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The Evolution and Future of NBA Game Style

Ziqi Gong[1,*] **and Yulong Li**[2]

[1] *Trinity-Pawling School, Pawling, NY, 12456, United States, zgong@trinitypawling.org*
[2] *Pioneer Academy, Wayne, NJ, 07470, United States, andyoffer2023@gmail.com*

**corresponding author*

Abstract:

Prior to the twenty-first century, offense in the paint was the key way for an offense; nevertheless, the game pace tends to grow annually, and three points have now become the dominating offensive tactic. In the current era, the three-point shot has arguably become the most critical element of offensive strategy. Players who can shoot accurately from beyond the arc are in high demand, and even traditional centers are increasingly expected to develop their outside shooting to remain relevant. The league's trends vary each period. As the league enters the 2020s, new trends in playing styles and players are expected to emerge. In the future, the game speed will increase, and even more three-point shooters will appear in the game, providing the traditional center extra options. To support our theory, this paper will give data from the 1950s to the present: the three-point ratio each season, the two-point ratio per game for each season, and the number of personal fouls per game each season. However, we only considered data collected after the 1980-1981 season, as no data for three points were collected prior to that time. Basketball has undergone significant strategic evolution since its inception, with offensive tactics adapting to changes in player skillsets, coaching philosophies, and game rules.

Keywords: Basketball analytics, data visualization, ANOVA, t-Test, regression, three-point field goals.

1. Introduction

1.1 Research background

If you ask anyone to name the most competitive and profitable basketball league in the world, everyone who knows the National Basketball Association (NBA) will undoubtedly give out the same answer - the NBA league. A competitive NBA season typically consists of 82 regular season games per team spread over five to six months or two to five games per week. In addition, players participate in a month-long preseason of games and practices [1]. One of the most fascinating elements of NBA games is the unpredictability of each game, and no two games in NBA history were the same. However, the NBA's game style changes annually and has significantly changed over the decades. For example, the most

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phenomenal three-point shooter, Stephen Curry, changed the game style of NBA games completely and brought the NBA to the era called "Small Ball" through his fantastic three-point shooting skills, that is, a style of play that sacrifices height, physical strength and low post offense/defense in favor of a lineup of smaller players for speed, agility and increased scoring (often from the three-point line) [2]. Athletes have become public entertainment items since the professional league was first established. Yet, recently, fantastic moves such as crossovers have been decreasing and 3-pointers have increased significantly more compared to 2-pointers, and even centers who never shoot threes in the past will post up to the three-point line to shoot threes[3]. As a result, diminishing the vitality of NBA games will lead to considerable economic loss as the total number of audience members will decrease significantly if they find NBA games boring to watch [4].

This paper seeks to identify the past game style of NBA games, compare that with the current NBA game style, and predict the game style of the NBA in the future. Accordingly, the management layer of the NBA will be able to implement changes to maximize the NBA's economic prospects. We hypothesize that by comparing the dominant game style of the NBA in the past with the game style currently, the game style of the NBA in the future can be predicted. Before the 21st century, offense in the paint was the primary approach for offense, but the game pace tends to increase annually, and three points now have become the dominant technique for offense. In the future, the game speed will be faster, and more three-point shooters will appear in the game, giving the conventional center more opportunities. To support our hypothesis, this paper will provide data ranging from the 1950s until the present: the ratio of the three points per season, the ratio of two points per game for each season, and the personal fouls per game each season. However, we only used data after the 1980-1981 season because, before 1980-1981, no data for three points were collected.

1.2 Research framework

This paper begins by introducing the methodology we used for collecting and analyzing the data we collected. We will then go on to our analysis of the data we collected, and we will propose our hypothesis based on the correlations we observed. Finally, we will put our hypothesis in a broad view, especially with the economic prospect of the NBA.

