How the three-point Shot Progressed in the National Basketball Association Since Stephen Curry was Drafted

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Abstract:

This study aims to determine if three-point shooting has significantly progressed since Stephen Curry was drafted into the National Basketball Association (NBA) in 2010. The primary dataset, sourced from Kaggle, and scraped from the NBA stats API, includes play-by-play data for every NBA game from 1997, allowing for the analysis of trends both before and after Curry's draft in 2010. Each play is represented by an individual row with 16 columns of data detailing specific aspects of the play. A secondary dataset from basketballreference.com, available via kaggle provides team win-loss records from 2000 to 2023. Through analysing visualisations, and making statistical comparisons, this report highlights the evolution of three-point shooting before and after Curry's entry into the NBA.

Introduction and Motivation:

The focus of this investigation is to explore how the three-point shot has progressed in the NBA since Curry was drafted. Widespread claims from basketball players and enthusiasts suggest that Curry has significantly influenced the league's increased emphasis on the three-point shot. However, these claims are often made without supporting data or visual evidence.[1] This study aims to fill that gap by analysing shooting metrics on multiple levels, including individual player trends, team specific progression and league-wide changes. Understanding the three-point shots progression is crucial for analysing the NBA's tactical evolution over the past 25 years. This investigation will provide data visualisations on how three-point shots have become more prevalent in the NBA for players, teams and the NBA's global fanbase.

Datasets:

To conduct this investigation, two datasets were selected, both sourced from Kaggle. The primary dataset was scraped from the NBA Stats API, containing detailed play-by-play data for every NBA game since 1997.[2] While the dataset spans back to 1997, the focus of this analysis is on the past 25 years, beginning in 1999. This dataset includes twenty five files, each representing a season of NBA games. Each play is represented as a row, with 16 columns detailing specific attributes, such as the player involved, the description of the play and other play identifiers. This made it straightforward to filter and access specific types of plays, such as three-point attempts. Some files (years) contained over 600,000 rows, providing an extensive amount of data for trend analysis. Additionally a second dataset, scraped from basketballreference.com's API was used to specifically focus on team performance.[3] This dataset was chosen for its efficiency in providing team performance data, more specifically win-loss records, eliminating the need to manually extract and calculate records from the larger play-by-play dataset. By combining the visualisations from both of the datasets, the study allowed for the examination of three-point shooting trends and their correlation with the teams success.

Methods and Experimental Setup:

To create visualisations for NBA three-point shooting trends, Python and Jupyter Notebook were used for data processing and visualisation. The Pandas library handled multiple CSV files from the 1999 to 2023 seasons. Python's defaultdict library was used to efficiently organise the data into arrays of hashmaps, where one hashmap handled the data for that specific year. This setup allowed tracking the frequency of makes and misses for both teams and individual players to be easily accessed. Python's heapq was used to rank player three-point shooting performance.

The visualisations were conducted using Matplotlib and Seaborn to generate line plots, scatter plots, bar charts, pie charts and density heatmaps. These visualisations highlighted key trends in the progression of three-point shooting across seasons, comparing individual, team, and league-wide performance to assess how the three-point shot evolved both before and after Curry's entry into the NBA. Special attention was given to Curry's performance, where his impact was measured against league averages and the performance of top shooters in different seasons.

Although formal statistical significance tests were not applied, the visual evidence provided compelling insights into the influence of Curry on the game. Only the most relevant visualisations were selected to accurately represent how the three-point shot has evolved.

Results:

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[1] Powell, S. (2022). *Stephen Curry reached 'his own level' and left behind a new-look NBA*. [online] www.nba.com. Available at: https://www.nba.com/news/stephen-curry-changed-game-long-before-3-point-milestone [Accessed 28 Jul. 2024].

