AÇIK ERİŞİM
OPEN-ACCESS

*Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*
*Gazi Journal of Physical Education and Sports Sciences*
2023, 28(3), 206-214

# Statistical Modelling of Home Advantage and Away Disadvantage of Turkish Super League Teams

## Türkiye Süper Lig Takımlarının Ev Sahibi Avantajı ve Deplasman Dezavantajının İstatistiksel Modellenmesi

Research Article / Araştırma Makalesi

Ümit KUVVETLİ [1]

Özgül Vupa ÇİLENGİROĞLU [2]

[1] Bakırçay University, İZMİR

[2] Dokuz Eylül University, İZMİR

## Abstract

It is a fact that for all sports branches, being home or away is one of the most critical factors influencing the outcome of the game. Although there are many studies on Home Advantage (HA), most of these studies have been made specifically for leagues as a whole, and the number of studies examining HA at the team level is quite limited. In this study, the HA and away disadvantage (AD) values were calculated, using Poisson regression, for each team played at least 3 seasons in the Turkish Super League between 2000/2001 and 2021/2022 seasons, based on the goals they scored and conceded in their home and away matches. According to the results of the study, 32 of the 34 teams included in the analysis were found to have a home advantage that statistically varied between 56.2% and 81.8%. Evaluations using AD determined that AD values ranged between 46.7% and 65.4% and only 9 teams did not have an away disadvantage in the league. However, the results of the study indicated that the main factor determining the ranking in the league is the away disadvantage of the teams. The reason why the teams have different HA and AD values can be shown as the effect of the spectators, and different game tactics applied in home and away matches.

Keywords: Football, Home advantage, Away disadvantage, Turkish Super League, Generalized estimated Model, Poisson regression

Corresponding Author / Sorumlu Yazar
Assist. Prof. Dr. Ümit KUVVETLİ
umit.kuvvetli@bakircay.edu.tr

## Öz

Tüm spor dalları için ev sahibi olmanın (HA) veya deplasmanda (AD) olmanın sonucu etkileyen en önemli faktörlerden olduğu bir gerçektir. HA ile ilgili birçok çalışma olmasına rağmen, bu çalışmaların birçoğu ligler özelinde yapılmış olup, takım seviyesinde HA inceleyen çalışma sayısı oldukça sınırlıdır. Bu çalışmada, Poisson regresyon kullanılarak Türkiye Süper Ligi'nde 2000/2001 ile 2021/2022 sezonları arasında en az 3 sezon yer alan takımların evlerinde ve deplasmanda oynadıkları maçlarda attıkları ve yedikleri gol sayıları üzerinden, takım özelinde HA ve AD değerleri hesaplanmıştır. Çalışma sonuçlarına göre, analize dahil edilen 34 takımın 32 tanesinin istatistiksel olarak %56.2 ile %81.8 arasında değişen ev sahibi avantajına sahip olduğu bulunmuştur. AD açısından değerlendirildiğinde ise, AD değerlerinin %46.7 ile %65.4 arasında değişmekte olduğu ve sadece 9 takımın deplasman dezavantajına sahip olmadığı tespit edilmiştir. Bununla birlikte, çalışma sonuçları ligde sıralamayı belirleyen esas faktörün takımların deplasman dezavantajı performansı olduğunu göstermiştir. Takımların farklı HA ve AD değerlerine sahip olmasının sebebi olarak seyirci avantajı, içeride ve dışarıda uygulanan farklı oyun taktikleri gibi faktörler gösterilebilir.

Anahtar Kelimeler: Futbol, Ev sahibi avantajı, Deplasman dezavantajı, Türkiye Süper Ligi, Genelleştirilmiş tahmin modeli, Poisson regresyon

Received / Geliş Tarihi : 30.03.2023
Accepted / Kabul Tarihi : 20.07.2023
Published / Yayın Tarihi : 31.07.2023

Ethical Statement / Etik Bilgilendirme
This research does not require ethics committee approval.

DOI: 10.53434/gbesbd.1272670

Citation / Atıf: Kuvvetli, Ü. and Çilengiroğlu, Ö. V. (2023). Statistical modelling of home advantage and away disadvantage of Turkish Super League teams *Gazi Journal of Physical Education and Sports Sciences, 28*(3), 206-214.

## Introduction

Football is the most popular of sports, played, watched, used for betting, entertainment, and health in the world and in Turkey. Thus, millions of people follow this sport. There are numerous factors affecting the success and performance of teams in football. These factors can be listed as spectators, referees, weather conditions, field conditions, homeowner and opponent's performance, game performance and match indicators (red card, yellow card, shot, offside…) (Günay, Yüce & Ocak, 2017; Müniroğlu & Deliceoğlu, 2008; Tütüncü & Yolgörmez, 2021).

One of the most critical factors that change the performance and directly affect the results of the match is the advantage of being at home in football (Pollard, 1986). The advantage of playing at home is an important factor to consider in competition-based sports. With this factor, it is known how competing at home or away affects the outcome of sports competitions (Sampedro & Prieto, 2012; Werlayne, 2017). The main reasons for home advantage (HA) were attributed to spectators, referees, geographical features, experience, distance, tactics, rules, psychosocial factors and team characteristics (Carlos & Volossovitch, 2017; Carron, Loughhead & Bray, 2005; Courneya & Carron, 1992; Işıkdemir, 2020; Pollard, 2008; Pollard & Gómez, 2014; Tütüncü & Yolgörmez, 2021). There are also studies examining HA at the team level (Goumas, 2017; Pollard, 2008) including studies, number of which is limited, examining the disadvantage of playing away at team.