2. Methodology

This research collected data from Basketballreference.com. We collected data of the ratio of the three points per season, the ratio of two points per game for each season, and the personal fouls per game each season from season 1950-1951 to the present. After we collected the data, we did t-Test: showing how close two variables are related; ANOVA: showing the continuity of variations; and regression: showing the inverse relationship between two variables. However, we only used data after season 1980-1981 because before season 1980-1981, some of the data were missing and not recorded.

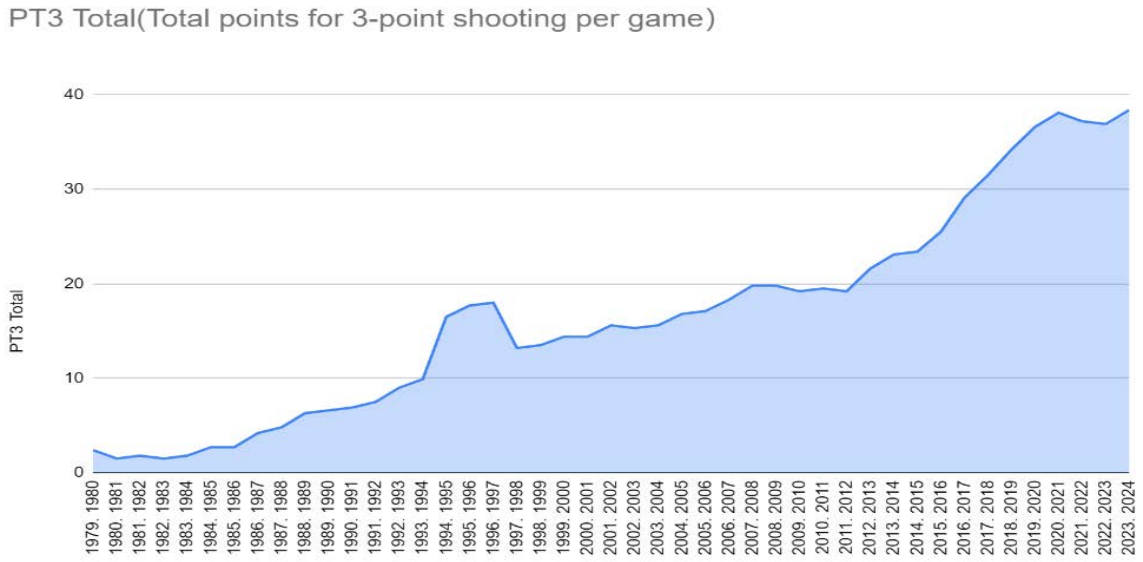

Figure 1 Total points for three-point shooting per game from 1979 to 2024.

Descriptive analyses are provided. Figure 1 shows the total number of three points in the year on average and shows an increasing trend of total three-point shooting per game from season 1979-1980 to season 2023-2024. Additionally, we made a graph from the 1979-1980 season to the 2023-2024 season to identify the trend of three points annually.

To identify the past game style of NBA games and that of now and predict the game style of NBA in the future, we looked specifically at the average Pt3 field goal, Pt2 field goal, and personal fouls for each season from season 1980-1981 to 2023-2024. The reason for collecting data for each season is that we can demonstrate the continuous variation trend from one year to the next. We categorized each season from seasons 1980-1995 as Group 1, each season from seasons 1996-2010 as Group 2, and each season from seasons 2011-2024 as Group 3.

Table 1. *The variables and corresponding description mentioned in the study.*

Variables	Description
Two-point field goals	The number of two-point field goals that a player or team has successfully made.
Three-point field goals	The number of three-point field goals that a player or team has successfully made.
PT3 Total	The total number of the points that were made by three-point shots per game.
Free throws	The number of free throws that a player or team has attempted.
Personal fouls	The total number of fouls that a player or team has committed.

3. Results

3.1 Pt3 Field Goals' Effects on Pt2 Field Goals

By conducting a regression for Pt3 field goals per game and Pt2 field goals per game for each season about every fifteen years, we found out that the R square value (≈0.748) is relatively high, which refers to the two values - Pt3 field goals per game and Pt2 field goals per game - are closely associated with each other.

