

Yelp Reviews Sentiment Analysis

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In this project, we analyze how sentiment and review length in Yelp reviews relate to star ratings, then model this relationship to predict ratings and identify what drives customer satisfaction.



Motivation and Context

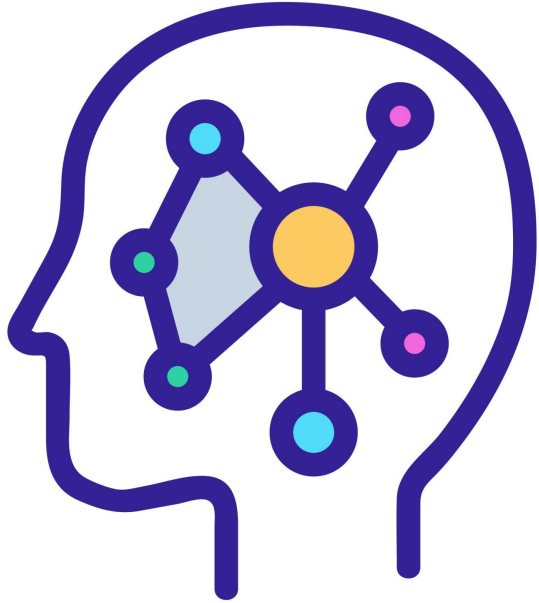
Research Question: To what extent can dining-related language in Yelp restaurant reviews be used to predict customer star ratings, and which attributes of the dining experience contribute most to these predictions?

Hypothesis: Positive sentiment language (and shorter review length) will be associated with higher star ratings (4-5 stars), while negative sentiment language will be associated with lower star ratings (1-2 stars).

Goal: Use Yelp restaurant review content and length to predict customer star ratings with 90% accuracy, while identifying which dining-related aspects most strongly influence overall customer satisfaction

Why Does This Matter?

- Reviews are important for both customers and restaurant owners [1,4]
- The restaurant industry represents a significant portion of the overall business economy [3]



Motivation and Context: Modeling Approach

- Create a sentiment classification pipeline that maps the textual features of the review to the associated star rating
- Convert the review into a numerical format using TF-IDF
- Train a logistic regression model and a random forest model
- Evaluate both models to select the approach that best balances predictive accuracy and interpretability

Data Acquisition and Explanation

Dataset Overview: Yelp restaurant reviews containing customer-written review text paired with 1–5 star ratings, primarily from dessert establishments

Format & Size: Text-based dataset (CSV) with thousands of reviews

Key Features:

- *Star Rating* (numeric, 1–5) — prediction target
- *Review text* (string) — primary input feature
- *Review length* (integer) — derived control variable

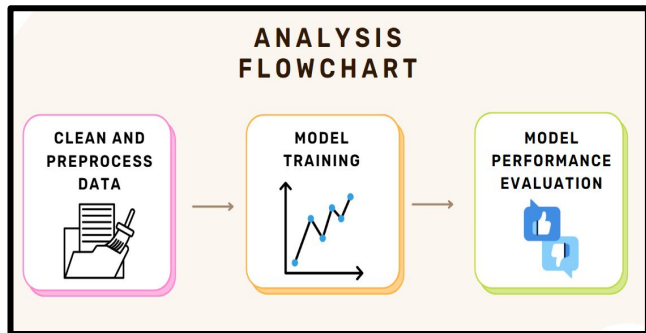
Additional Fields: The dataset also includes Yelp URLs and review dates; these columns were excluded from analysis because they are not related to sentiment or star ratings

Data Acquisition: Data sourced from a publicly available Kaggle Yelp restaurant reviews dataset