[2] *Szymon Jóźwiak (2023). NBA Play-by-Play Data (1997-2023). [online] Kaggle.com. Available at: https://www.kaggle.com/datasets/szymonjwiak/nba-play-by-play-data-1997-2023?select=pbp2023.csv [Accessed 1 Aug. 2024].*

[3] *Kaggle.com. (2023). NBA Teams Stat 2000-2023. [online] Available at: https://www.kaggle.com/datasets/bluedreamv1b3/nba-teams-stat-2000-2023?select=advanced_stats_total.csv [Accessed 15 Aug. 2024].*

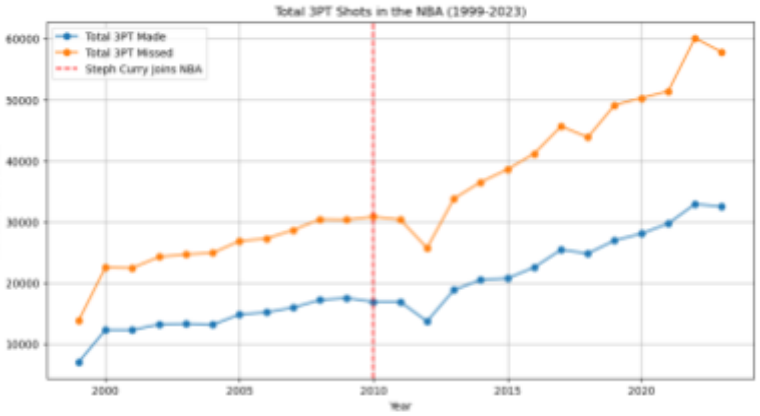


Figure 1: Progression of total NBA 3PT shots per year

Figure 1 illustrates the number of three-point shots made and missed in each NBA season from 1999 to 2023. The data demonstrates a consistent upward trajectory, with minor deviations in both three-point attempts and successes. In 1999, NBA teams made a total of 7,031 three-pointers. By 2010, coinciding with Curry's entry into the league, this figure had risen to 16,888, marking a significant increase. In the most recent NBA season, the number of three-point shots made surged to 32,480.

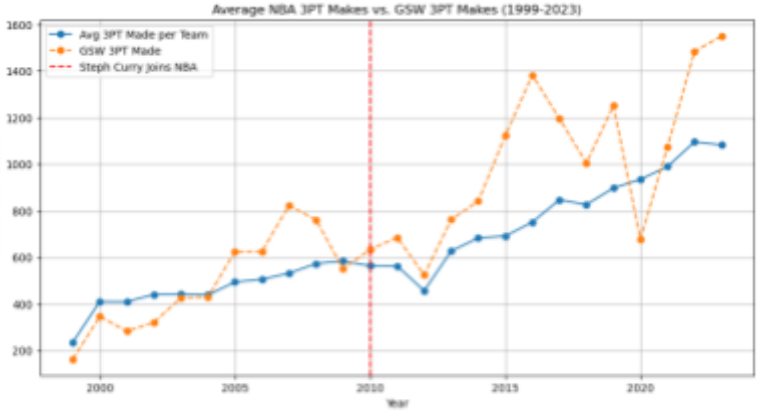


Figure 2: Average NBA 3PT Makes vs GSW 3PT makes (1999 - 2023)

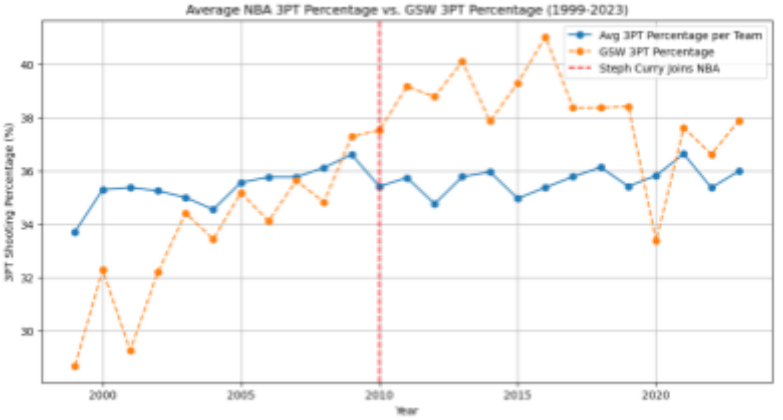


Figure 3: Average NBA 3PT Percentage vs GSW 3PT Percentage (1999 - 2023)