Subsequently, we did an ANOVA for both the Pt3 field goals per game and Pt2 field goals per game (Table 2). According to the p-value, for both of the data sets, we found out that the R square values for both of them are relatively high (both are significantly lower than 0.05/4=0.0125), which means that Pt3 field goals per and Pt2 field goals per game have tremendous variation and difference.

Table 2. *t-Test and ANOVA for Pt3 field goals per game and Pt2 field goals per game*

	Pt2
Pt3	-0.668. (-2.98) [-1.379, 0.043]
Constant	28.299* (3.64) [3.567, 53.032]
observation	5
Notes: '***' refers to *p-value* less than 0.001 '**' refers to *p-valve* less than 0.01 '*' refers to *p-value less than* 0.05 '.' refers to *p-value* less than 0.1 ' ' refers to *p-value* less than 1	

In the right column, there are three numbers. The left one refers to the Coefficient value. The middle number in the parenthesis is the t value - the size of the difference relative to the variation in your sample data. The right number in the bracket refers to the Upper 95%, and the left one refers to the Lower 95%.

To more thoroughly identify the trend and association of Pt2 and Pt3 field goals, we conducted a T-test for both of the data sets (Table 2). For Pt3 field goals, we found out that the p-value for comparing group 1 and group 2; group 1 and group 3; group 2 and group 3 are all significantly lower than the standard p-value (0.05/4=0.01666). Similarly, for Pt2 field goals, the p-value for comparing group 1 and group 2; group 1 and group 3; group 2 and group 3 are all significantly lower than the standard p-value. The two phenomena both indicate that Pt2 field goals and Pt3 field goals continuously vary from the three eras we categorized - varying significantly and continuously. Further-

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more, according to the mean value of the three eras we categorized, as the proportion of Pt3 field goals increases, the proportion of Pt2 goals decreases correspondingly.

It can therefore be predicted that the Pt3 field goals will tend to increase at a rapid rate and that it will increase more rapidly in the future, according to the trend of its mean value (Figure 3). Moreover, according to the mean values of Pt2 field goals (Figure 4), Pt2 field goals tend to decrease continuously, indicating that the increase in Pt3 field goals caused the decrease in Pt2 field goals.

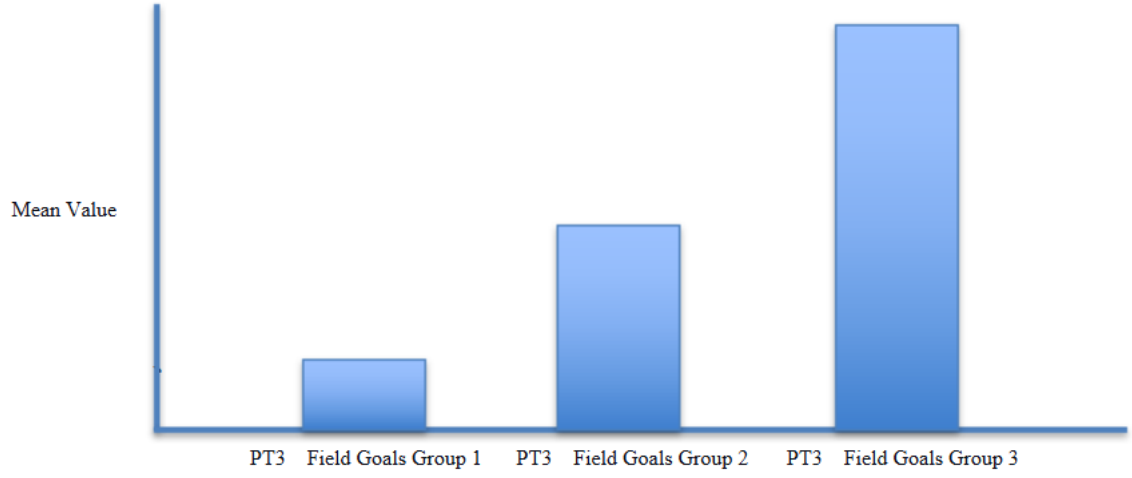

Figure 3 The Mean Value of PT3 Field Goals for Each Group

In figure 3, we first calculated the mean value of the PT3 Fields Goals for each of the group we categorized, and then, we found an increasing trend from group 1 to group 3, indicating that PT3 Field Goals kept increasing over years.