The calculation of HA has been based on very simple mathematical processes. HA is calculated and expressed as a percentage in two ways. Firstly, HA is calculated as the number of games won by teams playing at home (as a percentage of decided games). Secondly, HA is calculated as the number of points won by teams playing at home (as a percentage of total points earned) (Pollard, 1986). This method has been used by researchers for many years (Pollard & Gómez, 2015). However, it does not take team skill into account, which will affect the calculation of HA (Pollard, Silva & Mederios, 2008; Rooney & Kennedy, 2018).

Although it is valid for the league in general, this approach, which is based on the amount of the team's total points earned at home, gives very misleading results on the team basis. For instance, if team “A” beats team “B” 4-0 in the home match and 1-0 away, team "A" will have 3 points in both games. However, it is not possible to interpret the home advantage of "A" team according to the points calculation. In addition, when the analysis is made on the number of goals scored and conceded, it is seen that the team "A" performed better at home than the same opponent played away. This is actually the exact equivalent of being a homeowner. There are many such examples during a football season. Point-based "home advantage" calculations do not take into account the main objective of a football team, i.e. the goal. Also, calculations made on points do not take team ability into account. According to this calculation method, theoretically a team that wins all its matches in the league has a home advantage of 50%. Similarly, the home advantage of a team that has lost all the away games and take only 1 point in the home games will be 100%. These findings also make the results of the analysis based on the point calculation per team quite controversial.

The solution to this situation is to calculate the scored and conceded goals instead of the points calculation in the home advantage or the away disadvantage calculations made per team. Since this approach is based solely on the number of goals scored and conceded (the performance of the displayed team) rather than points won, it adds a deeper insight into the home advantage and away disadvantage. There are several approaches to HA calculations based on the number of goals. The first of these is an approach proposed by Clarke and Norman (1995) using the least squares method based on team power & ability. In another approach used by Marek and Vavra (2017), the matches played by the same opponents are combined and the home advantage is calculated according to the number of goals scored and conceded in both matches. Another approach, the one used in this study, was devised by Goumas (2017) to calculate the HA of individual teams in Champions League. In this approach, a team's HA is calculated by considering the abilities of both teams. In this calculation, HA is the ratio of goals scored by the relevant team to all goals scored.

Interesting results were obtained examining home advantage for different countries using various variables. Between 2014-2015, the Iranian Football Super League was examined for the number of winnings and losses, number of goals, yellow and red cards. The results of the study indicated that the HA and the goals were higher, and the loss of away, the number of yellow and red cards was higher (Talab & Mehrsafar, 2016). Armatas and Pollard (2014) calculated the home advantage for teams in the Greek Super League between the 1994-1995 and 2010-2011 seasons to be between 49.5% and 80.5%. In the study examining the top 10 national football league matches of Europe in the 2015-2016 season, it was determined that the percentage of winning the matches by playing in the home field was over 50% (Leite, 2017). İnan (2018) calculated the home advantage based on points for 54 seasons between 1963 and 2018 for the 9 major football leagues, including the Turkish Super League. The analysis revealed that the home advantage in the included leagues ranged from 61.2% to 66.4%. The study conducted in the Chinese Super League for the 2014-2016 seasons found a 60% home advantage. In addition, it has been determined by this study that superior and inferior teams experience home advantage differently (Liu et al., 2019). According to Öndes (2019), the home advantage for teams in the Turkish Super League ranges from 45% to 82.3%. On the other hand, Gürkan et al. (2017) calculated the home advantage for teams in the Turkish

1st League to be between 48.9% and 85.7%. The study on the Italian league Serie A, showed that the performance of the players was high because the players were accustomed to the size of the field, the ground and other features related to the field (Ponzo & Scoppa, 2018). The results of the study examining the home advantage of teams in different football leagues in England according to their positions in the league, revealed a relationship between the position of the teams in the league and the HA (Ramchandani, Millar & Wilson, 2021). The study examining the HA by using multivariate regression for the Chinese Super League, concluded that the number of spectators had a positive effect on the yellow cards shown in the matches, the goals scored and the points per match (Krumer, Shapir & Zou, 2022).

Turkish Super League is one of the most important football leagues in Europe. Although there are some studies on the home advantage (HA) at the team level in the Turkish Super League, unfortunately these studies do not include more than descriptive statistics. In addition, there is no study in the literature about the away disadvantage (AD) of the teams in the Turkish Super League. In this study, the matches played in the league between the years 2000 and 2022 were analysed, and the HA and AD of the individual teams, which played at least 3 seasons in the league, were modelled.

### *Turkish Super League Literature Review*

Sports is a very popular sport all over the world because of the opportunities it provides both in terms of entertainment and finance. Especially, since the Turkish Super League, which is affiliated to the Turkish Football Federation, has these characteristics for Turkish football, it is important to examine the factors affecting the performance of this league (team, offense, defence, player...). There are many factors that affect the performance (offensive & defence) of a match. The number of goals scored in football can give important information about the offensive performance of the team, and the number of goals conceded can give important information about the defensive performance. In this respect, the number of goals scored and conceded by teams at home and at the opponent's field can also reveal useful information about offensive and defensive performance in the home and away field. The number of goals scored and conceded are important data that can guide the offensive and defensive tactics that the teams would implement in their own fields and in the opponent's fields. In addition to many factors affecting match performance in recent years, there are many studies in the literature about home advantage and away disadvantage. These studies were also carried out by various researchers in the Turkish Super League.

The home ownership advantage for football clubs competing in the Turkish Super League in the 2004-2005 season was analysed by correlation and one way analysis of variance. The results showed the importance of home advantage and playing a more attack game during the match (Seçkin, 2006).