| Yelp URL | Rating | Date | Review Text |
|---|--------|-----------|--|
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 1/22/2022 | All I can say is they have very good ice cream I would for sure recommend their cookies and creme ice cream it is very good |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 4 | 6/26/2022 | Nice little local place for ice cream.My favorite is their pumpkin shake (Fall season special).(My Sweetness tolerance is low) Their LARGE SIZE ice cream usually seems too sweet after having ice cream for a while. But love t |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 8/7/2021 | A delicious treat on a hot day! Staff was very friendly and helpful-- gave us a sample and let us order a little earlier than open. |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 4 | 7/28/2016 | This was great service and a fun crew! I got the banana cream pie with chocolate ice cream. I loved the flavor of this. It had freshly cut bananas, graham crackers and chocolate ice cream. YUM!! The only thing that I noticed |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 6/23/2015 | This is one of my favorite places to get ice cream in the CU area. It's a bit of drive, but it is worth it. It's about 10 minutes from the far side of Urbana. Getting there is really easy. The atmosphere of the Dairy Barn is very kid fr |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 5/1/2019 | I've been coming to this ice cream stand since I was a little girl back in the 1970's. (Yes, it's been here for that long! Just not under the same ownership.) But not much has changed in those years in regards to their basic ice |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 1 | 8/11/2016 | The soft-serve is way too sweet and has a strange Splenda-like aftertaste. The flavors tasted very artificial, and I ended up with a stomach ache when I got home... I really don't recommend this place, your simple Baskin Rob |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 11/5/2016 | My husband and I stopped here on the way back to Monticello from Westville (Go Sages!). He had a chocolate shake and I had a cookie dough tornado. Both were very tasty and refreshing. What a cute place filled with char |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 8/19/2015 | Little piece of heaven, the best ice cream shop near Champaign Urbana. Decent prices, superb taste; What else do you need on a hot summer day! This place is cash only, and sometimes you can smell cow dung. Other tha |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 2 | 7/26/2019 | Went here for the 1st time tonight. I ordered a turtle tornado. It was excellent. TONS of pecans and lots of flavor. I guess I could be picky and say that it melted incredibly fast. Too bad my wife and son didn't have the same e |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 4 | 3/30/2015 | Our bike club comes here often year round for evening ice cream cycling excursions from Champaign-Urbana. The staff is always VERY friendly and accommodating. The ice cream is tasty, although I do prefer the fattier tast |
| https://www.yelp.com/biz/sidney-dairy-barn-sidney | 5 | 5/18/2018 | Best ice cream in the area! I love their featured flavor of the week! The staff is always very friendly and the service is generally pretty fast! |

Analysis Plan and Justification

ANALYSIS FLOWCHART

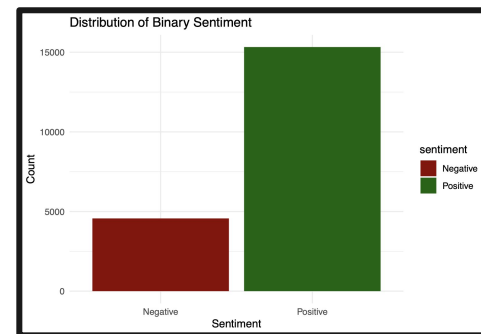
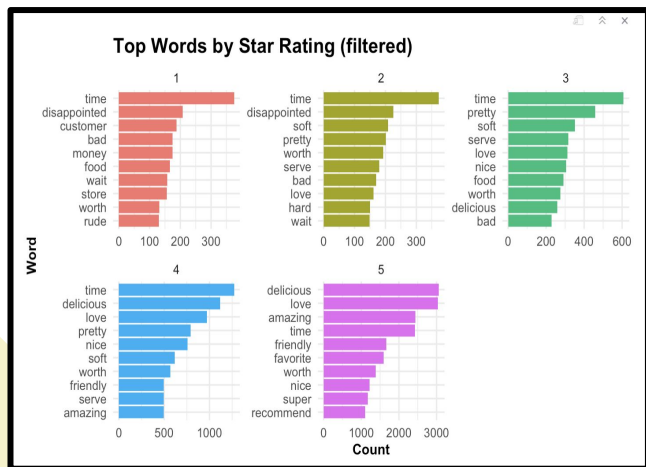


Analysis Plan:

- Preprocess data and perform basic EDA
- Create TF-IDF Features
- Model Training
 - Logistic Regression
 - Random Forest
- Model Evaluation
 - Confusion Matrices
 - Look at Accuracy, Precision, F1, Recall
 - Cross Validation

Challenges EDA Revealed:

- Skewed Ratings (4 and 5 Stars)
- Domination of Food Related Nouns



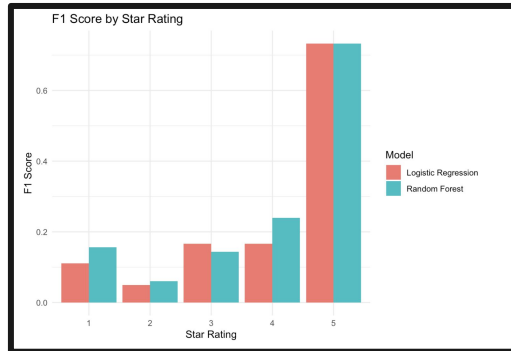
Tricky Analysis Decision

Initial Approach:

