# Optimizing Business Success on Yelp: Analyzing Factors for Star Ratings

ADSP 31008 - Group 10

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# Problem Statement & Objectives

## Problem Statement

Yelp's challenge is to refine business onboarding to better reflect the impact of customer interactions and preferences on star ratings.

## Purpose and Objectives

1. Predict star ratings and understand driving factors
2. Equip businesses with actionable strategy to elevate their ratings
3. Boost user engagement through data models for Yelp

## Solution Value

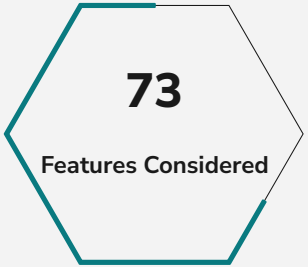
Analyze the Yelp dataset to predict star ratings, provide businesses with strategic insights to enhance user experience and foster a robust Yelp community.

## Target Variables

- **Primary Target Variable**
  - **Star Ratings (star_x)**: The average star rating a business receives.

- **Target City: Santa Barbara**
  - Tourist Attraction
    - Rich data for Yelp
  - High Economic Activities
    - Nightlife +, bars +
  - Cultural Diversity
  - Seasonal Business Pattern

## Definition & Scope of Features





**Main Categories for features:**

| | |
|---|---|
| **Business:**  <br>**Services options** (Takeout, caters), **dining experience** (ambience, outdoor seating), **presence of amenities** (e.g., TV, Wi-Fi, parking) | **Review:**  <br>Sentiment scores, frequency of positive/negative words, length of review. |
| **User Engagement:**  <br>Number of reviews received, average stars given by user, number of friends, elite status duration. | **Temporal Data:**  <br>Check-in times, frequency of reviews over time, temporal patterns in user activity, tips information. |

# Data Exploration

**5 Data Sets** (Business, User, Review, Checkin, Tips)
**150,346 businesses** (location, ratings, attributes)
**1,987,897 users**
**6,990,280 reviews** (reviews with rating and text)
**908,915 tips** (user tips with text and compliment)
**131,930 check-ins** (user check-ins at business)

**Primary Unit**

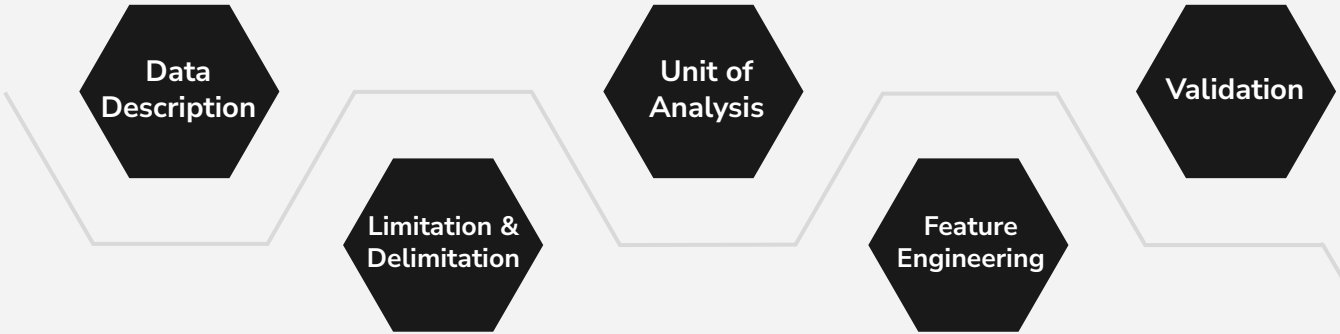
Businesses: Evaluated through ratings, categories, and attributes.

Users: Analyzed via reviews, tips, and engagement metrics.

**Secondary Unit**

Reviews: Insights on customer satisfaction and feedback.

**Cross Validation:** Employ cross-validation techniques to ensure model reliability across different subsets of data.




**Subjectivity: Check-in and tips,** being subjective, might introduce bias in understanding business quality so we didn't incorporate in feature engineering.

