2020

Capstone Project Report

THE NFL – ARE YOU READY FOR SOME FOODBALL

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Phillip Todd Danner

Introduction

The NFL (National Football League) is one of the most popular and successful sports and entertainment leagues in the world. In 2019 the 32 league teams garnered more than $15 Billion dollars collectively in revenue from various avenues such as ticket sales, media contracts, sponsorships and concessions among others. This success translates to the success of the local areas lucky enough to have a team, providing a positive impact on the local economies in many ways.

From a host city's perspective there is great benefit from increased sales tax and property tax revenues, increased real estate investment and development, elevated potential to create new jobs and higher prospect of luring corporations to move to the area.

From a fan perspective, the environment around the game is more than just the game itself. NFL fans like to enjoy themselves before and after the game though socialization with other fans. In other words, NFL fans like to eat and drink! Cities that have developed healthy availability of options for their NFL fans within the area of the game are poised for success in keeping a fan-base happy and incurring more revenue for their city coffers.

To have an NFL team franchise is a jewel in the crown of any city lucky enough to have one and a well-sought-after prize for those who do not. Hence, it is critical that cities understand their unique position, and the importance of knowing where they stand in comparison to other NFL cities on the basis of fostering a fan friendly atmosphere in and around the stadium, making it more enticing for the fan to want to attend a game in person, and thus increasing the revenue for the team.

The goal of this report is to analyze the availability, variety and quality of food related venues within walking distance to the game to help cities understand how they compare to their fellow member cities. Additionally, we will examine similarities between stadiums to hopefully aid the fan to understand what options are available, especially if they might intend to travel and support their team away. Lastly, we will investigate if a winning culture has any correlation with how fan friendly a city can be.

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Data Analysis Strategy

The analysis started with collecting information about each team including stadium and team winning percentage for previous seasons. This information will rely on various sources and was compiled manually, given that there are only 32 teams and no single reliable source available for all information required. Location data for the stadiums (latitude, longitude) was gathered using the geo-location, Geopy Nomanatim, The beginning stadium data set resembled something as show below:

	Team	Division	Stadium	Capacity	WinPerc	Address
0	Arizona Cardinals	NFC West	Sundevil Football Stadium	63,400	34.03%	500 E Veterans Way: Tempe: AZ 85287
1	Atlanta Falcons	NFC South	Mercedes-Benz Stadium	71,000	49.57%	409 Nelson St SW: Atlanta: GA 30313
2	Baltimore Ravens	AFC North	M&T Bank Stadium	71,008	65.77%	1101 Russell Street: Baltimore: MD 21230
3	Buffalo Bills	AFC East	Bills Stadium	71,608	49.73%	One Bills Drive: Orchard Park: NY 14127
4	Carolina Panthers	NFC South	Bank of America Stadium	75,523	46.57%	800 South Mint Street: Charlotte: NC 28202
5	Chicago Bears	NFC North	Soldier Field	61,500	50.60%	1005 S 4th St: Minneapolis: MN 55415

Location data for each stadium was used to gathering venue data from Foursquare.com and included only “Food” related venue categories. The initial radius from the stadium used for gathering venue information will be 500m (deemed as “walking distance”).

Methodology

The original data was gathered, cleaned and organized in preparation to perform the following three analysis focus areas:

Stadium Ranking for comparison to peer cities

1) Ranking of Stadiums by Quantity of Venues
2) Ranking of Stadiums by Variety of Venues
3) Ranking of Stadiums by Quality of venues (by average user rating)
4) Overall ranking score to identify the best stadium.

Clustering to identify similarities between stadiums/cities

K-Means clustering was chosen for identifying similarity between stadium using the optimal number of clusters.

Correlation investigation to understand relationships to winning culture

Correlation and possibly regression analysis will be performed using team winning percentage (and possibly other criteria) against Quantity, Variety and Quality of venues.

Data Acquisition and Preparation

The initial stadium data set was gathered form the following sources:

Teams Names and their home stadiums:
https://en.wikipedia.org/wiki/List_of_current_National_Football_League_stadiums

Team Winning Percentage:

https://en.wikipedia.org/wiki/List_of_all-time_NFL_win%E2%80%93loss_records

Stadium Street Address information:

https://www.google.com/maps/place/Bank+of+America+Stadium/@35.2258152,-80.8550352,17z/data=!3m1!4b1!4m5!3m4!1s0x8856a02cbdb65535:0x480ec8bd36ab934f!8m2!3d35.2258108!4d-80.8528465

	Team	Division	Stadium	Capacity	WinPerc	Address
0	Arizona Cardinals	NFC West	Sundevil Football Stadium	63,400	34.03%	500 E Veterans Way: Tempe: AZ 85287
1	Atlanta Falcons	NFC South	Mercedes-Benz Stadium	71,000	49.57%	409 Nelson St SW: Atlanta: GA 30313
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5	Chicago Bears	NFC North	Soldier Field	61,500	50.60%	1005 S 4th St: Minneapolis: MN 55415

Stadium Dataset Format Example

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The stadium dataset as compiled into a CSV file for import into an NFL Stadium pandas dataframe in the code. Geopy Nominator was used to gather Latitude and Longitude for each stadium and added back to the NFL Stadium dataframe. Folium library was used to map each stadium for validation that all Latitude and Longitude values were correct:

Stadium Map

A list of venues (along with category and rating information) within a 500m radius of the stadium was retrieved from Foursquare.com using the Foursquare API explore functionality . Additionally, all food related Foursquare categories were discovered and placed into a list which was then used to filter the stadium venue dataset to only included Food related venues, reducing the retrieved venue count from 1741 total venues to 574 food related venues.A final call was made to Foursquare to retrieve an overall rating for each venue in the food venue dataset. Resulting in the complete data set for analysis.

