



# Machine Learning Final Project

Yelp Review Analysis for Chipotle with Natural  
Language Processing

Group 8

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## Executive Summary

Chipotle has been losing customers and isn't performing well in the competitive fast-casual dining industry these years. It tried many methods to improve customer experience and regain customers such as establishing new safety protocols and introducing digital ordering channels such as online and mobile app ordering. As Chipotle embraces increasingly modern strategies, we recommend a data-driven approach to help it improve business. In this project, we use several natural language processing tools to analyze its reviews on Yelp to discover areas of improvement and propose suggestions accordingly.

We first use Textblob to calculate the sentiment score of each review. Then, we draw word clouds for positive and negative reviews respectively to see what words appear frequently in positive or negative reviews.

Based on insights from word clouds, we use two other methods to conduct further analysis. First is topic modeling. We use it to extract six topics from all reviews, calculate the average sentiment scores for each topic, and draw a radar graph to show how positive each topic is. We can tell from the radar graph which topics are Chipotle's advantages and which are its disadvantages. The other is a time series analysis of word sentiment, through which we see how occurrence frequency of important words such as "line" and "burrito" in the positive or negative reviews change from month to month. Based on this, we observe the trend of Chipotle's key business aspects over time.

From our analysis, we discover that Chipotle is losing its edge of freshness and quality of ingredients. It has also been suffering from long customer wait times, which was mitigated by the mobile ordering app to some extent. However, wait time is still a serious problem at Chipotle that leads to customers leaving many negative reviews on Yelp. Therefore, we suggest that Chipotle should do more investigation on why the ingredients lose their freshness and qualities, and improve its online ordering system to cut the customer wait time.

## Introduction

Founded in 1993 by Steve Ellis, Chipotle Mexican Grill is a reputable American restaurant chain that has been serving Tex-Mex cuisine to more than one million customers daily. Chipotle falls in the fast-casual sector of the restaurant industry, sitting between the typical fast food establishments and the traditional full-service restaurants. Fast casual, as a new riser in the restaurant industry, contains great potentials for growth and opportunities. Compared to full service and fast food, fast casual makes up the smallest portion of the restaurant industry, taking only 7.7% of the restaurant market share. However, fast casual has been the fastest-growing segment of the restaurant industry and has not lost its momentum. According to the Top 500 Chain Restaurant Report, fast casual chains generated \$42.2 billion in total U.S. sales in 2018, which bested any other sector's growth that year (Maze).

As one of the first chains in the fast casual dining industry, Chipotle is in competition with fast casual establishments such as Taco Bell, Qdoba Mexican Eats and Panera Bread. To stand out in the competition, Chipotle builds its brand on the promise of "food with integrity". Such a promise is supported by Chipotle's key values including the freshness of its meal items and high-quality sourcing of its ingredients. Chipotle also maintains the classic cooking method to create tasty flavors. With such strategic factors, Chipotle is able to adopt a premium pricing strategy that offers customers best-quality products at a reasonable price. With this strategy, Chipotle successfully secured its spot in the restaurant industry. According to CSI Market, Chipotle holds 2.4% market share of the restaurant industry.

However, since 2015, Chipotle began to lose its customers due to a series of health issues such as norovirus, E.Coli and Salmonella that sickened a great number of consumers across the U.S. Because of these food scandals, Chipotle's revenue took a big plunge in 2015 and 2016. Behind the scene, consumers were losing trust in Chipotle's promise of "food with integrity". Since 2015, both profitability and reputation of Chipotle were on a decline. In 2018, Chipotle shut up to 65 underperforming stores as an effort to revamp and improve profitability (Wise).

