NBA Player Analysis

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Abstract

In the dynamic arena of professional basketball, traditional statistics such as points per game, rebounds, and assists often fall short in comprehensively assessing a player's overall impact on the court. This project introduces a visualization platform designed to deepen the analysis of NBA player effectiveness by incorporating a wide array of performance metrics. Through the application of innovative data visualization techniques including radar charts, composite scoring systems, & heat maps, this platform facilitates nuanced comparisons of player performances in the 2023-2024 NBA regular season. We utilized a Python dashboard to create these radar charts which can be found here: [NBA Player Analysis]. Our findings reveal distinct patterns in player effectiveness, highlighting the unique contributions of role players compared to their more versatile counterparts. Another pattern it highlighted was what types of players the best teams are composed of and what their average stat breakdown was. It also brought insights into what stats are important for high-scoring players, and who the best NBA players are across all skills. The platform serves as a vital tool for coaches, analysts, sports bettors, and fans, enhancing decision-making and engagement with the sport.

The motivating problem behind this project is the limitation of conventional basketball statistics, which often do not capture the full spectrum of a player's contributions to the game. This issue is particularly significant as basketball evolves, with an increasing emphasis on diverse skill sets and strategic versatility. In the past decade, with the arrival of players like Steph Curry, statistics like 3 points made became more valuable in many team's strategies. This phenomenon could also happen to other statistics or playing styles in the future. We want our dashboard to be able to help track these changes. The project is driven by the need to provide a more holistic evaluation of player performance, going beyond basic metrics to include aspects like defensive rating, true shooting percentage, and versatility index. This deeper analysis is essential for teams aiming to optimize strategies and for fans and analysts interested in the subtleties of player impact.

1 Data Source

Our research utilized an extensive dataset from NBAStuffer.com, which detailed the 2023-2024 NBA regular season player statistics. This dataset included a wealth of information essential for our analysis, encompassing both basic and advanced basketball metrics. Key data fields included the player's name, team, and position (Guard, Forward, Center), along with their age and the total games played (GP) for the season. Player involvement and efficiency were measured through minutes per game (MPG), usage rate percentage (USG%), and turnover percentage (TO%). Offensive capabilities were assessed through statistics such as total free throw attempts (FTA), free throw percentage (FT%), total two-point attempts (2PA), two-point percentage (2P%), total three-point attempts (3PA), three-point percentage (3P%), effective field goal percentage (eFG%), and true shooting percentage (TS%). The dataset also provided metrics on scoring, including points per game (PPG), rebounds per game (RPG), assists per game (APG), steals per game (SPG), blocks per game (BPG), and turnovers per game (TPG). Additionally, it featured calculated metrics such as points plus rebounds (P+R), points plus assists (P+A), combined points, rebounds, and assists (P+R+A), along with the versatility index (VI), which measures a player's ability to contribute across points, assists, and rebounds. Lastly, player impact on team performance was quantified through offensive rating (ORtg) and defensive rating (DRtg), estimating points produced or allowed per 100 possessions. This comprehensive data set provided a robust foundation for our project, enabling thorough analysis and insights into player performance and strategic dynamics within the NBA.

2 Related Works

2.1 Quantifying NBA Player Skill Levels

David J. Berri's 1999 article , "Who Is 'Most Valuable'? Measuring the Player's Production of Wins in the National Basketball Association," develops an econometric model to quantify each NBA player's contribution to their team's wins [1]. Berri critiques subjective methods like MVP voting and proposes a model that uses player and team statistics to objectively measure player productivity. Like Berri's work, our project aims to move beyond traditional basketball metrics to assess player effectiveness more comprehensively. Both approaches strive to provide a deeper understanding of player impact through quantitative analysis. While Berri's model focuses on econometrics to relate player performance to team wins, our project employs visual analytics and interactive dashboards, making the analysis accessible to a wider audience including fans and casual bettors. Unlike Berri's single metric focus, our project allows the exploration of various performance metrics through visual tools like radar charts, facilitating user-driven exploration of player effectiveness.