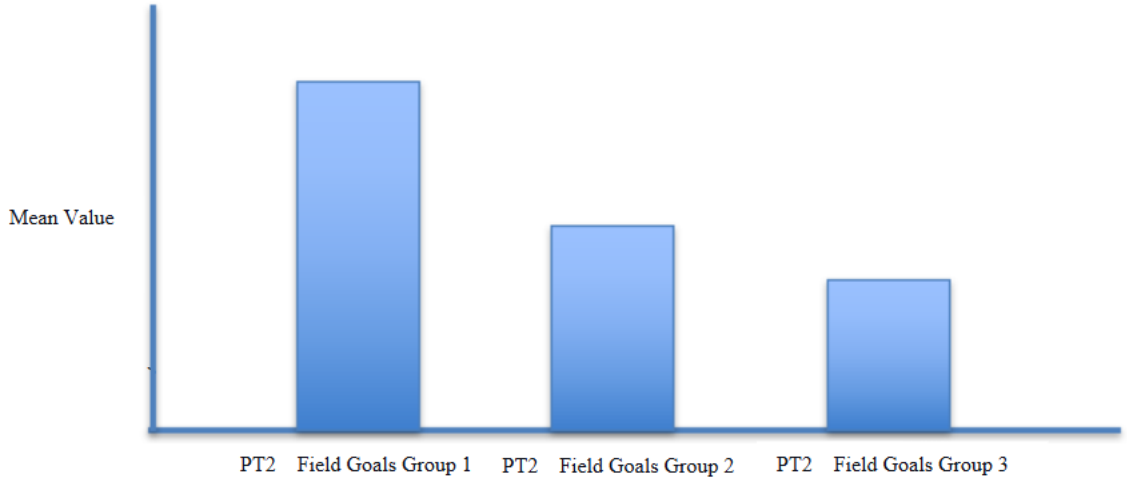

Figure 4 The Mean Value of PT2 Field Goals for Each Group

In figure 4, we first calculated the mean value of the PT2 Field Goals for each of the group we categorized, and then, we found an decreasing trend from group 1 to group 3, indicating that PT3 Field Goals kept decreasing over years.

It can be hypothesized that as three points become the dominant offense choice, and as more and more players choose to shoot for threes, the occurrence of two-point shots will decrease as players can only choose either 2-point or 3-point for one offense - thus Pt2 field goals and Pt3 field goals are inversely related. Moreover, as players choose three-point shots as their first offense choice, they will need fewer dribbles to make the three-point shot happen because the three-point line is widespread enough that players do not generate space by themselves through dribbles and crossovers.

It can be furthermore hypothesized that as three points become the dominant offense choice, fewer players will

choose to make fantastic moves to do crossovers and fewer attacks in the paint will occur, which will reduce body contacts and thus decrease fouls - ultimately leading to the decrease of free throws as fouls are reduced [5]. "In the league's early days, physicality was essential to the ball game. With players like Magic Johnson and Penny Hardaway at the point guard position, everyone on the floor was pretty aggressive on the floor. Guys like Dennis Rodman and Shaquille O'Neal raised strength to another level. From 1950-2009, 51% of MVP winners were centered, and 33% of top-three picks were centers [1]." However, such a phenomenon is not the case today and it can be predicted that players in the future will be more likely to avoid body contact as they do not want to be caught on fouls, and amusing moves such as crossovers will tend to decrease as players to dot need to make too many moves to shoot a three-point compared to shooting a two-point because players need to create space to shoot a two-point as the two-point range is more narrow.