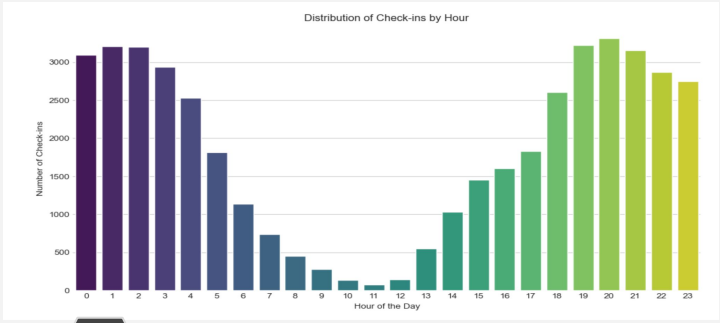
**Focus Area:** Analysis centers on **user interactions, review and business-related metrics.**

**Text Features:** Identify significant words or phrases (TF-IDF).

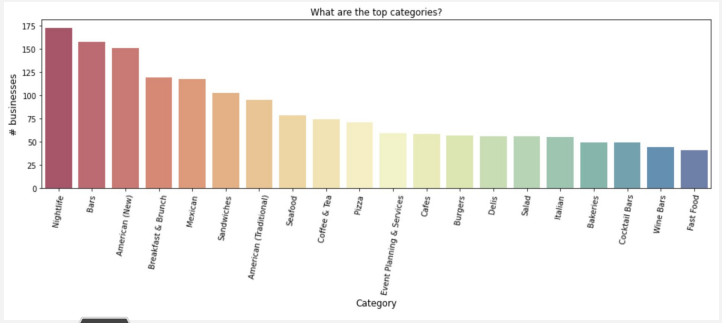
**Truncated SVD:** Avoid sparse matrix issue since user compliment/feedback/fans have a lot zeros.

**One-Hot Encoding:** Each category value is converted into a new column and assigned a 1 or 0 (notation for true/false) value to the column.

