Clustering of NBA Team Cities and Performance Analysis

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#### Introduction

#### **Motivation:**

One rumor has it that a series of key losses at the Los Angeles Lakers can partially be attributed to late nights at an underground poker game

#### **Question:**

Does the "flavor" of a city, i.e., the types of venues surrounding that city's basketball arena, have an effect on the performance of visiting teams?

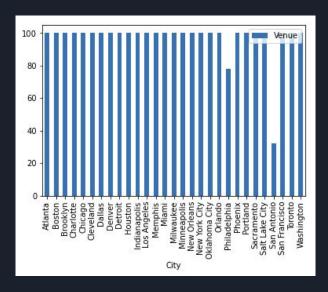
#### Data

The data needed to answer the question comes from three sources:

- 1. Google Maps to determine arena location by latitude and longitude
- 2. Venue data retrieved within a 2km radius of each arena using the Foursquare API
- 3. Basketball-Reference.com was scraped to get results for every game played from 2009 to 2019 during the months of October-May

# Venue Data - Exploratory Analysis

- Obtained venue information for area within 2km radius of each arena using Foursquare API
- San Antonio has significantly fewer venues than other cities
  - This caused the city to act as an outlier when initially testing clustering
  - San Antonio removed from the following analysis



## Venue Data - Venue Location Percentages

	City	Accessories Store	American Restaurant	Antique Shop	Aquarium	Arcade	Arepa Restaurant	Argentinian Restaurant	Art Gallery	Art Museum		Vegetarian / Vegan Restaurant	Video Game Store	Vietnamese Restaurant	Warehouse Store
0	Atlanta	0.00	0.03	0.0	0.02	0.0	0.01	0.0	0.05	0.00	***	0.0	0.0	0.01	0.0
1	Boston	0.00	0.01	0.0	0.02	0.0	0.00	0.0	0.00	0.00		0.0	0.0	0.00	0.0
2	Brooklyn	0.00	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.00		0.0	0.0	0.00	0.0
3	Charlotte	0.00	0.03	0.0	0.00	0.0	0.00	0.0	0.01	0.01		0.0	0.0	0.00	0.0
4	Chicago	0.01	0.01	0.0	0.00	0.0	0.00	0.0	0.01	0.01		0.0	0.0	0.00	0.0

The data is organized to show the ratio of venue type to total number of venues for each city.

This data is used along with k-means clustering to separate the cities into three groups.

## Venue Data - Bar Cities

	City	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue	Labels
8	Detroit	American Restaurant	Farmers Market	Concert Hall	Lounge	Park	Coffee Shop	Hotel	Diner	Bar	Dessert Shop	0
9	Houston	Hotel	Bar	Vietnamese Restaurant	Cocktail Bar	New American Restaurant	Cajun / Creole Restaurant	Burger Joint	Baseball Stadium	BBQ Joint	Park	0
10	Indianapolis	Bar	Hotel	Steakhouse	Mexican Restaurant	Pizza Place	Brewery	Grocery Store	History Museum	New American Restaurant	Burger Joint	0
11	Los Angeles	Hotel	Coffee Shop	Bar	Burger Joint	Sushi Restaurant	Theater	Gym	Latin American Restaurant	Steakhouse	New American Restaurant	0
12	Memphis	Bar	Park	American Restaurant	Café	Southern / Soul Food Restaurant	Burger Joint	Music Venue	Hotel	Museum	Coffee Shop	0
14	Milwaukee	Bar	Hotel	Steakhouse	Coffee Shop	Pub	Brewery	Theater	Spa	American Restaurant	German Restaurant	0
18	Oklahoma City	American Restaurant	Brewery	Bar	Hotel	Pizza Place	Breakfast Spot	Coffee Shop	Sandwich Place	Pub	Restaurant	0
19	Orlando	American Restaurant	Bar	Hotel	Lounge	Coffee Shop	Brewery	Cocktail Bar	Theater	French Restaurant	Beer Bar	0
21	Phoenix	Coffee Shop	Art Gallery	Lounge	Pizza Place	Bar	Music Venue	Hotel	Mexican Restaurant	Cocktail Bar	Basketball Stadium	0

The first group is cities that have a high proportion of bars.

