

# **Sentiment analysis for ipad 2 and linear modeling**

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## **Introduction**

Whenever we need to make a decision, we often seek out the opinions of others. In the past years, we seek opinions from friends and family or companies would use surveys, focus groups, opinion polls, and consultants. Now, customer reviews on the Internet has risen exponentially over the last decade. It is an important resource for buying products or attending events. In these situations, we would like to see what others are saying about them. Also it is a significant aspect for companies making decisions about their products or services.

Sentiment analysis is a computational study of how opinions, attitudes, emotions, and perspectives are expressed in nature language. It provides techniques for extracting useful information from nature language, summarizing it. It can thus be vital to service providers or production company, allowing them to quickly assess how new products and features are being received.

I am going to analyze the sentiment analysis for ipad 2 in Amazon. Since amazon has huge resources of customer reviews with their rates. So my major interest in this research is to convert descriptive customer reviews into numeric sentiment scores so that we can view the customers' attitudes directly. Secondary interest is to check whether the amazon rates reflect the sentiment score well.

## Data description

First, let us look at the normal format of customer reviews in amazon.

8,278 of 8,428 people found the following review helpful

★★★★☆ **A Step Closer**, March 15, 2011

By **Craig Whisenhunt** - See all my reviews

REAL NAME

This review is from: **Apple iPad 2 MC755LL/A Tablet (16GB, Wifi + Verizon 3G, Black) 2nd Generation (Personal Computers)**

For anyone out there who is considering whether or not to make the leap and purchase the iPad 2, this review is for you. If you're still debating between the iPad 1 and the iPad 2 check out my review of the first generation iPad right here on Amazon to see a discussion of its strengths and weaknesses with a number of people commenting (both positively and negatively) over the past 11 months.

Let me begin by saying this upfront, I don't work for Apple, I don't own Apple Stock, and whether you buy an iPad, Xoom, a laptop or a pad of paper and pencil I don't get anything for writing this. I'm not an Apple "fanboy" although I can give credit where credit is due and lately Apple has deserved a lot of credit for some of their products.

### Physical Characteristics

The iPad 2 is absurdly thin. More importantly than it's thinness is its tapered edge which feels more natural in your hand. One of the biggest complaints about the original iPad was that it really wasn't tremendously comfortable to hold for long periods at a time. For a tablet device designed to be held, that's a pretty big deal. Apple really has done an amazing job of cramming everything into an even smaller space than before and the difference is really noticeable when you're holding the device. In addition to the tapered edge, Apple managed to reduce the overall weight of the iPad 2. That might not seem like a huge deal to most, especially when you consider the weight difference isn't tremendous when you're already under 2 pounds, but I spend a good part of my day holding the iPad in my hands and the weight difference is surprising by the end of the day. The first generation isn't heavy by any means, but the iPad 2 outshines it.

