

A Study of Home Audiences Affects the Team's Performance

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Abstract. Home field advantage and referee bias are common in football matches, and many relevant studies suggest that audience is an important factor affecting these two phenomena. This paper selects Arsenal's first eight rounds of premier League matches in their home field in 2020-2021 as the research object, and uses mathematical statistics method to analyze the influence of live audience on the home advantage of Premier League matches by taking the audience as the dependent variable and the four indicators of home advantage (points, goals, shooting, red card and yellow card, foul times and possession rate) as the independent variable. The results show that the home court advantage of games without spectators is lower than that of games with spectators. In the games without spectators, there was no significant difference between home and away games in the five indicators reflecting the sum of home advantage. Therefore, the loss of audience reduces home field advantage.

Keywords: Football team, Match victory, home advantage, Spectators.

1. Introduction

Since the birth of football, it has attracted most people from all over the world to participate in and watch, and the group of “fans” was born. There is an inseparable relationship between fans and a team. Fans will love a team for various reasons, such as results, historical background, and even the color of the shirt. Professional football competition is not only a contest of skills, tactics, physical fitness, psychological quality and other aspects, but also the complementary combination of the match lineup and the overall state of the team [1]. At home, the encouragement and cheers of the fans also have a great influence on the performance of the team on the field. It is well known that playing at home is an advantage for the home team, a phenomenon known as home advantage [2]. Home advantage means that the home team is more likely to win than the visiting team. The percentage of points obtained at home to the total points obtained at home and away (HA%) is generally taken as the calculation method of home advantage. Numerous studies have observed home advantage in leagues, international competitions and men's and women's football competitions in different countries around the world [3]. There are many factors that affect the home advantage of football matches, among which the most significant factor should be the influence of the on-site audience. Most of the on-site audience support the home team, and the athletes of the home team will gain support and recognition from it, which is conducive to the home team to play a higher competitive level [4]. Some studies also point out that the home team still has advantages in the number of goals scored, the percentage of possession and the number of shots [5]. This is also an important factor influencing the referee's decision to favor the home team [6]. Specifically, the number of red and yellow cards awarded and the number of fouls have a great deal to do with the outcome of a game.

To sum up, the audience has an influence on the direction of a football match. In fact, the issue of “home-field advantage” has long been a concern for sports fans and statisticians. The Journal of Baseball Research looked at all Major League Baseball games from 1901 to 2002 and found that the difference between a team's road winning percentage and its home winning percentage was 0.082 [7]. Home court advantage means it's easier for a team to win on its home court [8]. At the same time, some scholars also studied the influence of the number and density of spectators. Dowie studied the relationship between the home advantage of the four divisions of the English Football League and the absolute number of spectators. Although the number of spectators varied from 2,500 to 25,000, the home advantage did not change [9]. Whether the home field environment can form the home field advantage is also affected by the nature of the athletes' tasks. The nature of competition tasks refers

to the degree of importance and difficulty perceived by coaches and athletes for the specific competition objectives proposed by others (or organizations), that is, the importance and difficulty of competition tasks perceived by coaches and players [10]. Nowadays, there are very few empty matches in modern football matches, but in 2020, the five major European leagues resumed with empty matches after a period of suspension due to the COVID-19 pandemic.

Based on the above reasons, this paper also compares the home games of Premier League team Arsenal in 2020-2021 season and the home games in 2021-2022 season when fans are allowed to attend, to study whether home advantage will affect the direction of the game and the referee's decision.

2. METHODOlogy

Descriptive statistics refers to the activities of characterizing data by tabulating and classifying, graphing, and calculating general data. Descriptive statistical analysis is to make statistical description of the relevant data of all variables in the survey, including frequency analysis, central trend analysis, dispersion degree analysis, distribution and some basic statistical graphs. In this paper, data and some indicators will be used for analogy, and descriptive statistical analysis will be used for investigation and research.

Regression refers to the use of statistical methods to establish a mathematical model between two or more variables to express the relationship between variables Relationship. The nominal linear regression (MLR) algorithm, also known as the inverse least square method or P-matrix algorithm, is based on the classical minimum two.

Based on the multiplication algorithm is obtained through improvement. MLR only requires that the size of the competition result be known, and if the choice is related to the impact factor. The regression coefficient of nominal linear regression can be obtained by linear regression of prime. The change relationship between the element and the game result, but because there may be fuzziness between the two, its functional relationship cannot be passed.