Figure 4: Golden State Warriors Wins Progression

Figure 2 shows the Golden State Warriors' three-point shots (in orange) compared to the league average per team (in blue). Before Curry's arrival, the Warriors frequently fell below the league average three-point shots made. However, after Curry joined the team, the Warriors consistently outperformed the league average in three-point shots made, except in 2020 when he played only five games due to injury. Notably, in the 2016 season, the warriors made 1,383 three-pointers, far exceeding the league average of 750.8.

Figure 3 compares the Warriors' three-point shooting percentage to the league average. From 1999 to 2008, the Warriors consistently fell below the league average. However, from 2009 to 2023, they consistently outperformed the league, peaking at 41.04% in 2016, while the league average remained at 35.37%. In 2020, when Curry was injured, the Warriors' percentage dropped below the average again, highlighting Curry's critical role in the team's shooting success. Despite a relatively stagnant league average, the Warriors' three-point percentage has trended upward, reflecting Curry's transformative impact.

Figure 4 displays the Warriors' wins progression, the graph shape closely resembles their three-point makes and shooting percentage (Figures 2, and 3). This correlation suggests that the Warriors' success is directly linked to their improved three-point performance. Notably, the Warriors won championships in 2015, 2017, 2018 and 2022, during periods of strong three-point shooting. The rapid increase in NBA three-point attempts could be attributed to other teams observing the correlation between the Warriors' success, and their three-point performance.

