

Soccer Country? The Percentage of Stadium Occupancy and Its Variability in the 2018 Brazilian Championship

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Abstract: The article's research problem is to explain what relationships are between the main variables that determine the percentage of occupancy in stadiums in 2018. Starting from an empirical problem limited to the Brazilian Championship — low public attendance at the soccer stadiums in the main national championship — we intend to investigate the variables via quantitative methodology that indicate the occupation in arenas, presenting the reasons for the audience variation in the stands at “Brasileirão 2018”. It stands out as a positive result from which it was possible to know the percentage of 66% of the public that attended the championship according to the parameters proposed in this study.

Key words: soccer; stadium occupancy; 2018 Brazilian championship; statistics

JEL codes: B23, A11, A12, C01, C1, C15, C12, C13, B00, B22, C3, C35, C36, C38, Z2, Z39, R15, Q31

“And, therefore, I would say that the first mass, by Portinari, is inaccurate. Those Indians in bikinis, showing the navel, should not be on screen, or otherwise: they could be, but in shorts, boots and yellow shirt.”

(Nelson Rodrigues, O GLOBO, 1962)

1. Introduction

1.1 The Soccer Paradox in Brazil

Brazil is not only known as a soccer country, as its references declare it, but it also carries the prestige of the best in the world with its selection that features a five-star coat on the left side of its yellow shirt, the most victorious in quadrennial competitions.

Outside the four lines of the grassy field, soccer in the country also represents significant social importance due to the numbers and figures that are involved in this sport (Gastaldo, 2009). The theme is also ubiquitous in daily conversations and in newspapers with exclusive editorials for public debate (Coelho & Tiesler, 2006), so great is the attention of a nation focused on sports.

Other arguments that justify in material terms the particularity of what soccer represents in the Brazilian context would be the grid of channels that talk about the subject, the growth of the figures involved and the social vision of the sport. The first foundation that highlights the topic of study can be found in the hours dedicated to

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television broadcasts. With data recovered from IBOPE, until 2012, the modality represented 54% of the total transmissions in comparison with all other sports, which added up to an annual total of 29 thousand hours on open and closed channels¹. Regarding the money that revolves around the sport, only CBF (Brazilian Soccer Confederation), has a larger budget than the Ministry of Sports in Brazil, around half a billion reais². Other Serie A clubs also exceed these values.

Finally, several studies show that soccer becomes the only way found as a possibility of social ascent to the less privileged strata in society (Guedes, 1982; Damo, 2005; Soares, 2003; Souza et al., 2008).

Despite this popularity, seen in various dimensions, on television and in everyday language, soccer is hardly present in the reality of stadiums, that is, to paraphrase Nelson Rodrigues, on the stage where drama, tragedy, horror and compassion reign³, we have still a small number of spectators in the stands to follow the matches, having such importance in the country that it is assumed as the main one in the most practiced sport in the world.

For comparison, we have the occupancy rates of 2012 in the national championships also most watched in the world with an average very close to the total occupation. Bundesliga, Germany's national championship, has the highest average number of spectators, reaching 95% of occupancy. Next is England with 95% of occupancy, with slightly smaller stadiums than the Germans. Third is the Spanish championship, with 83% occupancy⁴. However, in 2018, the biggest Brazilian national championship broke its record of occupancy in the stadiums since it moved to fixed points (2003). However, paradoxically, this represents only 43% of the percentage of audience that was in the stadiums.

This study also reveals that the Brazilian Championship is only in 15th position in terms of occupying stadiums compared to other leagues, behind the second divisions of Germany and England and countries that have a much smaller tradition in soccer, such as the United States, China, Japan and Turkey (Aguar and de Sá Ribeiro, 2017).

We can also see in the table below the growing annual average of the public occupation in the last ten years, which little changed in the current numbers:

Table 1 Average of Annual Occupants of Brazilian Championship

2008	16,992
2009	17,807
2010	14,800
2011	14,976
2012	13,148
2013	14,969
2014	16,537
2015	17,051
2016	15,219
2017	15,961
2018	18,821

¹ Data taken from: <http://www.ibope.com/pt-br/noticias/Paginas/Aumenta-o-total-das-horas-de-esportes-transmitidos-na-TV.aspx>.

