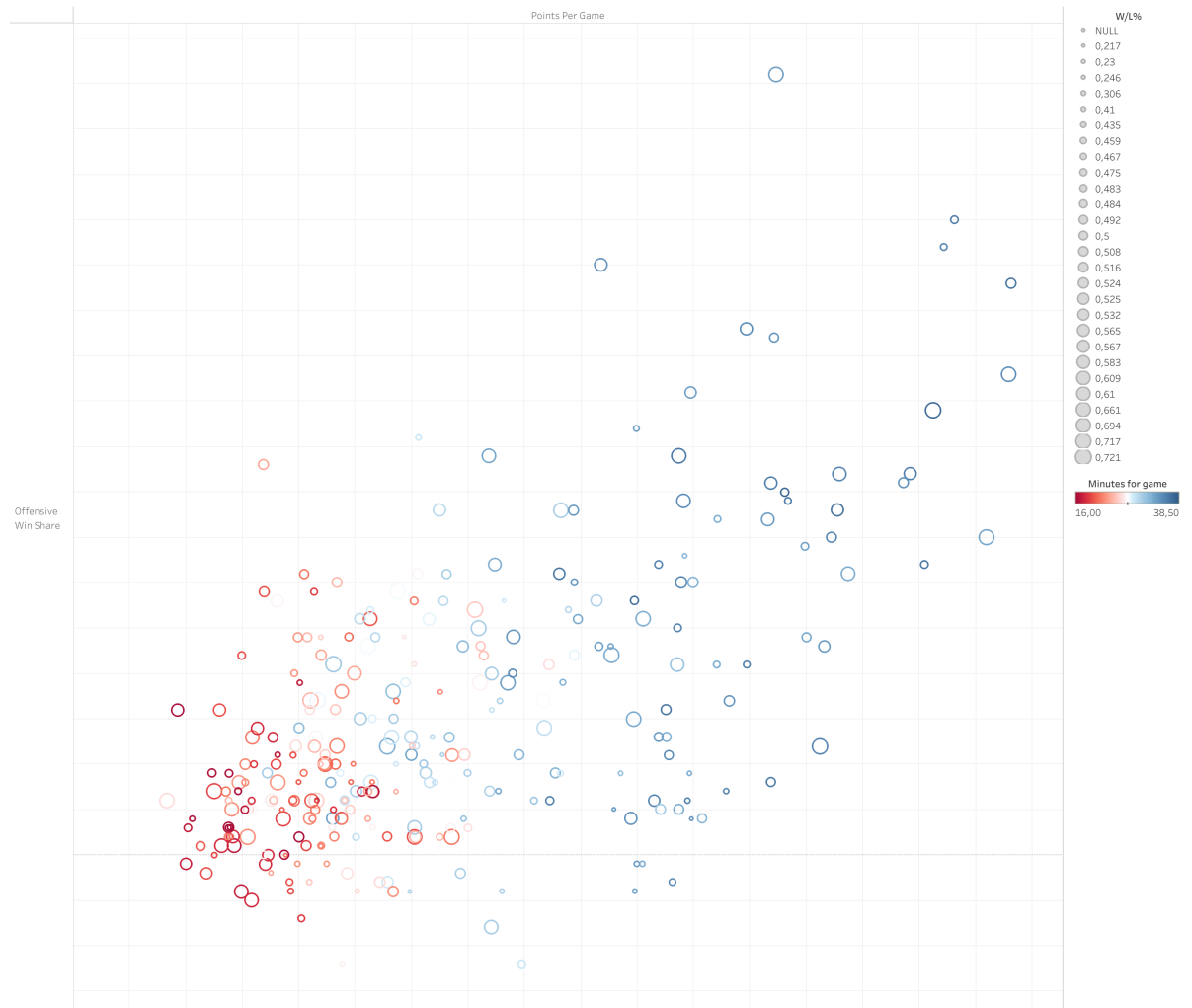


Figure 18: principal player's statistics for 2022-2023 season

This scatter plot has been made to evaluate the best candidates for the MVP award: on both axis there is a selector where the user can choose one out of six attributes he/she wants: Points per Game, Assist Per Game, Rebound per Game, Player Efficiency Rating, wins-share, Offensive Win Share. After the user selects two statistics, on the graph compares all the player of this season that have at least 16 minutes played for game, to eliminate the problem that can occur with some of the more advanced statistic and to make the graph more clear. Also we added different point size based on how much game the player's team have won since when the data are collected.