Stadium	Capacity	Win Perc	Stadium Latitude	Stadium Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category	Venue ID	Venue Rating
Sundevil Football Stadium	63,400	34.03%	33.426552	-111.933277	Snooze, an A.M. Eatery	33.423735	-111.934702	Breakfast Spot	5489c1fe498ebda5dea9a9f1	9.1
Sundevil Football Stadium	63,400	34.03%	33.426552	-111.933277	Shawarma Corner	33.424591	-111.934941	Middle Eastern Restaurant	5b9076a41a29250025ad827a	8.1
Sundevil Football Stadium	63,400	34.03%	33.426552	-111.933277	Phoenicia Cafe	33.423498	-111.936854	Mediterranean Restaurant	4a692b83f964a520b5cb1fe3	8.7
Sundevil Football Stadium	63,400	34.03%	33.426552	-111.933277	Original ChopShop Co.	33.422225	-111.935875	American Restaurant	51d1e3d4498ea96dd5fc8167	8.9
Sundevil Football Stadium	63,400	34.03%	33.426552	-111.933277	The Chuckbox	33.422160	-111.936423	Burger Joint	4bf1d51999d02d7fdd9ec948	9.0

Stadium Dataset Format Example

Date: 12/13/2020

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Ranking Analysis

From the Stadium Venue dataset the following values were calculated for each stadium:

Calculated Value	Description
Venue Count	Total number of nearby venues
Venue Distinct	Total number of distinct venue types
Venue Rating Mean	Average customer rating of nearby venues

Each stadium was then given a rank among its peers for each of the calculated values as well as an overall average rank.

Team	Stadium	Venue Count	Venue Distinct	Venue Rating Mean	Venue Count_rank	Venue Distinct_rank	Venue Rating_rank	Avg_rank
Arizona Cardinals	Sundevil Football Stadium	36	20	7.144444	8	4	10	7.33
Atlanta Falcons	Mercedes-Benz Stadium	22	14	5.486364	12	11	22	15.00
Baltimore Ravens	M&T Bank Stadium	10	8	5.260000	19	21	23	21.00
Buffalo Bills	Bills Stadium	3	3	6.933333	26	25	12	21.00
Carolina Panthers	Bank of America Stadium	28	19	8.075000	9	5	5	6.33
Chicago Bears	Soldier Field	22	11	5.745455	12	13	20	15.00
Cincinnati Bengals	Paul Brown Stadium	47	22	7.993617	1	2	6	3.00

Stadium Ranking Dataset Format Example

Bar Plots of the Teams/Stadiums along side each ranking criteria and analyzed.

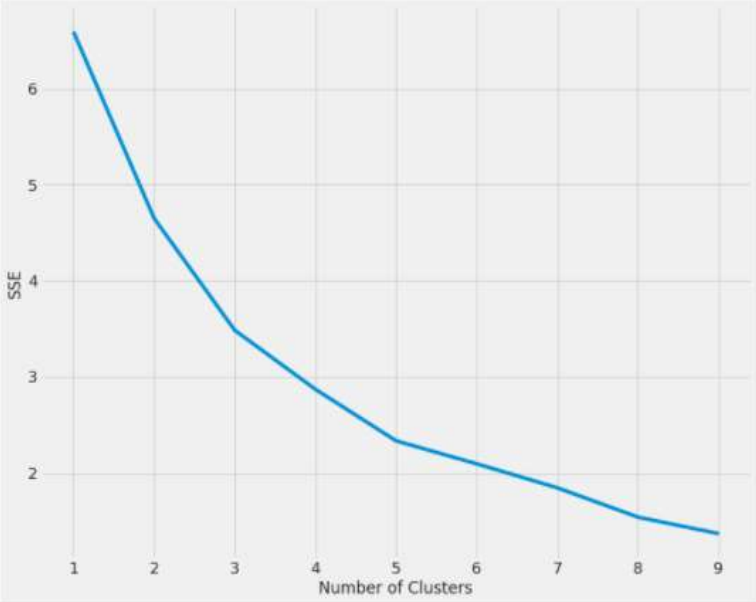
Clustering Analysis

The stadium data was transformed to a usable format for K-Means Cluster analysis by first applying one hot encoding to break the venues into individual columns and then computing an average of venue type frequency for each team/stadium.