² The portfolio lost the Ministry legitimacy in 2019, but has its budget in 478 million, while CBF's spending is around 545 million. Available online at: <https://oglobo.globo.com/politica/orcamento-do-ministerio-do-esporte-quintuplica-em-oito-anos-movimenta-5-bilhoes-3080037>, <https://epoca.globo.com/esporte/epoca-esporte-clubes/noticia/2018/06/cbf-fatura-alto-com-selecao-brasileira-eis-de-onde-vem-e-para-onde-vai-o-dinheiro.html>.

³ The author makes an allusion in his book of Aristotle's Drama classical theory in the poetic work. RODRIGUES, Nelson. *À Sombra das Chuteiras Imortais*, São Paulo: Cia das Letras, 1993.

⁴ A study conducted by Esporte Pluri consultancy, available online at: <https://gq.globo.com/Essa-e-nossa/noticia/2013/07/os-20-campeonatos-com-maior-media-de-publico-no-mundo.html>.

Given the understanding of this problem and the facts presented about Brazilian soccer, this study focuses on exploring the reasons for the variation of the public and characterizing the reality of the occupation of fans in stadiums during the 2018 Brazilian championship. Thus, we have as main problem of our research: What are the relationships between the main variables that determine the percentage of occupancy in stadiums in the 2018 Brazilian Championship?

In the next topic, the objectives of this study are presented. Then, the approach given to the theme, the way in which the data were studied and the delimitations of the work that qualify the research are justified.

1.2 Study Objective

The main objective of this research is to determine the variables that explain the public oscillation of all stadiums used by soccer teams throughout the 1st division of 2018 Serie A Brazilian Championship.

1.3 Specific Objectives

With the main objective as a guide, the specific objectives will serve to indicate the steps to be followed in our investigation:

- Data survey about matches and fans in 2018;
- Explore the attendance to the stadiums;
- Analyze the relationships between the main variables;
- Compare the presence of fans in stadiums between the teams.

2. Delimitation Focus on Stadiums

This study focuses on the occupation of soccer stadiums used by teams in the 1st Division of Brazilian Championship in 2018. Given the little scientific production of studies on the subject (Coelho & Tiesler, 2006; Beccarini & Ferrand, 2006), and the scarcity of diagnosis that goes beyond sports journalism with absolute numbers, efforts that seek new answers dedicated to the subject are rare (Souza, 2004; Aguiar, 2017). Thus, within this bibliographic analysis, this investigation becomes exploratory, from which we attribute the task of relating some relevant aspects of public participation in stadiums with other dimensions such as squad, values and types of arenas⁵, therefore, correlating with the guiding goal of this article. According to Ventura:

They are also useful in the exploration of new processes or behaviors, new discoveries, because they have the important function of generating hypotheses and build theories. Or even, by exploring atypical or extreme cases to better understand typical processes (p. 386).

The data were collected from Globo Esporte site at the end of the championship, taking the main base of information, as regards the occupancy rate and average values of the tickets⁶. A second important database was Transfmarkt Portuguese site⁷, specialized in monetary values that circulates in this sport. Finally, a last information that was considered to be important to explore the attendance of soccer fans in the arenas were the climatic conditions on the day and at the time of the match⁸.

As for the justifications, some on the issue can be listed. The first is summarized in the importance of the

⁵ The variables and constructed parameters will be better presented in the next topic.

⁶ <http://www.globoesporte.com>.

⁷ <http://www.transfermarkt.pt>.

⁸ <http://www.weather.com>.

stadium financial viability, from which the sports professionals responsible for the arenas frequently use data to make possible and reduce the financial losses of stadium operational cost. In this way, understanding some causes of fan occupation allows those in charge to analyze means and media actions taken in the public attendance in Brazilian stadiums.

The option to study only the 2018 Brazilian Championship, without considering other years, and working only with the first division is based on some criteria. One of them would be the lack of theoretical basis that allows us to understand which variables would have greater weight to encompass the percentage of stadium occupation in Brazil. Thus, several possibilities were selected within the universe of the theme to have a “kick-off” in the construction of answers to the research problem, typifying it as an exploratory study.

The results were delimited only for the year 2018, as the index of explanation could be increased for the attendance of fans in the stadiums, reducing external factors if a prospective research was chosen, for example (GIL, 2008).

