NBA analysis report

# an overlook in the evolution of the nba since the three-pointer

The National Basketball Association (NBA) has been the premier professional basketball league in the world for decades. With its high-flying dunks, flashy passes, and intense competition, the NBA has captured the hearts and minds of basketball fans around the globe. In this report, I will evaluate the trends in NBA franchise performance by examining the average statistics per game over time. By analyzing the statistical trends of NBA teams over the years, I hope to gain insights into the changing landscape of the league and identify potential factors that have contributed to these changes.

It is worth noting that the primary objective of this project was to explore statistical and software tools. As a student, I aspire to achieve significant results. However, it would be remiss of me to suggest that my work could surpass the contributions of the thousands of dedicated analysts who have devoted their careers to shedding light on this beloved game. So it is important to be clear that my conclusion could not be the most accurate and other explanations for the phenomena observed could be achieved in a more in-depth analysis.



Questions and objectives

The questions that guided this analysis at its inception were “How has performance evolved in the league, comparing the best performers and worst ones?” and “How, disregarding teams, tendencies in one stat affect other ones?”.

To look for answers I used the per-game stats from the [www.basketball-reference.com](http://www.basketball-reference.com/) database for the NBA since the introduction of the three-pointer in the 1979-80 season. Earlier seasons were excluded because the new scoring possibility was believed to be such a significant change that comparing performances before and after could obscure correlations. This does not rule out other regulation changes, but the three-pointer was interpreted as a more profound revolution, so I focused on the league after its implementation.

To answer the first question, I separated the league into two categories based on performance and plotted the averages against each other, along with the league average. I compared the top 25% of performers to the bottom 25%. As I was looking for the best at a specific aspect of the game rather than overall team success, I did not consider team position in the season or whether the same teams were in the top or bottom group for different stats. Teams were ranked by performance for each stat, and the groups were created accordingly.

The hypothesis is that the top and bottom groups will encounter a delay in their performance. The graph is expected to show a gradual improvement among the bottom 25% such as in three-point rate or turnover, with a reversed correlation for negative stats.

To answer the second question the method is simpler to apply. My goal was to find correlations, so I ran a Pearson test. This test measures the strength and direction of the linear relationship between two variables, classifying them between 1 and -1. I calculated the test for every stat combined with every other stat. And again, I based my analysis on overall league performance by comparing the average per-game statistic of all franchises in one stat with another all-franchise average.

While coding this brute force method is simple, many of the correlations are redundant or unimportant to include in this report. For instance, correlations between three-point and overall points or between offensive and defensive rebounds are not interesting. Appendix C contains a list of all correlations that were analyzed.



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My first step was to import the website data as an xlsx files and then allocate the statistics into objects using the openpyxl module. These objects corresponded to each season and contained a single parameter per statistic. The naming convention of the objects reflected the year in which the season ended; for instance, 1980 represented the 1979-1980 season. In total, I created 42 season objects, each with 22 arrays.

Next, an array was created in the code with the average of each stat for that year, including the overall, top 25% and bottom 25% averages. To accomplish this, additional functions were necessary, namely low\_quartile\_avg and top\_quartile\_avg, which were implemented to facilitate selections and calculations.

For the data visualization, I utilized matplotlib which is a user-friendly library for creating X-Y plots. My goal was to ensure the generated plots were easily comprehensible and self-explanatory. Throughout this project, I made several improvements to the code to ensure a cleaner and more concise plotting process. It's worth noting that the initial approach used in the first case was somewhat forceful and has since been improved.

The python file chunks.py is the one that contain this first piece of code. A sample of the results is shown here, note that you can find all the graphs of this stage in Appendix A.

Gráfico, Gráfico de linhas

Descrição gerada automaticamente

The test results were quite intriguing, as they showed that there was no significant delay between the top and bottom performers. This indicates that the hypothesis put forward in the previous section was incorrect. The graphs demonstrate a "shadow" effect, where all the lines exhibit similar variations, but there is a consistent gap between them.

Considering the results, I proposed a new hypothesis regarding per-game performances in the NBA league during the regular season. There appears to be a general tendency across the league, with both high-performance and low-performance teams exhibiting similar patterns of variation in their statistics over time.

To verify this new hypothesis, it is necessary to conduct another test. Merely observing that the graphs show similar variations is not sufficient to support such a claim. Therefore, I have decided to conduct a new test in which I will plot not the average of the groups (top, bottom, and all) but their variation between the current and previous year. If the lines align, it should be sufficient to confirm the new statement.

