

# Correlation between Winning Percentage in Home Stadium and Environmental and Crowd Pressure

## 1. Introduction

The concept of home advantage exists in competitive sports matches, where the home team is said to be more likely to win than the away team. The possible causes of this are as follows

- ① Familiarity with the natural environment (temperature, humidity)
  - ② Familiarity with the facility environment (venue equipment)
  - ③ Differences in the amount of support due to differences in the number of spectators.
- Of these, it is difficult to determine the causes of ② familiarity with the facility environment from the statistics presented here, so we will investigate the causes of ① familiarity with the natural environment and ③ differences in the amount of cheering due to differences in the number of spectators. However, in this study, we will assume that the number of spectators in ③ is larger for the home team and that the ratio is constant.

## 2. Methods/Results

### ① Proving Home Advantage

It is said that a home advantage exists, but we used a t-test to demonstrate whether this difference actually exists.

	winning at home(%)	winning at away(%)	case of winning
Niigata	57.69	54.90	home
Nishinomiya	69.81	48.15	home
Chiba	76.79	83.67	away
Aomori	29.63	37.74	away
Sendai	78.43	55.36	home
Kawasaki	72	65.38	home
Osaka	55.77	40.82	home
Shimane	52.94	52.7	away
Tokyo E	47.83	41.67	home
Tochigi	78.13	81.25	away
Hachioji	16.67	20	away
Toyama	54	58.49	away
Fukushima	46.3	33.96	home
Koshigaya	26.92	38.1	away
Yokohama	28.85	21.15	home
Kyoto	52	49.92	home
Kanazawa	40	30	home
Kumamoto	59.32	58.49	home
Gunma	67.92	72.88	away
Hiroshima	54.81	69.81	away
Kagawa	45.28	40.74	home
Sannenn	28.57	26.92	home
Yamagata	32.14	23.53	home
Shiga	48.08	25.57	home
Akita	44	27.45	home
Sinnsyu	86.21	79.25	home
A.Tokyo	78.43	73.21	home
Ryukyu	71.92	58	home
F.Nagoya	61.11	62.26	away
Tokyo Z	28.3	35.18	away
Shibuya	60.78	46	home
Mikawa	61.53	34.69	home
Nara	42.59	32.07	home
Fukuoka	19.6	25	away
Hokkaido	23.52	25	away
Ehime	41.5	40.74	home
Ibaraki	67.92	46.29	home
Utsunomiya	77.77	77.27	home
Nagoya D	48.57	49.99	away
Average	52.411085	47.328255	
T-test	0.0022791		

The table on the left shows the annual winning percentage of each team in the 2018-2019 B-League B1 when they played at their home stadium (henceforth referred to as home) and when they played at their away stadium (henceforth referred to as away). At the bottom of the table is the average of each team's home and away winning percentages.

As a result of finding the mean, it was found that home winning percentage > away winning percentage, which means that the team is more likely to win at home. Using the t-test, it was determined that the difference between the home and away winning percentages was valid, as the significant difference was  $p=0.002<0.05$ .

Using a t-test, we were able to determine that a home advantage

### ② Selection of the team with the highest winning percentage in its home stadium

	Winning at home(%)	Winning at away(%)
Nishinomiya	69.81	48.15
Sendai	78.43	55.36
Osaka	55.77	40.82
Fukushima	46.3	33.96
Shiga	48.08	28.57
Akita	44	27.45
Ryukyu	71.92	58
Shibuya	60.78	46
Mikawa	61.53	34.69
Nara	42.59	32.07
Ibaraki	67.92	46.29

In the data used in this study, not all teams had a higher winning percentage at home. Therefore, we determined the home and away winning percentages of all teams respectively, and examined the teams whose home winning percentage was more than 10% greater than their away winning percentage. As a result, we were able to select 11 teams.

### ③ Correlation between natural environment (temperature, humidity), attendance and winning percentage

Method ③ aimed to investigate ① familiarity with the natural environment and ② the size of the spectators cheering as described in the Introduction. Therefore, we took the numerical values that show the correlation between the values of win/loss, temperature, humidity, and number of spectators for the games played by the 11 teams selected in Method ① as their home teams. (The table below shows the correlation values for each team. Translated with www.DeepL.com/Translator (free version))

	temperature	humidity	number of spectators
Nishinomiya	-0.006	-0.078	0.168
Sendai	0.056	-0.045	-0.130
Osaka	-0.110	0.057	-0.159
Fukushima	-0.189	-0.076	-0.105
Shiga	-0.132	-0.001	-0.639
Akita	0.109	-0.120	0.007
Ryukyu	-0.211	-0.131	-0.092
Shibuya	-0.161	-0.181	-0.176
Mikawa	-0.086	0.045	-0.077
Nara	0.237	0.151	-0.269
Ibaraki	-0.014	-0.015	0.063

### ④ Visualizing Correlation

In section ④, we visualized the data on correlation obtained in section ③ using scatter plots. The scatter plots of the 11 teams are shown below. (Note: The horizontal axis represents the number of spectators (in thousands), humidity (10%), and temperature (°C), and the vertical axis represents 0 as a loss and 1 as a win.)



● number of spectators ● temperature ● humidity

From the above graph, it was easy to see that there was no correlation in the data, as there were no characteristics such as high attendance when winning and high humidity when losing. Also, there was no regularity in the variance of the data.

## 3. Consideration

2. What we were able to learn from the methods and results  
 From ①, home advantage actually exists.  
 From ③④, since there is only one number with a correlation of 0.5 or higher or -0.5 or lower, there is no correlation between the number of spectators, temperature, humidity, and the number of games won or lost.

## 4. Summary and Future Prospects

In this study, from the investigation of ① proof of home advantage, ② selection of teams with high winning percentages in their home stadiums, ③ correlation between natural environment (temperature, humidity), number of spectators and winning percentages, and ④ visualization of the correlation, it was found that there is no correlation between weather conditions, number of spectators and winning percentages in professional basketball games. In addition, there are some points to reflect on in this research.

- We did not have a breakdown of the number of spectators (the number of people supporting each team).
- We were only able to use one year's worth of data, so the overall results lacked credibility. In future research, we would like to improve on the above points, investigate the causes from different perspectives and items that we were not able to examine this time, and actively analyze teams that are stronger on the road.

## 5. Acknowledgments

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