The choice for the Brazilian Championship was made by having more rounds with similar audience intensity for each team in all rounds, allowing a distribution of matches over ten months that can be better evaluated. However, some possible external variables were included in the championship, which is able to change the frequency of the fan’s attendance at the stadiums, in the same way that the team could have played another championship in the midweek for example.

Another argument is consistent with the teams competing for the championship, since much of the financial income collected by the teams comes from the public that attends the matches.

Finally, one last and relevant justification is of interest to the sponsors, since with a high percentage of average occupancy, the more their brands will be seen by the audience, and aiming to improve the quality and recognition when diagnosing these nuances with the verification of the public variation present in the stadiums in front of their advertising signs (Trein & Barcellos, 2006).

In the next topic, the working hypothesis and the methodology used for data collection will be presented. In addition, all the variables that were created and obtained will be described for the understanding of the research.

3. Methods and Variables

The research method chosen for investigation is quantitative. Inferential statistics was used as a tool. But the question remains, why use statistics? In this case it was necessary to use the theory of probabilities to produce more striking results regarding the question of the problem. As the objective of this work is to understand the variation of the fans during the championship, we work with high numbers and many variables, and if someone wants to determine the explanatory weight of what corroborates in the occupation of the stadiums, it is necessary to explore the several relationships between the phenomena that circumscribe the reason for the fans' presence at the matches (Gil, 2008).

3.1 Hypothesis

Starting from this path, the following hypothesis based on our research is launched, from which it seeks to understand which of the variables has greater weight to explain the occupancy rate in the stadiums. It is believed that an expected return with a focus on the cast value and number of victories in a row will be obtained, as it is expected that the average occupancy rate will increase as the team wins over the championship.

3.2 Universe and Variables

Aiming to understand the reasons we seek to explain the public's presence in soccer stadiums, we intend to describe the universe of research and the variables created and/or collected to determine this phenomenon.

Our universe covers the entire Brazilian Championship of 2018. The 20 teams participated in the process, taking into account all 38 rounds (matches). It is noteworthy that the entire collection method was automated, reducing the human error that could occur if we had to do it manually.

It is worth saying that, before all the effort made for the collection, it was necessary to think about how the research would be produced based on the relationship between the variables. Through this, the various information about the percentage of fans was raised to understand what was the percentage of each stadium in a match of 2018 Brasileirão. Thus, the variables were determined in the following way:

- **Perc Occup:** Dependent variable. Continuous. This is the percentage of stadium occupation
- **Use:** Continuous variable. It is the use of the home team in the competition. It is calculated by the number of points won in the championship on the number of disputed points until the date of the match in question.
- **Rain:** Dummy variable. If it's 1, it was raining three hours before the match. If it's 0, it didn't rain.
- **Regional Classic:** Dummy variable. If the match in question is from two teams in the same state, the variable is marked as 1.
- **Home team position:** Continuous variable. Home team position in the competition until the date of the match.
- **Visitor's position:** Continuous variable. Visitor position in the competition until the date of the match.
- **Condition:** Categorical variable. This is the weather condition in three hours before the match. Variables can be:
 - "Mild" "Rain" "Heavy rain" "Light rain" "Clear" "Fog" "Cloudy" "Post-rain" "Sun"
- **Cum defeat:** Continuous variable. Quantity of team defeats in the competition until the date of the match.
- **T Cum Defeat:** Continuous variable. Number of team defeats considering other championships until the date of the match.
- **Tie Defeat Followed:** Continuous variable. Number of defeats or ties followed by the home team within the competition that the team had until the date of the match. If the team wins, the variable is reset to zero.
- **Tie Defeat Followed T:** Continuous variable. Number of followed defeats or ties by the home team considering other championships that the team had until the date of the match. If the team wins, the variable is reset to zero.
- **Weekend:** Dummy variable. If the match has occurred on a Saturday or Sunday, the variable is presented as 1.
- **Day of the Month:** Continuous variable. Refers to which day of the month the match took place.
- **CumTie:** Continuous variable. Number of ties by the home team in the competition until the date of the match.
- **Cum Tie T:** Continuous variable. Number of home team ties considering other championships until the date of the match.
- **Holiday:** Dummy variable. If the match has occurred in a national holiday, the variable is presented as 1.
- **Degrees:** Continuous variable. How many degrees Celsius was the temperature in three hours before the match