2.2 Stochastic Modeling for Basketball Player Performance Classifications

The article "A Continuous-Time Stochastic Block Model for Basketball Networks" introduces a method to analyze basketball games by modeling them as dynamic networks, categorizing players into clusters based on performance and interactions during games [8]. This approach goes beyond traditional statistics by integrating player interplay and game dynamics. Both this article and our project aim to provide deeper insights into basketball player performance, moving past conventional metrics. While the article focuses on dynamic interaction networks within games, our project employs interactive dashboards and visual tools like radar charts to analyze player effectiveness across seasons. Our approach enhances user accessibility and engagement, catering to a wider audience including casual fans, unlike the more complex network analysis model used in the article.

2.3 Radar Charts for Algorithm Evaluation

Peng et al. [5] is a 2019 evaluation of radar charts as a way to assess algorithms and filters across various error and precision metrics of different scales. The researchers found that radar charts, when laid out for their task, effectively communicated performance of the tested algorithms. While our project proposes a much simpler radar chart that has flipped vertices and the domain is vastly different, we can still see the semantic potential of these charts in evaluating NBA player performance.

2.4 Measuring Basketball Player Versatility

Rangel, Ugrinowitsch, & Lamas [6] present a paper that dives into the effect of versatile players in the NBA. In this paper the authors suggest that versatile players can have influence on the makeup of a team's roster, but the prevalence of versatile players may not indicate team success. The paper defines versatility in a similar way to our definition of a Role Player, where our 'Role Player' would align with a player who is not very versatile given the paper's definition, while a versatile paper would be considered by this paper to be 'well rounded'.

2.5 Gaussian Regression for Player Production

In contrast to our project, which leverages radar charts to provide a visual and quantitative comparison of NBA players across various performance metrics, the study described in "Modeling NBA Player Performance Using Gaussian Process Regression" [4] applies Gaussian process regression to analyze the impact of game participation and usage rates on a player's production over their career. This approach not only assesses how specific factors influence long-term performance but also utilizes a hierarchical model structure to enhance the accuracy of predictions based on player positions and game minutes.

2.6 Quantitative Analysis

The study by Dehesa et al. (2019) [3] aimed to analyze NBA players' performances by assessing both individual and team-based variables across 535 closely scored games. In contrast to our project, which employs radar charts to visually and quantitatively assess NBA players' performances across specific metrics like points per game and shooting efficiency, the referenced study uses cluster analysis to identify performance profiles based on a mix of individual and team-based statistics during close-scoring games. This approach focuses more on understanding player roles and dynamics within the context of team performance and game situations, rather than evaluating overall individual player effectiveness.

2.7 Exploring Player Tracking Data

Sampaio J et al. (2015) [7] utilizes player tracking data to analyze game performance in the NBA, focusing on different game roles and player performances in regular season games. The research underscores the importance of various game statistics, such as assists and defensive rebounds, in predicting game outcomes. This work complementsour project by highlighting how tracking data can enhance understanding of player contributions beyond traditional metrics.

2.8 Measuring Performance

Berri, D. J. [2] presents an in-depth statistical analysis of player contributions and team dynamics in the NBA, using advanced metrics to evaluate players' impact on their teams. It emphasizes the role of composite metrics, such as efficiency ratings, in capturing the multidimensional aspects of player performance. This relates to our project as it aligns with our use of composite scoring and radar charts to evaluate player effectiveness across multiple dimensions.

3 Project Description

3.1 Basic Radar Chart

Our project aimed to evaluate NBA players' overall performance across multiple skills, employing radar charts for visual analysis. We decided to use radar charts for several reasons, mainly due to their ability to display multivariate data in a way that is both spatially intuitive and visually engaging. Each axis represents a different attribute or skill of the player—scoring, shooting efficiency, defensive ability, and more—allowing us to plot a player's relative strengths and weaknesses in a comprehensive circular graphic. The specific statistics we incorporated into the radar chart include Points Per Game (PPG), True Shooting Percentage (TS

Additionally, we implemented a method to calculate the area enclosed by each players polygon on the radar chart, which serves as an overall "score" or index of a player's effectiveness across the selected metrics. This area calculation is important as it quantifies the visual representation provided by the radar chart, offering a single scalar value that summarizes a player's all-around performance. This feature enhances the analytical depth of our project, enabling us to rank players not only qualitatively through visual comparison but also quantitatively.

