

Aspect based Real-Time Opinion Mining for Online Feedback of Products at AMAZON™

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Abstract: Opinion mining and sentiment analysis are the enhanced techniques in the field of natural language processing to identify what people experience, behave, and gives feedback. Also, how these traits lure other customers in making decisions during the online shopping. Analysis of reviews is very important factor for buyers and sellers. As star-based feedback is no more effective therefore, various proprietary tools and complex analysis of customers' feedback analysis are already in the digital market. This paper introduces a simple but very relevant approach that encompasses the aspect-based analysis of opinion (reviews/ comments). The study takes data from Amazon™ mainly for cosmetic products. The results show that product performance or rating is very different if, aspects of i) product quality, ii) product packaging, and product shipment are taken into consideration. Aspect based method uses VADER sentiment analysis algorithm. The results show that aspect-based approach for opinion mining can be generally applied to any online store or application. Our approach gives true and effective feedback by categorizing the reviews with positive, negative, and neutral polarities. The results are found to be very promising, relevant, and effective when compared with star-based rating as well.

Keywords: Aspect-Base, category level, sentiment VADER, Customer Review, quality, packing, shipment, e-commerce

1. Introduction

Online shopping and e-commerce is emerging trend in shopping domain. Advance technologies have developed to attract people's interest towards online shopping. Many people divert towards its fascinated pattern of delivering goods and other accessories at doorstep and all quality products with different variations are easily accessible at your fingertip by using any web or mobile application. It also saves customer's time without any hurdles of shopping markets and hassles of product prices and discounts, improves customer's interaction and relationship and provides surely by delivering satisfactory and quality products. Therefore, opinion mining technique is become valuable and useful to identify the customer interest and desires about their products. It effectively works in detecting and extraction of opinion that is available in textual format, emojis, in stars and numbers. The main purpose of sentiment analysis is to understand and analyze the emotions and behavior of customers.

As there's huge influence of social media, where approximately every customer quickly shares their opinions in the form of likes, dislikes, comments, and responses which make a chain of linked customers and convert into indirect marketing and customer relationship. So, reviews of customer can be positive, negative and neutral. By those views its facilities vendor/manufactures/ supply chain to enhance their product, planning and strategies.

This research works highlight major three aspects faced by every customer i.e., Quality, Packing and Shipment.

1.1 Quality

Variation material: Every customer aim to invest his money in right directions whenever customer books an order, first point of view generates in mind that the product have own significance with the best quality to lead a strong relationship between customer and vendor in whole online shopping process.

Color difference (online/ordered): In online-shopping market, customer takes keen interest during searching product online and try to find different variants and colors and choose best suitable product and place the order but customer's behavior comes in panic condition and exhausted when found difference in product especially in color, because spend much time to pick suitable product after deep research. It is happening especially in those cases in which customer choose and place orders, product color that is not actually same on the delivery time.

1.2 Shipment

Major issues that are involved in the shipment include the followings.

Packing: On the customer hand, packing is the first impression during whole e-commerce process when customer receive parcel after placing order and compare the product and packing with the image shown in web or mobile application. So, product should be in well packaging to give positive impact and attract customer's interest. In some cases, it is found that non-interactive, inefficient, and

ineffective way of product representation creates negative impression on customer and loose customer loyalty.

Delay: The major factor of online shopping is proper convenience and logistics of product to the customer end in the pre-defined time frame but unfortunately, in actual scenario, when the product does not deliver on time, it makes the product useless. Meanwhile, it decreases the product worth.

2. Related Work

As this domain have vast emerging and fastest growing due to online shopping and analysis to grasp the market and get customer's intention. There's already outstanding work have done in the sentiment analysis especially on e-commerce business domain.

In [1] Jahanzeb Jabbar and his co-workers did research on real-time sentiment analysis on e-commerce application. They used Support Vector Machine techniques. Whole research is categorized in two levels i.e., review level and sentence level and them perform real-time product reviews which users share based upon their experiences. To identify the sentiment of whole sentence, calculate each word sentiment individually.

In [2] Doaa Mohey also performs research on sentiment analysis and do complete comparative analysis on different techniques, approaches, text mining algorithms and challenges facing during sentiment analysis and evaluation process. It provides detailed oriented study and helps to follow best practices while applying natural language processing and text mining techniques to get subjective results.

In this research [3] Truphi, S. Pabboju and G. Narashima worked on sentiment analysis based on streaming API using twitter.

In [4] X. Fang and J. Zhan research work based on subjective contents to handle basic issues to identify sentiment polarization based on categorization.