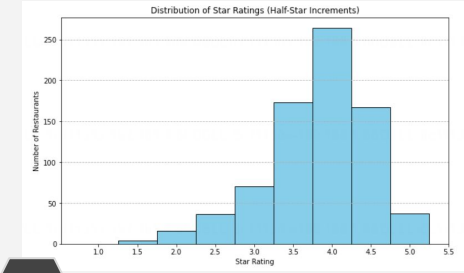
# Exploratory Data Analysis



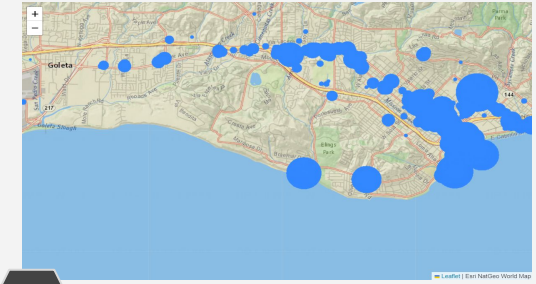

3 The distribution of check-in times is concentrated around **midnight**.




4 Nightlife is the top category

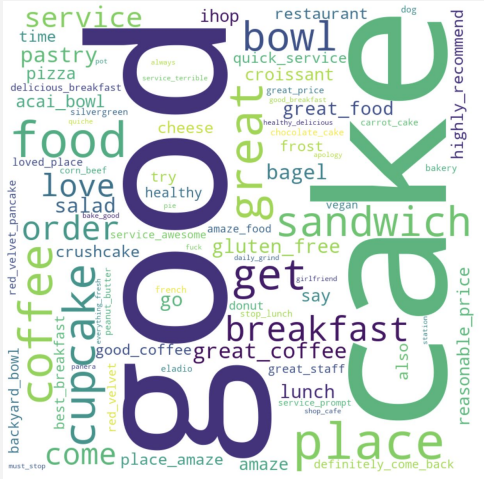



1 Star Ratings Distribution



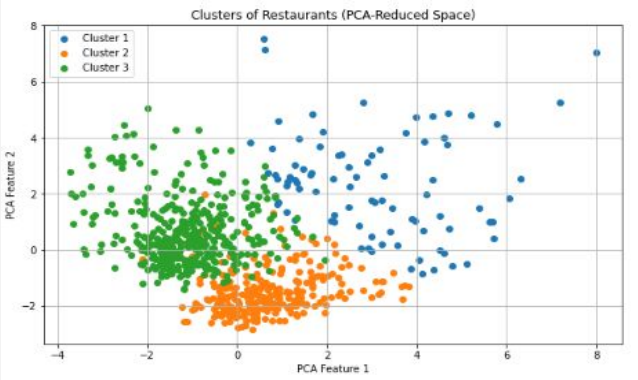

2 Geographic Business Density


5 Nightlife wordcloud (apply topic modeling)



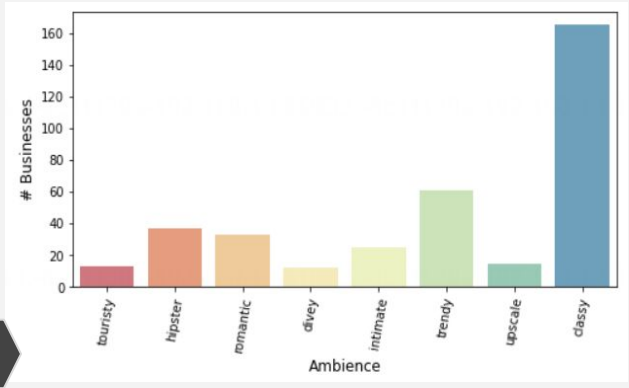

6 Breakfast & Brunch wordcloud

# Exploratory Data Analysis



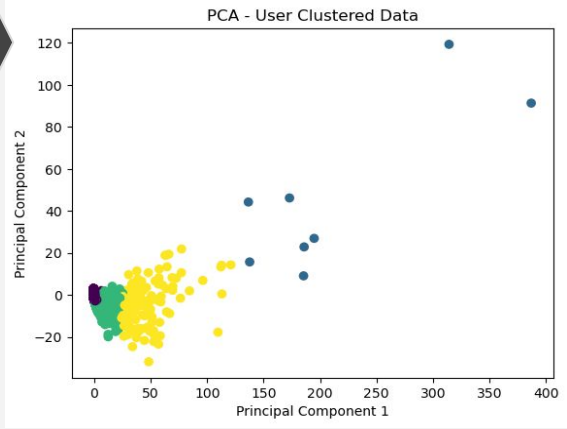

- Generate **loadings** of features
- Find clusters of restaurants

3



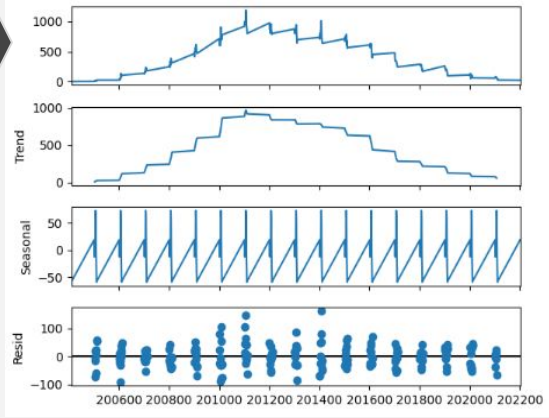

- Distribute of Ambience - (one of high loadings features)

4




- Used **T-SNE** to reduce sparse matrix
- Find KOL (more fans, high feedback(cool, funny))

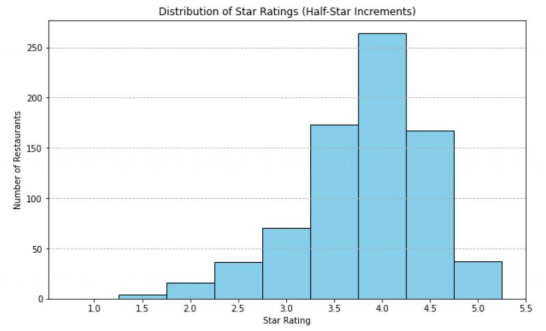
5



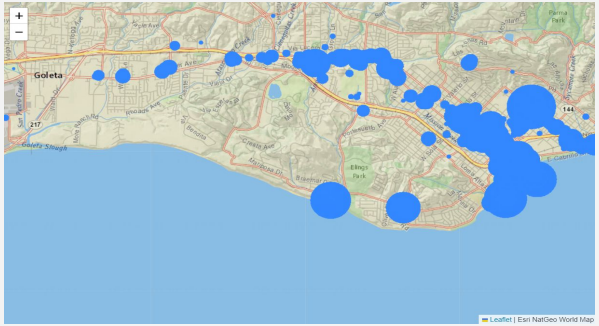

- A time series into **trend**, **seasonal**, and **residual** components for **users**
- Growth phase of user activity on Yelp, peaking around 2014 and then decrease

