
**FROM RATINGS TO REVENUES:
THE IMPACT OF SOCIAL MEDIA
ON THE RESTAURANT INDUSTRY**

BY

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Abstract

In a digital age where social media and the dining culture are quickly converging, consumers are becoming increasingly dependent on and heavily influenced by user-generated content in restaurant rating websites such as Yelp, Zagat, Foursquare, and Groupon. In this paper, we investigate whether user ratings have any statistically significant association with restaurant revenues. We also examine the factors that influence how customers rate their dining experience and the restaurant attributes that induce them to give higher ratings. We employ a regression analysis on data set of restaurants in New York City and verify, among other relevant findings, that there is a positive correlation between ratings and revenues. The results of this study collectively provide insights on how restaurateurs can utilize social media and its user-generated content to improve decision making, meet customer needs, and maximize their revenues.

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I dedicate this thesis to my parents, Stanley and Kathryn, as well as to my brothers, Alvin and Albert for instilling in me an insatiable interest and appetite for cuisine from an early age. Our weekly conversations about new dishes and new restaurants collectively inspired the conception of this thesis.

Chapter 1: Introduction

Overview of the study

My thesis aims to analyze if and how social media affects the performance and profitability of the restaurant industry in New York City. The definition of social media that I have used is “forms of electronic communication through which users create online communities to share information, ideas, personal messages, and other content,”¹ and for the purposes of this study, I have limited the definition to user-generated content that have a direct impact on the restaurant industry. I have studied such content from four specific websites, namely Yelp, Zagat, Foursquare, and OpenTable. Through analyzing the data extracted from those four websites, this study intends to achieve objectives including but not limited to the following:

- To measure the impact of social media in the form of restaurant rating websites on the revenues of restaurants located in New York City
- To distinguish the factor(s) of the dining experience that is/are most influential in the customer rating process
- To identify the types of pricing tiers, cuisines, and business models of restaurants that earn higher ratings from customers

Purpose and significance of the study

This work is considered significant by a wide audience due to the rising prominence of social media marketing in New York City. As social media conventions and roundtables

¹ “Social media.” Def. 1. *Merriam-Webster Online*, Merriam Webster, n.d. Web. 13 May 2013.

increase in number, the city's respect and understanding for the sector is steadily growing as well, alongside its well established yet progressively evolving restaurant industry. In fact, New York has earned itself the title of being the nation's restaurant capital, as its restaurant culture was a major catalyst of the development of the state and the nation at large. The centrality of the restaurant sector in the identity of New York is explained by a 2010 study conducted at Lehman College:

“Restaurants... dished up more than just food. They also provided a staging ground for social interactions and stratification, for gender mores and conventions, and for the working out of social relationships and public behavior in the increasingly complicated metropolis. Gotham's restaurants... were among the quintessential urban institutions of the nineteenth century, and, in accommodating their growth and proliferation, New Yorkers accommodated the urbanization of their culture.”²

The said topic is of great interest to me and in my opinion was worth pursuing because the spheres of social media and the restaurant industry both play important roles in shaping our culture today. Moreover, these two spheres are becoming increasingly correlated. Of the billions of real-time social media conversations that occurred within the second half of 2012, three product categories notably dominated social media share of voice (SOV)—Restaurants, Beverages, and Consumer Technology, all of which are closely related and relevant to this study (see Appendix, Figure 1). Restaurants took up a

² Cindy Lobel, “Out to eat,” *Winterthur Portfolio* 44, 2010: 193-220.

33.4 percent share that includes Starbucks, Burger King, and McDonalds, each of which garnered at least 2.3 million mentions each.³

The reason behind the dramatic increase in restaurant social media SOV is that as the restaurant industry becomes more and more competitive, restaurants are increasingly using social media to connect with tech-savvy customers. According to the National Restaurant Association, 90 percent of restaurateurs perceive social media as an important marketing tool, 95 percent guarantee presence on Facebook and 78 percent on Twitter in the next 2 years. In return, consumers are also using social media to seek ways to improve their dining experiences. Of the entire American consumer population, 28 percent select a restaurant by using social networking websites, while 40 percent use daily deal programs such as Groupon and LivingSocial to do so. In addition, 27 percent visit websites that are heavy on user-generated content such as Yelp, to view or post restaurant reviews.⁴ The prevalence of social media activity and its effects on the interactions between restaurateurs and customers makes this study relevant and significant in today's digital age.

Research questions

In correspondence with the aforementioned objectives, I first formulated one main question that serves as the main focus of this study, followed by two secondary questions that branch out from the primary question. The questions are as follows:

³ "Research shows restaurants dominate social media conversations," 12 July 2012, *Pizza Marketplace*, May 2013 <<http://www.pizzamarketplace.com/article/211055/Research-shows-restaurants-dominate-social-media-conversations>>.

⁴ Joann Pan, "Most Restaurant-Goers Rely on Online Reviews," 14 May 2012, *Mashable*, 13 May 2013 <<http://mashable.com/2012/05/14/technology-in-restaurants>>.

- 1) Is there a correlation between user-generated content such as restaurant ratings and revenues?
- 2) Which factor(s) of the dining experience is/are most influential to how a customer rates a particular restaurant?
- 3) What types of restaurants tend to earn higher ratings from customers, with respect to cost, cuisine, and business model?

Research model and hypotheses

In response to my research questions, I hypothesize that there is a positive correlation between restaurant ratings and revenues. I expect that higher ratings on restaurant rating websites such as Yelp and Zagat or check-in websites such as Foursquare would attract both old and new customers to the restaurants, and an increase in customer count would inevitably increase the revenue of those restaurants. I also expect that higher ratings on online reservation systems such as OpenTable would attract more reservations at a particular restaurant, and restaurant availability would most likely exhibit an inverse correlation with customer count. In other words, the more difficult it is to book a table, the higher the demand for the restaurant and the higher the revenue it generates within a given period of time.

I also hypothesize that food quality and customer service are the most important factors that make up a dining experience, which gives these two factors the greatest impact on how a customer rates or gives a review about a particular restaurant. Other factors such as atmosphere or ambiance would also have an effect on ratings but less so than the quality of the food and customer service.

Finally, with respect to cost, cuisine, and business model, I hypothesize that the restaurants that tend to receive higher ratings are the upscale, Western independent restaurants. I expect that upscale restaurants are charging a premium to enable them to serve better food, décor, and service. Since we are studying the behavior of an American population, I assume that the taste for Western food is dominant and that the taste for Asian food may have yet to be developed and acquired. As for the business model, I believe chain restaurants often have mediocre quality of food and customer service due to the challenges of maintaining operational efficiency and consistency across the chain, which means that independent restaurants tend to receive higher ratings from customers.

Outline of subsequent chapters

Chapter 2 provides the theoretical framework for the study, including previous similar studies that I have used for reference for replication or improvement. Chapter 3 contains the technical approach that I employed in order to parse, organize, and analyze the necessary data sets. Chapter 4 discusses the results and findings that specifically address each of the three research questions. Chapter 5 lays out a summary of the study, its limitations, and academic and practical implications. The Appendices section contains figures and other additional information for clarification as referred to accordingly throughout the main text.

Chapter 2: Theoretical Background and Related Work

History of restaurant ratings

Although the institution of the modern restaurant dates back to the eighteenth century in France, restaurant reviews did not exist until the nineteenth century. Pioneered by A. B. L. Grimod de La Reynière, the first edition of the *Almanach des Gourmands* was published in 1803 and introduced the practice of restaurant rating as we know it today.⁵

Notable milestones throughout the history of restaurant rating include the publication of the first Michelin guide in 1900, which popularized the star system for ranking restaurants; the compilation of the first *The Good Food Guide* by Raymond Postgate in 1933 which actively encourages readers to submit reviews for inclusion; and finally, the creation of online restaurant rating and review websites in 2004, which continues to proliferate and integrate themselves into the present generation's lifestyle. The technological advancement of our generation has truly caused a paradigm shift in the way restaurants communicate with its potential and existing customers.

The “always-on, always-connected” digital lifestyle has altered customer expectations by enabling the simultaneous accessibility of multiple customer service channels with an emphasis on social media. The online community expresses this cultural shift through an increased reliance on restaurant websites, online menu and ordering systems, daily deal programs, and user-generated restaurant ratings and reviews (see Appendix, Figure 2).

⁵ “Yelp Lesson: History of Restaurant Reviews,” 19 November 2009, *Yelp*, 13 May 2013 <<http://www.yelp.com/topic/san-diego-yelp-lesson-history-of-restaurant-reviews>>.

Theoretical framework

Although the importance of social media and its influence on consumer behavior is widely acknowledged and accepted today, my goal is to verify and measure its quantifiable impact on the performance of the restaurant industry in New York City. Two research studies conducted in 2011 have attempted to solve similar problems and established a theoretical background for my research methodology and technical approach, which will be discussed in Chapter 3.