In [6] P. D. Turney shares participation by doing study work on Bow (Bag of words) algorithm in sentiment analysis domain. A major part of study is that words relationship is not focus point, sentiment are calculated from each word of sentence and perform some aggregate functions.

3. Methodology

Machine learning model and technique have ability to do knowledge discovery from given set of data based on specific domain i.e. ecommerce or online shopping. Machine learning have various algorithm to find feature set by extracting the hidden pattern and train data to build strong model which help in analysis. In this research work, we are using VADER sentiment algorithm. It is a Lexicon and sentiment analysis tool which examines the sentiments that expressed on social media platform. Lexicon is a built-

in python library, and it uses domain dictionary which consist of keywords. It has list of words that are commonly labeled according to their sentiment representations as positive, negative, and neutral views. Vader algorithm only does not give the facts about positive and negative score but also tells the reaction of sentiments. The overall overview of research process is shown in the Fig.1.

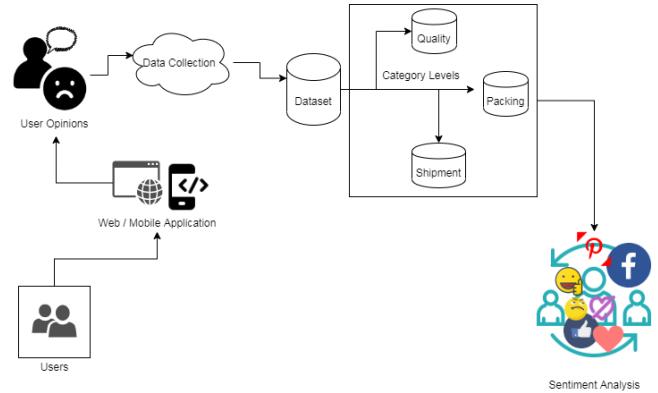


Figure 1. Process flow diagram of aspect based opinion mining

3.1 Data collection

The reviews collected from Amazon. Each review contains three common variables Customer ID, Review ID and rating polarity. There is a lot of data collected from frequently used E-Commerce applications. The Amazon dataset is stored in csv format which can easily import in python project. The data is categorized based on specified three levels i.e., quality, packing and shipment with respective customer name, rating, and customer's review. The overall overview of data collection from amazon is shown in the Fig.2 that sub-Domains are Fig.2.1, Fig.2.2, and Fig.2.3.

	Name	Rating	Review
0	Jessica	1.0 out of 5 stars	These wipes clearly have mold. I opened a new...
1	rosemck	5.0 out of 5 stars	... and has never felt this great! Smooth, hyd...
2	Diane Jackson	2.0 out of 5 stars	This has a strong smell and I felt it irritate...
3	A_Niki_W	5.0 out of 5 stars	I love these! Each contains 25 towelettes tha...
4	Tammy R.	5.0 out of 5 stars	I was about to order again and saw I didn't le...

Figure 2.1. Data collected from survey of Amazon for Packing

	Name	Rating	Review
0	Opinionated Horsewoman	5.0 out of 5 stars	This is one of my two most favorite body moist...
1	Anados Deferred	5.0 out of 5 stars	I have had issues with my skin as long as I ca...
2	consumer21	5.0 out of 5 stars	This moisturizing cream is the real deal. What...
3	Rejoice	5.0 out of 5 stars	? what a product it is . I have been applyin...
4	Rick Clark	5.0 out of 5 stars	I am a 65 year old man and for 20 years I have...

Figure 3.2. Data collected from survey of Amazon for Quality

shipping.head()			
	Name	Rating	Review
0	Customer	1.0 out of 5 stars	The product is good but this time when I got it...
1	VonZrP	5.0 out of 5 stars	I've had kidney stones for a while and they ma...
2	Rosa	5.0 out of 5 stars	I use this literally every day. I'm a doctor a...
3	Tripp Cady	5.0 out of 5 stars	I have seasonal dry skin and this is the one I...
4	Ariana	2.0 out of 5 stars	This product took 2 weeks to even though it w...

Figure.4.3. Data collected from survey of Amazon for Shipment

Tokenization: It is the process of dividing of whole sentence into single word such as keywords, phrases, adjectives, special characters are said to be as a token.

Data Cleansing: In this process, cleansing is performed to increase the sentence strength and remove of irrelevant word. After this procedure, whole dataset consist of meaningful words.

POS-Tagging: It is the process of assignment of different parts of speech to the sentences that includes verb, adverb, adjective, noun and pronoun.

Removing of special character: In this step, we apply POS-tagging technique to removing special character from sentence like (,), (!), (@) and so on.

