

# IBM Applied Data Science Capstone

## **Opening a Movie Theater in Denver, Colorado in 2021**

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## **Introduction**

Economists reporting in the Wall Street Journal project that the US economy will grow by 4.3% in 2021 following the 2.5% contraction of growth in 2020. This presents an opportunity for capitalizing on the resurgence of people going back out into the market.

Revenue for Movie theaters declined by 62.6% in 2020 due to the COVID-19 pandemic and the social distancing measures that were put in place. Most movie theaters generate the majority of their income in the summer months. However, due to social distancing, movie theaters were forced to close and thus unable to generate revenue.

Consulting the IBIS World market Research Report, movie theater revenue in 2021 is projected to show a growth of 147.1%. This growth is attributed to “restless consumers and a gradual estimated increase in per capita disposable income” that will drive theater admissions. People are expected to return to theaters to make up for the past year of which they have been unable.

## **Business Problem**

Our client would like to explore opening a movie theater in Denver, Colorado to capitalize on the projected increase of growth in 2021. Our objective with this project is to analyze the best locations in Denver, Colorado for opening either a brick and mortar movie theater and/ or a drive-in movie theater. Applying the data science methodology and machine learning techniques, this project aims to provide a response to the following question: Where is the best location to open a new movie theater in Denver, Colorado?

## **Target Audience**

This problem would be useful for real estate investors, entrepreneurs and business investors that are evaluating where to open a movie theater in Denver, Colorado. As the social distancing measures are relaxed and more people are spending disposable income, this project presents a great opportunity to capitalize on the projected increase in movie theater growth over 2021 and beyond.

## **Data Requirements**

The following data is needed to complete this project:

1. List of neighborhoods in Denver, CO. Only the neighborhoods in Denver will be used in this study.
2. Neighborhood Latitude and Longitude coordinates of Denver neighborhoods. These are required to gather data on the different venues in Denver and to plot the neighborhoods on a map for analysis.
3. Data on the venues in Denver pertaining to movie theaters. This data will be used to perform clustering analysis.

## **Methodology**

The data source for the list of neighborhoods is at the following wikipedia page: [https://en.wikipedia.org/wiki/Category:Neighborhoods\\_in\\_Denver](https://en.wikipedia.org/wiki/Category:Neighborhoods_in_Denver). Denver contains approximately 51 neighborhoods. This data will be web scraped from this wikipedia page by utilizing Python requests and beautifulsoup libraries. After

gathering and cleaning the neighborhood data, the coordinates of the neighborhoods will be imported using the Python Geocoder library. This will allow the latitude and longitude coordinates of each neighborhood to be created.

After cleaning the data, the next step is to utilize the Foursquare API to gather the venue data for all of Denver's neighborhoods. Foursquare is an accurate location platform that provides global point-of-interest (POI) data from over 46K sources. These sources are then validated by the millions of consumers. Foursquare has location information in over 190 countries and 50 territories, over 900 venue categories and 2.4 million POI updates monthly. For this project we will be using the movie theater venue category.

Using the Foursquare API, we have to sign up for a Foursquare Developer account to obtain a Foursquare ID and secret key to gain access to the API. We use Foursquare to gather the top 100 venues within the radius of 1000 meters of each neighborhood represented by a coordinate. The API call uses a For loop to iterate over the neighborhoods geographical coordinates. The API call returns JSON data in which the venue name, category, latitude and longitude of each neighborhood is placed into a pandas dataframe. We then verify that all the venue categories are unique and group the rows by neighborhood. After grouping the data we calculate the mean of the frequency of each venue's occurrence. Then we filter by "Movie Theater" to isolate the venue we are interested in. After completing this step we are done cleaning the data and ready to analyze the Movie Theater data using clustering.