- *Var Hour*: Continuous variable. Time the match took place.
- Stadium inauguration: Continuous variable. Age of the stadium where the match took place
- Played Another Champ This Week: Dummy variable. If the home team played a match from another league in the same week, it is shown as a value of 1.
- *Home team*: Categorical variable. What was the home team.
- *Month*: Continuous variable. In which month the match took place.
- *GDP Stadium City*: Continuous variable. GDP value of the city where the match was played.
- *Number Home Team Partners*: Continuous variable. Number of home team partners
- Home crowd team Ranking: Continuous variable. Team ranking of home match crowd. The team with the most fans has a value of 1 and the team with the least fans has a value of 20.
- *Ranking Visitor Fans*: Continuous variable. Team ranking of visiting fans. The team with the most fans has a value of 1 and the team with the least fans has a value of 20.
- Average City Income: Continuous variable. Average income of the city where the match took place.
- *Previous Result*: Categorical variable. The values represent the result of the last match in the competition. They may be:
 - “Victory” “Tie” “Defeat”
 - In the first round, all values for this variable are set to “0”
- *Round*: Continuous variable. In which round of the competition the match is taking place.
- *Week Year*: Continuous variable. Shows in which week of the year the match took place.
- *Month week*: Continuous variable. Shows in which week of the month the match took place.
- *Tg against*: Continuous variable. Balance of goals against the home team only considering the 2018 Brazilian Championship competition.
- *Tg against T*: Continuous variable. Balance of goals against the home team considering other competitions.
- *Tg Pro*: Continuous variable. Goal balance in favor of the home team considering only the 2018 Brazilian Championship competition.
- *Tg Pro T*: Continuous variable. Goal balance in favor of the home team considering other competitions.
- *Ticket*: Continuous variable. Average value of the stadium’s gross revenue.
- *Win streak*: Continuous variable. It considers the number of victories in a row by the home team considering only the 2018 Brazilian Championship competition. In case of defeat or tie, the variable is zeroed.
- *Win streak T*: Continuous variable. It considers the number of victories in a row from the home team considering other competitions. In case of defeat or tie, the variable is zeroed.
- Accumulated victories: Continuous variable. It considers the amount of accumulated victories of the home team considering only the 2018 Brazilian Championship competition.
- Accumulated victories T: Continuous variable. It considers the amount of accumulated victories of the home team considering other competitions
- *Value Home cast M*: Continuous variable. Value of the home team in millions of dollars.

Through the creation of variables and parameters used for analysis, some results were obtained that lead us to understand the variation of the average occupation in the Brazilian soccer stadiums. Thus, the next topic illustrates the data obtained, as well as its final result.

4. Results

The dependent variable has high dispersion per team, as shown in the graph below:

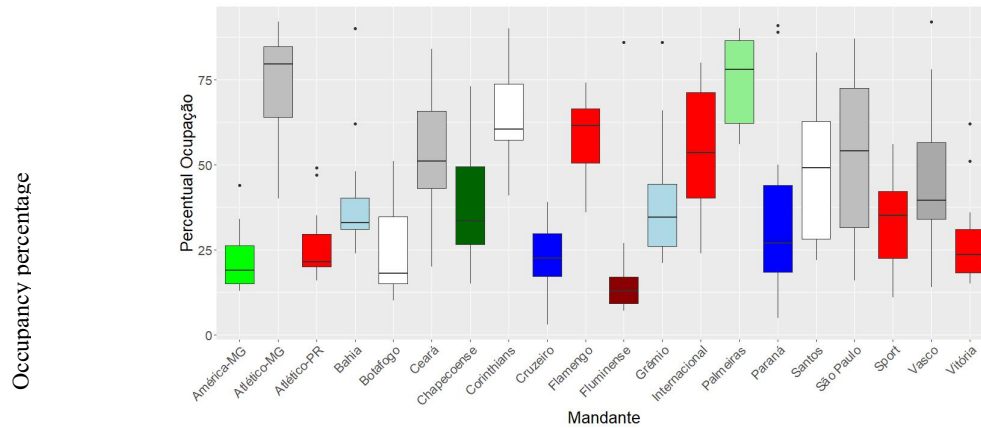


Figure 1 Dispersion of the Stadium's Occupancy Percentage by Team

Table 2 Distribution of the Teams' Occupancy Percentage

Home Team	Minimum	Q1	Median	Q3	Maximum	Diff_Q3_Q1	Diff_Max_Min
America-MG	13%	15%	19%	26%	44%	11%	31%
Atlético-MG	40%	64%	80%	85%	92%	21%	52%
Atlético-PR	16%	20%	22%	30%	49%	10%	33%
Bahia	24%	31%	33%	40%	90%	9%	66%
Botafogo	10%	15%	18%	35%	51%	20%	41%
Ceará	20%	43%	51%	66%	84%	23%	64%
Chapecoense	15%	27%	34%	50%	73%	23%	58%
Corinthians	41%	57%	61%	74%	90%	17%	49%
Cruzeiro	3%	17%	23%	30%	39%	13%	36%
Flamengo	36%	51%	62%	67%	74%	16%	38%
Fluminense	7%	9%	13%	17%	86%	8%	79%
Grêmio	21%	26%	35%	44%	86%	18%	65%
Internacional	24%	40%	54%	71%	80%	31%	56%
Palmeiras	56%	62%	78%	87%	90%	24%	34%
Paraná	5%	19%	27%	44%	91%	26%	86%
Santos	22%	28%	49%	63%	83%	35%	61%
São Paulo	16%	32%	54%	73%	87%	41%	71%
Sport	11%	23%	35%	42%	56%	20%	45%
Vasco	14%	34%	40%	57%	92%	23%	78%
Vitória	15%	18%	24%	31%	62%	13%	47%

The average difference between the minimum and maximum for each team is 54.5%, while the average interquartile difference is 19.9%.

The dispersion among the teams is also great. While some teams, such as Atlético-MG and Palmeiras, have a median occupancy percentage per game above 75%, many teams had a median occupancy percentage below 25%

during the 2018 Brazilian championship.

To understand how much and which variables matter most, determining the percentage of occupation of each match the 2018 Brazilian Championship, 4 algorithms were used: linear regression, decision trees, random forest with 500 repetitions and neural networks of size 3 and with 100 repetitions.

To determine the error we have when trying to estimate and see which variables are most important, the cross-validation method was used. This method consists of breaking the base into several parts, using a large percentage for training and the rest of the percentage is used as a test, trying to predict the results.

In this case, we divide the base and apply the models ten times, training with 90% of the base and then testing on the remaining 10% of the base. Thus, after ten times of training and testing, we have predictions for all matches.

The forecast error is as follows:

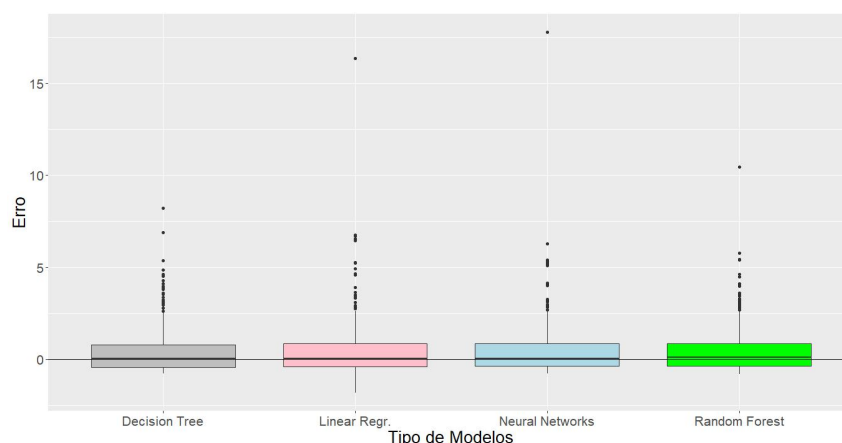


Figure 2 Prediction Error by Algorithm

Despite having an error in the median very close to 0, the error of the models was skewed with the outliers of the model, with MAPE close to 80%. The biggest outliers are due to matches with a low occupation percentage, the point of greatest error being the match in Mineirão in which Cruzeiro had only 3% of the occupation percentage, and all matches with more than 300% error were matches that had a maximum occupancy of 14% of the stadium.