Figure 1. Sample Amazon customer review

I retrieve the number of people found the following review helpful, the review star rate and the customer reviews as my dataset. Then I derived other variables such as sentiment score, length of customer reviews, number of positive words and number of negative words from these original dataset.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ReviewID	score	helpful_cour	helpful_total	perpos	perneg	sentiment.sc	numofpos	numofneg	length	customer_review				
2	1	1	4	8278	8428	0.04301075	0.01075269	60	80	20	1860	For anyone out there who is considering whether or n			
3	2	2	5	2003	2092	0.02824427	0.00763359	27	37	10	1310	People need to be aware that the reviews you see for			
4	3	3	4	1299	1383	0.03319283	0.01844046	28	63	35	1898	First things first: I consider myself relatively unbiased .			
5	4	4	5	1075	1144	0.02786994	0.0132714	22	42	20	1507	I have purchased both an iPad2 and Xoom for differer			
6	5	5	4	369	391	0.04632153	0.01089918	26	34	8	734	SUMMARY: White iPad 2 64GB Wifi-onlyA really wond			
7	6	6	5	287	303	0.03823529	0.00735294	21	26	5	680	If you're considering a tablet, the only rational choice			
8	7	7	3	631	679	0.02150538	0.02150538	0	6	6	279	i bought this from apple because amazon didn't have i			
9	8	8	5	78	81	0.04421326	0.0130039	24	34	10	769	The biggest change in our lives so far with the arrival c			
10	9	9	5	168	181	0.03081828	0.02231668	8	29	21	941	The iPad is an invaluable travel companion if you are :			
11	10	10	5	64	68	0.02378774	0.00823422	17	26	9	1093	So, you're thinking of buying an iPad however, you're			
12	11	11	4	71	76	0.03740458	0.01221374	33	49	16	1310	My primary reason to buy an iPad was both work and			
13	12	12	4	86	95	0.03338898	0.01168614	26	40	14	1198	So I'm in the kitchen, listening to my music library, an			
14	13	13	1	1014	1173	0.04317789	0.01036269	19	25	6	579	I bought an IPAD 2 64 gig 3g Verizon model the first w			
15	14	14	3	32	33	0.0620155	0.01550388	6	8	2	129	The iPad 2 really is a nice toy, but not more than that.			
16	15	15	4	93	105	0.04604317	0.00431655	29	32	3	695	The first iPad really defined the tablet market and whi			
17	16	16	5	48	52	0.01808786	0.00516796	5	7	2	387	When choosing which capacity iPad to buy, you shoul			
18	17	17	2	81	94	0.03442623	0.01721311	21	42	21	1220	Apple markets this as the ultimate portable computer			
19	18	18	3	28	30	0.05128205	0.00961538	13	16	3	312	At first this device was the best thing I had ever boug			
20	19	19	5	18	18	0.03036437	0.01315789	17	30	13	988	I was given an iPad 2 for Mother's Day this year and it			
21	20	20	5	44	50	0.03797468	0.02531646	1	3	2	79	Not previously owning an iPad I did not know what to			
22	21	21	5	30	33	0.04878049	0.01829268	5	8	3	164	I never got the iPad 1. Actually at first I thought it was			
23	22	22	3	27	30	0.02525253	0.01515152	2	5	3	198	Ok, my rating is a compromise, in terms of working ex			
24	23	23	1	59	70	0.02085071	0.04086739	-24	25	49	1199	The iPad alone I would give 4-5 stars to. Since there is			
25	24	24	5	14	14	0.04231626	0.0077951	62	76	14	1796	I thought about getting a tablet a hundred and seven			
26	25	25	1	20	22	0.00934579	0.04672897	-4	1	5	107	Got the product and had problems with it right away.			
27	26	26	5	31	36	0.03468208	0.02119461	14	36	22	1038	We are now the proud owners of two (2) iPad 2 tablet			
28	27	27	4	34	40	0.04301075	0.01075269	60	80	20	1860	For anyone out there who is considering whether or n			
29	28	28	5	15	16	0.01840491	0.01840491	0	9	9	489	I've postponed this review for a few months -- waiting			
30	29	29	4	14	15	0.03420753	0.01482326	34	60	26	1754	After playing around an iPad2 in the Apple store, I did			
31	30	30	5	20	23	0.030837	0.01982379	5	14	9	454	If you're deciding whether or not to buy an iPad 1 or i			
32	31	31	5	10	10	0.06568365	0.01072386	41	49	8	746	Ok now Im not rich so I dont have a Xoom and a Toucl			
33	32	32	4	10	10	0.04545455	0.02424242	7	15	8	330	I've done a ton of research on tablets, and ultimately i			
34	33	33	3	19	22	0.00621118	0.01242236	-1	1	2	161	The iPad2 I ordered from amazon came very quickly, z			
35	34	34	1	9	9	0.03960396	0.00990099	3	4	1	101	I was very excited to get a great deal on a 'new' iPad 2			
36	35	35	1	12	13	0.02941176	0.01960784	1	3	2	102	The company treated my return expeditiously and wa			
37	36	36	1	21	25	0.0041841	0.05857741	-13	1	14	239	An iPad-2 (64GB) purchased by me a year ago stoppec			