For that, I coded a new file, difference.py, which is similar to chunks.py but has a bit extra code to calculate the variations arrays, and plots accordingly. Again, a sample of the results is shown here, all the graphs can be seen in Appendix B.

The graphs support the new hypothesis as the variations of all three groups align despite some alternating differences that are not significant. This confirmation suggests that the steps taken by the Association to maintain balance in the league go beyond simply alternating which team is winning the games. Instead, it creates an environment where all teams follow the game tendencies without much differences in their knowledge of what should be done.

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Descrição gerada automaticamenteIt is worth noting that this conclusion applies to statistics that can result from various game strategies or actions. Teams can score points in different ways, commit turnovers or personal fouls in a variety of situations. Thus, this leveled environment applies to what teams are generally trying to improve, whether it be their 3-point rates, turnovers, or ability to prevent offensive rebounds. However, little can be said about the specific methods used to achieve these improvements.

Correlations in the Stats

Performing a Pearson correlation test in Python was straightforward, as numpy includes a built-in function for this purpose. Simply loading the arrays from the previous analysis was sufficient to generate a matrix that can be easily printed out. As with other cases, a new file named "correlation.py" was created, and a list of all correlations is presented in Appendix C.

Following the analysis of all possible correlations, I filtered out any correlation that was greater than 0.9, regardless of whether it was a positive or negative. While previous research has indicated that a correlation of 0.5 is considered high, my attempts have shown that most stats are correlated. I believe these connections arise from the nature of the analysis, where the variables are all intertwined in a single game and have great influence in each other.

Furthermore, I removed redundant correlations, such as FG and FG attempted, and added others that did not meet the 0.9 threshold but could contribute to the hypothesis being developed. The selected correlations are listed below:

* Correlation of 0.91 between TOV\_avg and PF\_avg
* Correlation of 0.92 between TwoP\_attempted\_avg and TOV\_avg
* Correlation of -0.84 between ThreeP\_attempted\_avg and TOV\_avg
* Correlation of 0.85 between TOV\_avg and FT\_attempted\_avg
* Correlation of 0.88 between PF\_avg and OR\_avg
* Correlation of 0.95 between TwoP\_attempted\_avg and OR\_avg
* Correlation of 0.91 between OR\_avg and FT\_attempted\_avg
* Correlation of -0.94 between ThreeP\_attempted\_avg and OR\_avg
* Correlation of 0.89 between TOV\_avg and OR\_avg

Based on the analyzed correlations, my hypothesis suggests a connection between inside-the-ring plays and both turnovers and offensive rebounds.

Inside-the-ring plays often result in turnovers due to offensive fouls, traveling violations, or loss of ball possession. The physicality of layups and pivot plays contribute to these high-risk situations for turnovers.

Also, this type of play tends to involve more players being positioned near the basket and inside the ring, particularly the player who has just attempted to score and is typically situated directly beneath the basket. These conditions could lead to a greater number of offensive rebounds per game.

Therefore, based on our data, my final hypothesis suggests that statistics related to close scoring attempts, will correlate with both turnovers and offensive rebounds. Conversely, statistics that deviate from this style of gameplay should display an inverse correlation with both stats. Also, it's only fair to assume that turnovers and offensive rebounds should display a correlation with one another.

To strengthen this hypothesis, I plotted the statistics listed above:

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Descrição gerada automaticamenteThe data does support all the suggested correlations, but a more detailed analysis would be beneficial to provide a stronger statement. While this project will not undertake a deeper examination, a recommended approach would be to review video footage of turnovers and offensive rebounds to confirm if they do indeed occur primarily in near the rim situations.