## Problem Formulation

Since the negative impact from health scandals, Chipotle has strived to recuperate and regain its customers. It made several measures to address its weaknesses. First, Chipotle established new safety protocols to position the company as “industry leaders in food safety (Galarza).” Such protocols include rules such as branching fresh produce before they are used. This improvement in food safety aligns with the company’s goal of providing “food with integrity”. Chipotle also tried to address its shortcoming of a limited menu. It rolled out new menu items, including queso and quesadillas, to diversify its menu offerings. In early 2019, Chipotle introduced Lifestyle Bowls, diet-specific menu items made with ingredients that are already available (Taylor). This also shows the company’s attempt at providing wider and healthier food choices. Besides rectifying its weaknesses, Chipotle also sought additional channels such as online and mobile app sales to strengthen its business. In 2014, Chipotle introduced a mobile ordering app to let customers order and pay for food a few minutes before coming to the restaurant. This has helped reduce customers’ time in lines and improved their ordering experience. Concurrently, Chipotle has been making massive online orders and delivery pushes, including offering free deliveries to customers (Taylor). Now, Chipotle also partners with DoorDash to further improve its delivery experience. Chipotle’s push for digital sales aligns with its value of fresh food because it prepares its products with fresh and easy-to-preserve ingredients, which ensures the quality of delivered food.

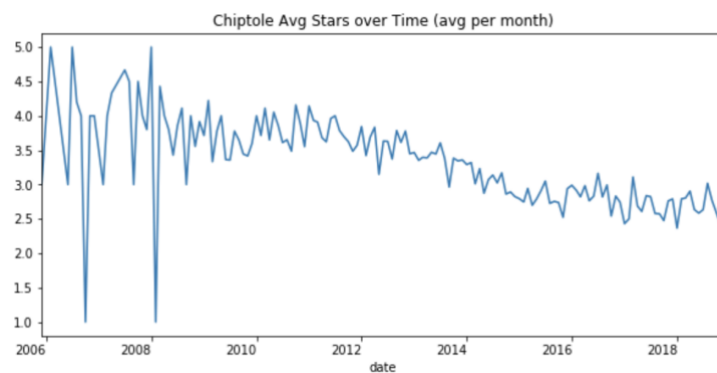
As Chipotle follows the general trend of E-commerce and becomes increasingly digital friendly, it is focusing more on its online channels. In response to this shift in strategy, we recommend Chipotle also pays attention to its online reviews. By analyzing its reviews, Chipotle can find valuable insights about key aspects or trends of its business and develop strategies accordingly to boost its business. In this project, we analyze Chipotle’s reviews on the Yelp platform using various natural language processing tools. With such a data-driven approach, we derive valuable insights about Chipotle and make recommendations on how to improve its business.

## Data Description & Preprocessing

### Data Description

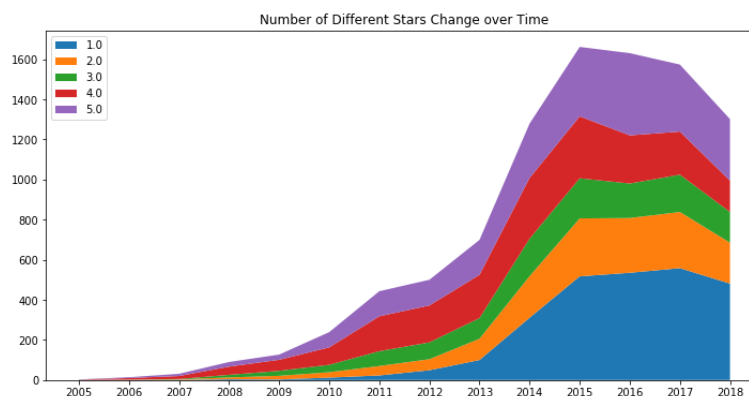
Yelp provides a comprehensive dataset in Yelp Challenge Dataset that includes all the merchants information such as addresses, tips, reviews, and reviewers. We merge the “business” table and the “review” table, and extract Chipotle’s information. There are 9590 reviews of Chipotle in total.

We calculate Chipotle’s monthly average star rating of reviews since 2006, and find that it gradually declines over time: back in 2010, the average review star was about 4.0, but now it is about 3.0 (Graph 1).