In September 2011, a Harvard Business School study by Michael Luca explored the effects of online consumer reviews on restaurant demand.⁶ In order to do so, he analyzed a merged data set of Yelp ratings and restaurant data from the Washington State Department of Revenue for restaurants in Seattle from 2003 to 2009. He then tested the hypothesis that Yelp has a causal impact on restaurant revenue using a regression discontinuity approach by employing the following regression equation:

Where, $\ln(\text{Revenue}_{jt})$ is the log of revenue for restaurant j in quarter t , β is the coefficient that represents the impact of a 1-star improvement in rating on a restaurant's revenue, T is a binary variable that indicates the position of the rating relative to the rounding threshold, and q_{ojt} is the unrounded average rating.

Luca's key findings can be summarized in three statements. First, a one-star increase in Yelp rating does have a causal impact in the form of a 5-9 percent increase in revenues,

⁶ Michael Luca, "Reviews, Reputation, and Revenue: The Case of Yelp.Com," Harvard Business School 12-016 (2011): *Social Science Research Network*, 13 May 2013 <<http://ssrn.com/abstract=1928601>>.

which Luca derived using the described regression discontinuity approach for his data set of Seattle restaurants. Second, the ratings have a greater impact on restaurant revenues than the reviews, as it is more practical to compare restaurants using their overall average ratings than read through numerous reviews on different restaurant pages. Third, a greater number of restaurant reviews translates into a greater causal impact on that restaurant's revenues.

Similarly, Berkeley economists Michael Anderson and Jeremy Magruder implemented a regression discontinuity design using the following estimating equation:

Where, y_{it} represents the availability of a reservation for a party of four at a particular hour in restaurant i on date t , DR_{it} is the rating that Yelp displays next to the restaurant's name, and R_{it} is the actual average rating of reviews for that restaurant.

Anderson and Magruder examined 328 restaurants in Yelp's most active market, San Francisco and merged two data sets consisting of Yelp star reviews and the availability for a table for four on Thursday, Friday, and Saturday evenings.⁷ The reservation availability data was extracted from an unnamed "large online restaurant reservation website." Their findings estimate that a half-star rating increase causes restaurant reservations to sell out 19 percentage points more frequently. Particularly, a shift from 3 stars to 3.5 stars increased a restaurant's likelihood of selling out at the 7:00 p.m. prime

⁷ Michael Anderson and Jeremy Magruder, "Learning From The Crowd: Regression Discontinuity Estimates of the Effects of an Online Review Database," *The Economic Journal* 122.563 (2011): 957-989, *Wiley Online Library*, 13 May 2013 <<http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0297.2012.02512.x/abstract>>.

time from 13 percent to 34 percent, while a shift from 3.5 stars to 4 stars increased that likelihood to 54 percent (see Appendix, Figure 3). The study also finds that an increase of 6-8 percent in customer count yields additional weekly gross profits of up to \$816, which when accumulated over time makes a significant difference in the long-term profitability of a restaurant. However, one must note the Yelp star ratings were recorded in February 2011, while reservation availabilities were from the four-month period of July to October 2010. Since restaurant ratings can change quickly, the time mismatch between the two data sets has raised questions regarding the accuracy of the data.

Regardless, both studies confirm the positive impact of Yelp ratings on restaurant performance, whether in the form of revenues or reservation availability. However, the New York research analytic company NPD Group seemingly contradicts these studies by affirming that the influence of online ratings and reviews is relatively weak. According to an NPD research report in August 2012⁸, online marketing influenced an unsubstantial 6 percent of research respondents, of which only 14 percent were influenced by online reviews and recommendations (see Appendix, Figure 4). Angelsmith, Inc., a digital marketing agency in California, also conducted a survey in August 2012 on the influence of user-generated reviews websites. Among over 500 respondents, nearly 50 percent revealed that the top influence of their dining decisions is a trusted friend, family member, or co-worker, while 22.8 percent consider user-generated review websites as most influential. Meanwhile, upon receiving a personal recommendation, 80 percent of the group of respondents performs additional research—27.7 percent from user-generated

⁸ Paula Forbes, "Surprise: Diners Don't Pay Much Attention to Yelp Reviews," 13 July 2012, *Eater National*, 13 May 2013 <<http://eater.com/archives/2012/07/13/surprise-diners-dont-pay-much-attention-to-yelp-reviews.php>>.

review websites, 27 percent from restaurant websites, 25.2 percent from other friends, and 16.4 percent from food blogs.⁹ While restaurant rating websites do not appear to have a strong influence on consumers, they could possibly have a greater influence on the long-term performance and profitability of restaurants.

On factors: food vs. décor vs. service

As for the factors that influence the customer rating process, a study done by Yelp concludes that customer service has the greatest impact on ratings. Yelp generated a word cloud to visually represent the text data contained in positive reviews, in which larger font size represents greater usage frequency of that word. The words “friendly”, “nice”, and “helpful” appeared to have been most frequently used by Yelp users (see Appendix, Figure 5). The set of reviews taken under consideration is a suitable representation of user behavior, as Yelp users notably give more positive reviews than negative (see Appendix, Figure 6). Yelp adds that a review mentioning good customer service is more than five times as likely to be accompanied by a 5-star review than a 1-star review, and approximately 70 percent of reviews mentioning bad customer service come with a 1-star review.¹⁰ These findings highlight the importance of customer service in the customer rating and review process.

⁹ Carin Oliver, “Why Influencers Matter To Restaurants,” *Angelsmith*, 13 May 2013 <<http://angelsmith.net/blog/why-influencers-matter-to-restaurants>>.

¹⁰ Todd Wasserman, “11 Things You Didn't Know About Yelp,” 3 September 2012, *Mashable*, 13 May 2013 <<http://mashable.com/2012/09/03/10-yelp-facts>>.

On cost: upscale vs. affordable restaurants

Dan Grigsby, a partner at mobile development agency Drivetrain used a behavioral economics theory called the “endowment effect” to study the correlation between price and average rating of mobile applications.¹¹ While the average rating for top 10 paid applications was 3.9 out of 5.0 stars, free applications averaged at 3.4, and every price increase is associated with a corresponding ratings increase (see Appendix, Figure 7). I will be investigating whether a similar phenomenon occurs in the restaurant rating system by observing if upscale restaurants receive higher average ratings than affordable restaurants.

On cuisine: Western vs. Asian cuisines

My interest in studying the perceptions towards different cuisines was motivated by an article discussing Chinese restaurant service performance in the Midwestern United States. The article stresses that of the three most popular ethnic cuisines in the United States (Italian, Mexican, and Chinese), the Chinese restaurant industry is a remarkably important sector. According to the Chinese Restaurant News, the total number of Chinese restaurants has exceeded the total number of McDonald’s and Burger Kings combined, and those 46,700 establishments nationwide generate annual revenues of over \$20 billion.¹²

¹¹ Dan Grigsby, “App Store Heresies,” 15 October 2009, *Mobile Orchard*, 13 May 2013 <<http://mobileorchard.com/app-store-heresies-higher-price-better-ratings-dont-discount-your-app-at-launch>>.

¹² Jintao (Emily) Ma, Hailin Qu, David Njite, and Su Chen, “Western and Asian Customers’ Perception Towards Chinese Restaurants in the United States,” *Journal of Quality Assurance in Hospitality & Tourism*, 12:2 (2011): 121-139, *Taylor & Francis Online*, 13 May 2013. <<http://www.tandfonline.com/doi/pdf/10.1080/1528008X.2011.541818>>.

I conducted interviews with classmates regarding their perceptions towards Western restaurants and Asian restaurants, and one respondent discussed his regression analysis project on Michelin-awarded New York restaurants. His findings reveal that while there seems to be very minimal patterns between the ratings, prices, and cuisine types, Asian restaurants are relatively newer and less established compared to its Western counterparts. As such, they have greater marginal benefits per additional star and thus greater incentive to impress their customers.

However, the non-awarded majority seems to paint a different picture. The Chinese restaurant industry is generally known for its poor image and poor customer service. A striking example is the Big Wong King restaurant in the Chinatown of Manhattan. Despite a sanitary rating of C, it has a 4-star rating and 640 reviews on Yelp and an overall rating of 83 percent on Zagat as of May 2013. To shed light on this observation, I will be comparing the overall ratings of both Western and Asian restaurants, categorized by type of cuisine.