	Team	American Restaurant	Asian Restaurant	BBQ Joint	Bakery	Bistro	Breakfast Spot	Bubble Tea Shop	Burger Joint	Café	...	Sandwich Place	Seafood Restaurant	Sna Pla
0	Arizona Cardinals	0.055556	0.000000	0.027778	0.000000	0.000000	0.083333	0.027778	0.083333	0.027778	...	0.055556	0.000000	0.0000
1	Atlanta Falcons	0.045455	0.000000	0.090909	0.000000	0.000000	0.181818	0.000000	0.000000	0.090909	...	0.045455	0.045455	0.0000
2	Baltimore Ravens	0.300000	0.000000	0.100000	0.000000	0.000000	0.000000	0.000000	0.100000	0.000000	...	0.000000	0.000000	0.0000
3	Buffalo Bills	0.333333	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.0000
4	Carolina Panthers	0.071429	0.000000	0.000000	0.035714	0.000000	0.000000	0.000000	0.000000	0.071429	...	0.035714	0.035714	0.0000
5	Chicago Bears	0.090909	0.000000	0.045455	0.000000	0.000000	0.000000	0.000000	0.045455	0.045455	...	0.090909	0.045455	0.0000
6	Cincinnati Bengals	0.042553	0.000000	0.000000	0.000000	0.021277	0.063830	0.000000	0.063830	0.063830	...	0.127660	0.021277	0.0000

Stadium Venue Encoded Dataset Format Example

The data was fed into K-Means cluster algorithm for 1-10 kclusters and the results were evaluated using elbow analysis to determine the most appropriate value for seed clusters



K-Means Elbow Analysis

From the elbow plot, the ideal number of groups was identified as 5. The K-Means algorithm was run with 5 seed groups for the final analysis of grouping and the stadium dataset was updated with the Cluster Label and the most common venues for each stadium

Team	Division	Stadium	Capacity	WinPerc	Address	latitude	longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Mc Comm Ven
Arizona Cardinals	NFC West	Sundevil Football Stadium	63,400	34.03%	500 E Veterans Way, Tempe, AZ 85287	33.426552	-111.933277	0	Pizza Place	Coffee Shop	Breakfast Spot	Burger Joint
Atlanta Falcons	NFC South	Mercedes-Benz Stadium	71,000	49.57%	409 Nelson St SW, Atlanta, GA 30313	33.751282	-84.399564	0	Breakfast Spot	Restaurant	BBQ Joint	Café
Baltimore Ravens	AFC North	M&T Bank Stadium	71,008	65.77%	1101 Russell Street, Baltimore, MD 21230	39.277966	-76.623809	0	American Restaurant	BBQ Joint	Steakhouse	Southern Soul Fooc Restaurai
Buffalo Bills	AFC East	Bills Stadium	71,608	49.73%	One Bills Drive, Orchard Park, NY 14127	42.771341	-78.787363	0	American Restaurant	Hot Dog Joint	Restaurant	Creperie
Carolina Panthers	NFC South	Bank of America Stadium	75,523	46.57%	800 South Mint Street, Charlotte, NC 28202	35.225835	-80.851772	0	Pizza Place	Steakhouse	American Restaurant	Coffee Shop

Stadium Venue Clustered Dataset Example

Clusters were plotted on a color-coded map and individual cluster results were analyzed.

Correlation Analysis

The rankings data was merged with the stadium data to prepare for analyzing any correlation between team / stadium details such as team winning percentage, stadium capacity, etc.

	Team	Division	Stadium_x	Capacity	WinPerc	Address	latitude	longitude	Stadium_y	Venue Count	Venue Distinct	Venue Rating Mean	Venu Count_ran
0	Arizona Cardinals	NFC West	Sundevil Football Stadium	63,400	34.03%	500 E Veterans Way, Tempe, AZ 85287	33.426552	-111.933277	Sundevil Football Stadium	36	20	7.144444	8
1	Atlanta Falcons	NFC South	Mercedes-Benz Stadium	71,000	49.57%	409 Nelson St SW, Atlanta, GA 30313	33.751282	-84.399564	Mercedes-Benz Stadium	22	14	5.486364	12
2	Baltimore Ravens	AFC North	M&T Bank Stadium	71,008	65.77%	1101 Russell Street, Baltimore, MD 21230	39.277966	-76.623809	M&T Bank Stadium	10	8	5.260000	19
3	Buffalo Bills	AFC East	Bills Stadium	71,608	49.73%	One Bills Drive, Orchard Park, NY 14127	42.771341	-78.787363	Bills Stadium	3	3	6.933333	26
4	Carolina Panthers	NFC South	Bank of America Stadium	75,523	46.67%	800 South Mint Street, Charlotte, NC 28202	35.225835	-80.851772	Bank of America Stadium	28	19	8.075000	9