3.13 Radar chart

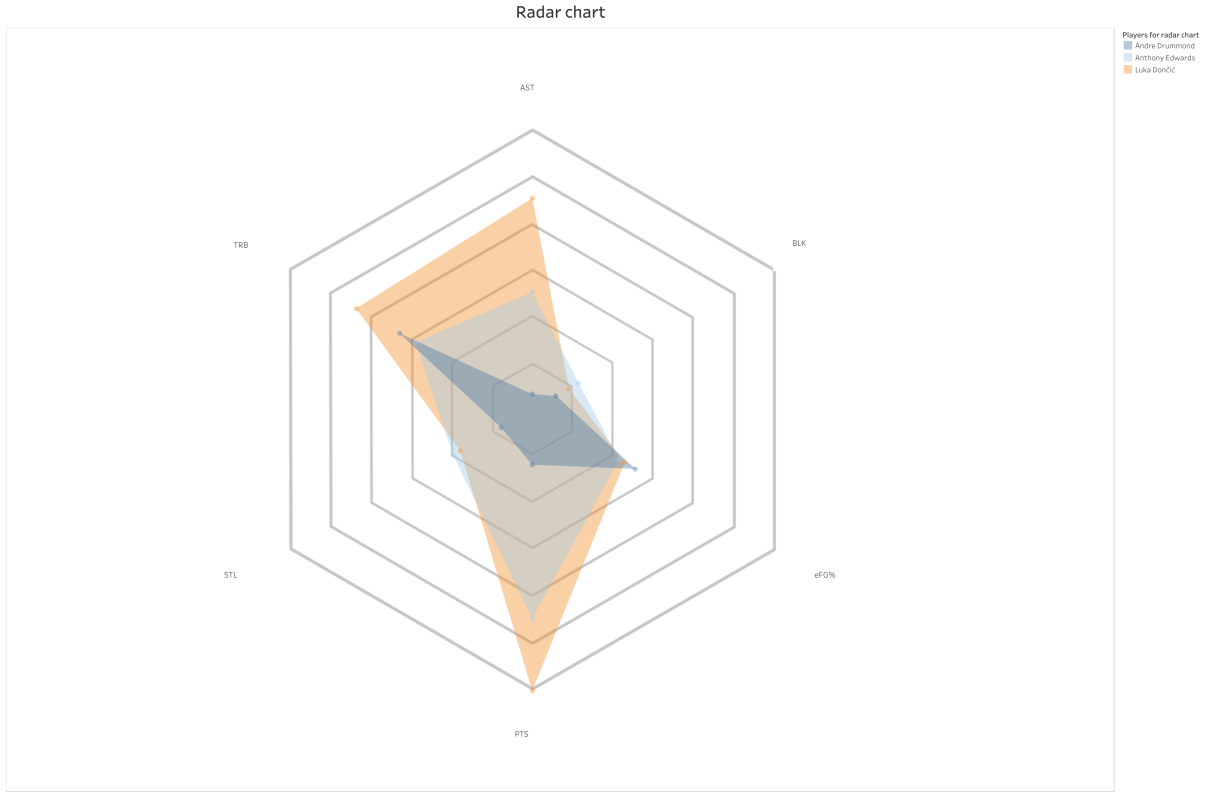


Figure 19: Radar

The purpose of the Radar Chart is to compare two or more player with some of the main features. The user can select which players he wants to seen into the Radar and each player will be displayed with a different colour. On every angle of the hexagon there is a statistic: AST, PTS, TRB, BLK, STL and eFG(assist, points, total rebound, steal, block and effective field goal). Every data for this statistic are standardized with the formula:

$$y(x_i) = \frac{x_i - \min}{\max - \min} \quad (1)$$

where x_i is the value of a single player for a single statics; \min and \max are respectively the minimum and maximum among all players for the statistic from which x_i was taken. More the shape is near the angle, more the player is ranking higher in that statistic. Obviously, these are all statistics where higher the value is, better is the player.