# Exploratory Data Analysis

## General Info Yelp Reviews in Santa Barbara



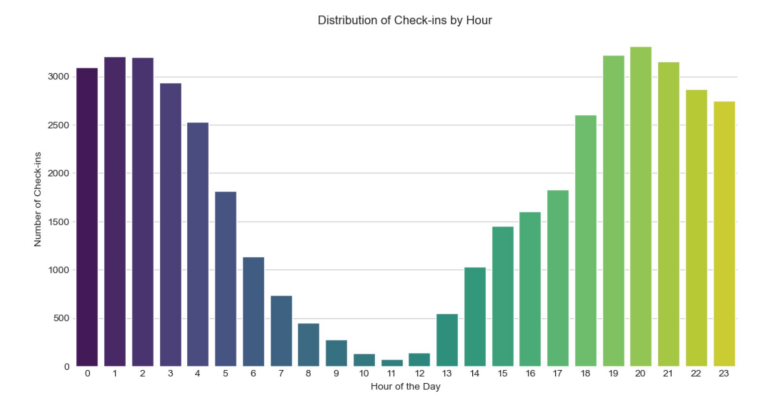

Star Ratings Distribution



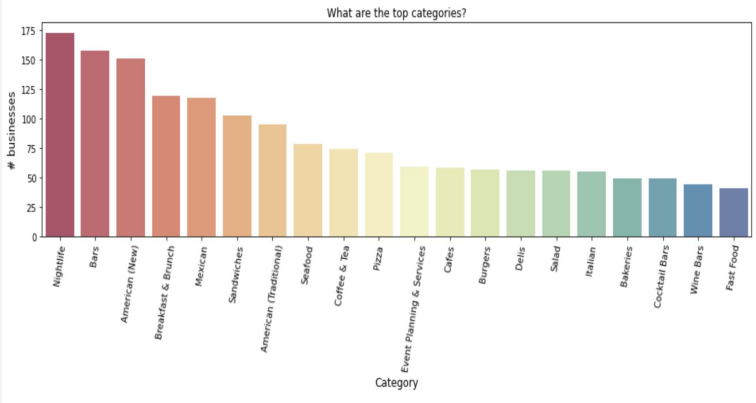

Geographic Business Density

# Exploratory Data Analysis

## Deep Dive into Consumer Behavior and Preferences




Check-in time concentrated around midnight

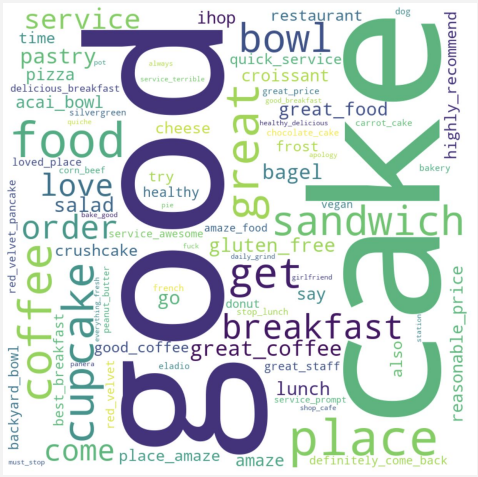



Nightlife and bars are the top two categories

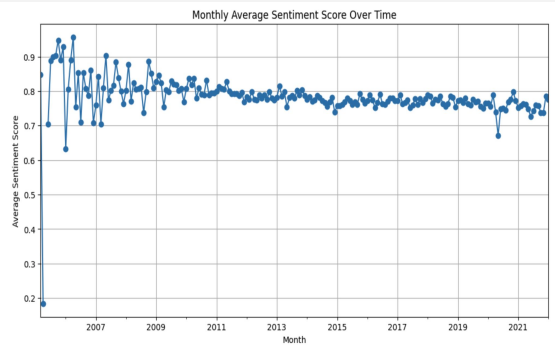
# Exploratory Data Analysis

## Topic Modeling & Sentiment Analysis towards reviews


Nightlife Wordcloud




Breakfast & Brunch Wordcloud



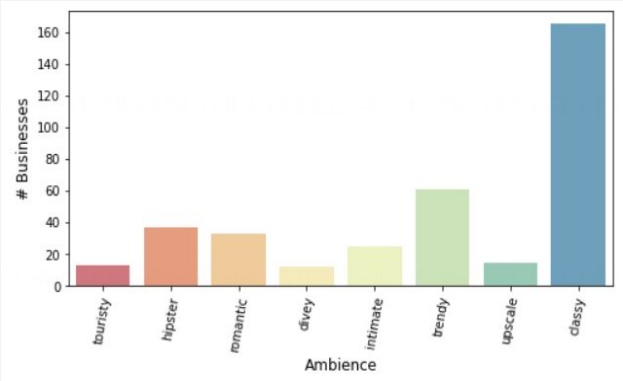

Time series analysis of **sentiment scores**