On business model: chain vs. independent restaurants

Michael Luca discusses that chain restaurants showed minimal to no relationship between its revenues and ratings received on Yelp¹³, despite their wide accessibility and sizable aggregated annual revenues of approximately \$125 billion, which represents over 50 percent of the revenues of the American restaurant industry (see Appendix, Figure 8). Meanwhile, as Yelp's penetration of a market increases, restaurant revenues appear to

¹³ Michael Luca, "Reviews, Reputation, and Revenue: The Case of Yelp.Com," Harvard Business School 12-016 (2011): *Social Science Research Network*, 13 May 2013, <<http://ssrn.com/abstract=1928601>>.

shift away from chains toward independent restaurants. In order to verify this phenomenon, I will be comparing the overall rating of chain restaurants against that of independent restaurants.

Chapter 3: Methodology

Technical approach

Problem areas that researchers have found in common include the difficulty of determining the direct correlation between ratings and revenues, as social media and its effects are extremely tricky to isolate and difficult to quantify. In addition to that, majority of restaurants do not disclose their revenue figures publicly, so researchers resort to using revenue proxies such as reservation availability in the study by Anderson and Magruder. In light of these constraints and limitations, I will also be using proxies for revenues, which I will further discuss in the latter part of this chapter.

To add specificity to the research problem, I have formulated three research questions that are designed to generate specific answers. As discussed in Chapter 1, this study is focused on answering the primary question, “Is there a correlation between user-generated content such as restaurant ratings and revenues?” This is followed by two additional questions that address the factors that influence the customer rating process and identify the types of restaurants that earn higher ratings from customers.

After careful consideration of research objectives and theoretical findings, I approached the study using the three-step process outlined below:

- Step 1: Parse online restaurant rating websites
- Step 2: Organize parsed data into Excel data sets
- Step 3: Analyze data using regression models and other statistical methods

Research design

First, to parse the necessary data, I hired two freelancers to collect information through Web scraping, a technique employed to extract large amounts of data from websites using a web crawler or an Internet bot that systematically browses a specific set of webpages. Instead of manually copying the data from websites, the Web scraping software will perform the same task within a fraction of the time. All information was obtained within the same time frame to avoid any discrepancies or mismatches in data.

To define the research subject population, I limited this study to restaurants located within New York City, and the set of restaurants does not include establishments that primarily serve beverages such as bars or cafés. After obtaining the parsed list of restaurants, I ensured that the restaurants had profiles on each of Yelp, Zagat, Foursquare, and OpenTable, as I will be using metrics from all four websites simultaneously in my analysis. I also filtered out the restaurants with less than 500 reviews to confirm the credibility of the ratings as well as the sustainability of the restaurant quality over time, as the initial operations of a newly opened restaurant is usually not indicative of its long-term performance. After meeting all these requirements, I obtained a final sample of approximately 150 restaurants.

Second, to organize the combined data set, I selected the characteristics that would be relevant and appropriate for this study, as described in the following table:

Source	Selected characteristics
Yelp	<ul style="list-style-type: none"> • Business name • Average user rating • Number of reviews
Zagat	<ul style="list-style-type: none"> • Food, décor, and service ratings • % Liked user rating • Average cost of a meal • Number of users • Number of favorites
Foursquare	<ul style="list-style-type: none"> • Average user rating • Number of people • Number of check-ins • Date of first review
OpenTable	<ul style="list-style-type: none"> • Average user rating • Reservation availability data

Finally, after organizing the parsed data into Excel data sets, I found that the most suitable technical approach for this study is a regression analysis. As discussed in Chapter 2, previous studies have similarly employed methods involving regression analysis to measure correlations between ratings and revenue proxy variables. Previous studies discuss regression discontinuity approaches due to the Yelp rating system—Yelp rounds average ratings to the nearest half-star, so a 3.74 average rating rounds down to a 3.5, while a 3.76 average rating rounds up to a 4. However, the parsed list that I obtained already had its star ratings rounded to the nearest half-star, so it was unnecessary to consider discontinuity approaches.

For the regression analysis, the logarithm of a daily revenue estimate (“DRE”) served as the independent variable or revenue proxy. The daily revenue estimate represents the average daily revenue from Foursquare users when they check-in to a particular

restaurant. To calculate the estimate, the number of Foursquare check-ins is expressed as a fraction of the number of days since the first review on Foursquare, multiplied by the average cost of a meal as estimated by Zagat:

The formula should eliminate any inconsistencies concerning the differences of restaurant opening dates or Foursquare profile registration dates. Also, an upscale restaurant is likely to have fewer check-ins in a day as opposed to a more affordable restaurant, which means that the number of check-ins alone would not be indicative of the revenues received in a day. I measured the relationship of the daily revenue estimates with both Yelp and Zagat ratings in order to confirm the validity of the relationship, if any, between ratings and restaurant revenues.

I used a total of seven dependent variables, which are the Yelp rating, Zagat % Liked, Foursquare rating, OpenTable rating, the logarithm of the number of Yelp reviews, a reservation difficulty metric, and a customer retention metric. I decided to include the number of Yelp reviews because of its impact on ratings and revenues, which is highlighted in the discussion in Chapter 2. Also, instead of the actual values, the natural logarithms of the daily revenue estimate and number of Yelp reviews are taken in order to normalize their fat-tailed distributions and linearize their relationship with the other variables.

The reservation difficulty metric represents the percentage of unavailable time slots for any given restaurant, which is obtained by recording the availabilities of restaurants for

each of the dinner reservation timeslots. Specifically, the reservation availability data is obtained for a table for 4 on Saturday from 5:00 p.m. to 11:00 p.m., measured in 25 15-minute intervals. A portion of the data set of reservation availabilities is illustrated below:

OpenTable Reservation Availabilities for a table for 4 on Saturday, April 13 at 7:00 p.m. (recorded on Sun Apr 7)

Restaurant Name	5:00	5:15	5:30	5:45	6:00	...	10:00	10:15	10:30	10:45	11:00	%Availability
Bouley	1	1								1	1	20%
Jean Georges		1					1			1	1	16%
Union Square Café							1	1	1	1		24%
Marea									1	1	1	16%
Café Boulud			1	1			1	1	1			36%
Buddakan NY	1	1								1	1	16%
Ruth's Chris Steak House	1	1	1	1	1		1	1	1	1		96%
Lincoln Ristorante							1	1	1	1		40%
Ai Fiori	1	1	1	1			1	1	1	1		72%
Victor's Café	1	1	1	1	1		1	1	1	1	1	100%

In order to make any potential correlation easier to observe, I subtracted the reservation availability percentage from 100 percent and called it the reservation difficulty metric:



It only makes sense that the more difficult it is to reserve a table at a particular restaurant, the higher the demand from customers there is, which ultimately leads to higher revenues.

The customer retention metric is designed to gauge the customer satisfaction or retention equity of a restaurant. I expressed the total number of check-ins, which includes “repeat customers” of a given restaurant, as a fraction of the number of check-ins from unique Foursquare users:



Similarly, I ran a regression analysis to identify which factor among the food, décor, and service exerts the most influence on the overall rating of a restaurant. I used the Zagat food, décor, and service ratings as dependent variables and the overall % Liked rating as the independent variable to represent how customers rate the overall dining experience.

With respect to comparing the ratings for different types of restaurants, I categorized the restaurants according to the average cost of a meal (\$30 and under, \$31-\$50, \$51 and over), business model (chain restaurants, independent restaurants), and cuisine (Chinese, Mexican, Italian, American, French, Japanese). I analyzed and compared these different factors using weighted average calculations, with the number of reviews of a restaurant assigned as “weights” to their respective ratings.