Stadium Rankings Dataset Example

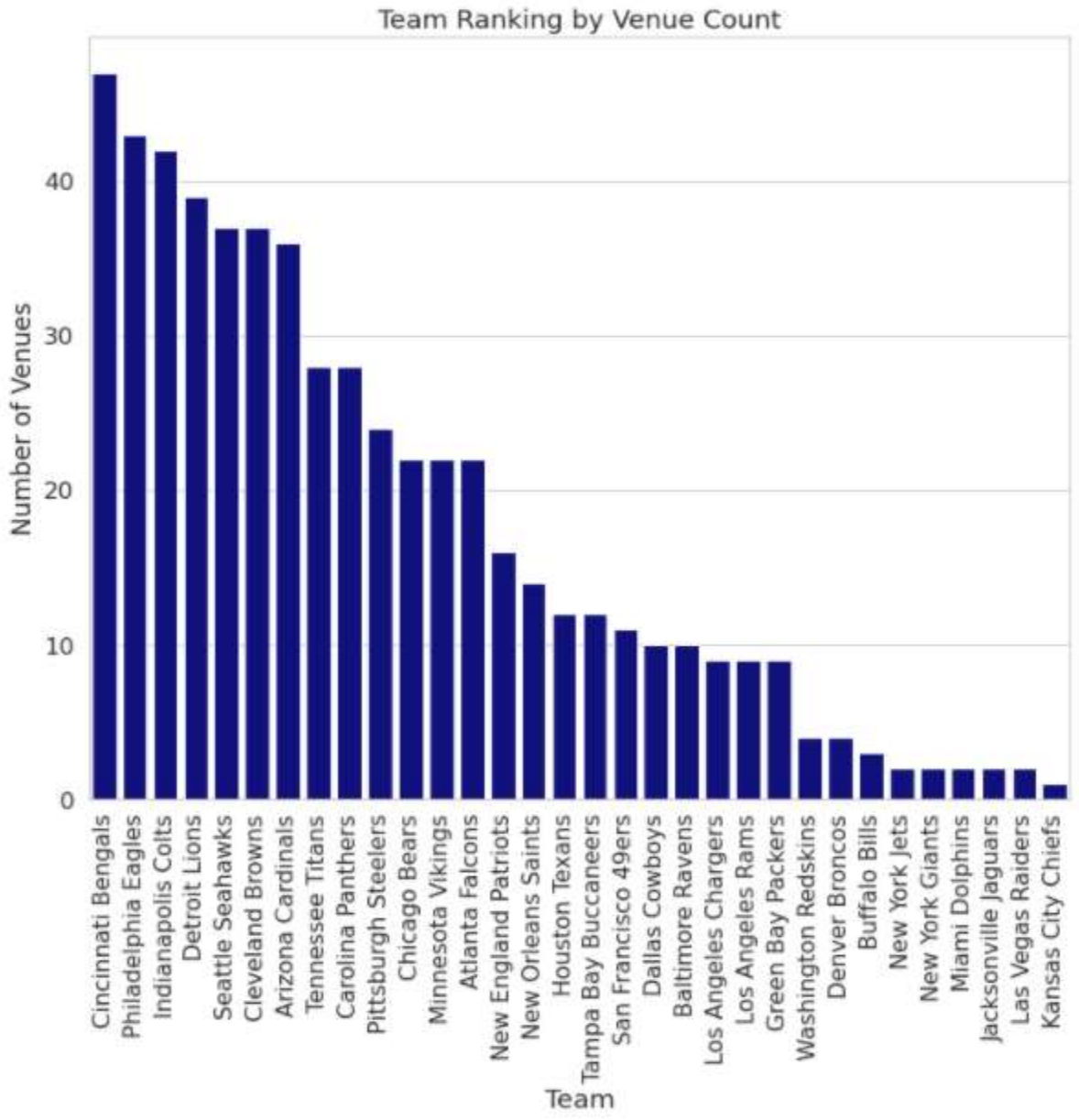
The dataset was analyzed using Pearson correlation to determine if there were possibly any relationships that could provide insight into the rankings.

Results

The following are the results from the three analysis focus areas, Ranking, Clustering and Correlation.