The decision to implement radar charts in our dashboard was driven by the need for a visual tool that could compare multiple variables simultaneously. This is particularly effective in sports analytics, where assessing a player's ability across various metrics is essential for a holistic review. Radar charts also facilitate a direct comparison between players, which is ideal for our project's aim to determine the best all-around players. By normalizing the data across each axis, we ensured that each stat contributed equally to the visual outcome, thus preventing any single metric from skewing the analysis.

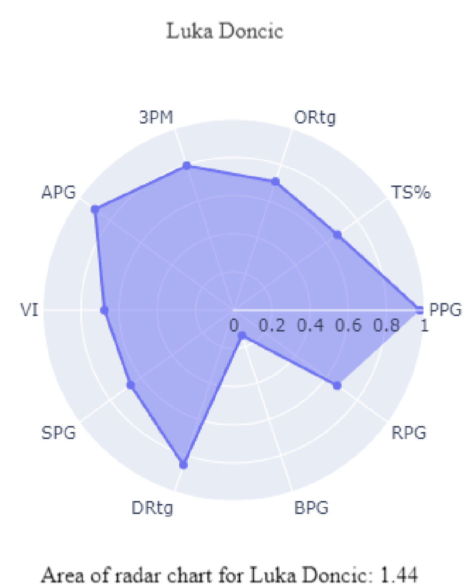

Figure 1: Basic Radar Chart for Luka Doncic

3.2 Stacked Radar Charts

We also implemented stacked radar charts as a method to compare NBA players more directly and dynamically. This visualization technique allows us to overlay multiple players' performance metrics on a single radar chart, effectively illustrating how they stack up against each other across various dimensions like scoring efficiency, defensive capabilities, and playmaking. Each player's performance is represented as a distinct layer within the radar, with different colors for clarity, making it easier to visually analyze differences and similarities in performance metrics.

Table 1: Basketball Player Statistics used for Visualization

Field	Statistic	Definition
MPG	Minutes Per Game	Time player is on the court in a game, measured in minutes
3PM	3 Points Made	Total 3 Point shots made for the season (This stat was constructed by us using 3PA and 3P% fields from the original dataset)
TS%	True Shooting Percentage	Measure of shooting efficiency that takes into account field goals, 3-point field goals, and free throws
PPG	Points Per Game	The average number of points scored per game by the player
RPG	Rebounds Per Game	The average number of rebounds collected per game by the player
ASP	Assists Per Game	The average number of assists per game by the player
SPG	Steals Per Game	The average number of steals per game by the player
BPG	Blocks Per Game	The average number of shots blocked per game by the player
VI	Versatility Index	Metric that measures a player's ability to produce in points, assists, and rebounds
ORtg	Offensive Rating	Estimates the number of points produced (including assists) by a player per 100 offensive possessions
DRtg	Defensive Rating	Estimates the number of points allowed (including blocks, steals) by a player per 100 defensive possessions

This method enhances our analysis by allowing simultaneous comparisons of multiple players, which is particularly useful in debates about player rankings and MVP considerations. By assessing how players' metrics fill the radar chart space, we can deduce which areas a player excels in or needs improvement. The area enclosed by each layer of the chart also provides a quantitative measure of overall effectiveness, turning complex multivariate data into a comprehensible and comparative format. This approach not only aids in player evaluation but also adds a strategic layer to team management decisions, offering insights into how different players' skills complement each other on the court.

3.3 Exploring Role Players

These charts not only display individual player profiles but also enable direct comparisons between players, highlighting areas of strength and weakness. One visualization can help identify role players and their unique abilities. The green lines highlight when a player performs above his composite score in a stat while the red

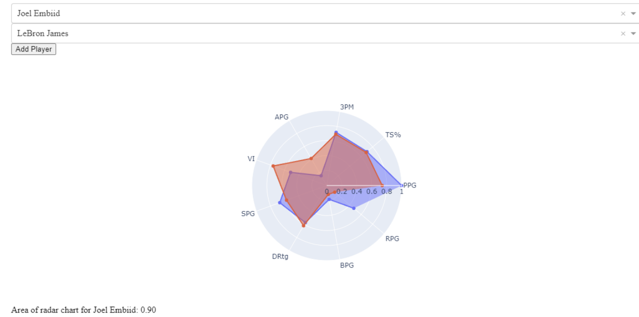

Figure 2: Stacked Radars with Embiid and Lebron

lines highlight the inverse. This feature could be used by teams to fill gaps in their roster and help with decision-making in trades and even potentially drafting in the future.