- Converge to mean score of 0.75

# Exploratory Data Analysis

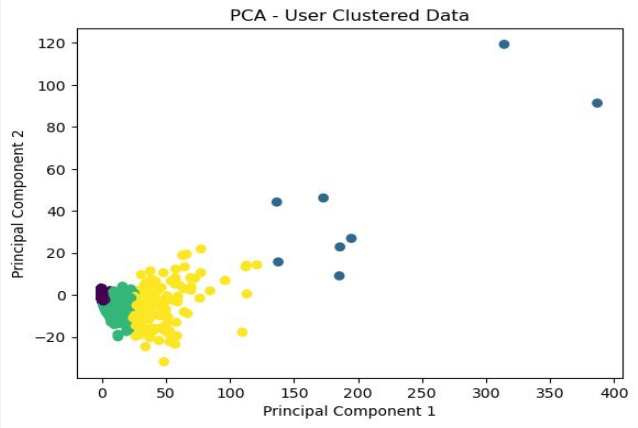
## Business Features Analysis


- Generate **loadings** of features
- Find clusters of restaurants




- Distribute of Ambience - (one of high loadings features)

## User Data Analysis

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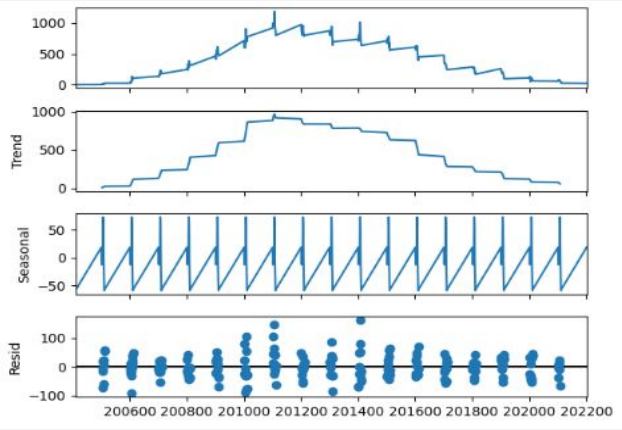


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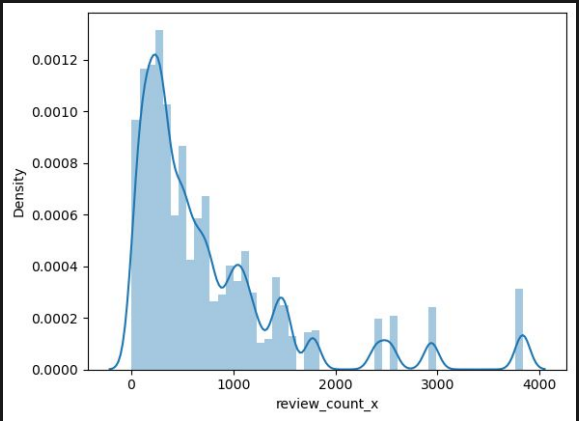
# Methodology: Feature Engineering

## 1. Numerical




## 2. Categorical (HC)

- Casual Dining & Drinks
- Diverse Cuisine & Entertainment
- Health & Lifestyle
- Nightlife Essentials
- Sophisticated Eats
- Traditional Comfort Foods