Graph 1

Graph 2 shows how the number and proportion of different stars change over time. As the time passes, 5-star and 1-star reviews increase in both number and proportion, with 1-star reviews increasing more significantly. This might be the main reason why the average star rating gradually declines in Graph 1.



Graph 2

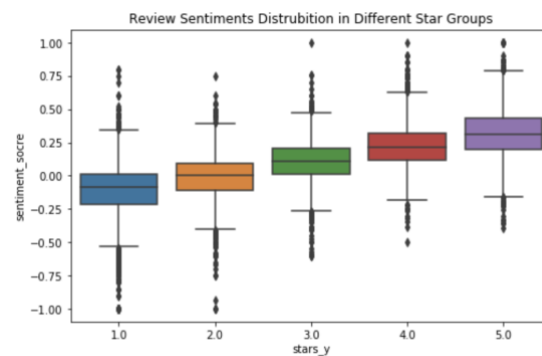
## Sentiment Scores

We use Textblob to assign each review a sentiment score to measure how positive or how negative the review is. If the sentiment score is greater than 0, the review is positive, and on the contrary, the review is negative. From Graph 3, we can see that positive reviews are twice as many as negative reviews.

Graph 4 is drawn to see the relationship between reviews stars and sentiment scores. Obviously, as the stars increase, the average sentiment score also increases. However, for 1-star reviews, they might be either positive or negative, but for 4-star and 5-star reviews, they are basically positive.



Graph 3



Graph 4

## Word Cloud

We first use word cloud to see the big picture of the reviews. We draw one word cloud for positive reviews and negative reviews respectively to see the difference. We remove the words that appear very frequently in both positive and negative reviews, including “chipotle”, “burrito”, and “place”, because they are very large in both graphs. We can see that the largest words in positive reviews are “meat”, “staff”, and “service”, while the largest words in negative reviews are “line” and “chicken”. Customers like the meat at Chipotle, but it seems that it is not the case for chicken. Even though the line in Chipotle may be a little long and customers have to wait for a little while, they are satisfied with Chipotle’s staff and service.



Graph 5



Graph 6

# Topic Modeling

With the big picture of the reviews in mind, we use topic modeling, specifically Latent Dirichlet Allocation via Mallet (LdaMallet), to extract key topics from all the words. Then, we measure the sentiment score of each topic to see in which aspects Chipotle does well and in which it does poorly.

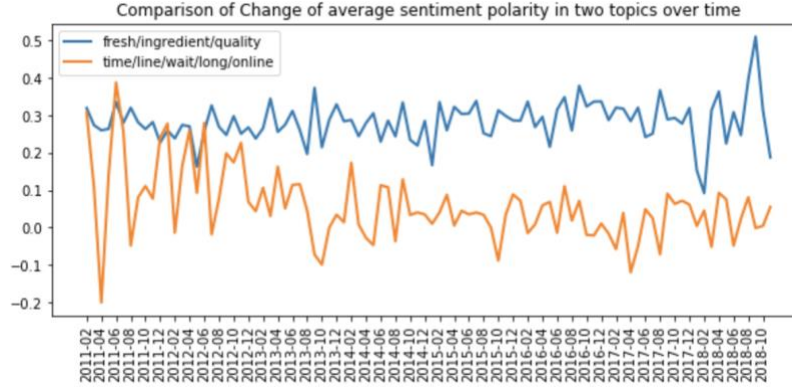
We draw a hexagon and add 0.1 for each score to make the comparison clearer. We can see from Graph 7 that the ingredient-related topic (fresh/ingredient/quality) gets the highest score, echoing Chipotle’s values of “freshness” and “integrity”. The environment-related topic (location/clean/nice/friendly) gets the second highest. Line-related topic (time/line/wait/long/online), food-related topic (meat/chicken/chip/rice/guacamole/steak/lettuce), service-related topic (service/employee/bad), and payment-related topic (pay/manager/cashier) get the lower scores.