The HA of the Turkish Football Super League between 2004-2014 seasons was analysed as a percentage. The HA was calculated by using the number of match wins of the home and away teams, their situation according to the seasons, teams and geographical regions (Göral, 2015). In the study examining the home advantage in the Turkish Football 1st League between the 2005-2015 seasons, the average home advantage was found to be 61.10%. In addition, in this study, the average home advantage of the teams that completed a season as champions was found to be 56.40%, while it was determined that this rate was 61.23% for the relegated teams (Gürkan, Göral & Saygın, 2017). In the study conducted in the Turkish Super League in the 2015/2016 season, it was concluded that the ball possession percentages of the teams playing in their own field, their playing time, the number of balls in the attack zone, the number of shots on target, the number of corner kicks and the number of passes from the midfield to the attack zone were higher than the away teams (Gurkan, 2018). The study conducted for all teams in the Turkish Super League for the seasons 1995/96 and 2016/17, determined that being the host is an important advantage when comparing the home and away teams (Öndes, 2019). For the 2019-2020 season, HA and spectator effect analysis of the Turkish Super League was conducted. In this study, the analysis of scores, forward and away goals were obtained by paired t-test and correlation analysis (Subak & Kaya, 2021).

A total of 145 football teams were examined in the study, which analysed the HA of the teams in the Turkish professional football leagues (Super League, 1st, 2nd and 3rd League) during the Covid-19 epidemic (in the 2020-2021 season). In this study, the number of goals scored and conceded, and the points scored in the matches in the home and away matches were used. The difference between leagues with reference to number of goals and score parameters was analysed by ANOVA. The analysis results revealed that the Super League teams were the teams that scored the most goals and scored in the home matches. A significant difference was also determined among the Super League teams according to the number of goals and score parameters. As a result, it has been determined that although the matches are played without spectators in the 2020-2021 season of the Turkish Super League, the advantage of being the home team is higher than other professional football leagues (Arı & Apaydın, 2021).

Tütüncü and Yolgörmez (2021) have compared the matches played before and during the Covid-19 pandemic. By analysing 1752 matches played in Germany, England, Italy, Spain, and Turkey, they have concluded the matches played with or without spectators had no effect on the performances of the home teams, while the absence of spectators increased the performances of the away teams.

The study, evaluating the effect of the match participation level in the Turkish Football Federation Super League on the home advantage between the 2017-2020 seasons, concluded

that Monday and derby matches significantly affected the number of spectators by using the least squares model. In this study, the number of goals scored by the home and away teams, their scores, the number of spectators, the capacity of the stadium, the time and date of the match, the air temperature at the match time and many other variables were collected (Demirgil, 2022).

## Method

### *Research Group and Data Collection*

The data used in this research were matches from 20 seasons, between the 2000/2001 to 2021/2022 seasons of the Turkish Super League. All matches in a season are played in pairs, one at each team's home field. During the analysed period, 6.920 matches were played in the league. Teams, which played at least 3 seasons during the analysed period were taken for the study. The reason for selecting this approach is to enhance the statistical power of the analysis. The data for all matches was obtained from the official website of the Turkish Football Federation, which provides open access to match data (www.tff.org).

### *Statistical Analysis*

HA for each team was calculated as the percentage of goals scored and conceded in home matches by that team. Correspondingly, AD for each team was calculated as the percentage of goals conceded in away matches. For instance, if a team scored 60 goals in the matches at home and conceded 20, then their unadjusted HA would be 60/(60 + 20) × 100% = 75%. HA greater than 50% indicates that they perform superiorly in home matches. Assuming that same team scores 30 goals and concedes 50 goals in away matches, the unadjusted AD for this team would be 50/ (30+50)*100%=62.5% and means poorer performance in away matches. A value of 50% for HA or AD for any team indicates no home advantage or away disadvantage. A value of higher than %50 for HA indicates superior performance in home matches and a value of higher than 50% for AD indicates inferior performance in away. Multivariate regression analysis was employed in the study to control for the confounding effect, given that simple calculations of HA and AD may be biased by variations in team ability.

A paired design was applied to model the HA. This design included 2 observations (a home team and an away team). The mean number of goals scored by the home and away teams was estimated using a repeated measures regression analysis with Generalized Estimated Equations in SPSS Version 26. Repeated measures analysis is used when observations occur in pairs and the result of interest is to be linked within each pair. In the study, since the number of goals scored in pairs is discrete, the Poisson regression (Karlis & Ntzoufras, 2003) model was used. Robust estimation of variance was used, as this produces valid standard errors even if the within-group correlations deviate from the correlation structure specified in the model (White, 1982). An additional advantage of robust variance is that it prevents under-estimation of standard errors when count data are over-dispersed. This modelling strategy has previously been used to investigate HA in terms of goals scored (Goumas, 2014a) and disciplinary sanctions issued by referees (Goumas, 2014b) in football, and is described in detail by Goumas (2013) (Goumas, 2017).

In this study, the ability of each team in the Turkish Super League was determined. The measure of team ability was determined as its position in the final league table at the end of that season, in any given season. In this case, the ability variable could also be added to the regression model to control the skill difference of the home team and the away team. In addition, since playing as the home (1) or playing away (0) is thought to affect the home advantage while modelling, location is also added to the model as a variable.