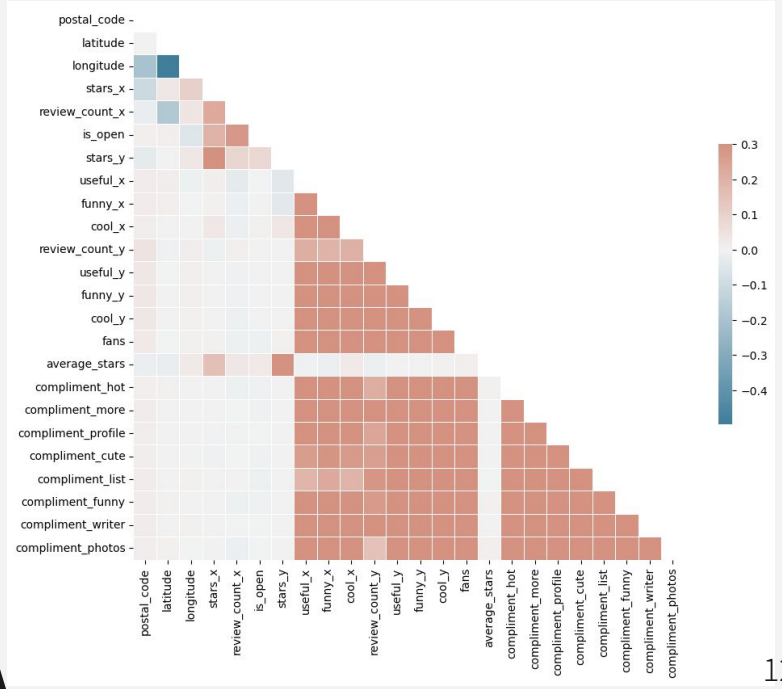
## 3. Date

Number of days using Yelp

## 4. Text(TF-IDF Vectorizer)

- Preprocessed the text data
- Removed stopwords
- Lemmatized the text
- Vectorized with TF-IDF

## 5. Sparse-Matrix (Truncated SVD)



# Methodology
# Modeling Framework

## Model Descriptions

Baseline:
– Linear Regression

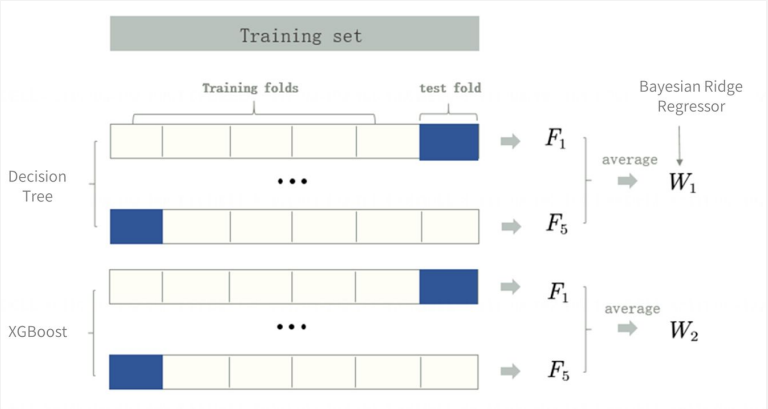
Non-Linear:
– SVM (linear & non-linear)
– Decision Tree
– Random Forest
– AdaBoost
– XGBoost

– Customized Ensemble Model: Stacking the base models above using **Bayesian Ridge Regression**

## Model Selection and Validation

**Model Performance Evaluation:**
CV error > training set error: overfitting
CV error ≈ training set error >> test set error: underfitting

**Randomized Search Cross-validation (5-fold)** was employed to assess model generalizability, with **RMSE (Root Mean Squared Error)** as the performance metric to compare different models' predictive accuracy.