Appendix A

Gráfico, Gráfico de linhas

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Appendix B

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Appendix C

Correlation of 0.9623558584009754 between FG\_avg and FG\_attempted\_avg

Correlation of 0.9324555435762188 between FG\_avg and FG\_rate\_avg

Correlation of -0.40231367502606574 between FG\_avg and ThreeP\_avg

Correlation of -0.3951361096563055 between FG\_avg and ThreeP\_attempted\_avg

Correlation of -0.7610135636433714 between FG\_avg and ThreeP\_rate\_avg

Correlation of 0.8061969284916222 between FG\_avg and TwoP\_avg

Correlation of 0.680698041125456 between FG\_avg and TwoP\_attempted\_avg

Correlation of 0.6130358305913227 between FG\_avg and TwoP\_rate\_avg

Correlation of 0.63414675810952 between FG\_avg and FT\_avg

Correlation of 0.5591304673401795 between FG\_avg and FT\_attempted\_avg

Correlation of 0.3991203281445918 between FG\_avg and FT\_rate\_avg

Correlation of 0.5435725283817489 between FG\_avg and OR\_avg

Correlation of -0.007237662347510794 between FG\_avg and DR\_avg

Correlation of 0.9598501763015381 between FG\_avg and AST\_avg

Correlation of 0.6437795142765118 between FG\_avg and STL\_avg

Correlation of 0.5703530937213522 between FG\_avg and BLK\_avg

Correlation of 0.6850663201169368 between FG\_avg and TOV\_avg

Correlation of 0.5574013178954329 between FG\_avg and PF\_avg

Correlation of 0.9403217216169477 between FG\_avg and PTS\_avg

Correlation of 0.7996437913673988 between FG\_attempted\_avg and FG\_rate\_avg

Correlation of -0.21974888813724258 between FG\_attempted\_avg and ThreeP\_avg

Correlation of -0.2087381915476553 between FG\_attempted\_avg and ThreeP\_attempted\_avg

Correlation of -0.6464162069460474 between FG\_attempted\_avg and ThreeP\_rate\_avg

Correlation of 0.6675469621159391 between FG\_attempted\_avg and TwoP\_avg

Correlation of 0.532588518351919 between FG\_attempted\_avg and TwoP\_attempted\_avg

Correlation of 0.6796006199017331 between FG\_attempted\_avg and TwoP\_rate\_avg

Correlation of 0.45929014977021326 between FG\_attempted\_avg and FT\_avg

Correlation of 0.3697765142210331 between FG\_attempted\_avg and FT\_attempted\_avg

Correlation of 0.5156300610011374 between FG\_attempted\_avg and FT\_rate\_avg

Correlation of 0.3924773696658255 between FG\_attempted\_avg and OR\_avg

Correlation of 0.21552583151741905 between FG\_attempted\_avg and DR\_avg

Correlation of 0.9271313620639651 between FG\_attempted\_avg and AST\_avg

Correlation of 0.5730109638066551 between FG\_attempted\_avg and STL\_avg

Correlation of 0.49588975983597655 between FG\_attempted\_avg and BLK\_avg

Correlation of 0.5424045128062461 between FG\_attempted\_avg and TOV\_avg

Correlation of 0.3786030101954009 between FG\_attempted\_avg and PF\_avg

Correlation of 0.9537726799598418 between FG\_attempted\_avg and PTS\_avg

Correlation of -0.5821523651179535 between FG\_rate\_avg and ThreeP\_avg

Correlation of -0.5811441439722016 between FG\_rate\_avg and ThreeP\_attempted\_avg