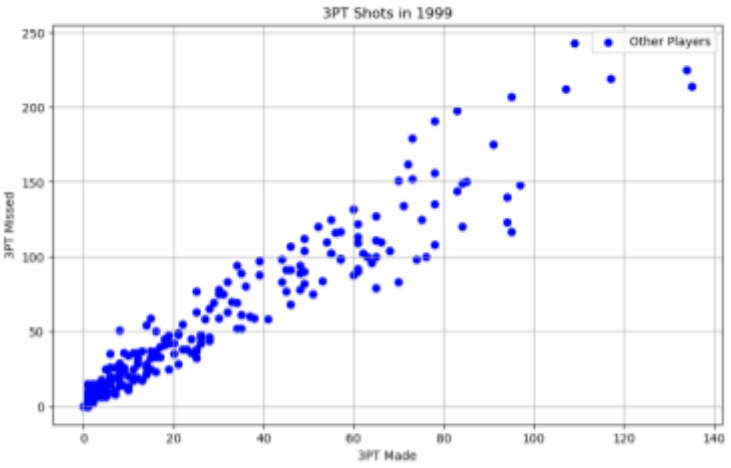


Figure 5: 3PT misses / makes of every player in the 1999 NBA Season

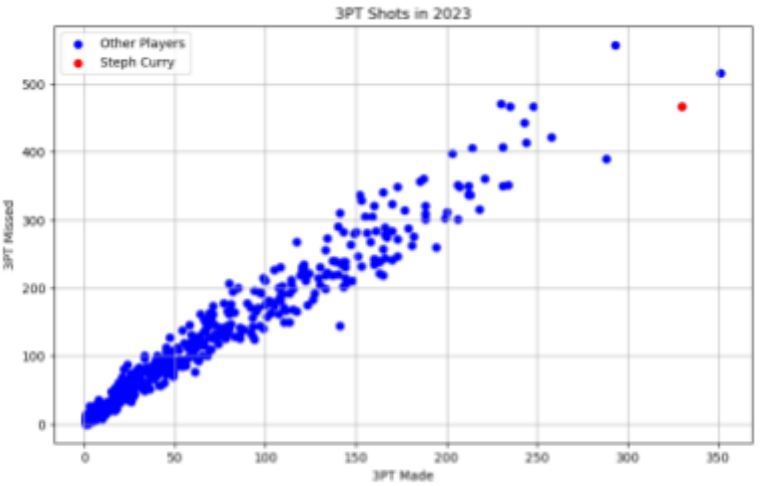


Figure 6: 3PT Misses / Makes of Every Single Player in the 2023 NBA Season

Figure 5 presents a scatter plot showing every NBA players' three-point shot makes and misses from the 1999 NBA season, with the x axis representing makes, and the y axis representing misses. For comparison, figure 6 displays the 2023 season. The different scales between the two graphs highlight the evolution of three-point shooting. In 1999, Dee Brown led the league with 135 makes and 214 misses. By today's standards, that performance would rank him only 92nd in made three-pointers, highlighting the significant shift in what is considered elite three-point shooting over the past 25 years.

FIgure 6 emphasises Curry, highlighted in red, who made the second-most three-point shots in the 2023 NBA season. Curry's performance, alongside other elite three-point shooters exemplify the increased volume of three-point shooting in the modern NBA. Appendix 1 supports this trend by showing the top five three-point shooters from each season since 1999, with makes ranging from just over 100 in earlier years to nearly 500 in recent seasons. This wide variation reflects the growing emphasis on three-point shooting in the league, with both average players and elite players improving. Notably, Curry ranked in the top five three-point shots in nine out of his fourteen seasons.