In estimating HA and AD for individual teams, the data containing each of the matches was divided into 2 sets. The first set was the HA data set of the home matches of the selected team, and the second data set was the AD data of the away matches of the selected team. A unique team ID value was assigned to both the home team and away team observations for each home (HA data) and away (AD data) match played by the selected teams. Table 1 shows a total of 2 matches played between Fenerbahçe (1 of the selected teams) and Sivasspor (an unselected team), 1 match in each team's home ground. The regression coefficient for these terms is therefore interpreted as the difference in HA or AD (on the log scale) relative to the reference team.

**Table 1.** Example observation pairs of Home Advantage (HA) and Away Disadvantage (AD) dataset

| Dataset | Match ID | Location | Team | Ability | Goals |
|---|---|---|---|---|---|
| HA | 2.161 | Home | Fenerbahce | 2 | 1 |
| | 2.161 | Away | Sivasspor | 3 | 0 |
| AD | 2.319 | Home | Sivasspor | 3 | 1 |
| | 2.319 | Away | Fenerbahce | 2 | 4 |

Linear combinations of equations (generalized linear models) were used to estimate adjusted HA and AD regarding the percentage of goals scored in home matches by each team (HA) and the percentage of goals conceded in away matches by each team (AD). To test for variation in HA and AD between teams, a chi-square test was performed and p values less than 0.05 were interpreted to be significant.

HA and AD were taken from the Poisson regression coefficient (β) for match location (0 = Away, 1 = Home) for each team using the following equation (Goumas, 2017):

$$HA\ and\ AD = \frac{\exp(\beta)}{\exp(\beta)+1} \times 100\%$$

The standard error (SE) for HA and AD can be calculated as follows, where "*se*" represents the standard error of beta (Goumas, 2013):

$$SE(HA\ and\ AD) = HA - \left(\frac{\exp(\beta - se)}{\exp(\beta - se)+1} x100\right)$$

## Results

### *Home Advantages by Teams*

Teams, which played at least 3 seasons during the studied period, in total 34 teams, chosen for the analysis. Some of these teams have been in the league with several different names (İstanbul Başaksehir FK, eg.) during the period analysed. Within the scope of the analysis, the data of these teams were combined under the last name of the teams. For each team, the number of the seasons played in the league, the number of matches played, goal scored for and against, crude and adjusted HA values, and the Chi-square p-values for adjusted home advantage values being greater or less than 50% have been shown in Table 2. The adjusted HA values are used to rank teams in a descending order after adjusted for team ability and season.

**Table 2.** Home advantage (%) for Turkish Super League teams in 2000/2001 to 2021/2022 seasons

| Teams | Season | Home matches | Goals for | Goals against | Home Advantage (%) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Crude | Adj (SE) | p |
| Kocaelispor | 4 | 68 | 111 | 112 | 49.8 | 81.8 (3.9) | 0.000* |
| Elazigspor | 4 | 68 | 74 | 83 | 47.1 | 73.7 (7.3) | 0.003* |
| Samsunspor | 7 | 119 | 171 | 172 | 49.9 | 72.9 (2.9) | 0.000* |
| Diyarbakirspor | 6 | 102 | 123 | 128 | 49.0 | 72.6 (5.2) | 0.000* |
| Kasimpasa | 13 | 226 | 358 | 338 | 51.4 | 72.4 (2.1) | 0.000* |
| MKE Ankaragucu | 15 | 258 | 362 | 359 | 50.2 | 71.8 (2.2) | 0.000* |
| Osmanlispor FK | 3 | 51 | 69 | 69 | 50.0 | 71.4 (4.2) | 0.000* |
| Denizlispor | 12 | 207 | 293 | 240 | 55.0 | 71.2 (2.3) | 0.000* |
| Caykur Rizespor | 15 | 260 | 362 | 338 | 51.7 | 70.8 (3.0) | 0.000* |
| Yeni Malatyaspor | 10 | 175 | 261 | 230 | 53.2 | 70.5 (2.6) | 0.000* |
| Galatasaray | 22 | 379 | 838 | 340 | 71.1 | 70.4 (0.9) | 0.000* |
| Fenerbahce | 22 | 379 | 867 | 352 | 71.1 | 70.3 (0.9) | 0.000* |
| Mersin Idmanyurdu | 4 | 68 | 80 | 99 | 44.7 | 69.8 (5.3) | 0.001* |
| Alanyaspor | 6 | 107 | 205 | 140 | 59.4 | 69.4 (3.2) | 0.000* |
| Antalyaspor | 16 | 277 | 408 | 357 | 53.3 | 69.4 (2.2) | 0.000* |
| Manisaspor | 6 | 102 | 129 | 141 | 47.8 | 69.1 (5.4) | 0.001* |
| Bursaspor | 17 | 289 | 432 | 293 | 59.6 | 68.8 (1.6) | 0.000* |
| Konyaspor | 16 | 277 | 395 | 300 | 56.8 | 68.8 (1.7) | 0.000* |
| Goztepe | 7 | 124 | 175 | 180 | 49.3 | 68.7 (3.1) | 0.000* |
| Besiktas JK | 22 | 379 | 755 | 365 | 67.4 | 68.4 (0.9) | 0.000* |
| Gaziantepspor | 17 | 289 | 410 | 344 | 54.4 | 68.4 (1.8) | 0.000* |
| Istanbul Basaksehir FK | 14 | 243 | 400 | 245 | 62.0 | 68.1 (1.4) | 0.000* |
| Gaziantep FK | 3 | 56 | 102 | 62 | 62.2 | 68.0 (3.7) | 0.000* |
| Istanbulspor | 5 | 85 | 100 | 119 | 45.7 | 66.8 (5.6) | 0.004* |
| Trabzonspor | 22 | 379 | 673 | 409 | 62.2 | 66.8 (1.1) | 0.000* |
| Kardemir Karabukspor | 7 | 119 | 144 | 150 | 49.0 | 66.5 (4.7) | 0.001* |
| Akhisarspor | 7 | 119 | 157 | 146 | 51.8 | 66.0 (4.3) | 0.000* |
| Kayserispor | 17 | 294 | 406 | 327 | 55.4 | 65.7 (2.1) | 0.000* |
| Sivasspor | 16 | 277 | 414 | 311 | 57.1 | 65.6 (1.6) | 0.000* |
| Genclerbirligi SK | 20 | 343 | 493 | 402 | 55.1 | 65.0 (1.9) | 0.000* |
| Ankaraspor | 6 | 102 | 113 | 143 | 44.1 | 64.8 (4.3) | 0.001* |
| Eskisehirspor | 8 | 136 | 187 | 154 | 54.8 | 60.7 (3.4) | 0.002* |
| Adanaspor | 4 | 68 | 86 | 130 | 39.8 | 57.7 (7.6) | 0.307 |
| Kayseri Erciyesspor | 4 | 68 | 71 | 92 | 43.6 | 56.2 (7.0) | 0.375 |