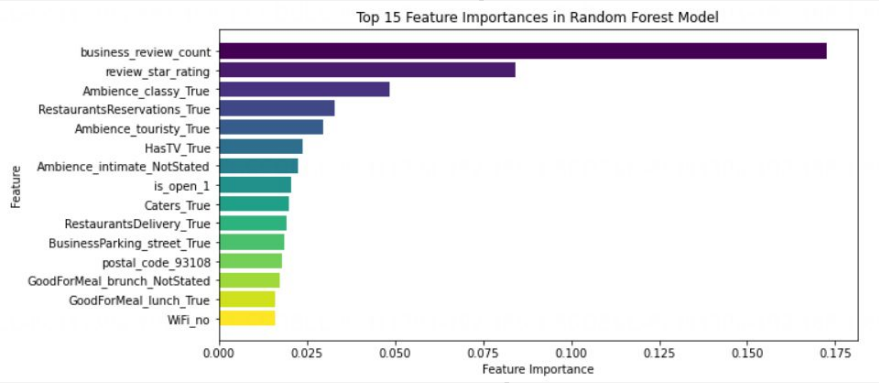



Ensemble Model -> Stacking

# Modeling Results

| | Default Parameters | | Cross-Validation (5-fold) | | | Stacking |
|---|---|---|---|---|---|---|
| **Model** | **Training RMSE** | **Test RMSE** | **CV RMSE** | **Training RMSE** | **Test RMSE** | |
| **Linear Regression** | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | |
| **SVM** | 0.47 (linear) | 0.47 (linear) | 0.078 (rbf) | 0.057 (rbf) | 0.077 (rbf) | |
| **Decision Tree** | 0.0 | 0.04 | 0.051 | 0.012 | 0.042 | |
| **Random Forest** | 0.014 | 0.039 | 0.045 | 0.018 | 0.039 | **Bayesian Ridge (Decision Tree, XGBoost)** |
| **AdaBoost** | 0.41 | 0.41 | 0.41 | 0.40 | 0.41 | Training RMSE: 0.022<br>Test RMSE: 0.035 |
| **XGBoost** | 0.064 | 0.074 | 0.050 | 0.025 | 0.047 | |

# Findings & Recommendations




**Impact of Review Volume and Quality**

Higher review counts and quality positively impact Yelp star ratings, indicating popularity and customer satisfaction.

***Encouraging Customer Reviews:*** Implement a feedback initiative, incentivize reviews, and train staff to prompt satisfied customers for feedback.

**Role of Key Opinion Leaders (KOLs)**

KOLs have a significant impact on star ratings due to their following and credibility.

***KOL Engagement:*** Invite KOLs for unique dining experiences, develop ongoing collaborations, and utilize their feedback for improvement and credibility-building.

**Significance of Ambience and Service:**

Ambience, service, and staff attitude strongly influence positive reviews.

***Focus on Experience and Service:*** Regularly update ambience and service based on feedback, consider customer preferences in strategic planning.

# Future Steps

## Improve Model

**Overfitting Mitigation:** Enhance overfitting prevention with improved regularization, better feature selection, and advanced validation techniques.

**Deep Learning Techniques:** Evaluate the use of deep learning models, like RNNs, to capture complex patterns in review sequences.

**Enhanced Sentiment Analysis:** Implement state-of-the-art NLP models (BERT, GPT) for nuanced understanding of customer sentiment in reviews.

## Improve Business

**Customer Experience Personalization:**

- Use review insights to customize experiences.
- Target marketing to diverse customer segments.

**Operational Excellence:**

- Utilize analytics for inventory, staffing, and menu optimization.
- Implement real-time quality control from Yelp feedback.

**Reputation Management and Response:**

- Establish a team to engage with reviews.
- Turn negative reviews into public service opportunities.

**KOL and Influencer Collaborations:**

- Partner with local influencers for events and promotions.
- Track influencer impact on customer perceptions.

## Improve Yelp Platform

**Enhanced Analytics Dashboard for Businesses:** Develop advanced dashboards with predictive analytics to provide businesses insights, enabling anticipation of trends and customer needs.