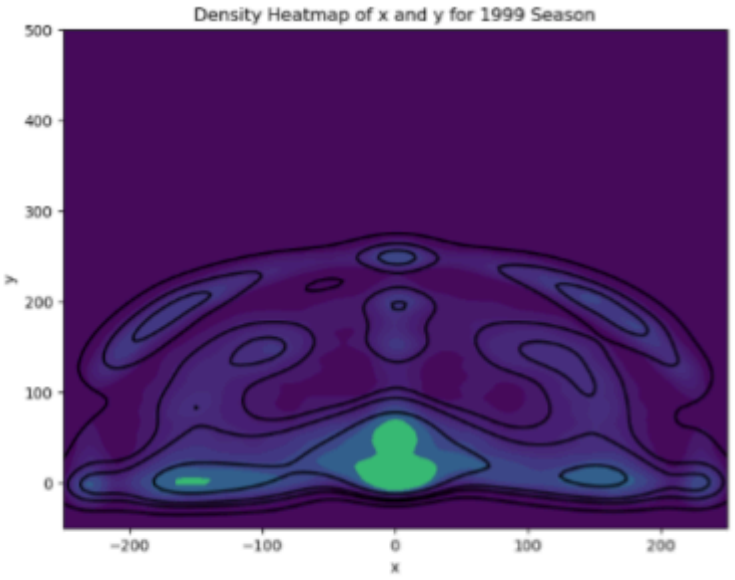


Figure 7: Density heatmap (makes and misses) for 1999 season

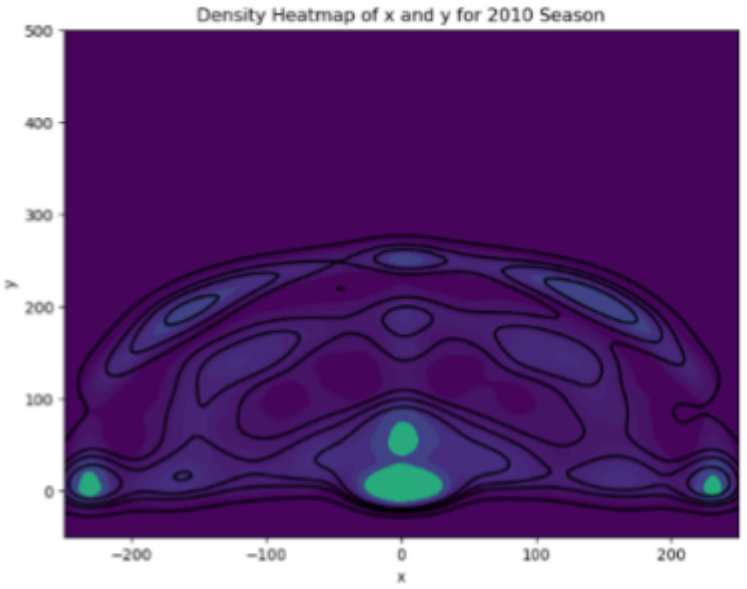


Figure 8: Density heatmap (makes and misses) for 2010 season

Figures 7 and 8 present density heat maps of all shots taken (made or missed) during the 1999 and 2010 NBA seasons respectively, offering visual comparison of shooting trends before Curry was drafted, as well as his first season. It is important to note that the colour intensity of each heatmap is proportional only to itself, so direct colour comparisons between separate heat maps are not accurate. However, it can still supply insightful insights into the NBA's shooting patterns. In the heatmaps, lighter colours indicate higher density of shots in that area , and the contour lines are used to differentiate different densities. The reader is invited to infer the location of the three-point line on the heatmaps, a labelled basketball court is provided in appendix 2 for reference.

When comparing the two heatmaps, shots taken near the basket with approximate coordinates $(0,\ 0)$ remain the most common in both seasons. However, the proportion of these close-range shots relative to other shots appear to have decreased

by the 2010 season. The baseline mid-range shots $\{y \approx 0, -200 \leq x \leq -100, 100 \leq x \leq 200\}$, which were evidently the second most popular shot in 1999 shows a decline in prevalence by 2010, with their density resembling that of other mid-range shots. In Appendix 3, the density heatmap for the 2023 season shows that while the density of three-point shots appears less dense, Figure 1 confirms a significant increase in overall three-point attempts. Conversely, the mid-range area shows almost no colour, reflecting a reduced emphasis on mid-range shots. Despite the rise in three-point attempts, shots near the basket still dominate, causing the area around the rim to appear denser on the heatmap compared to the three-point line. Also the three-point line covers more area, and if all three-point attempts were concentrated as closely as shots under the basket, the density would likely appear closer in colour to that area.

Discussion

The findings of this investigation indicate Stephen Curry's impact on the NBA's three-point shooting culture was not one of initiation, but rather acceleration. The data suggests that the three-point shot was already gaining prominence in the years prior to Curry's arrival. His arrival and the Warriors subsequent success appears to have amplified this existing trend. This acceleration is particularly evident in the sharp increase in three-point attempts after the beginning of Curry's career in 2010, both by the Warriors and the league.

Curry's influence extended beyond his dominant individual performance, but was extended to shaping his team dynamic as a three-point focused team. As the Warriors adopted a three-point offensive strategy, the visualisations suggest that other teams began to follow suit, recognising the Warriors direct correlation between three-point success and overall team success, which was observed in figures 2, 3 and 4.

The heat maps in figures 7 and 8 illustrate the tactical shift in the NBA; mid-range shots have waned in favour of three-point attempts. While under-the-basket shots remain the most frequent, the data demonstrates the consistent growth of three-point shooting in the NBA. However, it is important to acknowledge the three-point revolution was already underway before Curry's influence. External factors such as coaching philosophies, advancement in player training, fan involvement, rule modifications and many more likely contributed to the initial rise of the three-point shot. Curry's role can therefore be seen as a potential catalyst that accelerated an existing trend. The data shows that Curry was an innovator regarding the three-point shot, leading him and his team to well outperform the average NBA team in terms of three-point statistics, and whilst doing so outperform teams both during the regular season and NBA finals.

Future research could further explore factors that contributed to the initial rise of the three-point shot, as well as examining factors other than Curry's influence on why the three-point shot has become such a prevalent way of scoring in the modern NBA.