The ability of a team changes every season depending on team quality, the tactics they played and other factors. A team's adjusted HA value shows the superiority of that team in home matches against an opponent with equal ability, adjusted for all these differences. The adjusted HA can be interpreted as the level of HA expected to be gained by each team when playing an opponent of equal ability and eliminates any between-team variations because of effects of season.

Table 2 shows that all teams played at least 3 seasons in the league except Adanaspor and Kayseri Erciyesspor have a statistically significant HA value. Also, adjusted HA shows evidence ($\chi^2_{33} = 82.08; p = 0.00$) of among teams, varying from 53.2% to 81.8%.

## *Away Disadvantages by Teams*

The away disadvantage values that are adjusted for season and team ability effects for all teams are summarized and listed in ascending order in Table 3. Contrary to the HA values given in Table 2, it is seen that only 9 of 34 teams do not have away disadvantage in the league. The value of AD of the teams varies between 46.7 and 65.4 and there is statistical evidence ($\chi^2_{33} = 103.0; p = 0{,}00$) for among teams in terms of away disadvantages.

**Table 3.** Away disadvantage (%) for Turkish Super League teams in 2000/2001 to 2021/2022 seasons

| Teams | Season | Home matches | Goals for | Goals against | Away Disadvantage (%) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Crude | Adj (SE) | p |
| Fenerbahçe | 22 | 379 | 627 | 424 | 40.3 | 46.7 (1.9) | 0.071 |
| Galatasaray | 22 | 379 | 579 | 449 | 43.7 | 48.8 (1.9) | 0.509 |
| Osmanlıspor FK | 3 | 51 | 69 | 72 | 51.1 | 49.2 (4.4) | 0.863 |
| Besiktas JK | 22 | 379 | 607 | 447 | 42.4 | 49.3 (1.7) | 0.705 |
| Manisaspor | 6 | 102 | 113 | 165 | 59.4 | 51.5 (3.9) | 0.705 |
| Trabzonspor | 22 | 379 | 558 | 490 | 46.8 | 52.1 (1.6) | 0.201 |
| İstanbul Basaksehir FK | 14 | 243 | 300 | 311 | 50.9 | 53.1 (2.1) | 0.137 |
| Istanbulspor | 5 | 85 | 100 | 128 | 56.1 | 53.5 (3.1) | 0.249 |
| Kayseri Erciyesspor | 4 | 68 | 71 | 116 | 62.0 | 54.0 (4.1) | 0.328 |
| Kasimpasa | 13 | 226 | 282 | 373 | 56.9 | 54.7 (2.0) | 0.019* |
| Genclerbirligi SK | 20 | 343 | 410 | 547 | 57.2 | 55.9 (1.6) | 0.000* |
| Sivasspor | 16 | 277 | 348 | 441 | 55.9 | 56.4 (1.6) | 0.000* |
| Eskisehirspor | 8 | 136 | 150 | 201 | 57.3 | 56.8 (2.2) | 0.003* |
| Akhisarspor | 7 | 119 | 129 | 194 | 60.1 | 57.2 (3.1) | 0.021* |
| Bursaspor | 17 | 289 | 339 | 466 | 57.9 | 57.4 (1.7) | 0.000* |
| Alanyaspor | 6 | 107 | 127 | 167 | 56.8 | 57.7 (3.1) | 0.015* |
| MKE Ankaragucu | 15 | 258 | 279 | 445 | 61.5 | 58.0 (1.9) | 0.000* |
| Mersin Idmanyurdu | 4 | 68 | 70 | 118 | 62.8 | 58.3 (3.8) | 0.035* |
| Samsunspor | 7 | 119 | 125 | 193 | 60.7 | 58.5 (2.7) | 0.002* |
| Kayserispor | 17 | 294 | 328 | 492 | 60.0 | 58.7 (1.8) | 0.000* |
| Gaziantepspor | 17 | 289 | 316 | 452 | 58.9 | 58.8 (1.6) | 0.000* |
| Konyaspor | 16 | 277 | 292 | 449 | 60.6 | 59.9 (1.6) | 0.000* |
| Antalyaspor | 16 | 277 | 270 | 433 | 61.6 | 60.0 (1.8) | 0.000* |
| Yeni Malatyaspor | 10 | 175 | 166 | 274 | 63.2 | 60.4 (2.3) | 0.000* |
| Caykur Rizespor | 15 | 260 | 250 | 440 | 63.8 | 60.6 (1.9) | 0.000* |
| Denizlispor | 12 | 207 | 220 | 362 | 62.2 | 61.1 (1.8) | 0.000* |
| Goztepe | 7 | 124 | 124 | 210 | 62.9 | 61.7 (2.5) | 0.000* |
| Gaziantep FK | 3 | 56 | 54 | 95 | 63.8 | 61.8 (3.4) | 0.001* |
| Ankaraspor | 6 | 102 | 97 | 176 | 64.5 | 62.0 (3.0) | 0.000* |
| Adanaspor | 4 | 68 | 80 | 150 | 65.2 | 62.3 (4.6) | 0.000* |
| Elazigspor | 4 | 68 | 72 | 163 | 69.4 | 64.2 (3.6) | 0.000* |
| Kocaelispor | 4 | 68 | 69 | 147 | 68.1 | 64.3 (4.2) | 0.002* |
| Diyarbakirspor | 6 | 102 | 86 | 199 | 69.8 | 65.1 (3.4) | 0.000* |
| Kardemir Karabukspor | 7 | 119 | 122 | 244 | 66.7 | 65.4 (2.3) | 0.000* |