Graph 7



We assign each review to the topic that takes the greatest proportion of that review and calculate the average sentiment score for all the six topics over time. To see the trends of 4 lower-score topics more clearly, we draw the graphs that compare each one of them with ingredient-related topic (fresh/ingredient/quality). We found that the average sentiment score of line-related topic (time/line/wait/long/online) floats around 0.1 before 2013, significantly declines in 2013, and then floats around 0 (Graph 8).



Graph 8

## Time Series Sentiment Analysis

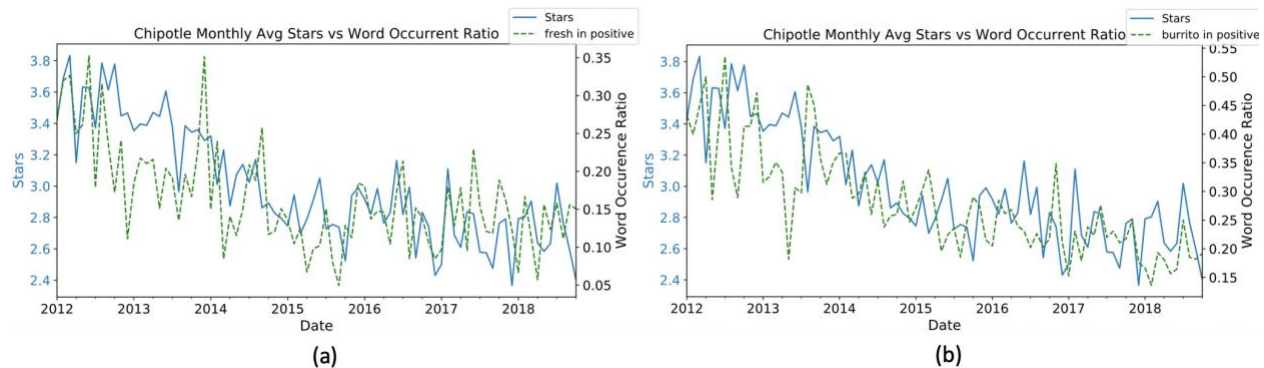
With a time-series approach, we visualize the change of sentiments of Words of Interest (WOI) together with the change of star rating on a monthly basis. We first define the metrics with which we measure the words' sentiments:

$$\text{Occurrence Ratio of WOI} = \frac{\text{Number of occurrence in reviews}}{\text{Total number of reviews}}$$

Like word cloud, we determine the sentiments of WOI based on its occurrence frequency in the positive/negative reviews. We normalize the occurrence because the total number of reviews varies from month to month. Thus, the metric measures the normalized frequency of WOI in reviews of either sentiment category. As shown in Appendix 1.1, both positive reviews and negative reviews gradually increase overtime. We also decide to only analyze reviews after 2012, because there were too few reviews before 2012 (Appendix 1.1). We use three approaches to interpret our visualizations of the metrics.

## 1. Decrease of Occurrence Ratio of WOI in Positive Reviews

If a word used to have a high positive ratio, we can say it served as the strength of the business. The decrease of positive ratio indicates the restaurant is losing edge in this aspect. Based on Graph 9, Chipotle should investigate the freshness of its menu items and the quality of its burrito products.

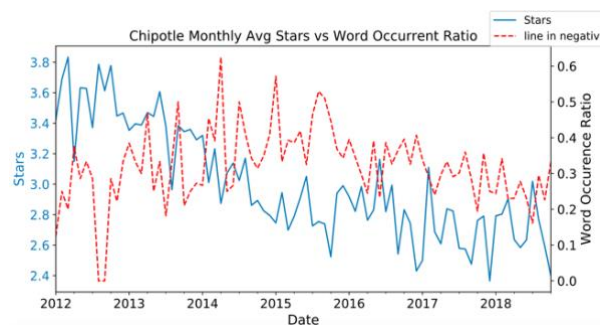


Graph 9

Graph 9 (a) The occurrence ratio of “fresh” - the key value of Chipotle - in positive reviews decreases by half, dropping from 0.3 to 0.15. (b) The same applies to Chipotle’s main product, “burrito”, dropping from 0.4 to 0.2.