4 Evaluation

We now evaluate our infographics. We performed three different types of assessments on our infographic:

- **User test:** We asked 5 people to perform three task on the infographic
- **Heuristic evaluation:** We asked 5 people to look at the infographic and to think out loud about what they were seeing
- **Psychometric Survey:** We gave to 33 people a survey, where we asked to look at the graph and to answer using a scale from 1 to 5 (poco - tantissimo)

4.1 User test

4.1.1 Users

We have asked five people to perform the User test: first, we registered for every person their sex and their age. Then we asked them three question (same as the Psychometric Survey) to establish their level of knowledge of the NBA. This level is evaluated by giving to every question a value, respectively 0.40, 0.35 and 0.25 (the last question have two correct answer, so if a person put only one correctly received 0.15 points). The data are summarized in the following table:

Table 1: Users

ID	sex	age	level of knowledge
ID1	F	25	0.55
ID2	F	25	0.90
ID3	F	28	0.55
ID4	M	19	1
ID5	M	61	0.90

4.1.2 Task

The three tasks that the users need to perform are:

1. Find the winner of DPOY in the 2016
2. Find the year when the salary cap (based on 2022 USD) is maximized and how much is it
3. Find the possible MVP candidates for the 2022-2023 season

To every task we assigned a valuation: C if it is completed without help, H if the user needed an help, E if the user committed an error.

In the next tables we show the results of the tasks:

Table 2: Task 1

ID	time (seconds)	result
ID1	47	H
ID2	40	C
ID3	52	H
ID4	25	C
ID5	38	C

Table 3: Task 2

ID	time (seconds)	result
ID1	55	C
ID2	43	H
ID3	67	C
ID4	75	H
ID5	32	C

Table 4: Task 3

ID	time (seconds)	result
ID1	89	E
ID2	95	E
ID3	78	E
ID4	41	C
ID5	75	C

As we can see, the users have performed very well:

- In the first task there are almost no errors, only some explanation about the meaning of the term DPOY, since some of the participants are not familiar with this topic. User ID4 had a minor time of execution because he had a great knowledge of the NBA.
- The second task showed the same pattern of the first, but this time user ID5 had the shortest execution time, mainly because of his statistic background.
- The third task had a success rate of 40%. This probably happened because some of the statistics showed are advanced statistic and some of the users didn't know the meanings of them (like PER or WS), so they didn't understand very well the graphs. Another issue is that the race for this MVP was very close and since the data are collected as of February 2023, the season wasn't finished yet. Most people gave as answer Embiid, but at the time, the experts have said that if the season would have ended in February, Jokic would win it, so we count Jokic as the winner.

4.2 Heuristic evaluation

We have asked 5 people to perform the Heuristic test, with the think-aloud method. The main outlooks recognised are the following:

- **Slider and Legend:** Sometimes the sliders are not very clear, and the user do not understand how to select the correct values. For example, in the "Physical Boxplot" dashboard, the slider is not completely clear, and the users often will not change the season, because they do not see the arrow on the right to change the year or also if they want to choose a specific season, it is difficult to understand what year it's been showed. Also the legend often are not very well understandable, or are put far away from the graph, so the users don't understand to which graph they belong.
- **NBA's language:** In the infographic we use a lot of specific words and statistic, so a lot of them are not very common, and hard to understand if a person doesn't look deeply into the NBA's world. Most of this problem occur in page 11, where the graph is mostly based on advanced statistic (a solution could be adding a little "dictionary" to explain complex terms).
- **Radar and Boxplot:** Some people had hard time to understand this two type of graphs, mainly because the Boxplot is not common so without a statistical background it is relatively hard to understand. The Radar chart on the other hand is used a lot in video-games, so young people have no difficult to understand it, but some older people need some time and some explanation to interpret it.
- **Dimension:** The last issue is regarding the dimension of the dashboard: a fixed size causes on some devices the necessity to move up, down, left and right to see completely a single dashboard and this gave some comprehension troubles of graphs, because its not easy see them completely on the screen.