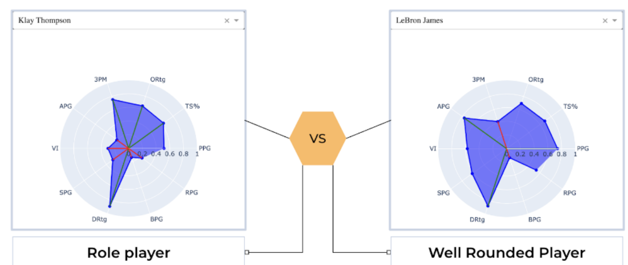

Figure 3: Role Player Comparison between Klay Thompson and Lebron

3.4 Composition of Teams

As mentioned in the related works section, Rangel, Ugrinowitsch, and Lamas found that player versatility had no confirmable effect on team strength, but did affect the roles of the players on their teams [6]. We were interested in following this up with qualitative analysis, and found interesting results. To find strong teams and players, we used the stacked reference charts to compare two teams with their own distinct play styles: the Denver Nuggets (Den) and the Golden State Warriors (GSW). In Sect. 3.4, we can see in the radars on the left how Den and GSW compare to average teams. DEN is clearly better than an average team in almost every category, and could be described as well rounded. This follows from their players, shown on the top right, with all three of their starters being

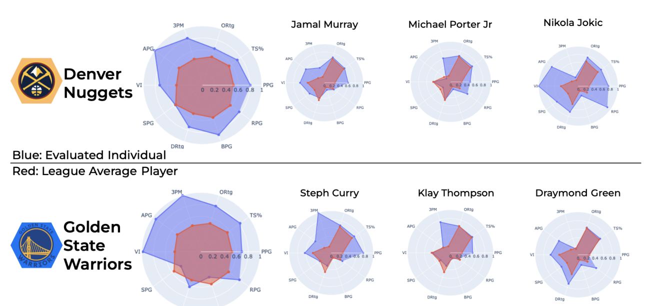

Figure 4: Team analysis of Denver Nuggets and Golden State Warriors

well rounded overall. Meanwhile, GSW show a similar trend, but by their radar chart appear to struggle more on defense. As we can see by the players on the bottom right, each player seems to be more of a role player. It is also worth noting that DEN is one of the top teams in the NBA, while GSW are closer to the middle of the league. While the difference in versatility goes in the direction of Rangel, Ugrinowitsch, and Lamas's paper [6], it is likely not the case that GSW is worse for having role players, but rather the sum of the role players strength is lower than that of DEN's. This follows by our area metric, where DEN has a composite score of 1.75 while GSW has a composite score of 1.7. Sect. 3.4

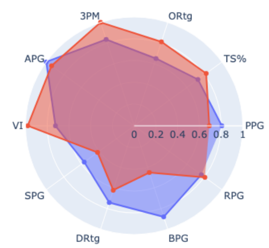

Figure 5: Direct Comparison Between the Denver Nuggets (Blue) and the Golden State Warriors (Red)

3.5 Correlation Heatmap

Furthermore, a significant component of the analysis focused on exploring the relationships between points per game (PPG) and other relevant basketball metrics. To facilitate this exploration, we utilized the Python libraries Seaborn and Matplotlib to create a correlation heatmap. This heatmap was constructed from a dataset that included key performance indicators such as Minutes Per Game (MPG), Usage Rate (USG%), and True Shooting Percentage (TS%). We selected seventeen metrics believed to potentially impact scoring effectiveness, encompassing various shooting efficiencies, game participation metrics, and defensive plays. The purpose of the heatmap was to visually depict the correlations between PPG and these metrics, offering a structured way to identify which statistics most strongly relate to scoring. This methodological approach served as a foundational step in our broader analysis, allowing for deeper insights into player performance optimization.