## 2. Increase of Occurrence Ratio of WOI in Negative Reviews

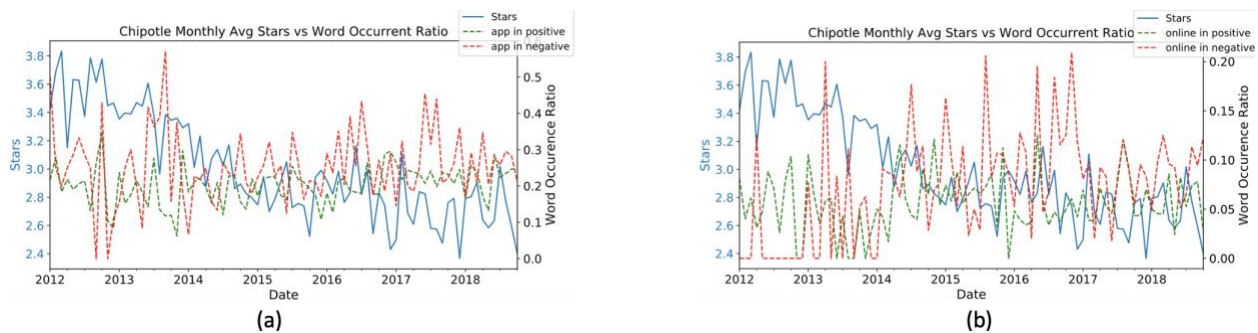
A WOI that has a higher occurrence ratio in negative reviews indicates Chipotle may underperform in this aspect. It can be seen from Graph 10 that the occurrence ratio of “line” increases from 2012 and decreases from 2015 onward. The decrease reflects Chipotle’s launch of its mobile ordering app in 2014, which aims to reduce line. Therefore, we may infer that Chipotle’s strategy in alleviating customers’ wait times through digital ordering was a success. Moving forward, Chipotle should pursue this initiative.



Graph 10

### 3. Comparison of Occurrence Ratios of WOI in Both Reviews

If a WOI has a higher occurrence ratio in positive reviews than in negative reviews, it is a positive sentiment. We visualize “great” as the baseline (Appendix 1.2). Consequently, when a neutral WOI has a higher occurrence ratio in positive reviews than in negative reviews, it can be regarded as a positive aspect of the business. Vice versa. Graph 11 shows that both “online” and “app” are neutral words but have consistently higher occurrence ratios in negative reviews than in positive reviews. This indicates that Chipotle is underperforming in the digital commerce channel. It needs to improve its mobile ordering app and online ordering system to enhance customer buying experience.



Graph 11

## Recommendations

Based on our analysis findings, we make recommendations to Chipotle in the areas of ingredient quality, wait times and digital ordering.

From topic modeling, we find that the ingredient-related topic (fresh/ingredient/quality) has the highest sentiment score, which aligns with Chipotle’s strategic advantage of providing fresh food with integrity. However, by visualizing the sentiment of the key word “fresh” over time, we discover that “fresh” is slowly disappearing in the positive reviews. This indicates that, from the perspective of consumers, Chipotle is losing its edge in sourcing fresh ingredients. Thus, Chipotle should investigate the freshness and quality of its ingredients for improvement to regain its strategic strength. On another note, we recommend Chipotle investigate its supply chain to see how to improve the quality and taste of its proteins, especially chicken,

which appears very frequently in negative reviews according to the word cloud. In terms of its menu items, Chipotle also needs to investigate the current quality of its most important product, burrito, which is seen less and less in positive reviews. Some market research can also be done on burrito to see why burrito is losing its appeal to customers.