Correlation of -0.8065665106346497 between FG\_rate\_avg and ThreeP\_rate\_avg

Correlation of 0.8856754793167568 between FG\_rate\_avg and TwoP\_avg

Correlation of 0.7844645197772855 between FG\_rate\_avg and TwoP\_attempted\_avg

Correlation of 0.46834285148039867 between FG\_rate\_avg and TwoP\_rate\_avg

Correlation of 0.7836387546715969 between FG\_rate\_avg and FT\_avg

Correlation of 0.7355660800994126 between FG\_rate\_avg and FT\_attempted\_avg

Correlation of 0.20597603302042503 between FG\_rate\_avg and FT\_rate\_avg

Correlation of 0.6680683649966938 between FG\_rate\_avg and OR\_avg

Correlation of -0.2923269513332388 between FG\_rate\_avg and DR\_avg

Correlation of 0.8893458277184922 between FG\_rate\_avg and AST\_avg

Correlation of 0.6517402372780566 between FG\_rate\_avg and STL\_avg

Correlation of 0.5905415980272329 between FG\_rate\_avg and BLK\_avg

Correlation of 0.7799354431837799 between FG\_rate\_avg and TOV\_avg

Correlation of 0.7155433950072243 between FG\_rate\_avg and PF\_avg

Correlation of 0.8181679678902283 between FG\_rate\_avg and PTS\_avg

Correlation of 0.9995537570895583 between ThreeP\_avg and ThreeP\_attempted\_avg

Correlation of 0.7772448372489569 between ThreeP\_avg and ThreeP\_rate\_avg

Correlation of -0.8659966564063316 between ThreeP\_avg and TwoP\_avg

Correlation of -0.9423923803029498 between ThreeP\_avg and TwoP\_attempted\_avg

Correlation of 0.4370232364753616 between ThreeP\_avg and TwoP\_rate\_avg

Correlation of -0.8644573694011288 between ThreeP\_avg and FT\_avg

Correlation of -0.8994345714226283 between ThreeP\_avg and FT\_attempted\_avg

Correlation of 0.36406069147015024 between ThreeP\_avg and FT\_rate\_avg

Correlation of -0.9388650643948733 between ThreeP\_avg and OR\_avg

Correlation of 0.8555799349667066 between ThreeP\_avg and DR\_avg

Correlation of -0.43490246121792314 between ThreeP\_avg and AST\_avg

Correlation of -0.7497912592975996 between ThreeP\_avg and STL\_avg

Correlation of -0.764188814748213 between ThreeP\_avg and BLK\_avg

Correlation of -0.8453214546533548 between ThreeP\_avg and TOV\_avg

Correlation of -0.8749084942131042 between ThreeP\_avg and PF\_avg

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Correlation of -0.2119644424676651 between FT\_rate\_avg and STL\_avg

Correlation of -0.18891799238579796 between FT\_rate\_avg and BLK\_avg

Correlation of -0.23458050319178203 between FT\_rate\_avg and TOV\_avg

Correlation of -0.30309366745438826 between FT\_rate\_avg and PF\_avg

Correlation of 0.5763738622942622 between FT\_rate\_avg and PTS\_avg

Correlation of -0.7874960506859318 between OR\_avg and DR\_avg

Correlation of 0.6252480886963611 between OR\_avg and AST\_avg

Correlation of 0.8911862508852216 between OR\_avg and STL\_avg

Correlation of 0.8537030529194165 between OR\_avg and BLK\_avg

Correlation of 0.8942369418736965 between OR\_avg and TOV\_avg

Correlation of 0.8820180324330713 between OR\_avg and PF\_avg

Correlation of 0.264847854289423 between OR\_avg and PTS\_avg

Correlation of -0.08668989929101839 between DR\_avg and AST\_avg

Correlation of -0.5204365653821231 between DR\_avg and STL\_avg

Correlation of -0.5302159513827442 between DR\_avg and BLK\_avg

Correlation of -0.5996274168886141 between DR\_avg and TOV\_avg

Correlation of -0.7072891381773199 between DR\_avg and PF\_avg

Correlation of 0.2696128023590046 between DR\_avg and PTS\_avg

Correlation of 0.7407288004587829 between AST\_avg and STL\_avg

Correlation of 0.6565472956323763 between AST\_avg and BLK\_avg

Correlation of 0.7192878527012498 between AST\_avg and TOV\_avg

Correlation of 0.6027517889595856 between AST\_avg and PF\_avg

Correlation of 0.8916307928121088 between AST\_avg and PTS\_avg

Correlation of 0.8158195314749219 between STL\_avg and BLK\_avg

Correlation of 0.8685298344902256 between STL\_avg and TOV\_avg

Correlation of 0.7196160798285804 between STL\_avg and PF\_avg

Correlation of 0.4190149850372219 between STL\_avg and PTS\_avg

Correlation of 0.7727607775465484 between BLK\_avg and TOV\_avg

Correlation of 0.7077574724743133 between BLK\_avg and PF\_avg

Correlation of 0.32475070933535816 between BLK\_avg and PTS\_avg

Correlation of 0.9077158423644945 between TOV\_avg and PF\_avg

Correlation of 0.441216562669936 between TOV\_avg and PTS\_avg

Correlation of 0.32517298205705064 between PF\_avg and PTS\_avg

CHAT PROMPTS

In this report, I want to emphasize that I utilized ChatGPT as a writing support tool. Utilizing tools to aid me in effectively communicating the outcomes of this project has been an essential component of its execution, and its use does not mitigate the authenticity or the authorial character of the work.

As the world moves towards prompt engineering, I believe that such tools will become increasingly integrated into both our personal and professional lives. In this report, I demonstrate how ChatGPT has helped me enhance the reader's experience by facilitating clearer communication of the ideas and discoveries made throughout this project. Underneath I present the prompt used in this report:

“Act now as a writing reviser in a software company. You have a good understanding of programming and its terminology and tools. You also specialize in reports in data analysis. Inside this company, you will work on making your team reports better written, with better clarity and reader experience. Each text given to you shall have alterations in multiple possible writing styles, always focusing on your role at the company. Also take into consideration that you are familiar with basketball, the NBA, and its terminologies. Now you must simply perform your duty, do not display any explanations about it, and you also do not need to display the original text. Here is a text for you to revise:”