3.2 Pt3 Per Game's Effect on Personal Fouls Per Game

Through the regression data analysis of Pt3 field goals and personal fouls per game, we obtained an R square of 87%, which is significantly lower than the standard value: of 0.05(5%), indicating a strong correlation between Pt3 field goals and personal fouls per game. To further understand the correlation, we did an ANOVA for the two data sets (Table 3). According to the p-value for this data set, we found out that the R square values for personal fouls in the three eras we categorized are also exceedingly low - 3.47625113470502E-74 and is significantly lower than 0.05/4=0.01666), given that the p-value for the ANOVA for Pt3 field goals is also significantly lower than 0.01666. Therefore, Pt3 field goals and personal fouls per game both have tremendous variation and difference.

Pt3 Attempts ~ Personal Fouls

Table 3. *t-Test and ANOVA for Pt3 field goals per game and personal fouls per game*

	Pt3 Attempts
Personal Fouls	-5.333*(-2.988) [-8.357, -2.309]
Constant	133.081**(6.305) [65.914, 200.247]
observation	5
Notes: '***' refers to *p-value* less than 0.001 '**' refers to *p-valve* less than 0.01 '*' refers to *p-value less than* 0.05 '.' refers to *p-value* less than 0.1 ' ' refers to *p-value* less than 1	

In the right column, there are three numbers. The left one refers to the Coefficient value. The middle number in the parenthesis is the t value - the size of the difference relative to the variation in your sample data. The right number in the bracket refers to the Upper 95%, and the left one refers to the Lower 95%.

To discover the variation trend of personal fouls per game, T-tests are done to verify the constancy of the variation (Table 3). The p-values for comparing Group 1 and Group 2; Group 1 and Group 3; and group 2 and Group 3 in terms of average personal fouls per season are all significantly lower than the standard p-value (0.05/3=0.01666), and the p-values for that of Pt3 field goals are significantly lower than 0.01666 as well. Both phenomena indicate that Pt3 field goals and personal fouls continuously vary from the three eras we categorized - varying significantly and continuously. Furthermore, according to the mean value of the three eras we categorized, as the proportion of Pt3 field goals increases, the proportion of personal fouls decreases correspondingly (Figure 3 and Figure 5)

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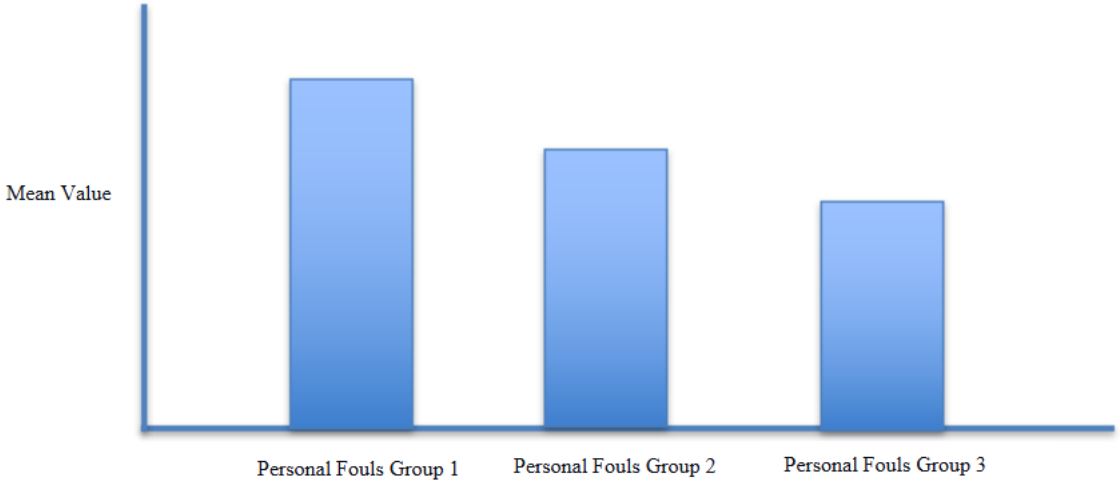