Chapter 4: Discussion of Results

Analysis and discussion of findings

After performing the methodology described in Chapter 3, I used the results to answer the research questions and test the hypotheses. First, I ran a linear regression using one independent variable (daily revenue estimate) and seven dependent variables (Yelp rating, Zagat % Liked, Foursquare rating, OpenTable rating, the logarithm of the number of Yelp reviews, reservation difficulty metric, customer retention metric). When examining the regression tables, I observed the following factors:

- **R Square**, which indicates the accuracy of the regression line's approximation – it measures how much of the output variable's variance is explained by the input variable's variance, which would ideally be at least 60 percent
- **Significance of F**, which represents the probability that the regression output could have been obtained by chance – a lower number would mean greater validity of the regression results
- **P-value of each coefficient and the Y-intercept**, which quantify the individual regression coefficient accuracy – a lower p-value would indicate a higher likelihood that the corresponding coefficient or Y-intercept is valid
- **Visual analysis of the residual chart**, which illustrate the differences between the predicted and actual values of the output variable – the more random and centered around zero the residuals appear to be, the more likely it is that the regression equation is accurate

The results of the first regression are as follows:

Regression Statistics	
Multiple R	0.760796
R Square	0.57881
Adjusted R Square	0.51608
Standard Error	0.414692
Observations	55

ANOVA					
	df	SS	MS	F	Significance F
Regression	7	11.10727308	1.586753	9.226958	3.95983E-07
Residual	47	8.08255565	0.171969		
Total	54	19.18982873			

	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-2.57526	1.748849573	-1.47255	0.147539	-6.093495371	0.94296759	-6.093495371	0.94296759
Log of # of Yelp Reviews	0.409043	0.109798372	3.7254	0.000522	0.188157055	0.629928714	0.188157055	0.629928714
Yelp Rating	0.034641	0.283661464	0.122122	0.903323	-0.536011818	0.605294681	-0.536011818	0.605294681
Zagat % Liked It	-0.58632	1.147754096	-0.51084	0.611854	-2.895302339	1.722664411	-2.895302339	1.722664411
Foursquare Rating	0.502865	0.138906691	3.620162	0.000719	0.223420545	0.78230897	0.223420545	0.78230897
OpenTable Ratings	0.116115	0.414236831	0.28031	0.78047	-0.717222458	0.949451543	-0.717222458	0.949451543
Reservation Difficulty	0.002653	0.215199647	0.012328	0.990216	-0.430272754	0.435578926	-0.430272754	0.435578926
Customer Retention	0.893904	0.552833896	1.616949	0.112582	-0.218254181	2.006062473	-0.218254181	2.006062473

Although the values of R Square and Significance of F are feasible, only two of the seven dependent variables demonstrate a low p-value or a better likelihood that their relationship with the independent variable is valid. In other words, the number of Yelp reviews and the Foursquare rating show strong correlation with the revenue proxy, while the other dependent variables show relatively weaker correlations. It is reasonable that the reservation difficulty metric and customer retention metric are not strongly correlated. On one hand, online reservation systems do not account for walk-in traffic, so the available data provides limited information. On the other hand, the number of repeat customers does not determine the daily revenues of a restaurant as much as the actual number of customers does. However, the difference in the p-values of the ratings from different websites is debatable.

I surmise that the differences in rating p-values and correlations are due to several factors. One is that the Yelp rating has a low p-value because the obtained data is extremely flat with majority of restaurants fluctuating between 3.5 to 4.5 stars, leaving very little room for variation. Also, the Zagat % Liked is not equivalent to ratings but is the % of people that claim that they liked the restaurant, which might not be representative of the average rating of the customers' individual dining experiences. As for OpenTable ratings, people use it primarily to make reservations and have very low incentive to leave ratings after dining at the restaurant, so the average ratings may not be very accurate.

To focus in on the valid correlations, I removed the five dependent variables with weak correlations and ran a separate regression. The results of the second regression are as follows:

Regression Statistics	
Multiple R	0.737182758
R Square	0.543438418
Adjusted R Square	0.525878358
Standard Error	0.410472021
Observations	55

ANOVA					
	df	SS	MS	F	Significance F
Regression	2	10.42849017	5.214245087	30.94741094	1.40276E-09
Residual	52	8.761338553	0.16848728		
Total	54	19.18982873			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1.825565975	1.003531674	-1.819141361	0.074649785	-3.839299557	0.188167607	-3.839299557	0.188167607
Log of # Yelp Reviews	0.338937097	0.095700638	3.54163886	0.000848894	0.146899722	0.530974471	0.146899722	0.530974471
Foursquare Rating	0.612256178	0.116610391	5.250442728	2.85076E-06	0.378260315	0.84625204	0.378260315	0.84625204

Evidently, the p-values for the two dependent variables remain significantly low, and the regression statistics exhibit reasonable R Square and F-significance values. The relationship between the variables is expressed as follows:

The residual plots and line fit plots consistently illustrate the positive correlation between the daily revenue estimate and the two dependent variables, the number of Yelp reviews and Foursquare rating (see Appendix, Figures 9a and 9b).

As for the food, décor, and service factors, the regression equation and statistics results show that the factor with the greatest correlation to overall rating is food, followed by service to a lesser extent:

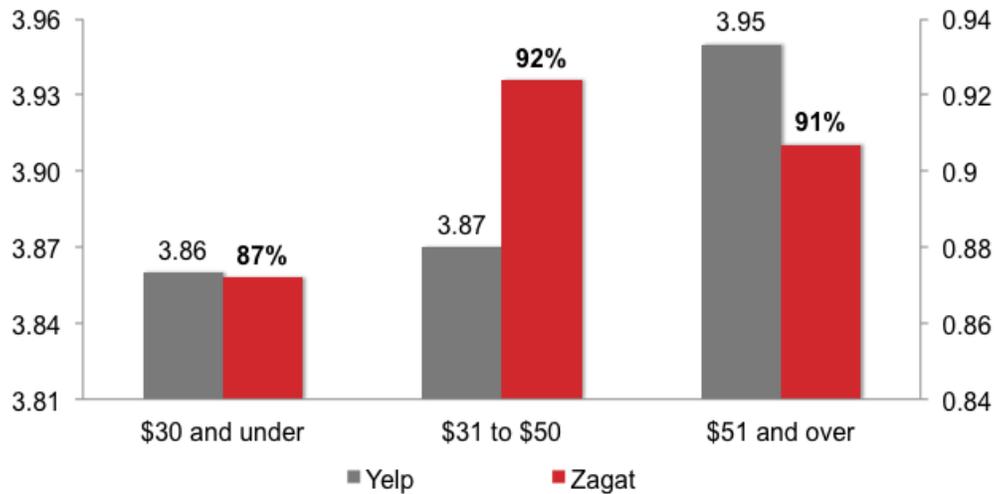
Regression Statistics	
Multiple R	0.760931287
R Square	0.579016424
Adjusted R Square	0.570122405
Standard Error	0.042739169
Observations	146

ANOVA					
	df	SS	MS	F	Significance F
Regression	3	0.356751848	0.118917283	65.10177343	1.53715E-26
Residual	142	0.259382399	0.001826637		
Total	145	0.616134247			

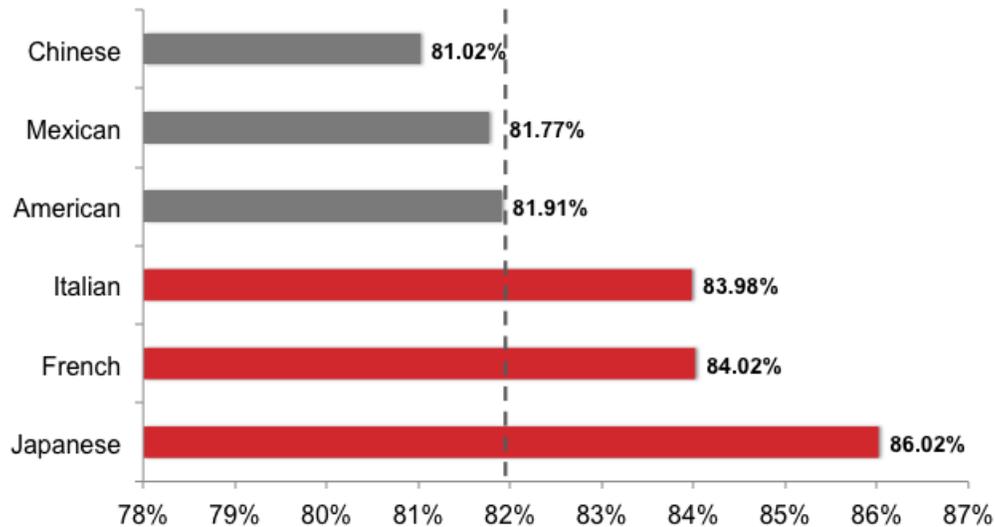
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.303973297	0.04453521	6.825460127	2.34991E-10	0.215935606	0.392010987	0.215935606	0.392010987
Zagat Food	0.02515591	0.002545885	9.881008533	7.5895E-18	0.020123177	0.030188643	0.020123177	0.030188643
Zagat Décor	-0.00159341	0.001456873	-1.093719187	0.275930032	-0.004473374	0.001286553	-0.004473374	0.001286553
Zagat Service	0.000203998	0.002407157	0.084746236	0.932582501	-0.004554497	0.004962492	-0.004554497	0.004962492

Note that the more conservative Adjusted R Square is at 57 percent and the F-significance value is extremely low at 1.54×10^{-26} , both of which indicate that the regression results are reasonable and accurate. We observe the positive coefficients of the Food and Service variables, with Food having the lowest p-value at 7.59×10^{-18} . The regression results as well as the residual and line fit plots reveal that based on our data, food is the most influential factor when making dining decisions, followed by service, while décor seems to have little to no correlation (see Appendix, Figures 10a, 10b, and 10c). Although the study by Yelp concluded that customer service is the most influential,

one must consider that they used a word cloud of the aggregated Yelp reviews. When diners write about their dining experiences, they tend to use similar adjectives such as “friendly” and “nice” when pertaining to service but highly varied words when describing the food, whether in terms of taste, quality, texture, or presentation of the dish.