4.3 Psychometric Survey

For the psychometric survey, we used a rating scale ranging from 1 to 5 to evaluate the quality of our infographics based on four attributes. A total of 33 participants were asked to rate each attribute and they are:

- Bello
- Utile
- Fornisce Informazioni
- Chiaro

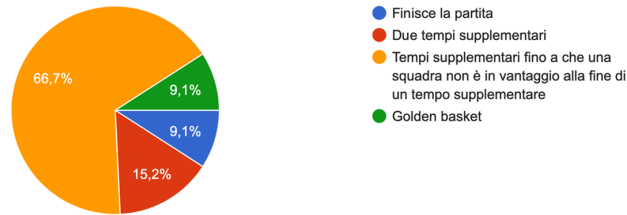
4.3.1 Pre-assessment

Before proceeding with this rating though, we conducted a questionnaire among the users consisting of three questions related to their general knowledge about the NBA. The purpose of this survey was to examine beforehand the contrasting ratings of our infographics, based on the participants' correct responses to the survey. By doing so, we aimed to divide any variations in the evaluations provided by those who demonstrated a solid understanding of NBA-related information compared to those who did not.

The first question we proposed was: *Cosa succede se una partita finisce in pareggio?* so we can see if the users know correctly the rule in a NBA game when it ends with a draw.

Cosa succede se una partita finisce in pareggio?

33 risposte

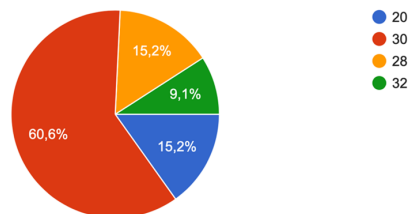


As we can see, 66,7% of the users answered correctly by choosing *Tempi supplementari fino a che una squadra non è in vantaggio alla fine di un tempo supplementare*, while the remaining 33,3% have answered in a wrong way.

The second question was about how many teams there are in the NBA.

Quante squadre ci sono in NBA?

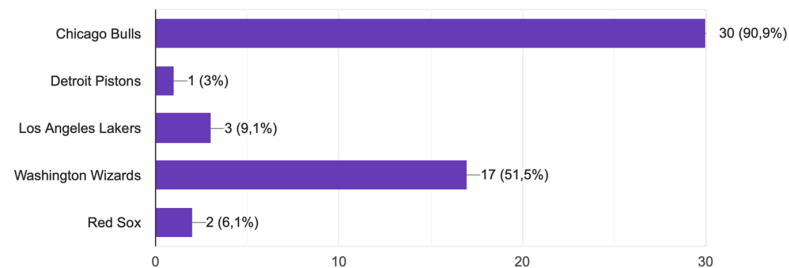
33 risposte



Even in this case, the majority (60,6%) has found the correct answer, that is 30 teams. The last question we asked to our participants was a more difficult and tricky question concerning the teams Micheal Jordan played for.

In quali squadre NBA ha giocato Micheal Jordan? (una o più risposte)

33 risposte



We can notice that 90,9% of the users have correctly guessed *Chicago Bulls* as the right answer, but only 51,6% of the participants have managed to find the other right answer, which is *Washington Wizards*.

4.3.2 Survey

As mentioned earlier, by including these questions in the survey, we were able to distinguish between users with varying levels of knowledge about the topic discussed in this report and analyze the disparities in ratings between them. As a result, we gained a valuable perception into how the assessments of our infographics differed based on the respondents' understanding and familiarity with the topic. First, let's have a look at this insights without distinguishing users:

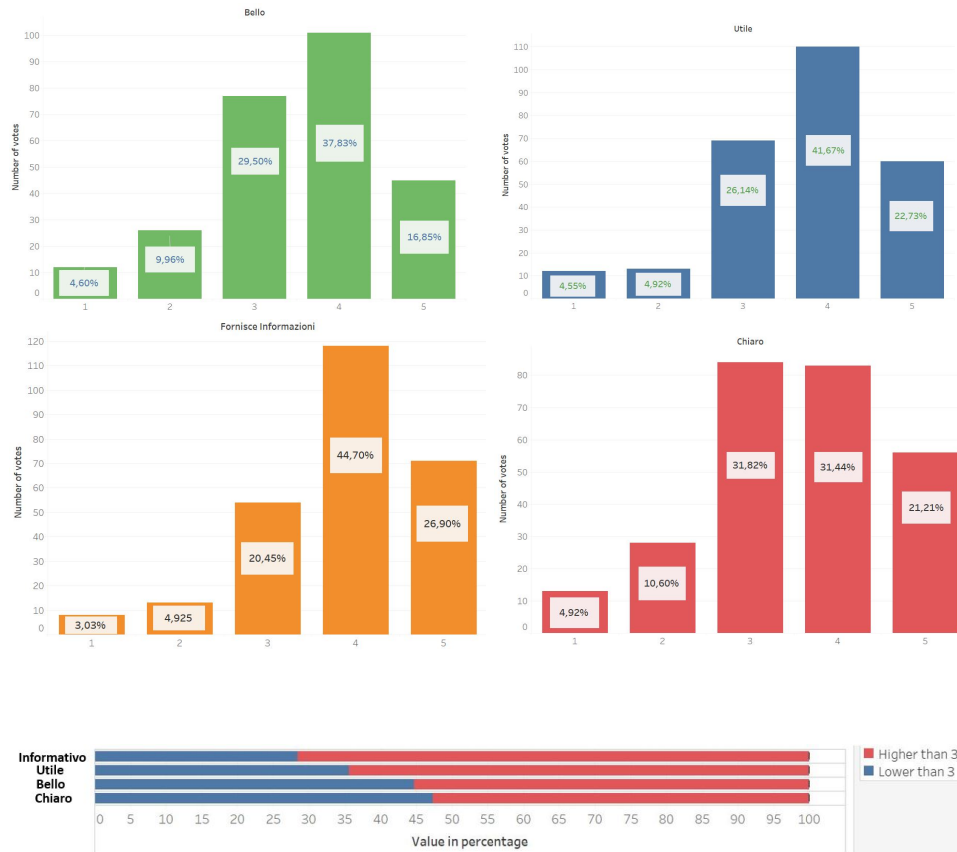


Figure 20: Data obtained through the psychometric survey

We can see from the results above that our infographics has received mostly positive reviews for every attribute, in particular:

- **Bello:** for this attribute we have most votes from 4 to 3 ratings followed by 5, respectively at 37,83%, 29,50% and 16,85%;
- **Utile:** also in this case the distribution of the votes is centered around the 3,4 and 5 rates, in particular we have a more concentration of votes in the 4 rate with a percentage of 41,67%;
- **Fornisce Informazioni:** in this attribute we find a similar distribution of the votes as seen in the previous features, therefore the 4 rate is, once again, the highest rate with a total of 44,70% of the votes;

- **Chiaro:** the distribution is not centered around the 4 value anymore but it's rather equally distributed between this rate and the 3 one, each with a percentage of votes at around 31%.

Finally, we can see in the stacked bar chart that every attribute has higher rates than three overall (red bar), with the attribute *Fornisce Informazioni* having the highest percentage at around 70% and as expected *Chiaro* has the least percentage of "higher than three" values, which is a little higher than 50%.

4.3.3 Weighted survey

Now we want to see how the rating just seen differs from the rating of participants who are actually knowledgeable of NBA and might have more capability to analyze more critically our infographics.

In order to create this difference, we weighted the right answers with a given weight and to the wrong answers we have assigned a weight equal to zero, deleting in practice this particular answer from the final review.

The weights between the questions are different as well, in order to give more value to the third question which is more difficult than the other two, in particular: for the first question we have assigned to the right answer, which is *Tempi supplementari fino a che una squadra non è in vantaggio alla fine di un tempo supplementare* a weight equal to 0.25; to the second question the right answer, which is *30 teams in NBA*, has received a value of 0.15 and finally, the last question's right answer, which is *Chicago Bulls or Chicago Bulls/Washington Wizards* we gave a weight of 0.10. We've also added a 0.50 score to every participants, so that also a person that have zero basketball background can say his/hers opinion.