Additionally, unlike other teams in the league, it is possible to say that Fenerbahçe has away advantage (p=0.071) and does not have away disadvantage. The fact remains that 5 of 9 teams have statistically significant HA and AD values are teams that have competed in the Super League for at least 10 seasons. Parallel to use of larger amount of data, this situation increases the reliability of the finding that these teams, Fenerbahçe, Galatasaray, Beşiktas, Trabzonspor and İstanbul Başaksehir, do not have away disadvantages in the away matches in the league. The fact that these teams being the champion at least once during the period analysed and that they have completed the league in the top ranks generally increases the reliability of the research results.

## Discussion

Football stands out as the predominant athletic pursuit not only in Turkey but also across the globe. This situation has led to the realization of many studies related to football. In football, where success is measured by the result, there are many different variables that affect success, one of them is the home advantage, which means that the teams play on their own home perform better.

There are many factors that affect a football team's home advantage or away disadvantage. Spectator support, psychological factors such as familiarity to the ground, climatic conditions, referees under the pressure of the spectator, etc. are some of these factors. This situation, which is called home advantage and away disadvantage, shows differences per team and there are many studies on this subject in literature. Although this reality, there is a need for many studies examining this subject from different views.

Most of the studies on home advantage in football are league-based studies and the number of studies examining this issue on a team basis is quite limited. In addition, almost all of the existing studies calculate the home advantage on a team basis over the points received. This approach ensures that the home advantage cannot be calculated correctly for a team that has won both home and away games against the same opponent. Moreover, since these studies do not take into account the ability of both the host and the opponent, the results obtained become biased. In addition, there is no indication of the statistical reliability of these studies conducted using points.

Various approaches have emerged based on the calculation of goals scored and conceded in the matches against this lack of home advantage over the points collected. In these approaches, the ability of the teams is also taken into account. One of these approaches is the Poisson regression used by Goumas (2017) to measure the home advantage and away disadvantage of teams played at least 50 matches in the UEFA Champions League.

The Turkish Super League, followed with great interest by millions of people throughout the country and especially by Turkish citizens living abroad, has been the top football league in the country for over 100 years. In this study, the HA and the AD of the teams in the Turkish Super League for being at least 3 seasons between the 2000/2001 and 2021/2022 seasons were examined. In accordance with the results of the study, it was determined that all teams that were in the Super League for at least 3 seasons during the analyzed period, except Adanaspor and Kayseri Erciyesspor, have the home advantage statistically and Kocaelispor was the team with the highest HA with 81.8%.

Pollard and Gomez (2009) conducted a study on the home advantage at the team level in the leagues of France, Italy, Portugal, and Spain, and they calculated the home advantage for all teams to be between 59.2% and 74.4%. Goumas (2017) found that in the UEFA Champions League, for 13 teams that played at least 50 matches, the home advantage ranged from 58% to 73%, while the disadvantage of playing away ranged from 45% to 68%. Pollard et al. (2008) found that in the top-tier Brazilian football league, Brasileirão Serie A, between 2003 and 2007, the home advantage rate was 65%, with individual teams experiencing home advantages ranging from 57.5% to 74.9%. Armatas and Pollard (2014) calculated the home advantage for teams in the Greek Super League between the 1994-1995 and 2010-2011 seasons to be between 49.5% and 80.5%. For the Turkish Super League, Öndes (2019) conducted a study using a point-based calculation to explore the team-specific home advantage, and it was found to range from 45% to 82.3%. In another study using a similar method, Gürkan et al. (2018) found that teams in the Turkish 1st League had a home advantage ranging from 54.5% to 65.3%. The findings from the study on the Turkish 1st League align with other studies investigating the team-specific home advantage. In both Brazil and Turkey, the high passion for football can be considered one of the main reasons for teams having a high home advantage. Additionally, the large geographical size of the countries introduces challenging travel conditions for away teams. Furthermore, the diverse climatic characteristics across the countries can be used to explain the difficulties of playing away matches for teams.

In a football league, the advantage of home teams also means that away teams are at a disadvantage. However, this situation is not as simple as it seems and depends on who the opponent is. For this reason, the away disadvantage for the teams in the league were also investigated besides the home advantages. According to the analysis results, it is seen that only 9 of the 34 teams do not have an away disadvantage statistically.