Figure 2. Sample Data

Data Name	Data Description
Review ID	The position of the review in all reviews
Score	Star rate for each review
Helpful_count	Number of people who think this review helpful
Helpful_total	Sum of number of people who think this review helpful and not helpful
Pertpos	Number of positive words in a customer review
Pertneg	Number of negative words in a customer review
Sentiment.score	Number of positive words minus number of negative words
Numofpos	Number of positive words, which means its value is greater than zero
Numofneg	Number of negative words, which means its value is smaller than zero
Length	Number of words in each review
Customer_review	Text content of customer review

Table 1. List of variables

## Analysis and Results

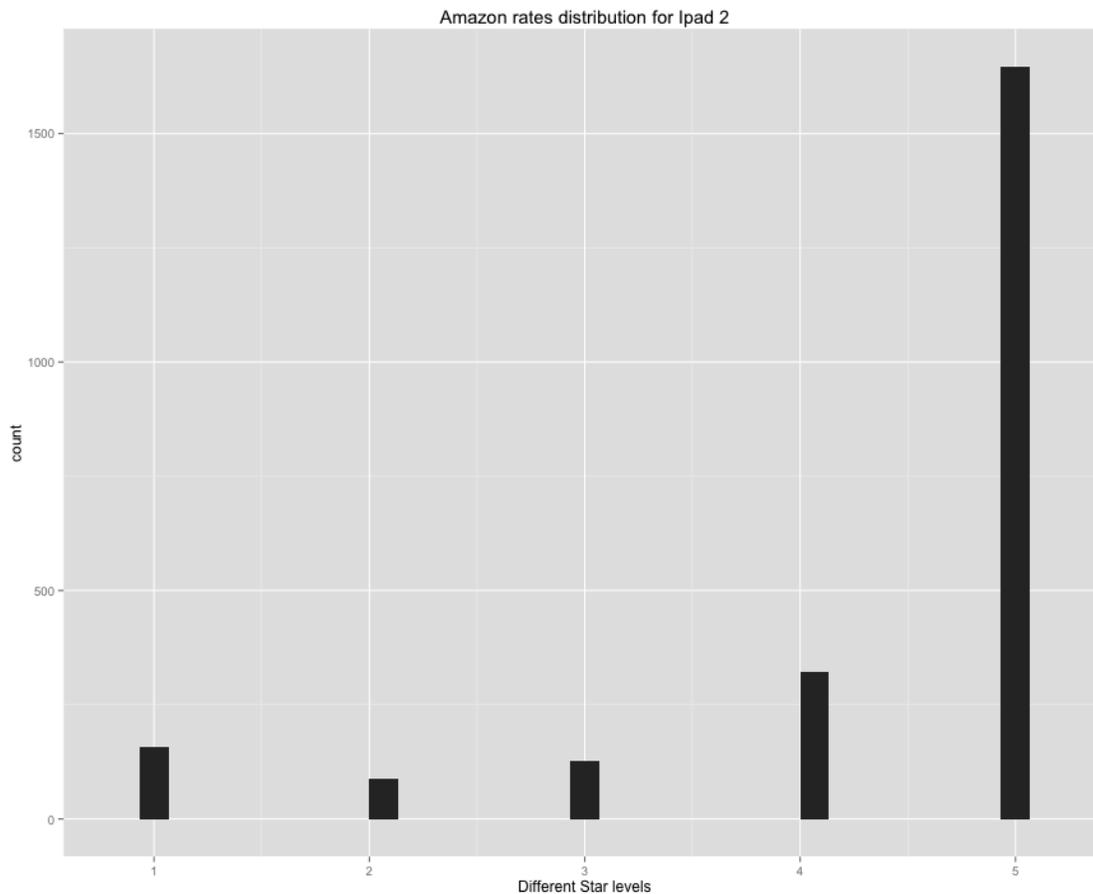
I am interested in how customers' feedback for Apple's products. Thus, I choose iPad second generation as an example to analyze. First step is to collect data from Amazon. I used the statistical software, R, to write down a function named data collection function, which can automatically retrieve customer reviews, star rates and helpful counts from Amazon. I input the production ID in Amazon and the function will automatically output these data in a CSV format file as my dataset.

Second, in order to analyze the sentiment in nature sentence, I need to build a sentiment word base, which contains a list of bad words and a list of good words. After a lot of searching around for the word base to analyze the sentence content, I found the AFINN wordlist, which has 2477 words and phrases rated from -5, which present very negative viewpoint, to +5, which imply very positive attitudes. Due to the uncertainty and simplicity, the author of the word base did not consider any words as neutral because it is hard to define a word as neutral attitudes.