## Venue Data - Coffee Cities

	City	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue	Labels
2	Brooklyn	Cocktail Bar	Italian Restaurant	Grocery Store	Coffee Shop	Bar	Bookstore	New American Restaurant	Ice Cream Shop	Wine Shop	Pizza Place	1
4	Chicago	Coffee Shop	Restaurant	Pizza Place	Sandwich Place	Deli / Bodega	Café	Yoga Studio	Brewery	Park	New American Restaurant	1
7	Denver	Brewery	American Restaurant	Hotel	Coffee Shop	Italian Restaurant	Theme Park Ride / Attraction	Park	Pizza Place	Mexican Restaurant	Seafood Restaurant	1
15	Minneapolis	Brewery	Theater	Italian Restaurant	Coffee Shop	Farmers Market	New American Restaurant	Park	Hotel	Scandinavian Restaurant	American Restaurant	1
20	Philadelphia	Sandwich Place	Italian Restaurant	Pizza Place	Lounge	Sports Bar	Food Truck	Baseball Field	Bar	Pharmacy	Park	1
22	Portland	Coffee Shop	Hotel	Brewery	Park	Bookstore	Spa	Bakery	Donut Shop	Sporting Goods Shop	Lounge	1
26	San Francisco	Coffee Shop	Café	Brewery	Park	Art Gallery	Gym / Fitness Center	Gym	Wine Bar	New American Restaurant	Pizza Place	1
27	Toronto	Coffee Shop	Park	Yoga Studio	Gym	Hotel	Art Gallery	Plaza	Italian Restaurant	Café	Liquor Store	1

The second group is cities that have a high proportion of coffee shops.

## Venue Data - Hotel Cities

	City	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue	Labels
0	Atlanta	Hotel	Art Gallery	Park	American Restaurant	Theater	Juice Bar	Coffee Shop	Mediterranean Restaurant	Burger Joint	Sandwich Place	2
1	Boston	Park	Historic Site	Italian Restaurant	Bakery	Hotel	Seafood Restaurant	Gastropub	Mexican Restaurant	Grocery Store	Sandwich Place	2
3	Charlotte	Hotel	Park	Italian Restaurant	Theater	American Restaurant	Brewery	Deli / Bodega	Performing Arts Venue	Coffee Shop	Pizza Place	2
5	Cleveland	Hotel	Coffee Shop	Theater	American Restaurant	Steakhouse	Lounge	Italian Restaurant	Park	Brewery	Deli / Bodega	2
6	Dallas	Hotel	Steakhouse	Coffee Shop	Italian Restaurant	American Restaurant	Restaurant	Pizza Place	Plaza	Mexican Restaurant	Cocktail Bar	2
13	Miami	Hotel	American Restaurant	Seafood Restaurant	Nightclub	Café	Park	Coffee Shop	Bar	Peruvian Restaurant	Japanese Restaurant	2
16	New Orleans	Hotel	Cajun / Creole Restaurant	Coffee Shop	Cocktail Bar	Seafood Restaurant	Hotel Bar	American Restaurant	Italian Restaurant	French Restaurant	Sandwich Place	2
17	New York City	Theater	Park	Hotel	Coffee Shop	Boxing Gym	Japanese Restaurant	Art Gallery	Mediterranean Restaurant	American Restaurant	Gym / Fitness Center	2
23	Sacramento	American Restaurant	Coffee Shop	Hotel	Seafood Restaurant	Pizza Place	Park	Dessert Shop	Café	Movie Theater	Sandwich Place	2
24	Salt Lake City	Hotel	Coffee Shop	Mexican Restaurant	Bakery	Park	Brewery	Burger Joint	Theater	Sandwich Place	American Restaurant	2
28	Washington	Hotel	Art Museum	History Museum	American Restaurant	Coffee Shop	Pizza Place	Plaza	Science Museum	Mediterranean Restaurant	Italian Restaurant	2

The third group is cities that have a high proportion of hotels.