It can be thought that the main reason for the differences between the HA and AD for the same teams is the game tactics applied in the match. However, the study findings show that the factor determining the overall ranking in the league is the away disadvantage. It is seen that the teams that will be at the top of the league should reduce their away disadvantage. The fact that none of the teams that have won the championship in the history of the league and are in the championship race in general

do not have an away disadvantage supports this finding. In addition, the results of the study show that the main factor determining the league result ranking is the away performance of the teams.

## Conclusion

Pollard and Gomez (2009) investigated the home advantage on a team basis in France, Spain, Portugal and Italy leagues and calculated the home advantage for all teams between 59.2%-74.4%. Goumas (2017) found the home advantage between 58%-73% and the away disadvantage between 45%-68% for 13 teams in the UEFA Champions League. Armatas and Pollard (2014) calculated the home advantage for teams in the Greek Super League between 49.5% and 80.5%. The results of this study show parallelism with different studies investigating the home advantage on a team basis. Pollard et al. (2008) calculated the home advantage rate of 65% for the Brazilian Seria A, which is Brazil's top football league, between 2003 and 2007. The home team advantage for the Turkish Super League teams varies between 56% and 81%, which is in parallel with the literature. The high passion for football in Turkey, as in Brazil, can be considered as one of the main reasons why teams have a high home advantage. In addition, different climatic characteristics are one of the reasons explaining the higher home advantage rate of the league compared to other European countries. On the other hand, although all teams in the Super League have the home advantage, there are very few teams that do not experience away disadvantages. This situation is quite striking in terms of demonstrating the characteristics of the league. It is often observed that teams without the disadvantage of playing away are usually involved in the title race. Additionally, the widespread fan support for Fenerbahce, Galatasaray, Besiktas, and Trabzonspor across the country may be a reason for these teams experiencing a lower away disadvantage compared to other teams.

The results obtained on a team basis in the study have some limitations as some teams have relatively little data. This situation ensures that the standard error values of the teams with little data are high and affects the reliability of the results obtained from these teams. However, in the preferred method in the study, each team was analysed separately. In this method, in which the effect of team ability is controlled, analysing the teams separately has increased the statistical power in determining the difference between the teams.

Determining the weight of the factors affecting the home advantage or the away disadvantage on a team basis, the effect of referees, spectators and the stadium renewal on the home advantage in Turkish Super League are possible topics to be studied in the future.

### Financial Resources

No financial support was received from institutions and/or institutions during the preparation and writing of this study.

### Conflict of Interest

We declare that there is no conflict of interest between the authors regarding the publication of this article.

### Authors Contributions

Research idea: UK, OVC; Research design: UK, OVC; Data collection: UK, OVC; Data analysis: UK, OVC; Writing: UK, OVC; Critical Examination: UK, OVC

## References

1. **Arı, E., & Apaydın, N**. (2021). Covid-19 Salgın Sürecinde (2020-2021 Sezonu) Türkiye profesyonel futbol liglerinde ev sahibi olma avantajının incelenmesi [The Examination of home advantage in Turkey Professional Football Leagues in Covid-19 pandemy period (2020-2021 Season)]. *Spor Eğitim Dergisi*, *5(*3*)*, 79-86.
2. **Armatas, V., & Pollard, R.** (2014). Home advantage in Greek football. *European Journal of Sport Science*, *14*(2), 116-122.
3. **Carlos H. A., & Volossovitch A.** (2017). Home advantage in Portuguese football: effects of level of competition and mid-term trends*. International Journal of Performance Analysis in Sport*, *17(3),* 244-255.
4. **Carron, A. V., Loughhead, T. M., & Bray, S. R.** (2005). The home advantage in sport competitions: Courneya and Carron's (1992) conceptual framework a decade later. *Journal of Sports Sciences*, *23*, 395–407.
5. **Clarke, S. R., & Norman J. M.** (1995). Home ground advantage of individual clubs in English soccer. *Journal of the Royal Statistical Society. The Statistician, 44,* 509–21.
6. **Courneya, K. S., & Carron, A. V.** (1992). The home advantage in sport competitions: A literatüre review. *Journal of Sport and Exercise Psychology*, *14,* 28–39.
7. **Demirgil, H.** (2022). TFF Süperlig'de Pazartesi ve derbi maçlarının ev sahibi takım avantajına etkileri [The Effects of Monday and derby matches on the home team advantage in TFF Super League]. *Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*, *27(*3*),* 247-264.
8. **Goumas, C.** (2014a). Home advantage in Australian soccer. *Journal of Science and Medicine in Sport, 17,* 119-123.
9. **Goumas, C.** (2014b). Home advantage and referee bias in European football. *European Journal of Sport Science; 14*, 243–249.
10. **Goumas, C.** (2013). Modelling home advantage in sport: a new approach. *International Journal of Performance Analysis in Sport, 13*, 428–39.
11. **Goumas, C.** (2017). Modelling home advantage for individual teams in UEFA Champions League football. *Journal of Sport and Health Science*, *6,* 321–326.
12. **Göral, K.** (2015). Türkiye futbol süper liginde ev sahibi olma avantajı [Home Ground Advantages of Turkey Spor Toto Super League Clubs]. *Uluslararası Hakemli Akademik Spor Sağlık ve Tıp Bilimleri Dergisi*, *5,* 72-82.
13. **Günay, M., Yüce, A., & Ocak, Y.** (2017). *Futbol-futsal antrenmanının bilimsel temelleri [Football-Scientific Basics of Futsal Training]*. Ankara: Batman Belediyespor Kültür Eğitim ve Spor Yayınları.