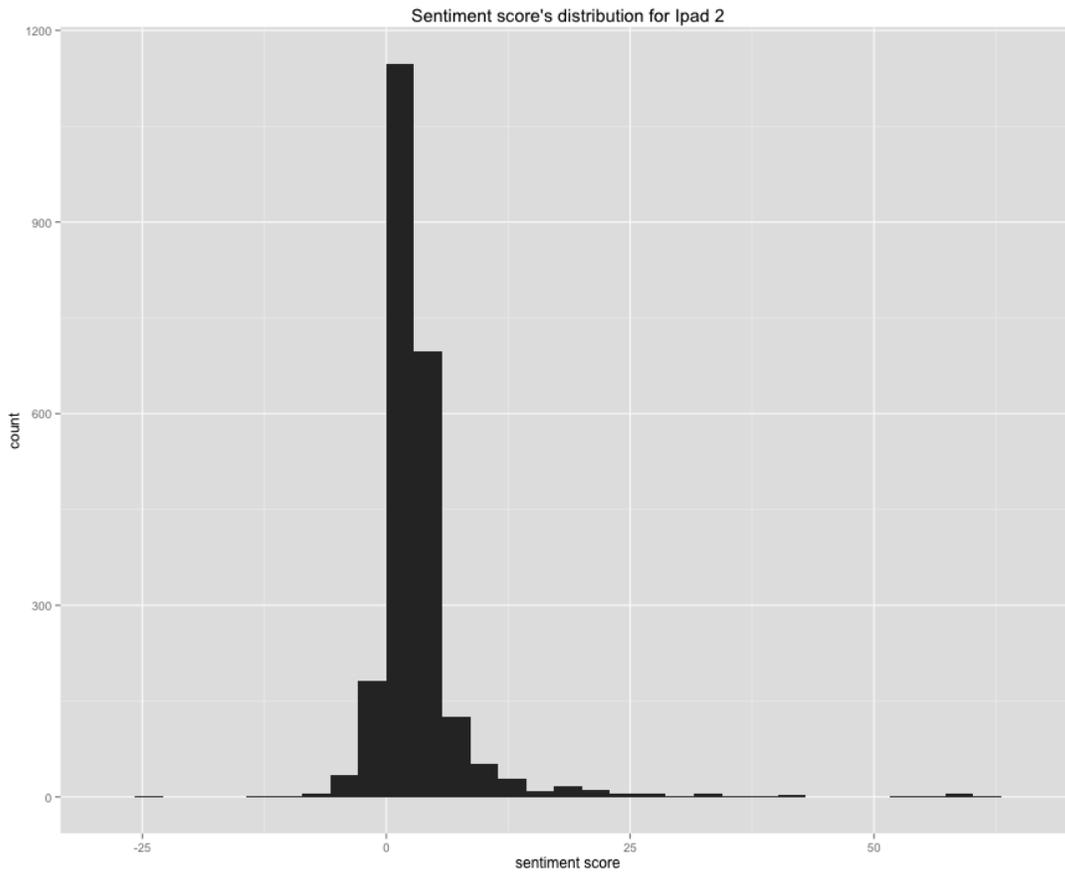
	words	scores	word
1	abandon	-2	abandon
2	abandoned	-2	abandoned
3	abandons	-2	abandons
4	abducted	-2	abducted
5	abduction	-2	abduction
6	abductions	-2	abductions
7	abhor	-3	abhor
8	abhorred	-3	abhorred
9	abhorrent	-3	abhorrent
10	abhors	-3	abhors
11	abilities	2	abilities
12	ability	2	ability
13	aboard	1	aboard
14	absentee	-1	absentee

*Figure 3. Word list*

My algorithm to calculate the sentiment score is by considering all the negative words as -1 point and all the positive words as 1 point. Then, I am going to use R to do text mining to count the number of positive words and negative words in each review and get the sentiment score for each review. For example, in the customer review “The ipad 2 is awesome. I really like it.”, I can get two positive words, “awesome” and “like”, based on the word list. So, the sentiment score of this sentence in my assumption is 2 points.