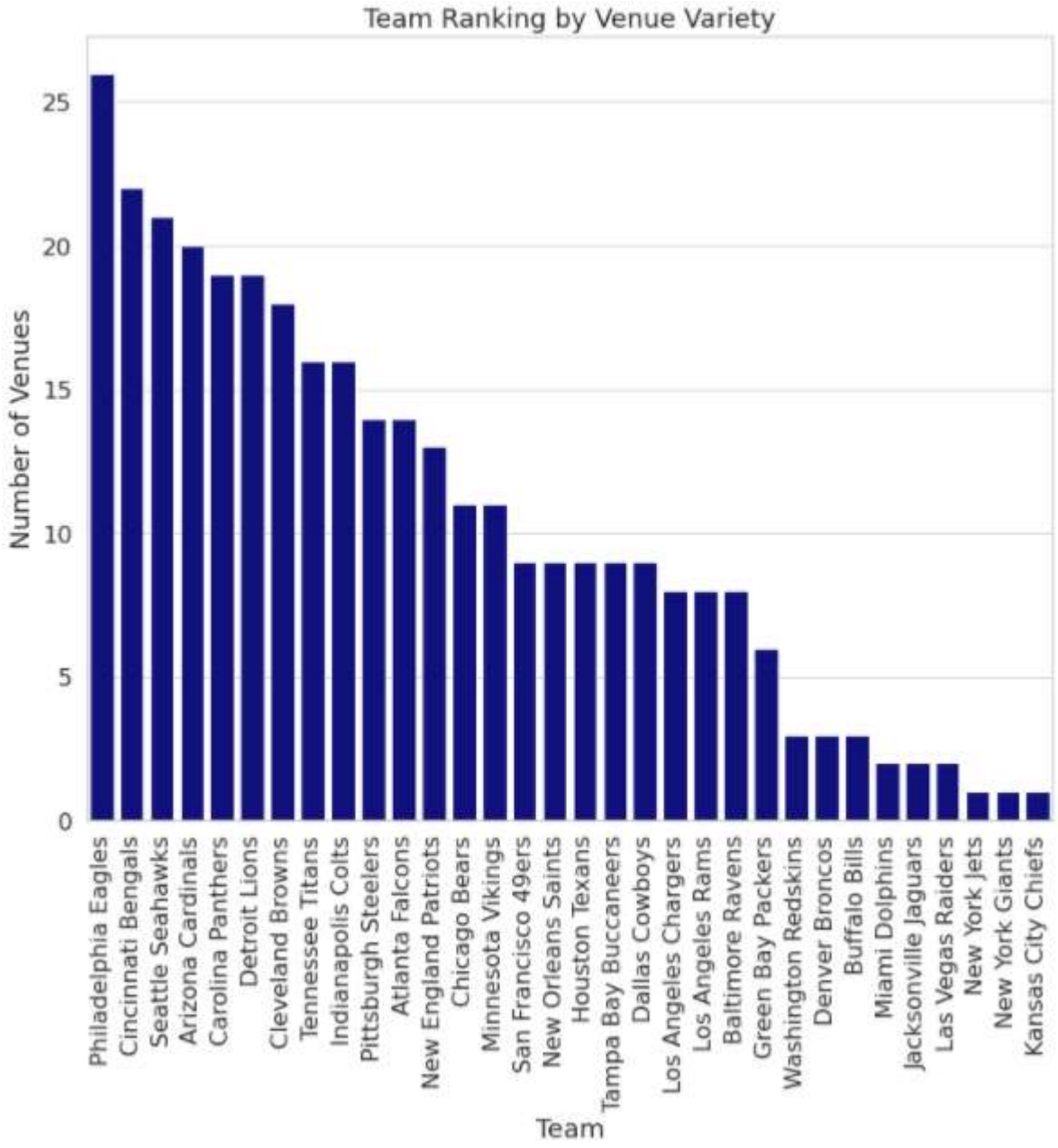
Ranking Analysis

The team venue rankings exposed a wide variety of results between stadiums.