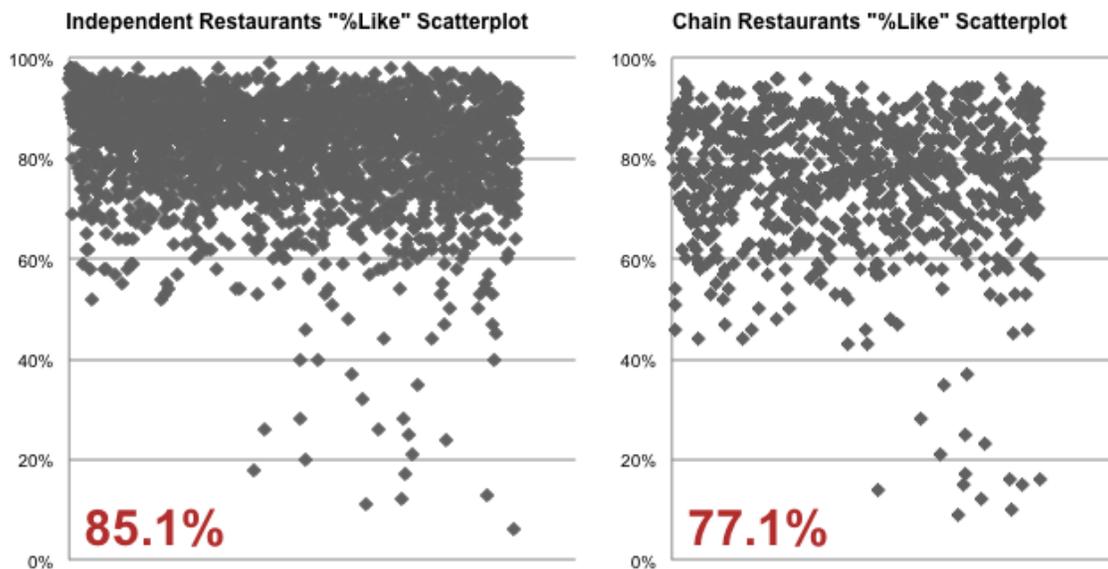
The above chart shows the average Yelp and Zagat ratings for three different sets of restaurants, categorized by their average costs. Zagat users appear to give the highest average rating of 92.4 percent to restaurants in the second tier of restaurants with average meal costs ranging from \$31 to \$50, while Yelp users give the highest average rating of 3.95 out of 5.00 stars to restaurants in the third tier (\$51 and over). This inconsistency might be explained by Yelp’s 5-star rating system. For instance, when users are deciding between giving a 3-star rating and a 4-star rating, knowing that a restaurant is more expensive could influence them to round up their ratings instead of rounding down. In relation to the endowment effect discussed in Chapter 2, we observe that the theory applies to Tier 1 restaurants as it has the lowest average rating from both Yelp and Zagat users, but Tier 2 and 3 restaurants do not provide as much clarity.



The data on restaurant by cuisine type reveals that Chinese, Mexican, and American restaurants have significantly lower average ratings compared to that of French, Italian, and Japanese restaurants. Clearly, whether a restaurant’s cuisine is Western or Eastern is not influential, as Chinese and Japanese are on opposite ends of the spectrum. This is most likely explained by the fact that Japanese restaurants that serve sushi tend to be priced very expensively, and fine dining restaurants in New York are more likely to serve French and Italian dishes as opposed to Chinese and Mexican. Meanwhile, the classification of American cuisine applies to a wide range of restaurants, from affordable burger joints to fancy steakhouses. Overall, this data reinstates the idea that upscale restaurants tend to receive higher ratings compared to casual restaurants.

With regard to the restaurant business model, the results from our data are parallel to that of the Harvard study, since independent restaurants exhibit a much higher average rating of 85 percent than the average rating of 77 percent of chain restaurants. However, one must keep in mind that Zagat users do not represent the entire dining population of New

York. The average Zagat or Yelp user most likely is using the said websites not only because they want to post ratings or reviews, but also because they are interested in reading other users' ratings and reviews about new restaurants. That being said, the demographics of the average user of a restaurant rating website must have a higher preference for and is more likely to give higher ratings toward the new and trendy independent restaurants as opposed to conventional chain establishments. Furthermore, a key characteristic of chain restaurants that independent restaurants do not possess is greater predictability in terms of the food and service that the consumer will receive. This characteristic implies that the information provided by Yelp or any other restaurant rating website does not affect customers of chain restaurants.



Summary of results

In response to the three research questions and hypotheses, the results of this study are summarized as follows:

- 1) My first hypothesis was verified by the regression results described in this chapter and is supported by the following two takeaways:

- a) Restaurant ratings and number of reviews have a statistically significant and positive association with revenues.
 - b) Reservation difficulty and customer retention do not have statistically significant associations with revenues.
- 2) Food and customer service are two factors that influence how a consumer rates or reviews his experience at a restaurant, with food being the most influential factor. Service is also influential, but less so, while décor shows minimal to no influence.
- 3) On cost, cuisine, and business model:
- a) While I did not specify the price ranges that differentiate an upscale restaurant from an affordable restaurant, Zagat users give the highest average rating of 90.7 percent to the second tier of restaurants with average meal costs ranging from \$31 to \$50, as opposed to the highest tier of restaurants with average costs of \$51 and over.
 - b) Chinese, Mexican, and American restaurants have lower average ratings than French, Italian, and Japanese restaurants, and those ratings seem to be driven by the average cost of the dishes they serve. My hypothesis is invalid as cost is a better determining factor of ratings than cuisine.
 - c) Independent restaurants exhibit a higher average rating of 85 percent than the average rating of 77 percent of chain restaurants, which verifies both my hypothesis and Michael Luca's theory regarding chain restaurants as described in Chapter 2.

Chapter 5: Conclusion

Limitations of the study

As with any other research endeavor, this study had limitations that affected the precision of the methodology and accuracy of results. For instance, most user-generated review websites impose strict measures for detection of and blocking Web crawlers, so the available data from Yelp, Zagat, Foursquare, and OpenTable was limited and kept my data set from being as comprehensive as I had wanted it to be. Also, metrics such as reservation availability do not take into account the number of seats or tables that a restaurant has. This means that a restaurant could have a high reservation difficulty metric because of limited seating capacity, not because of high customer demand. Most importantly, most restaurants do not disclose their revenue figures publicly, which prevented us from measuring the direct relationship between restaurant ratings and revenues.

Despite the limitations, this study provides strategic recommendations and contributions that can be divided into two categories—academic implications for the field of study and future work, as well as practical implications for restaurant owners and managers that seek to use social media resources to improve their businesses.

Academic implications

Should someone be interested to do research on the same subject area and seek replicate or improve this study, I would recommend observing and comparing ratings and revenues

or proxies throughout an extended period of time. That is, an increase in the number of check-ins or reservation difficulty might actually have been preceded by an increase in ratings, which would be more helpful in solving the problem in our case.

I also recommend using substituting other metrics for the variables that I employed in the first regression. An example of a more accurate metric is Michael Luca's data set of restaurant revenue figures from the Washington State Department of Revenue, which was briefly discussed in Chapter 2. For instance, substituting Foursquare metrics such as number of check-ins with a more accurate proxy of actual daily customer count will certainly yield more accurate results. Also, the population of users on OpenTable is not a very accurate representation of the dining population of New York City. Thus, I would suggest substituting OpenTable metrics for a larger, more comprehensive restaurant reservation availability database, if possible.

Practical implications

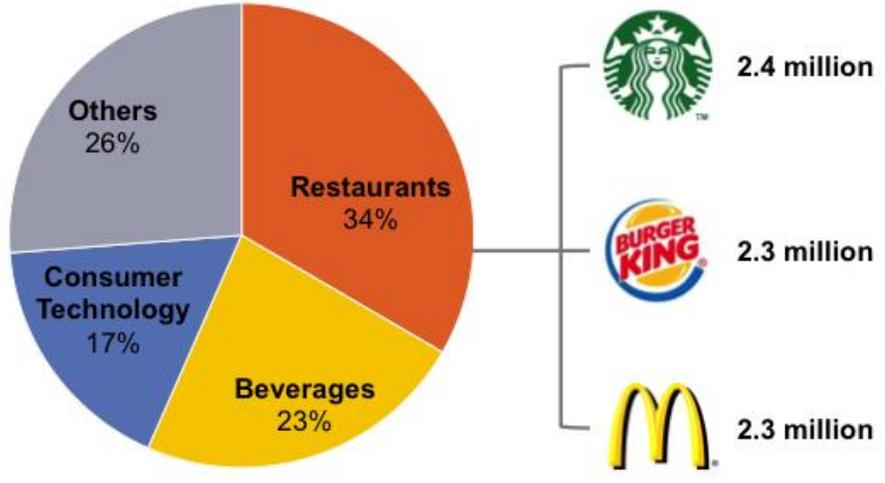
As for industry professionals such as restaurant owners and managers, the most significant and relevant finding of this study is that food is more central to a customer's dining experience than décor or service. This finding should be helpful in guiding restaurant owners and managers with regard to where they should focus their expenses and efforts. When starting up a new restaurant, one must note that although Japanese, French, or Italian restaurants receive relatively better ratings, these restaurants also tend to have more expensive dishes. Higher operating costs could offset the higher revenues that the owners could potentially earn. Moreover, building an independent restaurant might be more feasible than franchising a chain, because the accelerating growth of social

media and the information that it makes available proves to be more beneficial to independent restaurants than chain restaurants.