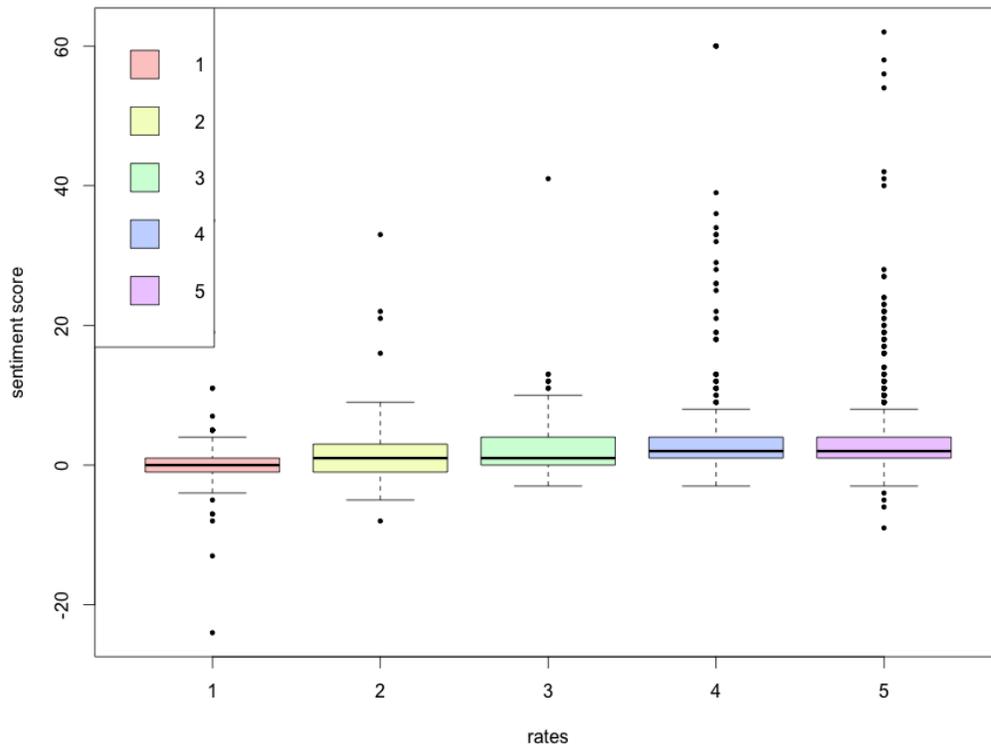


*Figure 4. Distribution of amazon rates*



*Figure 5. Distribution of sentiment score*

By comparing the distribution of amazon rates and sentiment score, ipad2 has a lot of five-star reviews, meanwhile, the distribution of sentiment score indicates that these reviews also reflect as many positive results. From this comparison, the sentiment score follows the amazon rates pretty well. We can say that the sentiment score can represent the amazon rate in some certain extend. The scale of the distribution of sentiment score is right tail, which means it has plenty of large positive scores. This feature shows that the sentiment score follow the amazon rate very well.



*Figure 6. Different Amazon Rate vs. Sentiment Score*

From the figure 6, we can see that obviously the “Five-Star rate” have a lot of positive sentiment scores according to the boxplot. While, “One-Star rate” have several points below zero. All medians of different amazon rate levels are close to neutral, which is zero. This results present that my general idea about the calculation of sentiment score is correct.

Since, my assumption of the sentiment calculation is correct to some certain extend. I am going to develop this skill to ipad2’s competitors. In this way, I want to compare whether ipad2 is more popular than its competitors. I build a list of names of the competitors and the product IDs so that it is easy for me to retrieve the data from Amazon.