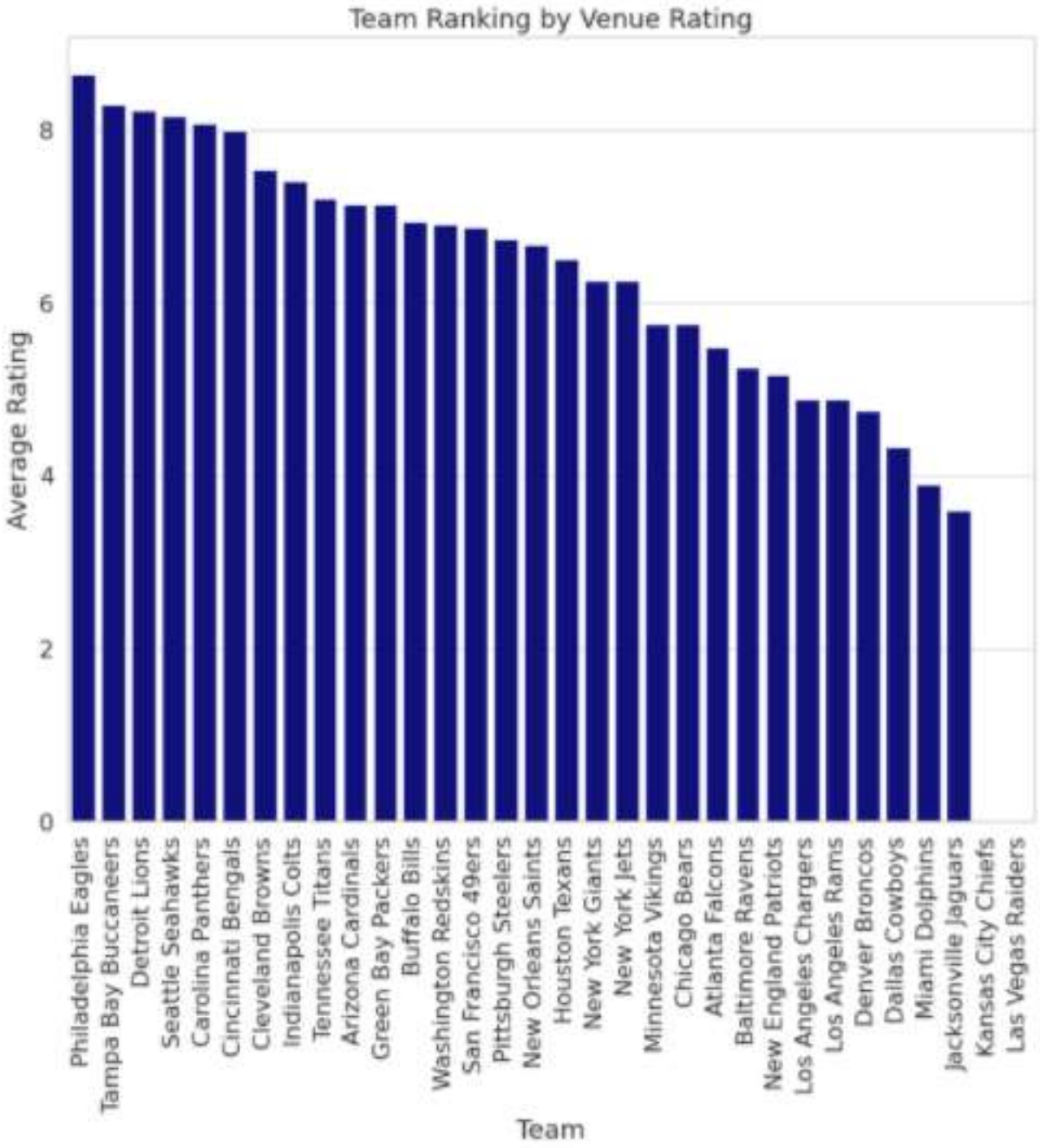
Team Ranking by Venue Count

The quantity of venues for each stadium varied widely ranging from 47 at the top end to only 1 at the bottom. Fans in Cincinnati, Philadelphia and Indianapolis clearly have more places to grab a bite within walking distance than do those in Kansas City, Las Vegas, Jacksonville, New York, or Miami. The results also indicate a relatively steady spread of venue counts across the majority of teams outside the bottom 6 or so teams.



Team Ranking by Venue Variety

The variety of venues for each stadium also varied widely ranging from 26 at the top end to only 1 at the bottom. Again, Philadelphia and Cincinnati top the list with Kansas City and New York rounding the bottom. This stands to reason that the cities with most venues should theoretically have the better chance at variety. Surprisingly, counter to this trend is Indianapolis, which drops to 9 in variety count (16) while boasting top three status in total count (42).



Team Ranking by Venue Rating

For venue rating we see Philadelphia tops the list again with the highest overall average customer rating (8.65). Edging to 2nd place of the ratings is surprisingly, Tampa Bay, boasting average customer rating of 8.3. While not faring very well in the quantity and variety rankings, apparently a fan would more than likely have a pleasant experience once finding their establishment of choice. The lowest ratings posted come from out cities with least selection, with no ratings from Kansas City and Las Vegas). Other under performers include Dallas, Denver, Miami, and Jacksonville, implying that it may be better to pack a lunch or rely your favorite tailgating buddy.

	Team	Stadium	Avg_rank
1	Philadelphia Eagles	Lincoln Financial Field	1.33
2	Cincinnati Bengals	Paul Brown Stadium	3.00
3	Detroit Lions	Ford Field	4.00
4	Seattle Seahawks	Lumen Field	4.33
5	Carolina Panthers	Bank of America Stadium	6.33
6	Indianapolis Colts	Lucas Oil Stadium	6.67
7	Cleveland Browns	FirstEnergy Stadium	6.67
8	Arizona Cardinals	Sundevil Football Stadium	7.33
9	Tennessee Titans	Nissan Stadium	9.00
10	Pittsburgh Steelers	Heinz Field	9.67
11	Tampa Bay Buccaneers	Raymond James Stadium	11.67
12	Chicago Bears	Soldier Field	15.00
13	Atlanta Falcons	Mercedes-Benz Stadium	15.00
14	Minnesota Vikings	U.S. Bank Stadium	15.00
15	New Orleans Saints	Mercedes-Benz Superdome	16.00
16	San Francisco 49ers	Levi's Stadium	16.33
17	Houston Texans	NRG Stadium	16.67
18	New England Patriots	Gillette Stadium	16.67
19	Green Bay Packers	Lambeau Field	18.67
20	Washington Redskins	FedExField	20.67
21	Buffalo Bills	Bills Stadium	21.00
22	Baltimore Ravens	M&T Bank Stadium	21.00
23	Dallas Cowboys	AT&T Stadium	21.33
24	Los Angeles Rams	SoFi Stadium	22.67
25	Los Angeles Chargers	SoFi Stadium	22.67
26	Denver Broncos	Empower Field at Mile High	25.33
27	New York Giants	MetLife Stadium	26.00
28	New York Jets	MetLife Stadium	26.00
29	Miami Dolphins	Hard Rock Stadium	28.67
30	Jacksonville Jaguars	TIAA Bank Field	29.00
31	Las Vegas Raiders	Allegiant Stadium	29.33
32	Kansas City Chiefs	Arrowhead Stadium	31.33

Team Overall Ranking

In the overall ranking, with an average ranking of 1.33, Philadelphia again tops the list as the most fan friendly city/stadium. Cincinnati follows a distant 2nd with average rank of 3, while the battle for 3rd most fan friendly city/stadiums belongs to Detroit and Seattle with Detroit winning by a hair (hopefully not in the soup). The usual suspects of Kansas City, Las Vegas, and Jacksonville round out the bottom three.