## NBA Record Data - Wins/Losses

- Record data is scraped from basketball-reference.com
- Each team's record at each other team's location is recorded
  - Home records are stored as seen for the Miami Heat to the right
- The following teams are consolidated:
  - New Orleans Hornets and Pelicans
  - Charlotte Bobcats and Hornets
  - New Jersey and Brooklyn Nets

```
{'Miami Heat': {'Miami Heat': {'wins': 303, 'losses': 143, 'ties': 0},
'Cleveland Cavaliers': {'wins': 9, 'losses': 8, 'ties': 0},
'Sacramento Kings': {'wins': 6, 'losses': 3, 'ties': 0},
'Portland Trail Blazers': {'wins': 5, 'losses': 5, 'ties': 0}.
'Orlando Magic': {'wins': 12, 'losses': 8, 'ties': 0},
'Philadelphia 76ers': {'wins': 13, 'losses': 9, 'ties': 0},
'Atlanta Hawks': {'wins': 11, 'losses': 9, 'ties': 0},
'Chicago Bulls': {'wins': 13, 'losses': 11, 'ties': 0},
'Memphis Grizzlies': {'wins': 4, 'losses': 5, 'ties': 0},
'Milwaukee Bucks': {'wins': 11, 'losses': 9, 'ties': 0},
'Washington Wizards': {'wins': 12, 'losses': 8, 'ties': 0},
'Phoenix Suns': {'wins': 8, 'losses': 1, 'ties': 0},
'Los Angeles Clippers': {'wins': 4, 'losses': 6, 'ties': 0},
'Utah Jazz': {'wins': 4, 'losses': 6, 'ties': 0},
'Houston Rockets': {'wins': 4, 'losses': 5, 'ties': 0},
'San Antonio Spurs': {'wins': 2, 'losses': 7, 'ties': 0},
'Toronto Raptors': {'wins': 9, 'losses': 13, 'ties': 0},
'Dallas Mavericks': {'wins': 7, 'losses': 3, 'ties': 0},
'Indiana Pacers': {'wins': 9, 'losses': 16, 'ties': 0},
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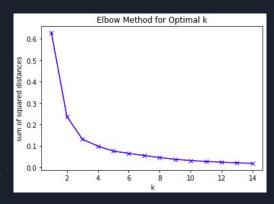
# NBA Record Data - Win Rate by City Type

- Records are consolidated for each team based on city type
  - Label 0 = Bar Cities
  - Label 1 = Coffee Cities
  - Label 2 = Hotel Cities
- Win rates are calculated and stored in a table as seen to the right

	Label 0	Label 1	Label 2
Miami Heat	0.510638	0.558140	0.534161
Cleveland Cavaliers	0.430556	0.436508	0.417722
Sacramento Kings	0.295302	0.274336	0.300813
Portland Trail Blazers	0.407407	0.428571	0.452703
Orlando Magic	0.309735	0.371681	0.362637

# NBA Record Data - Clustering

- NBA teams were clustered based on the records by city type shown on the previous slide
- Elbow method for k-means clustering (top right)
   showed that k=3 was optimal
- A review of the average win rates for each cluster (bottom right) suggests cluster simply represent medium-, low-, and high-performing teams, respectively



Record Labels 0 0.440517 1 0.328722 2 0.541704 dtype: float64

# NBA Record Data - Clustered Groups

 Groups do appear to be split by performance (high on top right, medium on bottom left, and low on bottom right)

20	Label 0	Label 1	Label 2	Record Labels	City Labels
Miami Heat	0.510638	0.558140	0.534161	2	2.0
Houston Rockets	0.463768	0.503937	0.567568	2	0.0
Oklahoma City Thunder	0.500000	0.540323	0.596026	2	0.0
Golden State Warriors	0.480000	0.576923	0.668966	2	1.0

No correlation between performance and home city type

	Label 0	Label 1	Label 2	Record Labels	City Labels
Cleveland Cavaliers	0.430556	0.436508	0.417722	0	2.0
Portland Trail Blazers	0.407407	0.428571	0.452703	0	1.0
Atlanta Hawks	0.391892	0.434783	0.457831	0	2.0
Chicago Bulls	0.485714	0.422680	0.462366	0	1.0
Memphis Grizzlies	0.412162	0.500000	0.421429	0	0.0
Milwaukee Bucks	0.344828	0.491667	0.366667	0	0.0
Los Angeles Clippers	0.500000	0.406504	0.524476	0	0.0
Utah Jazz	0.391304	0.446281	0.430894	0	2.0
Toronto Raptors	0.489362	0.465347	0.437158	0	1.0