Product Names	Amazon Rates	Product ID
Apple ipad 2	4.4	B0047DVWLW
Microsoft Surface Pro 2	4.1	B00FG7MVJU
Google Nexus 7	4.2	B00DVFLJDS
ASUS MeMO Pad HD 7	4.0	B00E0EY7Z6
Samsung Galaxy Note 10.1	4.6	B007M506WS
Samsung Galaxy Note 8.0	4.4	B00BQH8UEY
Fuhu Nabi 2	3.2	B008DBI5RI
ASUS Transformer Book T100	3.9	B00FFJ0HUE
Lenovo Miix 2	3.8	B00F2ENTYI
Amazon Kindle Fire HDX 8.9-inch	4.3	B00BHJRYYS

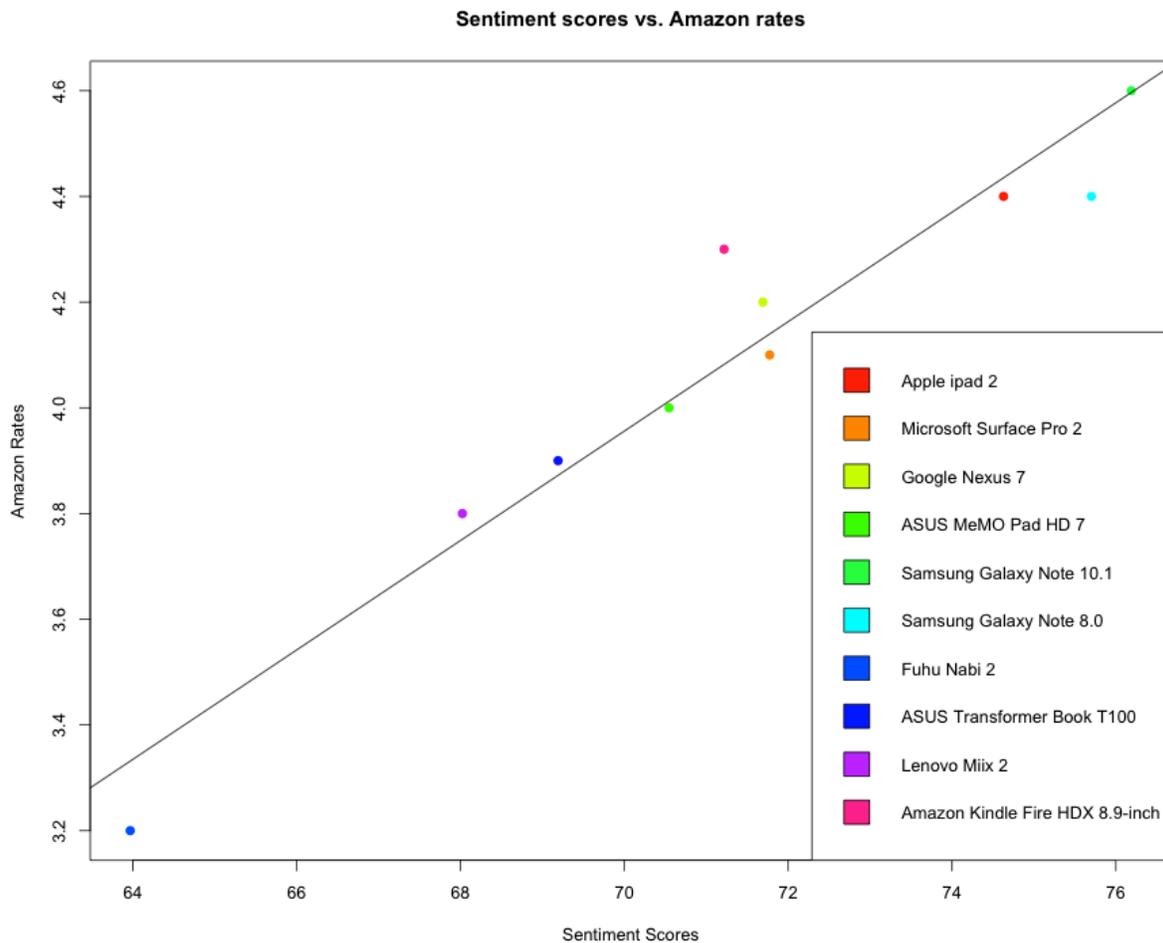
*Table 2. Names and Product IDs of Competitor*

By choosing nine competitor products from amazon, I retrieve all their customer reviews and run my sentiment analysis to get sentiment scores for these competitors. I built a function, which name is sentiment.score to calculate all the products' sentiment score. In order to compare the sentiment score with the amazon star rate, I combine all the sentiment score for each review into a whole single score. The way calculating this single sentiment score is trying to use the total number of positive words to be divided by the sum of total number of positive and negative words.