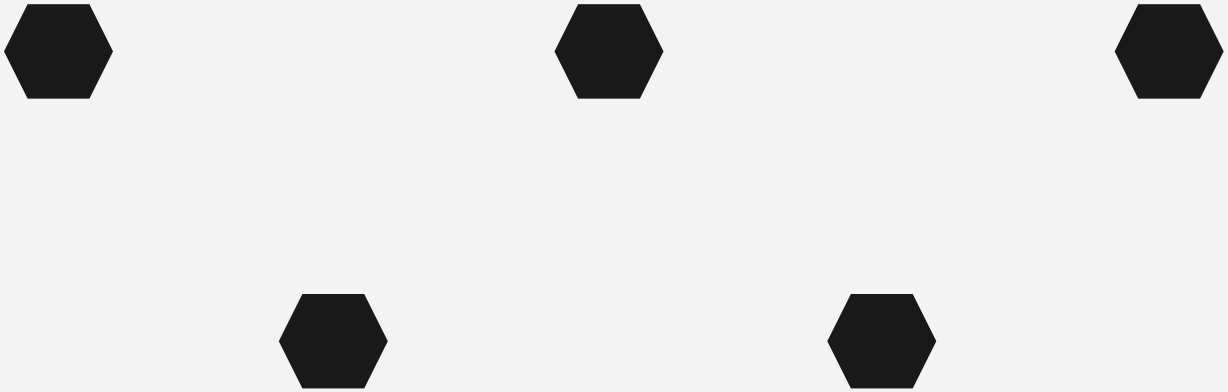
**Business Engagement Tools:** Create tools within Yelp that make it easier for businesses to engage with customers, respond to reviews, and manage their online reputation.

**Personalized Business Recommendations:** Use Yelp's data to offer personalized recommendations to businesses for improvement based on similar successful businesses in their area.


# THANKS

Open to questions!

# Results & Recommendations



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- Pack human resources 11
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## PHOTOS

- Reflection of rocky mountains and sky on beautiful lake
- Breathtaking view of sunnylvsfjorden fjord and famous seven sisters waterfall; norway
- Side view of man thinking in office while looking at sticky notes
- Medium shot women working together
- Red boat moored on the idyllic lake near the rocky mountains
- Leopard
- Rear view of a man with black backpack standing on bridge
- Medium shot smiley women making business plan
- Medium shot bored people working
- People assisting at business meeting
- Silhouette of a person's hand holding paper airplane against dramatic sky
- Railway train tracks with platforms

## Methodology

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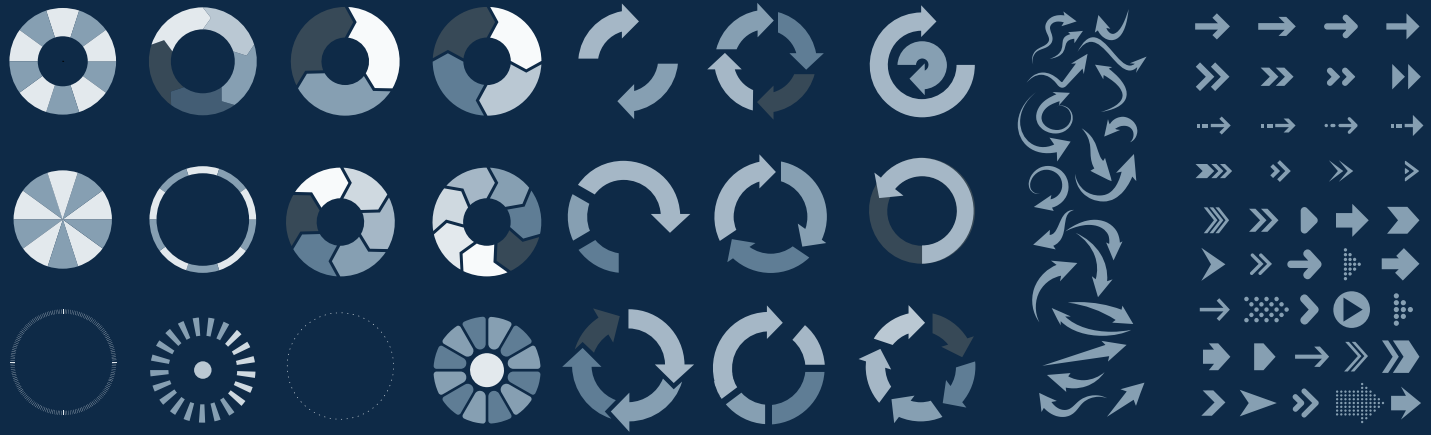

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# Performing Arts Icons

# SEO & Marketing Icons

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