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Clustering Analysis

The cluster analysis revealed that while the 5 clusters was the preferred grouping count, the vast majority of all stadiums (24) fit into one category, while the other groups are very small and dispersed.

Team Map by Cluster

This would imply that almost regardless of where the game is played, based on venue selection, a fan could expect to have a similar experience as far as venue type to their own hometown experience.

One caveat: There are two stadiums that share teams. New York Metlife Stadium hosts both the New York Giants and New York Jets, while Los Angeles Sofi Stadium is home to both the Los Angeles Rams as well as the Los Angeles Chargers. A more accurate analysis may be achieved by eliminating one of each team sharing the same venue. Especially in the case of cluster 2 below.

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Cluster 1

	Team	Stadium	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Arizona Cardinals	Sundevil Football Stadium	Pizza Place	Coffee Shop	Breakfast Spot	Burger Joint	American Restaurant
1	Atlanta Falcons	Mercedes-Benz Stadium	Breakfast Spot	Restaurant	BBQ Joint	Café	Southern / Soul Food Restaurant
2	Baltimore Ravens	M&T Bank Stadium	American Restaurant	BBQ Joint	Steakhouse	Southern / Soul Food Restaurant	Fast Food Restaurant
3	Buffalo Bills	Bills Stadium	American Restaurant	Hot Dog Joint	Restaurant	Creperie	Food Stand
4	Carolina Panthers	Bank of America Stadium	Pizza Place	Steakhouse	American Restaurant	Coffee Shop	Mexican Restaurant
5	Chicago Bears	Soldier Field	Coffee Shop	American Restaurant	Sandwich Place	Seafood Restaurant	Vegetarian / Vegan Restaurant
6	Cincinnati Bengals	Paul Brown Stadium	Sandwich Place	Coffee Shop	Café	Burger Joint	Restaurant
7	Cleveland Browns	FirstEnergy Stadium	Coffee Shop	American Restaurant	Steakhouse	Café	Sandwich Place
8	Dallas Cowboys	AT&T Stadium	Steakhouse	American Restaurant	Seafood Restaurant	Food Court	Fast Food Restaurant
10	Detroit Lions	Ford Field	Coffee Shop	American Restaurant	Burger Joint	Pizza Place	Café
11	Green Bay Packers	Lambeau Field	American Restaurant	Wings Joint	Bakery	Sandwich Place	Burger Joint
12	Houston Texans	NRG Stadium	BBQ Joint	Fried Chicken Joint	Sandwich Place	Coffee Shop	Deli / Bodega
13	Indianapolis Colts	Lucas Oil Stadium	American Restaurant	Sandwich Place	Steakhouse	Coffee Shop	Mexican Restaurant
17	Los Angeles Chargers	SoFi Stadium	Coffee Shop	Wings Joint	Food Court	Steakhouse	Southern / Soul Food Restaurant
18	Los Angeles Rams	SoFi Stadium	Coffee Shop	Wings Joint	Food Court	Steakhouse	Southern / Soul Food Restaurant
20	Minnesota Vikings	U.S. Bank Stadium	Coffee Shop	American Restaurant	Sandwich Place	Seafood Restaurant	Vegetarian / Vegan Restaurant
21	New England Patriots	Gillette Stadium	American Restaurant	Mexican Restaurant	Steakhouse	Seafood Restaurant	Burger Joint
22	New Orleans Saints	Mercedes-Benz Superdome	Pizza Place	Sandwich Place	Restaurant	Coffee Shop	Seafood Restaurant
25	Philadelphia Eagles	Lincoln Financial Field	Coffee Shop	Seafood Restaurant	Vegetarian / Vegan Restaurant	Bakery	Mediterranean Restaurant
26	Pittsburgh Steelers	Heinz Field	Coffee Shop	Bakery	Seafood Restaurant	Diner	Italian Restaurant
27	San Francisco 49ers	Levi's Stadium	Italian Restaurant	Coffee Shop	American Restaurant	Pizza Place	Fast Food Restaurant
28	Seattle Seahawks	Lumen Field	Coffee Shop	Café	Tea Room	Bakery	Dumpling Restaurant
29	Tampa Bay Buccaneers	Raymond James Stadium	Fast Food Restaurant	Coffee Shop	Pizza Place	American Restaurant	Sandwich Place
30	Tennessee Titans	Nissan Stadium	American Restaurant	Pizza Place	Sandwich Place	Mexican Restaurant	Diner

Cluster 2

	Team	Stadium	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
23	New York Giants	MetLife Stadium	Donut Shop	Wings Joint	Vegetarian / Vegan Restaurant	Food Truck	Food Stand
24	New York Jets	MetLife Stadium	Donut Shop	Wings Joint	Vegetarian / Vegan Restaurant	Food Truck	Food Stand

Cluster 3

	Team	Stadium	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
15	Kansas City Chiefs	Arrowhead Stadium	BBQ Joint	Wings Joint	Deli / Bodega	Food Truck	Food Stand
16	Las Vegas Raiders	Allegiant Stadium	BBQ Joint	Café	Wings Joint	Deli / Bodega	Food Truck