The final ratings have therefore changed from the original due to the influence of the weights: who gave the correct answer to every question has a weight in the final review much stronger than who did not correctly answer. Moreover, we have more values in the ratings due to the weights as well. The results are the following:

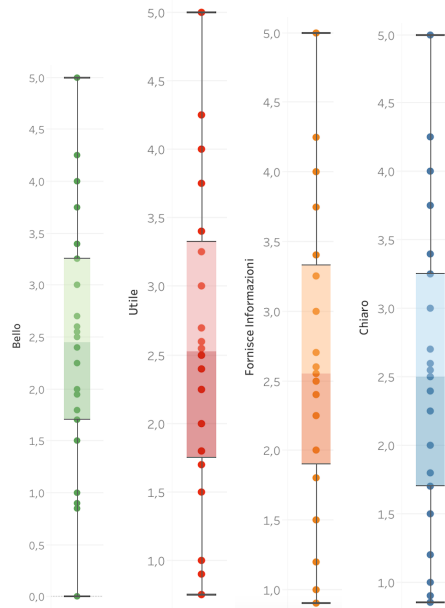


Figure 21: Data obtained by weighting

Contrary to our previous review, the results reveal a different narrative. Specifically, for each attribute, there is a notable shift towards lower ratings, indicating that users who answered the questionnaire correctly did not express a favorable opinion about our infographics compared to the other users. In particular, the median of the vote is near 2.5 on a scale of 0.5 to 5.

These results highlight a clear divergence in preferences and satisfaction levels between the two user groups, suggesting a potential mismatch between the expectations of knowledgeable users and the perceived quality of our infographics.

5 Conclusions

This report aimed to investigate the overall evolution of the NBA over the decades. Through an analysis of various datasets collecting different type of information and statistic of every NBA season, we have gained valuable insights into the main factors that shaped the league since its foundation, especially thanks to the infographics made on Tableau.

From our graphical representations, there are several factors that suggest the overall skill level of NBA players has continued to improve over time. The main reasons could be the advancements in sports science, training methods, and technology that have allowed players to optimize their physical attributes and develop their skills to a higher level. This includes improvements in strength and conditioning programs, nutrition, injury prevention, and recovery strategies.

The level of competition has also increased significantly over the years. The globalization of the game has led to a larger talent pool, with players from various countries showcasing their skills in the NBA. This increased competition has raised the bar and pushed players to continually improve and stay competitive.

The trends in the NBA's Most Valuable Player (MVP) and Defensive Player of the Year (DPOY) awards have also mutated over the decades. The MVP award has seen shifts from dominant big men in the early years to exceptional guards in the 1980s and 1990s, followed by the rise of centers like Shaquille O'Neal and Tim Duncan in the early 2000s. The modern era is characterized by the prominence of LeBron James and the emergence of dynamic point guards.

On the other hand, the DPOY award has recognized a mix of shot-blocking big men in the 1990s and 2000s, versatile defenders in the 2010s, and a combination of interior, perimeter, and team defenders in recent years. These trends reflect the changing styles of play and the impact of individual players on both ends of the court.

However, it's important to note that comparing players across different eras is challenging due to various factors such as rule changes, playing styles, and different eras' basketball contexts. Each era has had its own standout players and unique characteristics, making direct comparisons complex.

Regarding the infographic evaluation, we received mostly positive feedbacks from the interviewed, who found it highly informative and filled with valuable content.

From the User test we can notice every user could successfully perform basic tasks with the infographics, suggesting the importance of selecting suitable visualization techniques for displaying this type of data.

During the heuristic evaluation we found some issues related to our data visualization concerning the sliders configuration, the legend disposition and the dashboard size. Ultimately we proceeded to correct these aspects, making the presentation easier to comprehend.

The outcome of the psychometric survey indicates that our infographics has received a great overall appreciation, even though a weaker positive reaction speaking of the clarity of the plots. After weighting the results on the knowledge of the participants, the survey suggests us that our infographic is more suitable to explain and showing data to a public who's approaching and discovering the NBA, rather than an expert one.

Looking ahead, a potential future development could involve the application of advanced machine learning algorithms to uncover hidden patterns and insights within historical data. By leveraging large datasets of player statistics, game results, and award records, we could identify correlations and trends that were previously unnoticed. This could lead to the development of more robust predictive models for MVP and other awards, taking into account a wider range of statistical factors and contextual variables. This comprehensive and data-driven approach to NBA history and awards analysis has the potential to enrich our understanding of the game's past and shape future discussions and debates about the greatest players, teams, and moments in NBA history.

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