Regarding the models, the 4 algorithms performed very similarly. As shown in table below:

Table 3 Performance by Model

	Model			
	LR	DT	RF	RN
Average	49.67%	46.23%	47.24%	50.28%
Q1	-38,74%	-42,66%	-35,17%	-35,12%
Median	5.24%	4.33%	4.58%	4.63%
Q3	86.86%	78.89%	85.62%	86.08%
MAPE 5% trim	79.48%	76.77%	72.16%	73.24%

When generating the forecast, however, the presence of multicollinearity between the variables was alerted. Therefore, we made a correlation table and removed the variables that have a correlation above 0.9 among them.

Table 4 Correlations Among Variables

Var1	Var2	Value
Week_year	ROUND	0.99
ROUND	Month	0.98
Week_year	Month	0.99
week_of_month	day_of_month	0.97
accum_victories	TG_PRO	0.95
TG_PRO_T	TG_PRO	0.93
TG_AGAINST_T	TG_AGAINST	0.97
accum_victories_T	accum_victories	0.94
ROUND	accum_tie	0.91
Month	accum_tie	0.91
Week_year	accum_tie	0.92
accum_tie	accum_tie	0.93
TG_AGAINST	accum_defeat	0.94
TG_AGAINST_T	accum_defeat	0.91
accum_defeat	accum_defeat	0.97
defeat_tie_streak_T	defeat_tie_streak	0.96
accum_victories	TG_PRO_T	0.93
accum_victories_T	TG_PRO_T	0.97
TG_AGAINST	accum_defeat_T	0.93
TG_AGAINST_T	accum_defeat_T	0.95

Table 5 Selected Variables

Var1	Var2	Var3	Var4	Var5
Week_year	week_of_month	accum_victories	accum_tie	TG_AGAINST_T
Month	day_of_month	TG_PRO	accum_tie_T	TG_AGAINST
ROUND		TG_PRO_T		accum_defeat_T
		accum_victories_T		accum_defeat

The yellow variables were selected to remain in the model, as they were the ones with the highest degree of significance in the linear regression trained above.

When removing the variables and running the model again, the results are as follows:

Table 6 Results After Removing Variables With Multicollinearity

	Model			
	LR	DT	RF	RN
Average	49.71%	44.82%	46.93%	50.29%
Q1	-38.89%	-42.43%	-34.96%	-34.71%
Median	3.51%	5.01%	4.70%	6.01%
Q3	88.25%	77.63%	86.42%	87.60%
MAPE (5% trim)	78.31%	74.55%	71.62%	73.15%

As Random Forest remains the model with the lowest MAPE, this model will be used as a basis to determine which variables are the most important.