Cluster 4

	Team	Stadium	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
9	Denver Broncos	Empower Field at Mile High	Asian Restaurant	Breakfast Spot	Pizza Place	Wings Joint	Deli / Bodega
19	Miami Dolphins	Hard Rock Stadium	American Restaurant	Fast Food Restaurant	Vegetarian / Vegan Restaurant	Food Truck	Food Stand
31	Washington Redskins	FedExField	Fast Food Restaurant	American Restaurant	Pizza Place	Creperie	Food Stand

Cluster 5

	Team	Stadium	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
14	Jacksonville Jaguars	TIAA Bank Field	Food Truck	Breakfast Spot	Wings Joint	Deli / Bodega	Food Stand

Correlation Analysis

Analysis of the correlation between winning percentage or stadium capacity to any of the venue ranking criteria was unremarkable. The results of the Pearson correlation revealed the highest correlation of only 0.60 between stadium capacity and customer venue rating, and no significant correlation at all between winning percentage and any ranking.

	Capacity	WinPerc	latitude	longitude	Venue Count	Venue Distinct	Venue Rating Mean	Venue Count_rank	Venue Distinct_rank	Venue Rating_rank	Avg_rank
Capacity	1.000000	-0.036977	0.073684	0.217362	-0.490841	-0.469954	-0.060476	0.489968	0.507445	0.142774	0.409787
WinPerc	-0.036977	1.000000	0.106091	-0.097814	0.004323	0.122606	-0.154065	-0.093653	-0.124062	0.199769	-0.007311
latitude	0.073684	0.106091	1.000000	0.063016	0.297445	0.216691	0.215524	-0.248613	-0.210003	-0.270606	-0.261343
longitude	0.217362	-0.097814	0.063016	1.000000	0.053912	-0.000906	0.247048	-0.055319	0.021951	-0.196228	-0.081623
Venue Count	-0.490841	0.004323	0.297445	0.053912	1.000000	0.957622	0.625019	-0.965880	-0.946068	-0.706113	-0.939391
Venue Distinct	-0.469954	0.122606	0.216691	-0.000906	0.957622	1.000000	0.641313	-0.961507	-0.988148	-0.700947	-0.950496
Venue Rating Mean	-0.060476	-0.154065	0.215524	0.247048	0.625019	0.641313	1.000000	-0.692104	-0.653009	-0.897907	-0.803550
Venue Count_rank	0.489968	-0.093653	-0.248613	-0.055319	-0.965880	-0.961507	-0.692104	1.000000	0.977130	0.718877	0.967372
Venue Distinct_rank	0.507445	-0.124062	-0.210003	0.021951	-0.946068	-0.988148	-0.653009	0.977130	1.000000	0.691004	0.957556
Venue Rating_rank	0.142774	0.199769	-0.270606	-0.196228	-0.706113	-0.700947	-0.897907	0.718877	0.691004	1.000000	0.863259
Avg_rank	0.409787	-0.007311	-0.261343	-0.081623	-0.939391	-0.950496	-0.803550	0.967372	0.957556	0.863259	1.000000

Team Ranking Correlation Results

Discussion

Based on the Ratings Analysis there is a clear distinction on which cities provide a fan-friendly environment for eating and drinking around game time. Philadelphia, Cincinnati , Detroit and Seattle are well above average in the availability, variety, and quality of food and drink within walking distance of their NFL stadiums. These cities stand the better chance of having their NFL patrons spend time (and money) in local establishments before and after the game, thus boosting the local economy and making it more attractive for development. Other cities wanting to boost development around their own stadiums should look these cities for developing their own strategy for improvement.

Based on Clustering analysis, most cities (roughly 75%) were categorized in the same group, indicating that generally there are more similarities between city/stadium venues than differences. Fans in most cities should not expect a significant difference in type of venues available, but based on the rankings, fans would definitely tell the difference on availability, variety and quality.

Based on the Correlation analysis we can conclude that winning does not imply a better fan friendly environment around the stadium. This may, however, be a totally different scenario "Inside" the stadium.

Conclusion

Generally, the results indicate a good distinction of fan experience around each stadium. Cities should be able to learn from this analysis as start to understanding more about how they stack up against their peer cities related to fan experience, and begin to target action on how to improve if desired. Several assumptions and exceptions have been made within this analysis, and there may be room for improved analysis by adjusting the starting conditions or compensating for the assumptions made.

- The analysis was based on availability within 500m ("walking distance") of each stadium. No analysis was performed as to how accessible the area around the stadium actually is to pedestrian traffic. This radius could be expanded to incorporate a broader group of venues to evaluate the city as a whole, and to compensate for a fan-base who may not mind driving to their favorite food establishment.
- Addition of other area factors should be considered for evaluating correlation to the venue ranks in hopes to guide cities on how to promote growth of higher quality venues. While winning percentage and stadium capacity seemed to have no relevance on fan friendliness other factors may (distance from city center, climate, etc)
- This analysis really did not deal with the fact that there have been some recent moves in the last few years of teams to new stadiums within a city, or even teams that have relocated to new host cities. A more comprehensive historical analysis should be conducted to get a better picture of how cities can relate to fan friendliness.