On the other hand, wait times and lines are clearly a problem at Chipotle. Both topic modeling and word cloud show that “line” is a big contributor to customers’ negative sentiment towards Chipotle. To address this, Chipotle has sought digital channels such as online ordering and mobile app ordering. The wait time issue was ameliorated by the introduction of mobile app ordering in 2014, as shown in the sentiment analysis. However, this is not enough. We find that both “online” and “app” have a more negative note in the customers’ reviews, indicating dissatisfaction with Chipotle’s digital ordering experience. In this light, Chipotle needs to improve its online ordering system and mobile app, in order to better solve the wait time problem and improve customers’ buying experience.

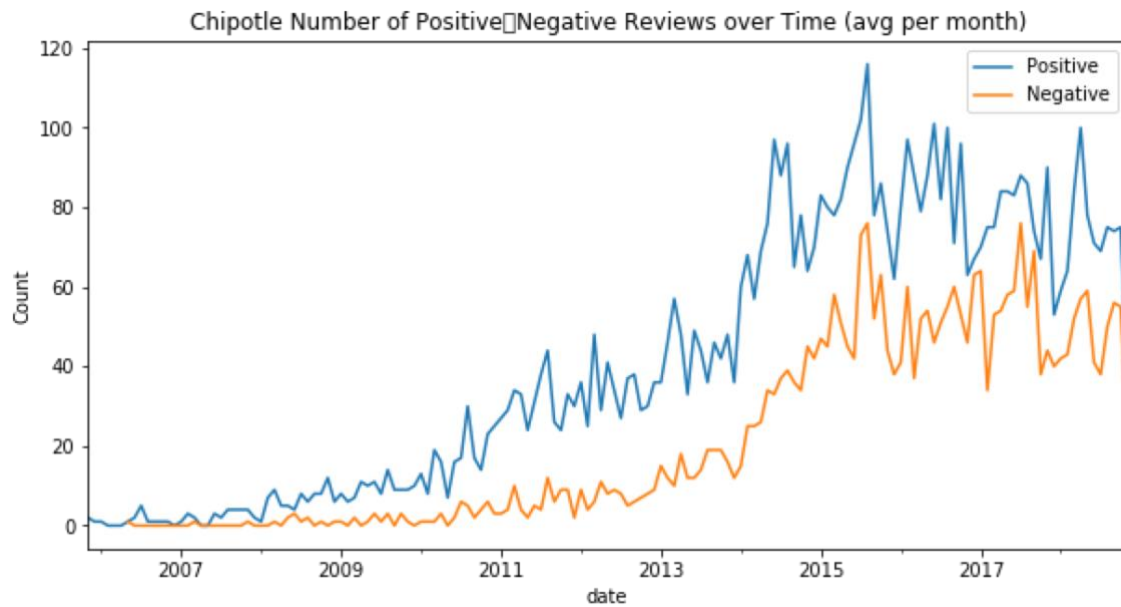
## Conclusions

Chipotle didn’t perform well these years, so we analyze its reviews on Yelp to find out the reasons. Combining the insights from word cloud, topic modeling, and time-series sentiment analysis, we draw the conclusion that Chipotle is not maintaining its edge of freshness and the good quality of food like it did before. The wait time customers spend in line is another serious problem at Chipotle. Although the mobile app and online ordering system mitigate the problem to some extent, they still need to be improved to truly solve the wait time problem and enhance customers’ buying experience. To sum up, we recommend that Chipotle should improve its ingredients’ freshness and quality, as well as the digital ordering systems, to regain customer satisfaction and rejuvenate its business.