Conclusion:

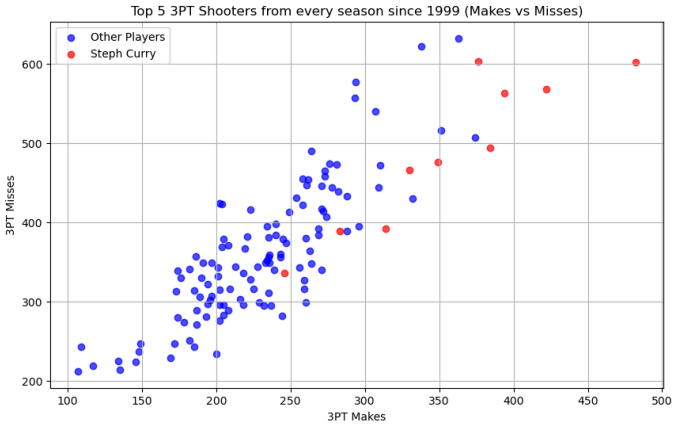
The analysis reveals that the three-point shot was already becoming a more prominent part of the NBA before Stephen Curry was drafted in 2010. Since Curry was drafted the three-point shot with minor corrections has consistently increased, with the three-point shot now being a key factor to teams success. Curry's influence appears to have accelerated the pre-existing growth due to the Golden State Warriors success as a team, coinciding with their three-point volume and efficiency increasing.

While the current emphasis on the three-point shot may have developed without Curry, the evidence suggests his influence amplified its adoptions. His individual performances, alongside the Warrior's success in winning multiple championships whilst being a three-point focused team have demonstrated the value of three-point shooting in the modern NBA. Today it appears that teams design their offenses with a focus on three-point shooting and close-range shooting. Previously the mid-range shot played a central role in offensive tactics, this has been a significant shift in the tactics of the NBA, with the three-point shot now becoming the cornerstone of an offense.

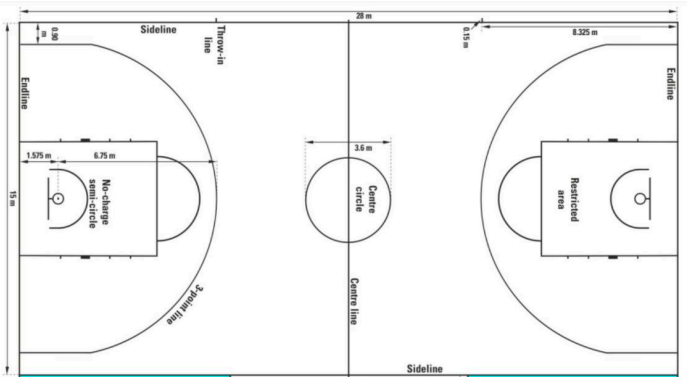
This study bridges the gap between popular opinion and statistical evidence, showing while Curry did not create the three-point revolution, his influence was instrumental in solidifying it as a defining feature of modern basketball. The NBA has evolved into a league where players prioritise close-range shots and three-pointers, with mid-range shots becoming increasingly rare. The future of the NBA's offensive strategies will likely continue to be shaped by Curry's lasting legacy.

Appendix:

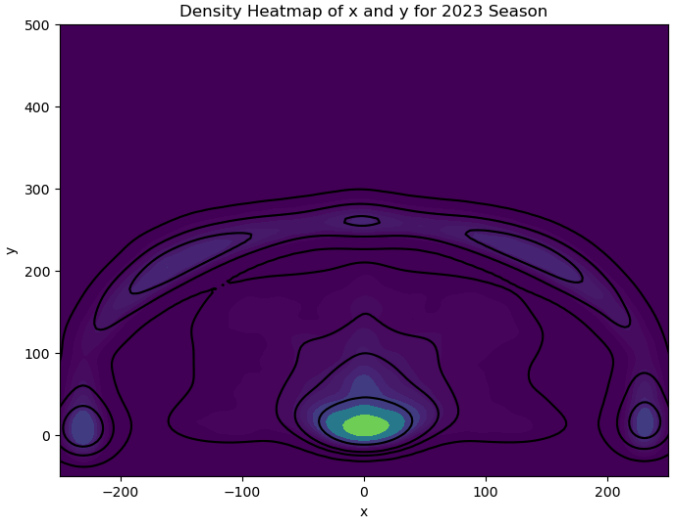
Appendix 1:



Appendix 2:



Appendix 3:



Feedback:

Feedback 1:

Name of presenter	Lachlan, Shinnick – NBA 3 pt shoot
What is good?	Interesting topic, great plots and visualisation.
What are some risks you can identify?	N/A
What might be an interesting aspect to explore?	So after the Steph Curry effect, did the mid-range shot became basically obsolete?