In conclusion, I believe that as the role of social media in the restaurant industry continues to expand, there will be a growing opportunity to study similar problems and subject areas. The evolving industry landscape and the changing opportunities for using social media means that future studies could yield different results than this study suggests. However, this study remains relevant and significant for both its academic and practical contributions as well as the future research opportunities that it catalyzes.

Appendices

Figure 1: Social Media Share of Voice in 2H 2012



(Source: PQ Media/uberVU Top 100 Brands in Social Media Worldwide 2013)

Figure 2: Increasing number of online reviews read by consumers

Customer Use of Online Reviews

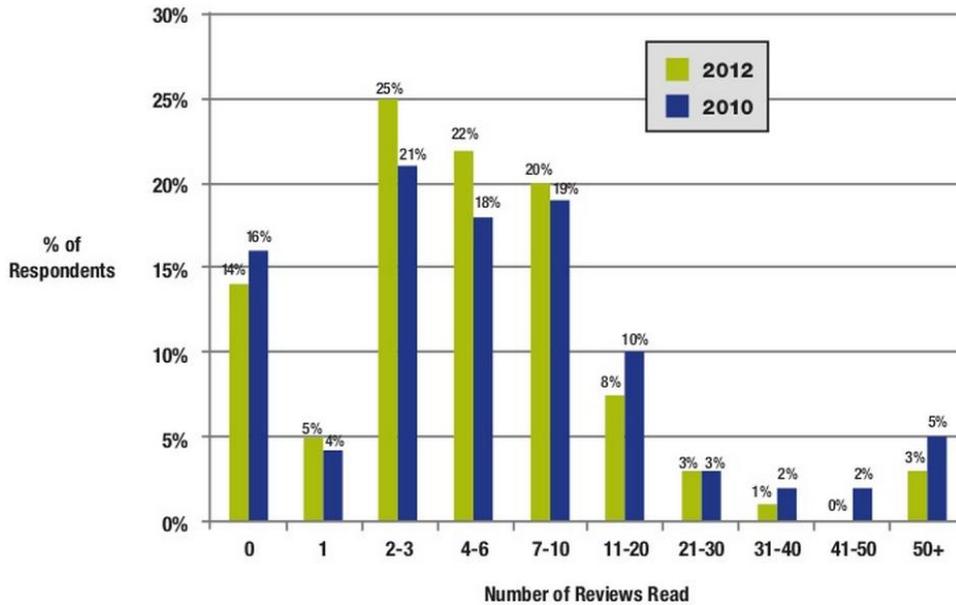


Figure 3: Reservation availability at 7:00 p.m. by average Yelp rating