Regression analysis is accurate, so we can use regression analysis to get the statistical relationship. This paper needs to establish a mathematical model between the competition feature vector and the competition result to reflect the influence factors.

Search keywords from premier League official website and CNKI and other authoritative websites: Stats such as ' football matches', 'home advantage', 'refereeing 'bias' and ' spectators' provide the necessary metrics and content for this article. Stats include goals scored per game, possession rate, The total number of points scored and refereeing decisions (including red and yellow cards and fouls) and the total number of shots scored, possession rate, points scored and refereeing decisions (including red and yellow cards and fouls) in the season when spectators return to the pitch (2021-2022). At the same time, the mean and standard deviation of these data will be compared to obtain the research results and objectives. SPSS.27 software was used as the research tool for calculation analysis and comparison.

3. Results and discussion

3.1. Home win probability

Through the research and analysis of 38 data, home games with crowds are easier to win the game. Table 1 calculates the analysis of Arsenal's goal number, shot number and possession ratio in 19 home games with spectators. Table 2 shows the performance analysis of Arsenal's goals, shots and possession in 19 home games with spectators. The study found that Arsenal scored significantly more goals and shots in games without spectators, and even scored as many as five goals in a game with spectators, compared with a maximum of four goals in a game without spectators. Arsenal scored 1.947 goals per game in front of a crowd, close to 2.0, but only 1.211 goals per game at home without a crowd. Taking a closer look at the number of shots on goal, the average number of shots on goal in

a home game with a crowd (18.842) was about 7.0 more than the average number of shots on goal in a home game without a crowd (12.105). In terms of possession rate, the same coach led the team in both seasons, so for tactical reasons, there was no significant change in possession rate between matches with and without spectators in the two seasons. In terms of standard deviation, the goals, shots, and possession figures for home games with spectators are much more stable than those for home games without spectators. In particular, the standard deviation of shots on goal is 6.405 for home games with spectators, but 4.713 for home games without spectators. The difference is close to 2.0.

Table 1. Analysis of competition data with spectators

Name	Quantity	Max	Min	Mean	S.D.
Goal	19	4	0	1.211	1.316
shooting	19	20	3	12.105	4.713
possession	19	0.69	0.35	0.542	0.114

So, to sum up, through the analysis of the data found in a home game with the audience, the team in scoring and goals are more home games than the audience, in this state can be speculated that the team in the game with the audience to the game than the audience easier to goal, thus easier to win, to improve the team at home.

Table 2. Analysis of competition data without spectators

Name	Quantity	Max	Min	Mean	S.D.
Goal	19	5	0	1.947	1.177
shooting	19	28	6	18.842	6.405
possession	19	0.76	0.3	0.56	0.12

To sum up, through the analysis of the data found in a home game with the audience, the team in scoring and goals are more home games than the audience, in this state can be speculated that the team in the game with the audience to the game than the audience easier to goal, thus easier to win, to improve the team at home.

In addition, in order to confirm the speculation, the research continued to carry out the basic probability calculation, using the relationship between the number of wins and the total number of matches, calculated that in the home games without spectators, the probability of winning is 36.80%, the probability of drawing with the opponent is 21.00%, and the probability of losing is 42.20%. According to the rules of Premier League games, Team earns three points for a win, one for a draw, and no points for a loss. The team has scored 25 points in 19 home games without spectators, a scoring rate of 57.8 percent.

At home games with crowds, Arsenal has a 73.60 per cent chance of winning, a 10.50 per cent chance of drawing and a 15.90 per cent chance of losing in 19 matches. A total of 44 points have been scored in 19 matches, with a scoring rate of 84.10%. According to the calculation, teams are more likely to win and score points in home games with spectators than in games without spectators, thus achieving better results. The calculation also confirms the hypothesis that teams are more likely to win home games when they have crowds.

3.2. The referee bias

Regarding the referee's penalty bias, this study collected the number of red and yellow cards and the number of fouls awarded in 38 matches as research data for analysis. home games with spectators are more likely to be biased by referees. Table 3 shows the data analysis for 19 home games with spectators. The study found that in home games with spectators, referees awarded 158 technical fouls to the home team in a single game, up to 11 fouls in a single game, seven yellow cards and three red cards to the home team in a single game. In terms of average, 5.1 fouls were awarded to the home team per match, 0.32 yellow cards per match and 0.1 red cards per match.