14. **Gürkan O., Göral K., & Saygın Ö.** (2017) Profesyonel futbolda ev sahibi olma avantajı: Türkiye 1. Liginin analizi, *Journal of Human Sciences*, *14(*4), 3292-3299.
15. **Gürkan, O.** (2018). İç saha ve deplasmanda oynanan müsabakaların bazı performans parametreleri açısından karşılaştırılması: Türkiye Futbol Süper Ligi örneği [The Comparisons of home and away competitions in terms of some performance parameters: the case of Turkey Football Super League]. *The Journal of Academic Social Science*, *6(76),* 442-448.
16. **Işıkdemir, E.** (2020). Is it the advantage to be the host in competitions played in soccer according to the score and elimination procedure. *Spormetre The Journal of Physical Education and Sport Sciences, 18*(2), 157-165.
17. **İnan, T.** (2018). Analyzing the home-field advantage in major european football leagues. *International Journal of Environmetal & Science Education*, *13*(2), 113-124.
18. **Karlis, D., & Ntzoufras I**. (2003). Analysis of sports data by using bivariate Poisson models. *The Statistician*, *52*, 381–93.
19. **Krumer, A., Shapir, O., & Zou, Y.** (2022). The size of the crowd and home advantage in football: evidence from Chinese Super League (October 1, 2022). Available at SSRN: https://ssrn.com/abstract=4275445 or http://dx.doi.org/10.2139/ssrn.4275445
20. **Leite, W. S. S.** (2017). Home advantage: comparison between the major European football leagues. *Athens Journal of Sports*, *4*(1), 65-74.
21. **Liu, T., Alcaraz, A. G., Zhang L., & Zhang, Y.** (2019). Exploring home advantage and quality of opposition interactions in the Chinese Football Super League. *International Journal of Performance Analysis in Spo*rt, *19*(3), 289-301.
22. **Marek, P., & Vávra, F.** (2017, June). *Home team advantage in English premier league*. Paper presented at Mathsport International 2017 Conference Proceedings/ Padua, Italy.
23. **Müniroğlu, S., & Deliceoğlu, G**. (2008). *Futbolda müsabaka analizi ve gözlem teknikleri [Competition Analysis and Observation Techniques in Football]* (1. Baskı.) Ankara: Ankara Üniversitesi Basımevi.
24. **Öndes, H.** (2019). Türkiye Spor Toto Süper Ligi kulüplerinin ev sahibi olma avantajı. *Spor Bilimleri Dergisi*, *30*(2), 74-84.
25. **Pollard, R. (1986).** Home advantage in soccer: A retrospective analysis. *Journal of Sports Sciences, 4,* 237–248.
26. **Pollard, R. (2008).** Home advantage in football: A current review of an unsolved puzzle. *The Open Sports Sciences Journal*, *1,* 12–14.
27. **Pollard, R., & Gómez, M. A.** (2009). Home advantage in football in South-West Europe: Long-term trends, regional variation, and team differences. *European Journal of Sport Science*, *9(*6*),* 341-352,
28. **Pollard, R., & Gómez, M. Á.** (2014). Components of home advantage in 157 national soccer leagues worldwide. *International Journal of Sport and Exercise Psychology*, *12,* 218–233.
29. **Pollard, R., & Gómez, M. Á.** (2015). Validity of the established method of quantifying home advantage in soccer. *Journal of Human Kinetics*, *45*(1*), 7*–8.
30. **Pollard, R., Silva, C. D., & Medeiros, N. C.** (2008). Home advantage in football in Brazil: Differences between teams and the effects of distance traveled. Revista Brasileira De Futebol (*The Brazilian Journal of Soccer Science*), *1(*1*),* 3–10.
31. **Ponzo, M., & Scoppa, V.** (2018). Does the home advantage depend on crowd support? Evidence from same-stadium derbies. *Journal of Sports Economics*, *19*(4), 562-582.
32. **Ramchandani, G., Millar, R., & Wilson, D.** (2021). The relationship between team ability and home advantage in the English football league system. *German Journal of Exercise and Sport Research, 51,* 354–361.
33. **Rooney L., & Kennedy R.** (2018). Home advantage in Gaelic football: the effect of divisional status, season and team ability. *International Journal of Performance Analysis in Sport, 18*(6), 917-925,
34. **Sampedro, J., & Prieto, J**. (2012). El efecto de marcar primero y la ventaja de jugar en casa en la liga de fútbol y en la liga de fútbol sala de España (The effect of scoring first and the advantage of playing at home in the football league and the Spanish football league). *Revista de Psicología del Deporte*, *21*(2), 301-308.
35. **Seçkin, A.** (2006, June). Home advantage in association football: Evidence from Turkish Super League. Paper presented at ECO-MOD Conference. *Hong Kong*, China.
36. **Subak, E., & Kaya, K.** (2021). Home advantage and audience effect analysis of Turkish Super League in Covid-19 Season. *Research & Investigations in Sports Medicine*, *7*(5), RISM.000674. 2021.
37. **Talab, R. H., & Mehrsafar, A. H.** (2016). An analysis of home advantage in Iranian football super league. *International Journal of Sport Exercise and Training Sciences – IJSETS*, *2*(4), 137-144.
38. **Tütüncü, O., & Yolgörmez, A. C.** (2021). Futbolda ev avantajı mı, deplasman dezavantajı mı? COVID-19 pandemi süreci örneği [Home Advantage or Away Disadvantage in Football? COVID-19 Pandemic Process Example]. *Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*, *26(1),* 137-149.
39. **Werlayne, S. S. L.** (2017). Home advantage: Comparison between the major European football leagues. *Athens Journal of Sports, 4*(1), 65-74.
40. **White, H.** (1982). Maximum likelihood estimation of misspecified models. *Econometrica*, *50,* 1-25.