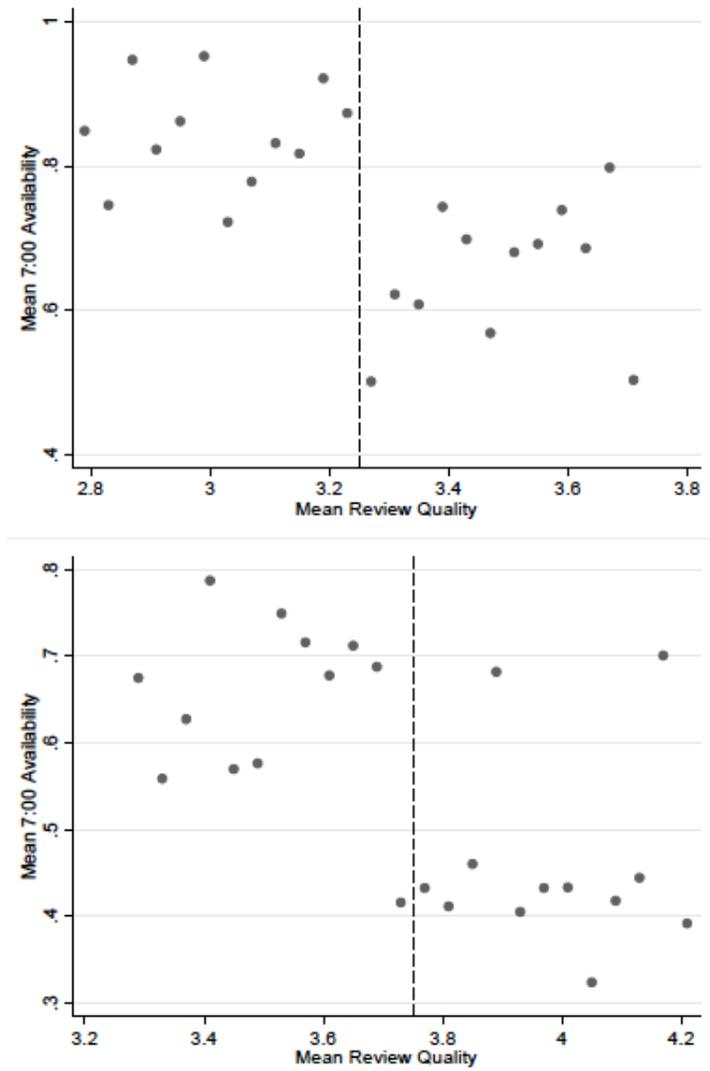


Figure 4: Influence of online marketing

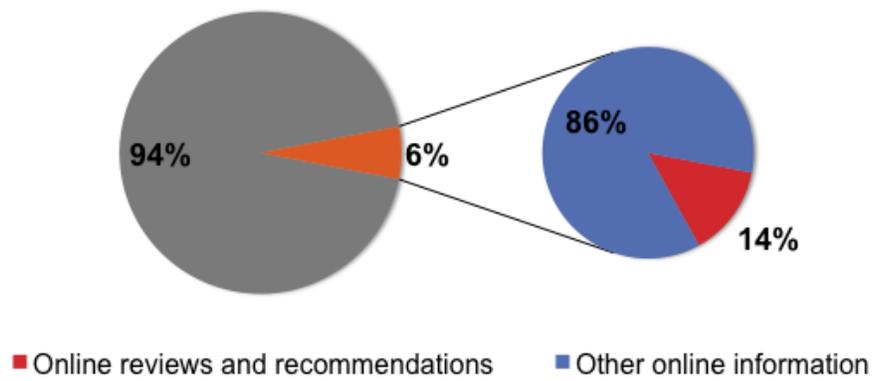


Figure 7: Rating averages and distributions of paid vs. free mobile applications

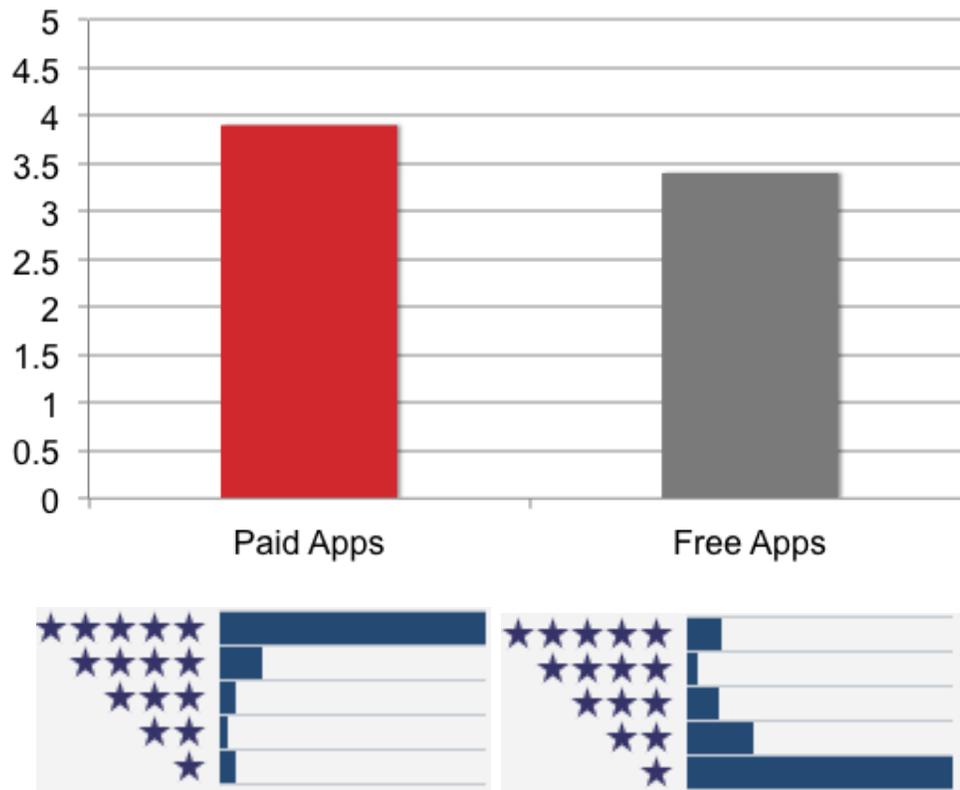


Figure 8: Differential response for chain restaurants

	Dependent Variable = ln (Revenue)		
	All Restaurants	Only Independents	Only Chains
On Yelp	0.097 *** (0.008)	0.097 *** (0.008)	0.000 (0.038)
On Yelp X Chain	-0.086 *** (0.029)		
Rating	0.065*** (0.009)	0.065*** (0.009)	0.005 (0.025)
Rating X Chain	- 0.055** (0.027)		
Observations	41766	39283	2483
Restaurants	3582	3439	143

Figure 9a: Residual plot and line fit plot using the logarithm of number of Yelp reviews

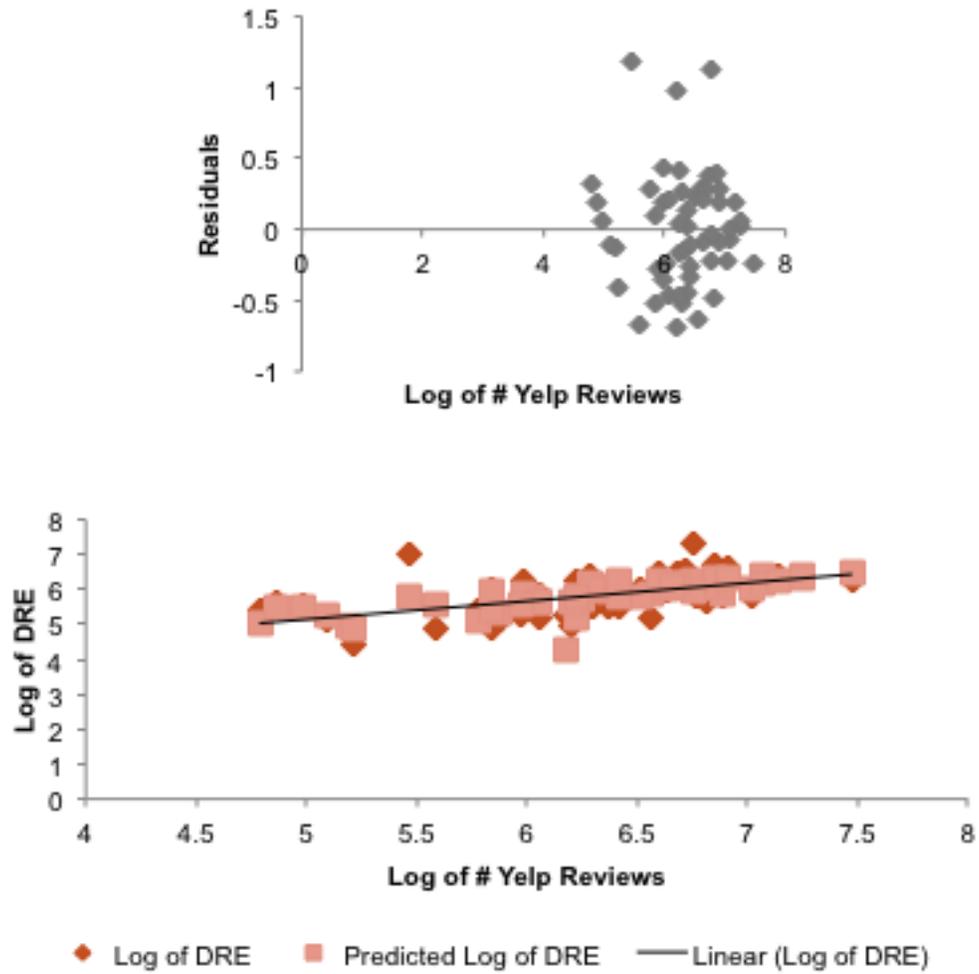
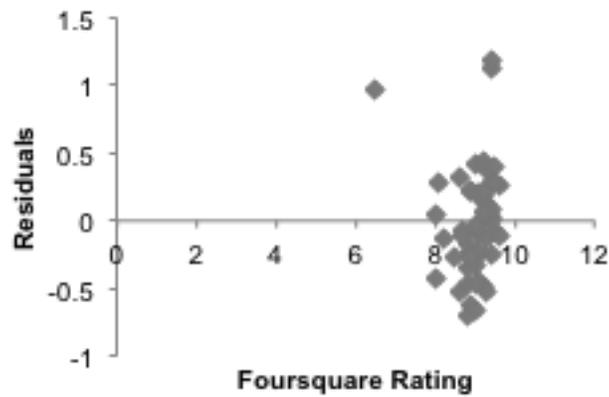