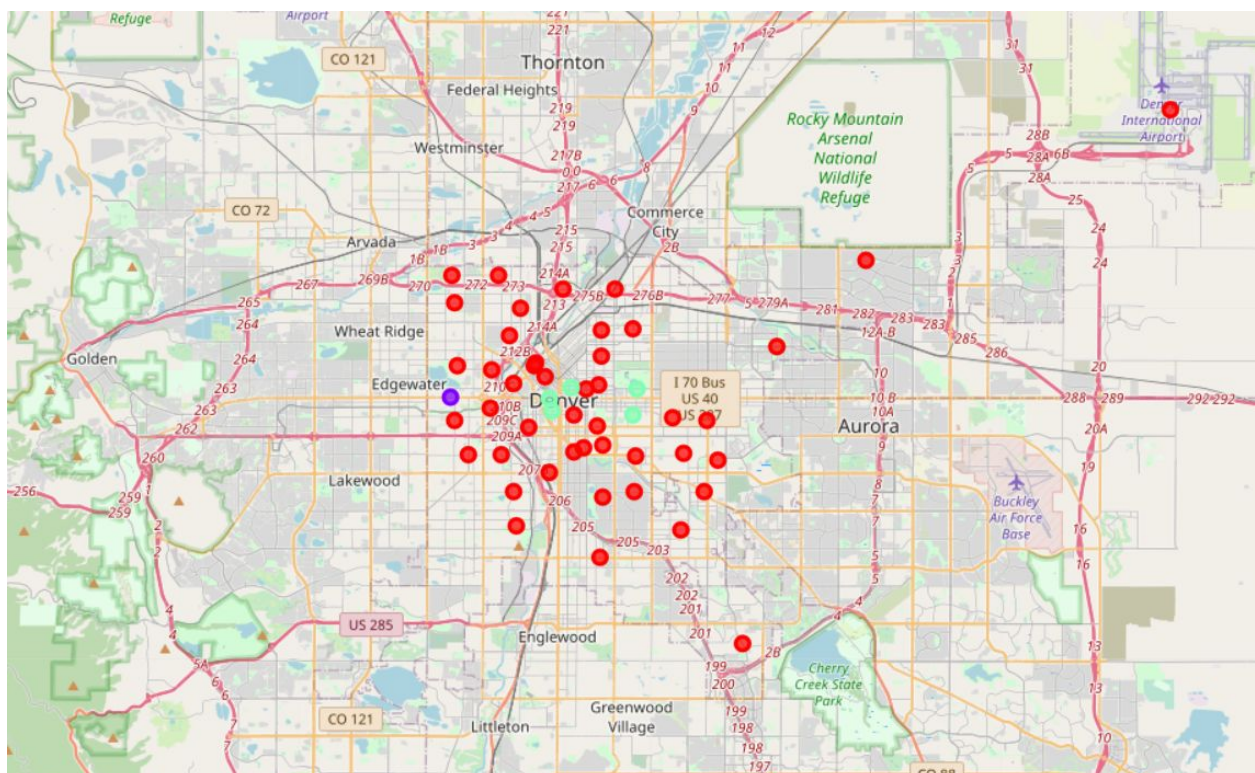
In order to analyze the data by clustering we use the technique: k-means clustering. K-means Clustering is an unsupervised machine learning algorithm that makes inferences from data by using input vectors. The purpose of using k-mean clustering is to group similar data points to uncover the underlying

patterns in the data. First we will find the best number of K clusters to use and then apply that number to the frequency of occurrence for all movie theaters in Denver, CO. By clustering the neighborhoods by frequency of the movie theater venues we were able to identify the neighborhoods with the highest frequency of movie theaters. This information will then help us to identify neighborhoods with the least competition and therefore the most opportunity for opening a movie theater in Denver.

## Results

The results we gathered from k-means clustering indicated that neighborhoods should be separated by 3 when filtering for movie theater venues

1. Cluster 0: Low concentration of movie theaters (Red)
2. Cluster 1: High concentration of movie theaters (Purple)
3. Cluster 2: Moderate concentration of movie theaters (Green)



## **Discussion**

As the majority of movie theater venues are located in Central Denver (Cluster 2, Green) and West Colfax (Cluster 1, Purple). Cluster 0 (Red) has the lowest concentration of movie theaters and also presents the greatest opportunity for opening a movie theater. These neighborhoods seem to be located in the periphery of Denver City. It is also important to note that these areas are also heavily residential. As such, suburban areas will most likely not be viable areas to open a movie theater due to zoning restrictions. The neighborhoods in North and South Denver which are close to major highways present the greatest opportunity to open a movie theater. As Denver continues to expand these areas will likely see development and present opportunities to capitalize on the increase in growth. A zillow survey indicates that Denver is one of the Top 5 real estate home markets in the country. This survey supports the prediction of further Growth nationally and locally.

## **Limitations and Suggestions for Further Research**

This project takes into consideration the frequency of occurrence of movie theaters, the projected movie theater growth, the National projected economic growth and the Denver real estate market growth for 2021. While we believe that Denver presents a great opportunity for investment in opening a new movie theater, we also believe it is important to also factor in the neighborhoods in the Denver Metro Area to possibly identify other opportunities in close proximity to Denver city. Due to utilizing the Free Foursquare account we are limited in the amount of API calls we are able to make and in the future it may be necessary to use a paid account to gather more local venues for clustering.

## Conclusion

Throughout the course of this project for identifying possible locations to open a movie theater in Denver, CO we have laid out the process for analyzing this issue. After collecting data from Foursquare, numerous resources on the economic growth rate of the movie theater industry and the national predicted growth we believe we have identified the neighborhoods with the greatest opportunity for investment. As we previously stated, the neighborhoods in Cluster 0 present the greatest opportunity for investment and we recommend expanding the clustering analysis to all the neighborhoods in the Denver Metro Area to identify other possible locations for opening a movie theater.

## References:

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