Product Names	Amazon Rates	Sentiment score
Apple ipad 2	4.4	74.62875
Microsoft Surface Pro 2	4.1	71.77372
Google Nexus 7	4.2	71.6909
ASUS MeMO Pad HD 7	4.0	70.5454
Samsung Galaxy Note 10.1	4.6	76.18816
Samsung Galaxy Note 8.0	4.4	75.70093
Fuhu Nabi 2	3.2	63.96681
ASUS Transformer Book T100	3.9	69.1898
Lenovo Miix 2	3.8	68.02205
Amazon Kindle Fire HDX 8.9-inch	4.3	71.2166

*Table 3. Sentiment Score Information*

The table above I construct is going to be used as my dataset to draw whether the amazon rate reflects the actual customer attitude well. I do a simple regression between the amazon rate and sentiment score as a simple regression model for predicting amazon rate based on the sentiment score for products. Y-axis indicates the amazon rate and the X-axis indicates the sentiment score. By comparing whether the point of a certain product is above or below the straight line, we can see whether the amazon rate of a product is overrated or underrated.



*Figure 7. Sentiment score vs. Amazon rate*

From the figure above, the straight line represents a simple linear regression between the Amazon star rates and the sentiment scores. According to the plot, we can see that the actual Amazon rate of Amazon Kindle Fire is far away from the straight line, which indicates that the Amazon rate of Kindle Fire is higher than what we predict based on the sentiment score. It means that the Amazon rate of Kindle Fire should be smaller than what it is now. The point of Fuhu is lower than the prediction that we make based on the sentiment score. The actual rate should be higher than the rate now. The rest of products are pretty close to our prediction. Hence, we can say that

the amazon rates of Kindle Fire and Fuhu do not correctly reflect their actual score that they deserved.

### **Conclusion**

The sentiment analysis reflect the customer reviews pretty well since the results of the sentiment score of each customer review of ipad 2 follows the amazon star rates well. I use ipad2 as a sample to test my sentiment analysis. The results show that my sentiment analysis is good at telling the producer what is the attitude of customer who bought products before. Secondly, I use the simple linear regression to test whether the amazon star rate gives a correct response based on the sentiment score. As a result, most of the amazon star rates follow the sentiment score closely. But sometimes the amazon star rate will underrate or overrate products. Hence, in general, sentiment score will be better as customer feedbacks for products. Amazon could find a better way to give customers better product rating system based on the sentiment analysis. In this case, customers will get better online shopping experience with Amazon.

### **Discussion**

In my research, I still have some problems need to improve. The most important problem is the calculation about the sentiment score. I use the +1/-1 method since it is easy to understand and simple for calculation. For more accuracy, we need to consider the different levels of negative and positive words. Also, a combination of words pairs and some connection will affect the sentiment score significantly. For instance, “very good” should have a more positive attitude than “good” does. “This is good, but I like another”. The connection word “but” totally change the customer’s attitude. Another one is that I need to choose a much more large size of data to do the regression. In this case, since it costs me plenty of time to retrieve the customer reviews from

amazon, I just choose the 9 competitors of ipad 2 to do the regression, which will be more accurate if I do the regression with around 1000 products. Finally, the method of calculation of getting the whole single sentiment score for a product needs to be improved.

## Reference

1. "Top 10 iPad Alternatives." *LAPTOP Magazine The Pulse of Mobile Technology RSS*. N.p., n.d. Web. 18 May 2014. <<http://blog.laptopmag.com/top-10-ipad-alternatives?slide=10>>.
2. "Andy Bromberg." *Andy Bromberg RSS*. N.p., n.d. Web. 18 May 2014. <<http://andybromberg.com/sentiment-analysis/>>.
3. "slides from my R tutorial on Twitter text mining #rstats." *Things I tend to forget*. N.p., n.d. Web. 18 May 2014. <<http://jeffreybreen.wordpress.com/2011/07/04/twitter-text-mining-r-slides/>>.