## Appendix

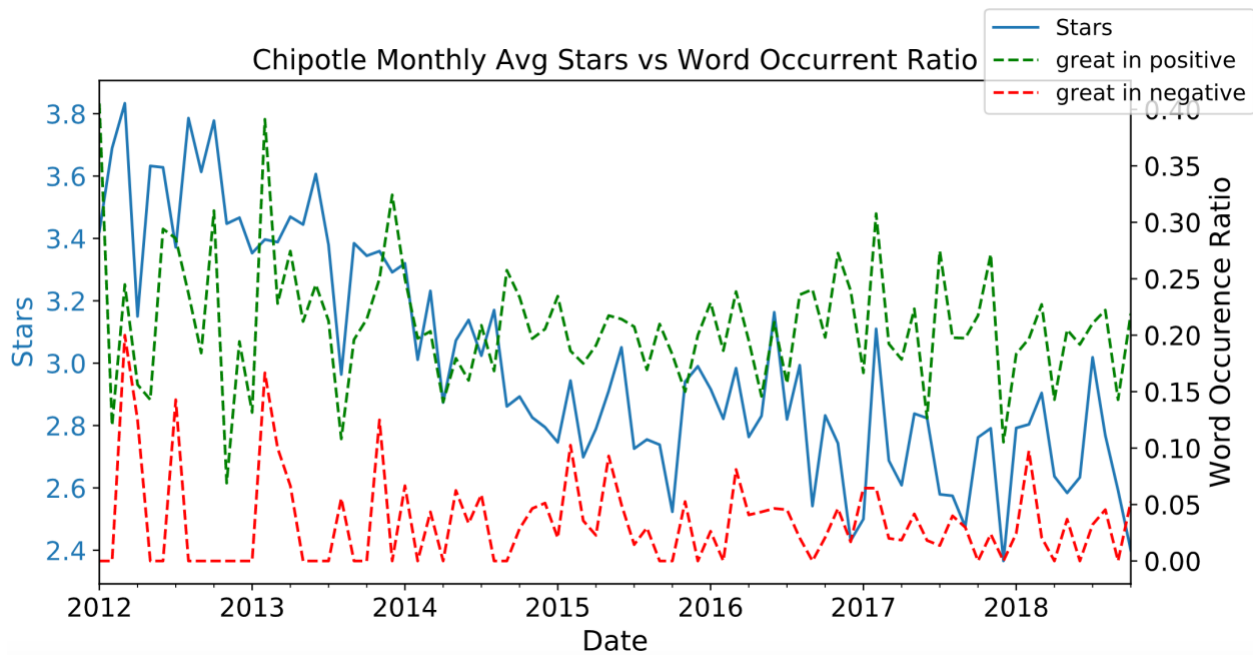
### Appendix 1.1

Both positive reviews and negative reviews gradually increase overtime.



## Appendix 1.2

We visualize “great” as the baseline for the comparison between occurrence ratios in positive reviews and negative reviews. As a positive word, “great” consistently has a higher occurrence ratio in positive reviews.



## References

1. Maze, Jonathan. "Fast-Casual Chains Are Still Growing." *Restaurant Business*, Restaurant Business, 10 May 2019, [www.restaurantbusinessonline.com/financing/fast-casual-chains-are-still-growing](http://www.restaurantbusinessonline.com/financing/fast-casual-chains-are-still-growing).
2. Wise, Alana. "Chipotle CEO Plans Marketing Blitz, Closing up to 65 Stores." *Reuters*, Thomson Reuters, 28 June 2018, [www.reuters.com/article/us-chipotle-investor/chipotle-ceo-plans-marketing-blitz-closing-up-to-65-stores-idUSKBN1JN33S](http://www.reuters.com/article/us-chipotle-investor/chipotle-ceo-plans-marketing-blitz-closing-up-to-65-stores-idUSKBN1JN33S).
3. Galarza, Daniela. "Chipotle's Recovery Plan, Explained in Five Easy Steps." *Eater*, Eater, 3 Feb 2016, [www.eater.com/2016/2/2/10900204/chipotle-turnaround-sales-down](http://www.eater.com/2016/2/2/10900204/chipotle-turnaround-sales-down).
4. Taylor, Kate. "Taco Bell's Ex-CEO Used These 6 Strategies to Spark Chipotle's Incredible Turnaround." *Business Insider*, Business Insider, 25 Apr. 2019, [www.businessinsider.com/chipotles-turnaround-strategy-pays-off-2019-4#new-menu-items-1](http://www.businessinsider.com/chipotles-turnaround-strategy-pays-off-2019-4#new-menu-items-1).