Dallas Mavericks	0.440994	0.424779	0.516129	0	2.0
Indiana Pacers	0.478261	0.361345	0.410256	0	0.0
Denver Nuggets	0.410256	0.436893	0.400000	0	1.0
Boston Celtics	0.477941	0.472000	0.494505	0	2.0

	Label 0	Label 1	Label 2	Record Labels	City Labels
Sacramento Kings	0.295302	0.274336	0.300813	1	2.0
Orlando Magic	0.309735	0.371681	0.362637	1	0.0
Philadelphia 76ers	0.323077	0.361905	0.303371	1	1.0
Washington Wizards	0.343284	0.398305	0.329193	1	2.0
Phoenix Suns	0.311111	0.360360	0.381944	1	0.0
Los Angeles Lakers	0.292857	0.403509	0.402685	1	0.0
Charlotte Hornets	0.333333	0.339806	0.282895	1	2.0
Detroit Pistons	0.252101	0.309735	0.345455	1	0.0
Minnesota Timberwolves	0.261438	0.252632	0.330935	1	1.0
New Orleans Pelicans	0.359477	0.330435	0.367521	1	2.0
New York Knicks	0.285714	0.345133	0.375796	1	2.0
Brooklyn Nets	0.307087	0.299065	0.329341	1	1.0

## Results - Performance at Bar Cities

	Label 0	Label 1	Label 2	Record Labels	City Labels
Chicago Bulls	0.485714	0.422680	0.462366	0	1.0
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Left - Teams that perform best at Bar Cities

Right - Teams that perform worst at Bar Cities

#### Results - Performance at Coffee Cities

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Washington Wizards	0.343284	0.398305	0.329193	1	2.0	Minnesota Timberwolves	0.261438	0.252632	0.330935	1	1.0
Utah Jazz	0.391304	0.446281	0.430894	0	2.0	New Orleans Pelicans	0.359477	0.330435	0.367521	1	2.0
Los Angeles Lakers	0.292857	0.403509	0.402685	1	0.0	<b>Boston Celtics</b>	0.477941	0.472000	0.494505	0	2.0
Charlotte Hornets	0.333333	0.339806	0.282895	1	2.0	Brooklyn Nets	0.307087	0.299065	0.329341	1	1.0
Denver Nuggets	0.410256	0.436893	0.400000	0	1.0						

Left - Teams that perform best at Coffee Cities

Right - Teams that perform worst at Coffee Cities

## Results - Performance at Hotel Cities

	Label 0	Label 1	Label 2	Record Labels	City Labels
Sacramento Kings	0.295302	0.274336	0.300813	1	2.0
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Charlotte Hornets	0.333333	0.339806	0.282895	1	2.0
Denver Nuggets	0.410256	0.436893	0.400000	0	1.0

Left - Teams that perform best at Hotel Cities

Right - Teams that perform worst at Hotel Cities

#### Discussion

A city's "flavor" does appear to have an effect on the performance of visiting teams.

- Plurality of teams performs worst at Bar Cities
  - o NY, Detroit, Phoenix, and Orlando have a 5-6% lower win rate than at other city types
  - o Golden State has a **9%** lower win rate
  - LA Lakers have an 11% lower win rate
- Teams can use this info to drive further investigate of team performance based on city type and attempt to mitigate losses seen above
- Future work: investigate effect of home team performance on this analysis
  - Implement weighting function to decrease value of a win at a poorly performing team and raise
     value of a win at a high performing team

#### Conclusion

- Classified NBA cities into three types: Bar Cities, Coffee Cities, and Hotel Cities
- Teams don't necessarily perform better in cities of the same type
- The "flavor" of a city does appear to have an effect on visiting team performance
  - Poor overall performance at Bar Cities and high performance at Hotel Cities
- Further investigation by a team could establish whether this is a causal relationship and if actions can be taken to mitigate these effects

# Sources

- Foursquare API
- Google Maps
- Basketball-Reference.con