Figure 9b: Residual plot and line fit plot using the Foursquare rating



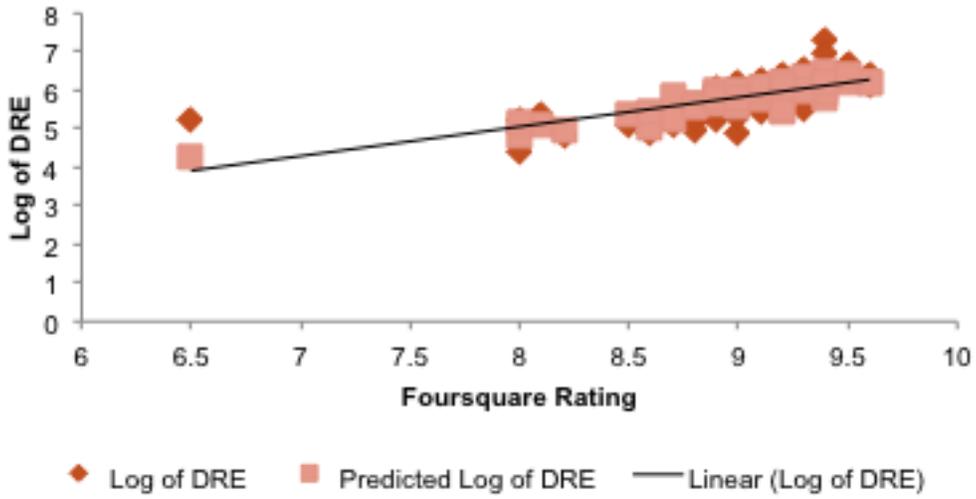


Figure 10a: Residual plot and line fit plot using the Zagat food rating

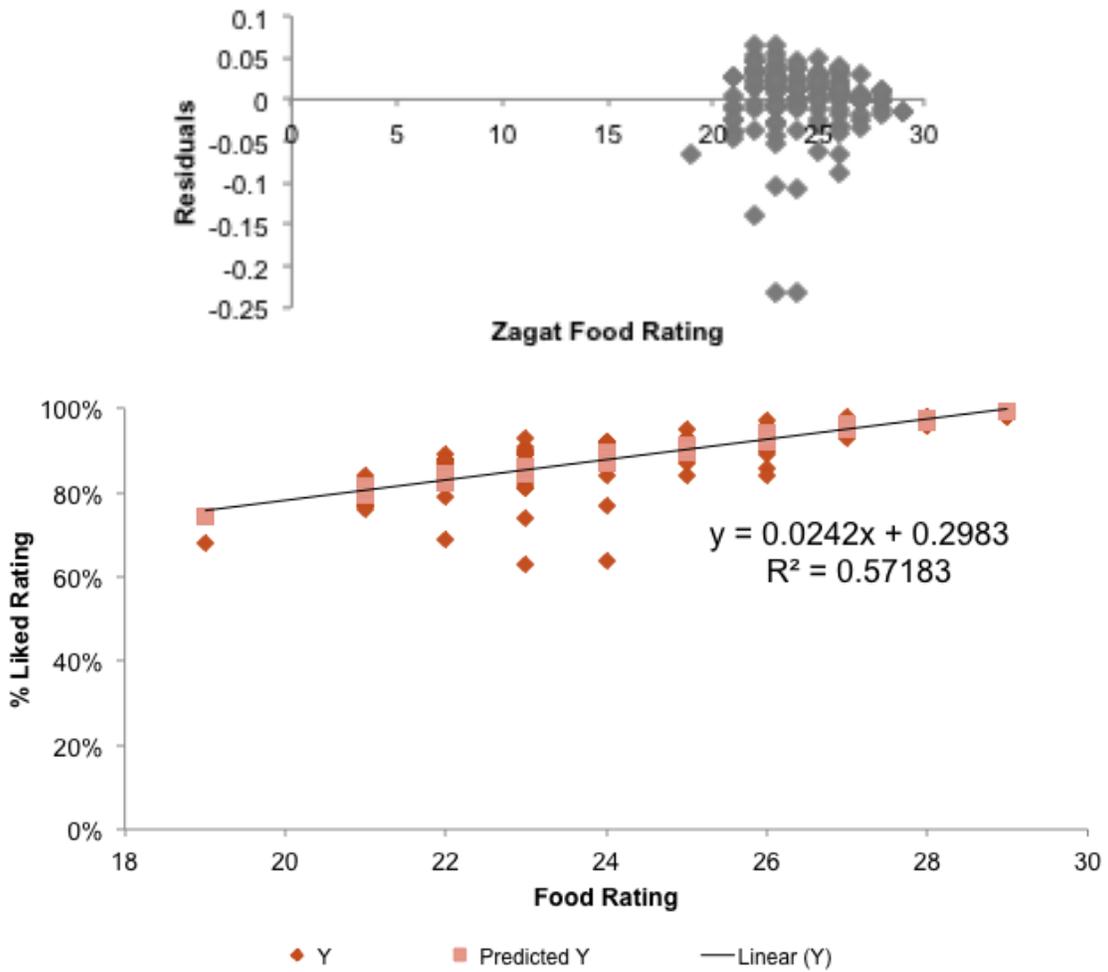


Figure 10b: Residual plot and line fit plot using the Zagat décor rating

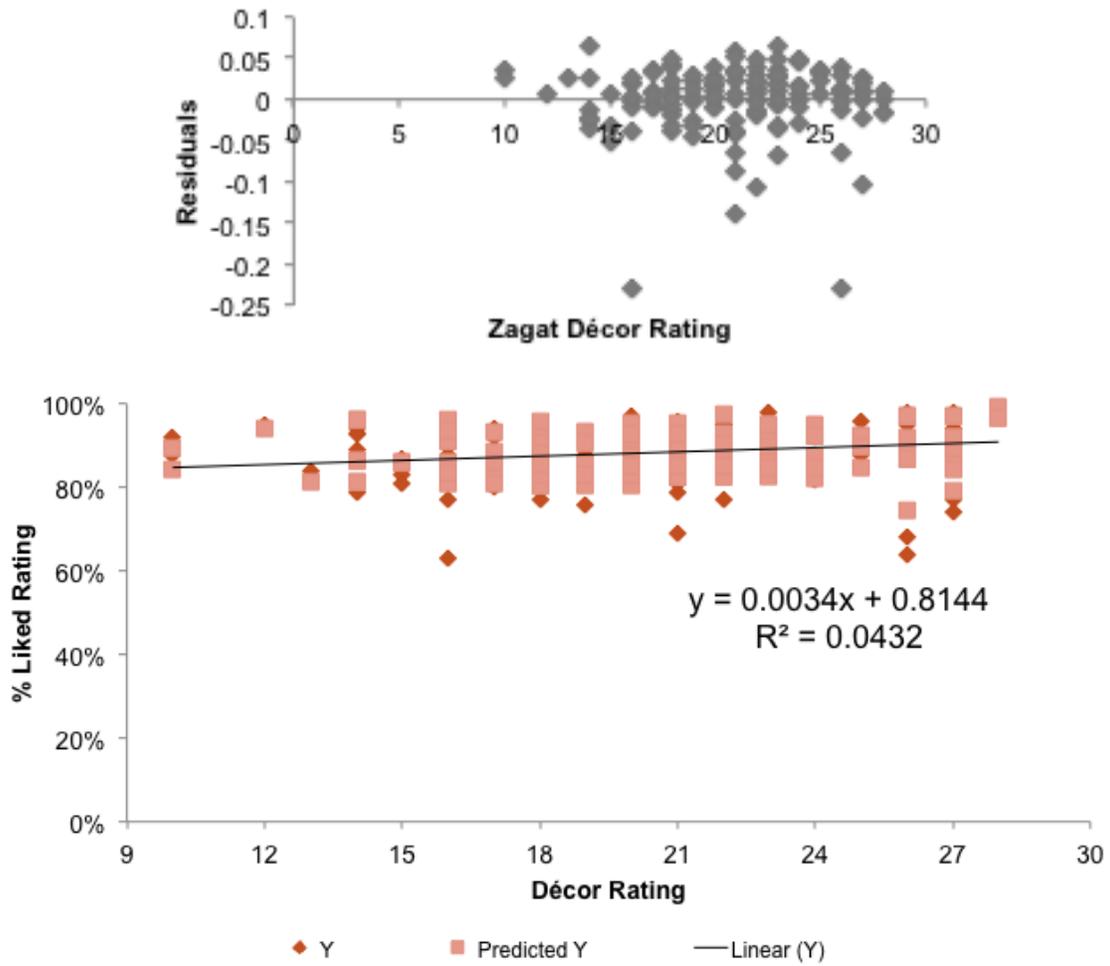
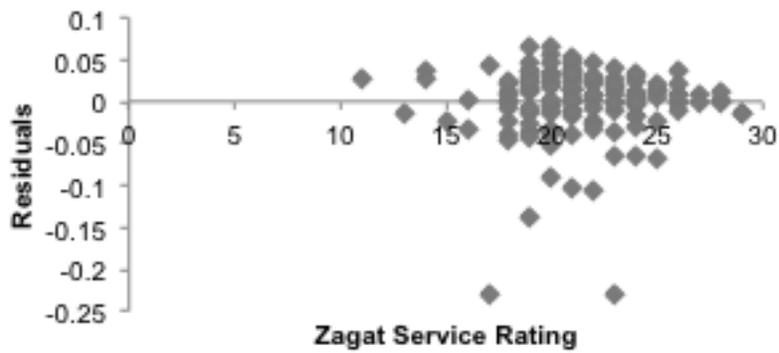
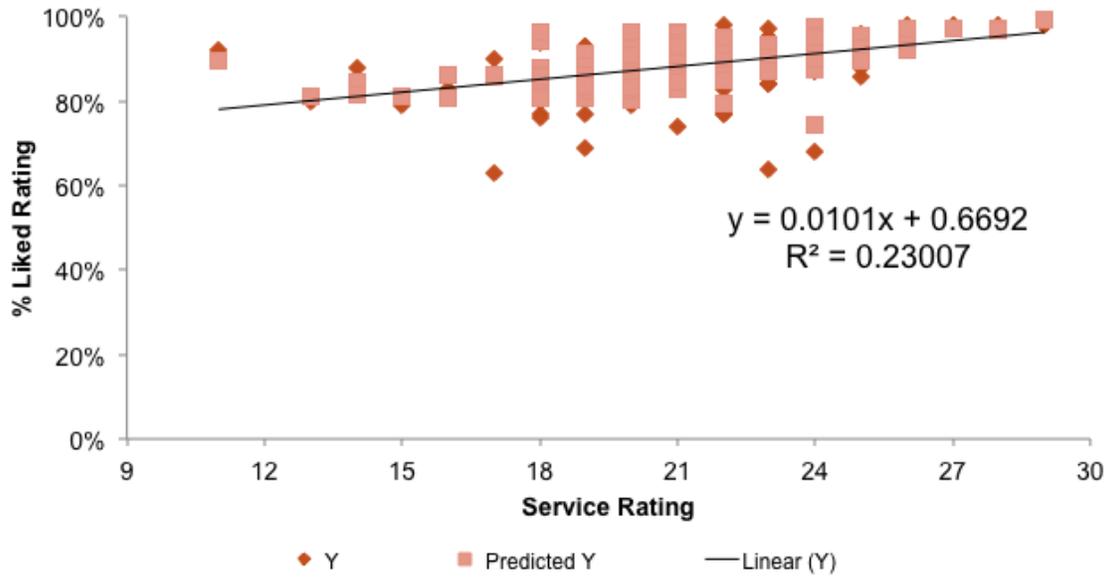


Figure 10c: Residual plot and line fit plot using the Zagat service rating





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