After this feedback I began to look at how not only the three-point shot progressed over time, but also how the other shots were affected by looking at density heatmaps (figures 7, 8 and appendix 3). The heatmaps supported this person's interesting aspect to explore, affirming that the mid-range shot does appear to be becoming an obsolete shot. This was in fact one of the main points of my conclusion.

Feedback 2:

Name of presenter	Lachlan Shinnick – Steph Curry
What is good?	Excellent analysis, clear question, good extension. Nice visualisation – the movement of the specific point from one scatter plot to the other was cool
What are some risks you can identify?	How do you know your dataset from Kaggle is reliable and lines up with the NBA stats?
What might be an interesting aspect to explore?	Look into the profit side of things – has GSW revenue increased? Jersey sales? Could look into draft stats as well? Players have moved to guard Steph differently to how they used to guard players (coming out to pressure above the 3-point line always) – has this resulted in other members of his team scoring more or changing their shot selection? Do teams play differently specifically when they play GS?

For the risks, regarding the reliability of the dataset, I cross-verified key statistics from the Kaggle dataset with official NBA stats to ensure accuracy. For example after extracting Dee Brown's 135 makes, 214 misses from the 1999 max heap, I cross checked these statistics with official NBA websites to ensure accuracy. I decided not to explore "the profit side of things" as this would not lead to answering my question on how the three-point shot has changed in the NBA. I also decided to not look into draft statistics, as they can bias through different NBA players coming from different levels of basketball, for example a division 2 college player is playing at a much lower level compared to someone who plays professional basketball in the NBL, hence it is unfair to compare their statistics. Lastly, determining how teams defend the Warriors is challenging due to limited defensive statistics, but his affect on his teams three-point metrics was evident in the Warriors visualisations' when Curry was injured in 2020 (figures 2, 3, 4).

Feedback 3:

Name of presenter	Lachlan
What is good?	Confident about the topic.
What are some risks you can identify?	Include more external factors.
What might be an interesting aspect to explore?	Can find out the optimal player for scoring more 3 pointers.

For the risks, to include more external factors, I addressed this by discussing how advancements in coaching strategies, analytics, rule changes and many more factors would have also inevitably contributed to the rise in three-pointers, not Curry solely. While I agree that an interesting aspect to explore could be finding out the optimal player for scoring more three-pointers would be interesting I don't believe this would have helped me answer my question on how the three-point shot has progressed in the NBA since Curry was drafted.

Feedback 4:

Name of presenter	**Shinnick, Lachlan**
What is good?	Visualise multiple types of graphs Use a good benchmark to compare the data
What are some risks you can identify?	N/A
What might be an interesting aspect to explore?	N/A

No feedback to respond to

Feedback 5:

Name of presenter	Shinnick, Lachlan
What is good?	- Interesting topic
What are some risks you can identify?	- Look at script too much
What might be an interesting aspect to explore?	- NA

This feedback is helpful, for my final presentation I plan to not have a script to follow, but practise what I am going to talk about on each slide, so it seems more natural.

Bibliography:

Kaggle.com. (2023). NBA Teams Stat 2000-2023. [online] Available at: https://www.kaggle.com/datasets/bluedreamv1b3/nba-teams-stat-2000-2023?select=advanced_stats_total.csv [Accessed 15 Aug. 2024].

Powell, S. (2022). *Stephen Curry reached 'his own level' and left behind a new-look NBA*. [online] www.nba.com. Available at: https://www.nba.com/news/stephen-curry-changed-game-long-before-3-point-milestone [Accessed 28 Jul. 2024].

Szymon Jóźwiak (2023). NBA Play-by-Play Data (1997-2023). [online] Kaggle.com. Available at: https://www.kaggle.com/datasets/szymonjwiak/nba-play-by-play-data-1997-2023?select=pbp2023.csv [Accessed 1 Aug. 2024].