5 Star Classification System

- Random Forest: 55% accuracy
- Logistic Regression 56% accuracy

Decent at predicting 5 star scores (F1: 75%) but poor at lower star ratings (F1: 15-25%)

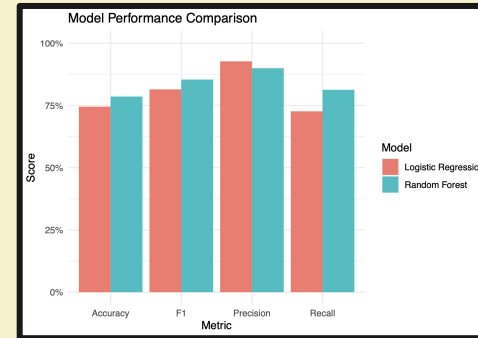


Revised Approach

Binary Classification (1-3 as negative and 4-5 as positive)

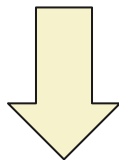
- **Random Forest: 78.56% accuracy**
- Logistic Regression: 74.49% accuracy

Improved accuracy, prediction, recall, F1, and ROC AUC: 0.832

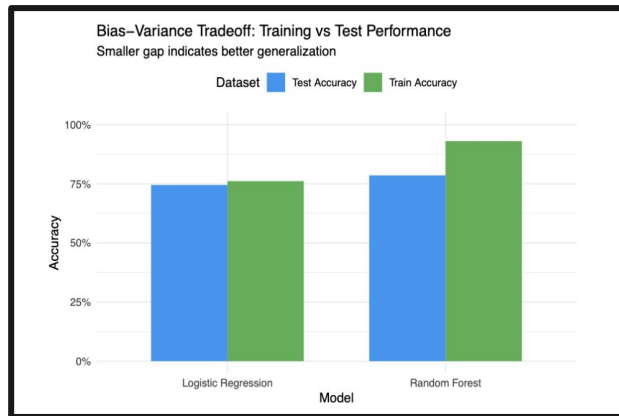


Bias and Uncertainty Validation

Machine Learning Bias

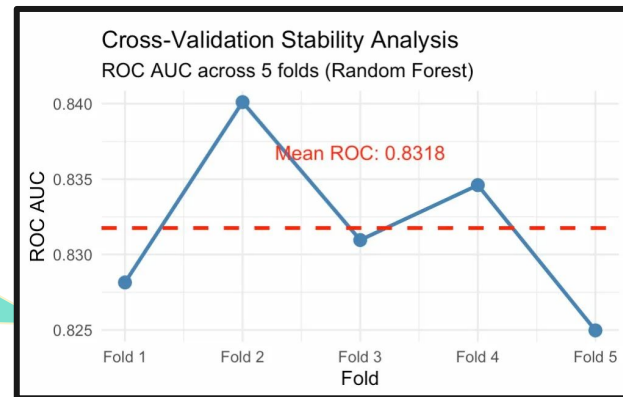


Train Test Split



Uncertainty Validation:
Cross Validation (ROC
AUC: 0.83)

Found that the Random Forest Model achieved better test performance!



Results and Conclusion

Hypothesis Supported: Reviews with positive sentiment language and shorter review length are more likely to receive higher ratings, while negative sentiment language is associated with lower ratings

Model Performance:

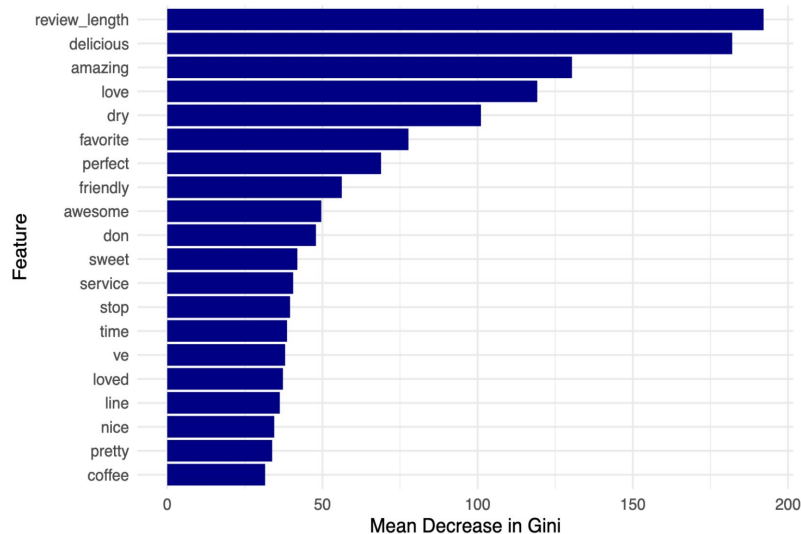
- Random Forest (binary classification): **78.6% accuracy**, ROC AUC = **0.83**
- Logistic Regression: **74.5% accuracy**
- Random Forest achieved the best balance of accuracy and recall

Key Findings:

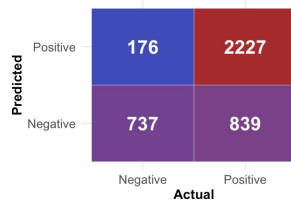
- **Review length** was one of the most important predictors, with negative reviews tending to be longer
- Positive words like *"delicious," "amazing,"* and *"love"* strongly predicted high ratings, while words like *"time," "disappointed,"* and *"rude"* were associated with low ratings

Conclusion: Yelp review language contains strong signals of customer satisfaction, and sentiment-focused text features can effectively predict restaurant ratings

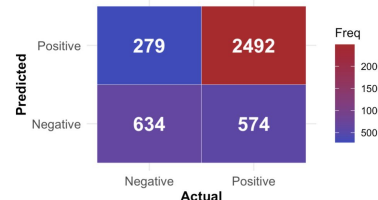
Top 20 Most Important Features



Logistic Regression - Confusion Matrix



Random Forest - Confusion Matrix



Next Steps

New Lines of Exploration

- Analyze temporal patterns in reviews to see how sentiment and ratings change over time or across seasons
- Incorporate reviewer history to separate individual bias from true sentiment

Improvement

- Use richer text representations to capture context beyond individual words
- Add additional features (like sentiment intensity or review structure) to refine model performance

New Questions

- Do the most predictive sentiment features differ by restaurant type or location?
- How well would this model generalize to non-dessert restaurants or other review platforms?

References and Acknowledgements

Github page: <https://github.com/KC-Night/DS-4002-Project1/tree/main>

[1] M. J. Baker and B. Hashimoto, "Expression of Customer (Dis)satisfaction in Online Restaurant Reviews: The Relationship Between Adversative Connective Constructions and Star Ratings," International Journal of Business Communication, vol. 61, no. 1, pp. 148–180, Jan. 2024, doi: 10.1177/23294884231200245. [Accessed: Jan. 30, 2026.]

[2] GeeksforGeeks, "Understanding TF-IDF (Term Frequency–Inverse Document Frequency)," Jan. 20, 2021. [Online]. Available: <https://www.geeksforgeeks.org/machine-learning/understanding-tf-idf-term-frequency-inverse-document-frequency/> [Accessed: Jan. 30, 2026.]

[3] National Restaurant Association, "National statistics." [Online]. Available: <https://restaurant.org/research-and-media/research/industry-statistics/national-statistics/> [Accessed: Jan. 30, 2026.]

[4] J. Pitman, "Local consumer review survey 2022," BrightLocal, 2022. [Online]. Available: <https://www.brightlocal.com/research/local-consumer-review-survey/> [Accessed: Jan. 30, 2026.]

[5] Kaggle, "Yelp restaurant reviews." [Online]. Available: <https://www.kaggle.com/datasets/farukalam/yelp-restaurant-reviews> [Accessed: Jan. 30, 2026.]

Closing: What Drives a 5-Star Review?

Big takeaway: How customers talk about their experience matters as much as what they ate.



Donna G.

Sidney, IL

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Sep 15, 2016

Hands down the best soft serve I've ever eaten. It's unlike any other soft serve. Love it, love it, love it !!!!!!!



Helpful 0



Thanks 0



Love this 0



Oh no 0

Questions?