Figure 5 The Mean Value of Personal Fouls for Each Group

In the situation of increasing three-point shots, the number of fouls is decreasing, which we believe is the result of more and more three-point shooters in the game, and their three-point accuracy is improving, so fewer players are entering the lane to play offense. Moreover, as players tend to shoot more threes, the frequency of body contact is much lower than that of players playing in the lane and making crossovers. Therefore, the number of fouls decreases, forming a close negative correlation with the number of three-point shots.

One implication of such a phenomenon is that less body contact will make the game boring, affecting the audience members of the NBA. If the audience members find the game boring, they will be less likely to spend money to buy tickets for NBA games, buy jerseys for the NBA, and spend money on NBA-related products, which will lead to a significant decrease in the income of the NBA industry.

4. Discussion

Our research is similar to the literature because our research and multiple published research articles all articulated that three-point shots are now becoming the dominant offense technique, and the three-point shots will tend to continuously increase - being the dominant element in the game [1]. One of the unique features of our research paper is that we collected the earliest recorded three-point data. We found that the first season that three points were recorded was season 1980-1981, which enables us to have a thorough overview of the Pt3 trend in NBA history - making our research different from other ones.

To vindicate and confirm our hypothesis, we first categorized all the data into three groups, about 15 years as a group. Next, we did a regression analysis for two of our KPIs (quantifiable measurements used to gauge a company's overall long-term performance) and found out that there is a strong correlation between the two datasets we chose [6]. Then, we conducted an ANOVA and T-test analyses for the two datasets that we are going to look at. With statistically significant alterations in shot patterns over two consecutive seasons, the NBA's current 3PT revolution did not occur suddenly; rather, it is the consequence of a gradual growth in 3PTA throughout the course of the seasons [7].

Finally, we analyzed the data we obtained and articulated our hypothesis and prediction of the future game style of the NBA.

However, our research has several limitations. For example, we did know about the three-point shots per game from the 1950s to 1980 because three-point shots were not that popular. As a result, the data for three-point shots were not available and we were not able to assume the three-point trend in the NBA from season 1950-1951 to 1980-1981. Moreover, we could have looked at the substitution of players for each season to determine whether the game pace of the NBA is increasing or decreasing.

Our research is significant in terms of its economic value. We predicted the future NBA game style and concluded that future NBA games might be less engaging as the proportion of three-point shots tends to increase, leading to the decrease of two-point shots and eliminating fantastic crossovers as well as dribbles - thus leading to decreased audience members. As the audience members of the NBA decrease, the total income of the NBA will decrease correspondingly [3]. The most extreme consequence is that the NBA league will not have enough funds to operate.

To avoid such adverse consequences, the management layer of the NBA can propose and implement several amendments to NBA rules, such as the second 3 zone, encouraging body contact and fantastic dribbles to make

the game more involving [8]. Therefore, the entire income of the NBA will be stimulated as the NBA games attract more audience members.

5. Conclusion

This essay analyzed the current and historical NBA game styles and predicted the league's future game styles. As a result, the NBA's management team can make adjustments to optimize the organization's financial prospects. We hypothesize that the dominant game style of the NBA in the past can be used to predict the dominant game style of the NBA in the future. Before the turn of the twenty-first century, the main offensive strategy was offensive in the paint. Over time, teams have transitioned from rarely making 3-pointers to focusing their offense on them, and as game speeds rise each year, three-pointers have taken over as the go-to offensive tactic [9]. The game will speed up as fouls tend to decrease in the future, and there will be more three-point shooters in the game. This modification altered the game's fundamental structure and influenced the economic freedom in the NBA industry [10].

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