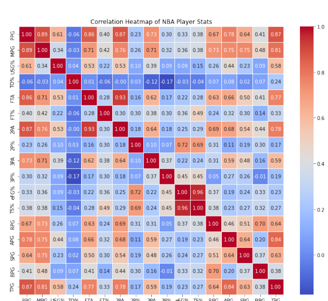

Figure 6: Correlation Heatmap

4 Findings

In our analysis using radar charts to evaluate NBA players' all-around skills, we found that Luka Dončić, Joel Embiid, and Nikola Jokić emerged as the players with the highest overall scores, as indicated by the area enclosed by their respective radar charts. This finding is a result of their exceptional performance across a wide range of statistical categories such as scoring, efficiency, playmaking, and defensive metrics. The analysis revealed that role players, often overlooked in traditional stats, can exhibit exceptional skills in specific areas, contributing significantly to team dynamics. For instance, players might excel in defensive ratings or three-point metrics while being average in overall scoring. This insight is crucial for team strategy, as it suggests the potential undervaluation of specialized skills in player recruitment and game planning. Additionally, the composite scores generated from our radar charts provided a quantifiable measure of overall effectiveness, offering a new metric for evaluating player performance.

In terms of what metrics are associated with high points per game (PPG), our findings from the correlation heatmap reveal several key stats that align closely with higher points per game, providing actionable insights for enhancing basketball performance. Notably, minutes per game (MPG), free throw attempts (FTA), assists per game (APG), and both types of shot attempts—2-point (2PA) and 3-point (3PA)—exhibit strong positive relationships with scoring. An interesting aspect of our analysis also points out that turnovers per game (TPG) correlate with higher scoring, which suggests that players who handle the ball frequently not only score more but also tend to have more turnovers. These insights are particularly valuable for coaches and team strategists. For instance, coaches aiming to develop prolific scorers might consider strategies to boost their players' court time and engagement in offensive activities. This could involve drills focused on increasing assists and shot opportunities or improving proficiency in drawing fouls and executing free throws—key factors that our analysis highlights as significant for scoring. Another real world example that can be used is shown by the strong correlation between MPG and PPG offers critical insights for sports bettors. Players who are consistently on the court for more minutes are likely to score more points, making them safer bets for achieving high scoring totals. This information could help bettors make more informed decisions, leading to more successful betting outcomes. Understanding these statistical relationships allows coaches and bettors to apply targeted strategies and make informed predictions, thereby enhancing their approaches based on solid data-driven insights. This methodical application of statistical analysis not only refines tactical planning but also deepens engagement with basketball by elucidating the statistical foundations of player performance.

5 Conclusion

In conclusion, our project has effectively demonstrated the significant benefits of employing advanced data visualization techniques to delve deeper into NBA player performance analysis. By stepping beyond the confines of traditional basketball statistics, our visualization platform has unlocked a more nuanced understanding of player effectiveness across a multifaceted array of performance metrics. This comprehensive tool has not only facilitated a richer analytical discourse among basketball coaches and analysts but has also enhanced fan engagement and understanding of the game's intricacies.

Through our innovative use of radar charts, correlation heatmaps, and composite scoring systems, we have provided users with the ability to explore player effectiveness in an intuitive and interactive manner. Our findings, highlighting the distinct contributions of both role players and versatile athletes, underscore the diverse skill sets that contribute to team success and player effectiveness. By quantifying these contributions, our project has offered new metrics and methods that can influence player selection, team assembly, and game strategy.

Furthermore, the correlations we identified between high points per game (PPG) and other key metrics such as minutes per game (MPG) and assists per game (APG) have significant practical implications. These insights enable coaches to refine training programs and game strategies to maximize player performance and scoring potential. Similarly, sports bettors can utilize these correlations to make more informed predictions about player and game outcomes, enhancing the accuracy and potential success of their bets.

Looking ahead, there is ample opportunity to expand upon this work by integrating predictive analytics to forecast player development trajectories and potential game outcomes. Enhancing the dashboard to include more personalized analytics and interactive features could further individualize user experience, allowing for more detailed player comparisons and strategic insights. By continuing to develop and refine these tools, we can provide even greater value to all stakeholders involved in the sport, from the strategists and participants to the fans and commentators, fostering a deeper, more comprehensive appreciation of basketball's complex competitive landscape.

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