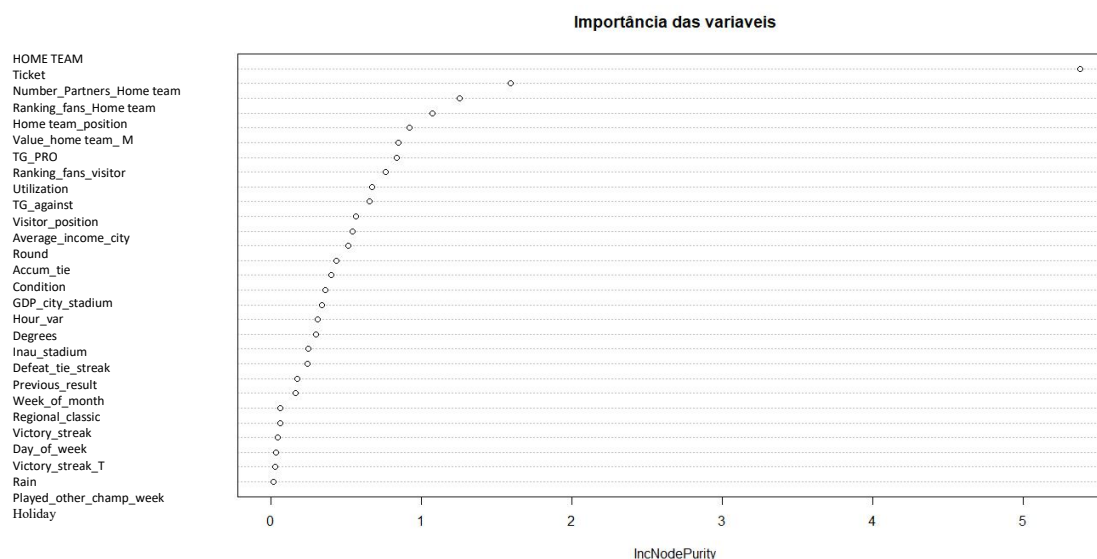


Figure 3 Importance of Variables

As we can see in the graph, the most important variables are: which is the home team, what is the ticket, the number of the home team partners, what is the home team's crowd ranking, the value of the home team, the number of goals in favor, the ranking of the visiting crowd, performance, visitor's position, the city average income and in which round the match was played.

Many of the variables are static in accordance with the home team. Thus, we run a model per team with only the variables selected above and the regional classic. The R^2 of a linear regression seeking to determine the percentage per team using the variables described above is as follows:

Table 7 R^2 Per Model of Each Team

Team	R^2
América-MG	0.5994364
Atlético-MG	0.7448472
Atlético-PR	0.7875274
Bahia	0.9938048
Botafogo	0.5152151
Australia	0.7952503
Chapecoense	0.5143482
Corinthians	0.588054
Cruzeiro	0.7025539
Flamengo	0.3681814
Fluminense	0.9561606
Grêmio	0.7684868
Internacional	0.6804985
Palmeiras	0.9319813
Paraná	0.8666023
Santos	0.6917921
São Paulo	0.820022
Sport	0.5551371
Vasco	0.8496148
Vitória	0.863246

Although many models have R^2 above 0.75, some teams did not have the variation well explained by these variables, such as Flamengo, Corinthians, Botafogo and Chapecoense. Perhaps other variables may better explain the fans' interest in going to the stadium for these teams, but in general, the selected variables explain a good part of the behavior for most of the clubs that competed in the 2018 Brazilian Championship.

5. Final Considerations

From the results obtained it is possible to conclude some facts about the main factors that lead to the variation of the percentage of average occupation of the Brazilian soccer stadiums. First, it should be noted that since it is a model built with an exploratory nature, we can say that the achieved results were positive. It is known that there are several factors that combined can further increase the suggested model for prospecting occupation in stadiums.

The first tests conducted to understand if there was a pattern between the percentage occupation and its variation throughout the championship proved to be little comprehensive in absolute terms. In other words, only viewing the mean variation throughout the year with the frequencies, without relating the variables, it was seen that the dispersion among the teams is high. However, when applying the regression algorithms with repetitions to ascertain the errors that may be caused by the tests, we were able to separate the outliers, that is, to understand, for example, that matches with a low percentage of occupation become more difficult to explain.

Answering the research question, what are the relationships between the main variables that determine the percentage of occupancy in stadiums in the 2018 Brazilian Championship? We conclude that, in general, our hypothesis was partially accepted, as it is possible to establish that the determining variables that reveal the stadiums with the largest audiences are mostly related to the team that is playing, such as victories, goals, team value, use and the ranking of the home crowd. Other variables also corroborate to our response: visitor position, city average income and the average ticket.

In the comparison between the teams, some were unable to explain the variation through the selected determinants, such as Flamengo, Corinthians, Botafogo and Chapecoense. It should be noted that in the future we can improve our model to better clarify the interest of these fans in going to the stadium.

Other factors, little considered in this study because they are linked to the quality of services offered to the public that frequents the stadiums, can be covered from the initiative of the managers of the sports arenas, also considering the difficulty in purchasing tickets, the violence around the stadium, TV broadcasting and the low quality of services offered may show more the variation in the frequency of fans in stadiums.

We also note in this article that, in addition of having their research objectives achieved, we present indirectly applied research measures that can contribute to avoid the depopulation of Brazilian stadiums. Thus, soccer stands out as a significant part of Brazilian society, and the presence and coexistence of fans of different teams in the full bleachers regains the popularity⁹ of the sport.

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⁹ Condition of what is known and loved by a large number of people, glory, renown, celebrity.

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