Table 3. Data analysis of the elements of referees' decisions in home games with spectators

Name	Quantity	Max	Min	Mean	S.D.
Foul	19	11	1	5.1	3.042
Yellow	19	7	1	0.32	0.552
Red	19	3	1	0.1	0.289

Table 4 shows the analysis of referees' penalty data in home games without spectators, the referee in the 19 no audience at home game to the home team a total of 189 fouls, single-game most fouls for 17 times the average sentence of 9.947 per game fouls, the single field for the home team up out of the three yellow CARDS, averages 0.947 yellow card game. Referees have shown the most amounts of red cards to the home team in a single match, averaging 0,105 per game.

Table 4. The analysis of referees' penalty data in home games without spectators

Name	Quantity	Max	Min	Mean	S.D.
foul	19	17	3	9.947	3.391
yellow	19	3	0	0.947	0.911
Red	19	1	0	0.105	0.315

Comparing the figures between the two tables shows that referees are far more lenient in awarding red and yellow cards and fouls in home games with spectators. Comparing the averages, it was found that referees awarded about 5.0 fewer fouls in home games with spectators than in games without spectators, 0.32 vs. 0.947 for yellow cards, which was relatively small, and 0.1 vs. 0.105 for red cards. It can be seen that the referee will have a certain bias to the home team because of the crowd in the game.

In terms of standard deviation, in home games with spectators, the standard deviation data are fouls (3.042), yellow cards (0.552) and red cards (0.289). In home games without spectators, the standard deviation figures are the number of fouls (3.391) yellow cards (0.911) and red cards (0.315). By comparing the data that have the home game of the audience all the data of standard deviation compared with the data no audience home game of the standard deviation is lower, in other words, the refereeing decisions in a home game with the audience is more stable, this may be because the audience Shouting and protest to the referee had to focus more on the game itself.

In addition, this study uses linear regression method to do some basic operations. A regression equation was calculated using referees' decisions in home games. From the number of fouls, the number of yellow cards, and the number of red cards, the points are used as the dependent variable. Table 5 shows the data analysis of the referee's penalty decisions in home games without spectators. According to the statistical calculation, the F-value of the referee's penalty decisions in home games with spectators is 0.361 and the P-value is 0.782.

Table 5. The data analysis of the referee's penalty decisions in home games without spectators

E	B	Standard error	R ²	F	P
foul	0.021	0.121			
yellow	0.158	0.263	0.067	0.367	0.782
red	0.745	1.122			

From the number of fouls, the number of yellow cards, and the number of red cards, the points are used as the dependent variable. Table 6 shows the data analysis of the referee's penalty in the home games with spectators. According to the statistical calculation, the F value of the referee's penalty in the home games with spectators is 2.273, and the P value is 0.122. VIF value is less than 5, which means that there is no Multilinearity.

Table 6. The data analysis of the referee's penalty in the home games with spectators

E	B	Standard error	R ²	F	P
foul	0.103	0.093			
yellow	0.143	0.162	0.313	2.273	0.122
red	-2.768	1.174			

Through research and investigation, it is found that the P value of home games with spectators is lower than that of home games without spectators by comparing Table 3.2.3 and Table 3.2.4. By contrast, in matches with spectators, the result of referee's penalty has a certain significance on the trend of the game, which further reflects the influence of spectators on the result of the game.

4. Conclusion

After sorting out and analyzing the above data, it can be found that the team with the home-court advantage of the audience can improve its shooting, scoring and possession, and reducing the number of fouls and penalties, thus improving the probability of winning in the home court and reducing the probability of losing in the home court. At the same time, the presence of the audience makes the referee's decision more important, and in some cases, they will make some decisions in favor of the home team, which will change the performance of the team and the direction of the game. The study also found that the fans as an important element of modern football sports, is one of the world football indispensable elements, these fans can bring great influence on the team's game, this study studies the role of fans in the game, only study also proved that the fans can decide to a certain extent the result of the game of the team's performance. It is often said that football is a very metaphysical sport, and everything is possible in the world of football. Therefore, in fact, the influence of a team's performance cannot be considered only from the factors of the audience, but the object of this study is to consider the performance of the team on the pitch.

But the difference between these factors is not that great, which means there is still a degree of possibility, and maybe this proves the saying that the football is round and anything can happen. If national football teams want to get effective development, the fan is a very key factor, which is the so-called "atmosphere" of a factor, therefore, suggest the football practitioners if hope his team can get better grades or better benefits, strive to build a local football culture to try, fan culture, such as service for the fans, Ticket prices for fans, benefits and so on. Such measures can help a team to have its own heritage and culture, and can greatly improve the team's results and performance.

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