3.2 Analyze sentiment review

- **Sentiment intensity:** It is the process to identify the frequency of words which is calculated by below mentioned formula

$$\text{Sentiment intensity / frequency of words} = \frac{\text{Total number of count}}{\text{Total number of count}} * \text{weight of polarity}$$

It highlights which sentence is high intense value than others. The total number of counts should be calculated based on reviews.

- **Density:** The analysis is identified by the total number of frequencies given to the most highly rated reviews.

3.3 Sentiment Polarity

This defines the reviews polarity such as positive, negative, and neutral. It shows the customer's reaction and response on the product. The compound values describe the commutative sum of all three polarities.

Customer share experiences in the form of reviews like "this is one of two most favorite body moisturizing" or "the product is good, but this time packing was not good" or may be "product was delivered with defectively" or whatever it only depends upon customer's experience and reaction, all these indicate polarity of sentence. polarity for each category level. Polarity classes are containing positive, negative. As shown in Fig.3.

```
{'neg': 0.024, 'neu': 0.715, 'pos': 0.261, 'compound': 0.9931}
{'neg': 0.074, 'neu': 0.745, 'pos': 0.181, 'compound': 0.992}
{'neg': 0.048, 'neu': 0.777, 'pos': 0.175, 'compound': 0.895}
{'neg': 0.0, 'neu': 0.813, 'pos': 0.187, 'compound': 0.977}
{'neg': 0.046, 'neu': 0.777, 'pos': 0.177, 'compound': 0.9797}
{'neg': 0.058, 'neu': 0.79, 'pos': 0.152, 'compound': 0.8789}
{'neg': 0.0, 'neu': 0.884, 'pos': 0.116, 'compound': 0.926}
{'neg': 0.0, 'neu': 0.824, 'pos': 0.176, 'compound': 0.8126}
{'neg': 0.0, 'neu': 0.894, 'pos': 0.106, 'compound': 0.7829}
{'neg': 0.127, 'neu': 0.777, 'pos': 0.097, 'compound': -0.0878}
{'neg': 0.064, 'neu': 0.841, 'pos': 0.095, 'compound': 0.411}
```

Figure.3. Sentiment polarity for each category level

3.4 Add sentiment to data frame

- **Data processing and sentiment analysis**

Data processing and sentiment analysis steps of this research work. First import the Amazon dataset into the project and start dividing sentences by denoting keywords, phrases, adjectives or in the form of single word. At this, the dataset is clustered based on keywords and it also reduces the size of dataset. The loss of data is not important in this process because it summarize the textual data in the form of words instead of sentences. Now move towards data cleansing process by saving this current form of data into container or variable. The next is to remove unwanted data like spaces, semicolon, irrelevant words, and other special characters.

It takes time depending upon size of dataset for compiling and executing the whole process. The whole data size is now too much reduced due to attempting tokenization process and data cleansing process. This data is read to apply POS-tagging process by classifying the data into phrases, adverb, adjective, verb with respect to our category level i.e., quality, packing and shipment. Some of them are classified with same classifier with highlighting rating. It may vary low to high or high to low depending upon classification of data as per phrases with respected to our category level.

At this stage, our Amazon data is ready to apply VADER sentiment analysis technique, so need to find out sentiment polarity in current data set. Polarity calculated against each word which represents the text or sentence, if the word exists in dictionary then increased in total polarity count. For example, in above dataset the Fig.2 shows the classify the shipping rating and reviews, if the word "product" is available in the domain dictionary then total priority count is increased so the Fig.2 contain lexicon "product" two times, it means that it increases total priority count two times in the current form of data set. Using current form of dataset, there's need to iterate each word and match with domain dictionary so that polarity calculate for each category level.

Let's see the Fig.4 and 5 which represent the distribution of sentiments and transpose the reviews into polarity of each category level.

	Name	Rating	Review	polarity
0	Opinionated Horsewoman	5.0 out of 5 stars	This is one of my two most favorite body moist...	{NEGATIVE: 0.024, NEUTRAL: 0.715, POSITI...
1	Anados Deferred	5.0 out of 5 stars	I have had issues with my skin as long as I ca...	{NEGATIVE: 0.074, NEUTRAL: 0.745, POSITI...
2	consumer21	5.0 out of 5 stars	The moisturizing cream is the real deal. What...	{NEGATIVE: 0.048, NEUTRAL: 0.777, POSITI...
3	Rejoice	5.0 out of 5 stars	?? what a product it is . I have been applyin...	{NEGATIVE: 0.0, NEUTRAL: 0.813, POSITI...
4	Rick Clark	5.0 out of 5 stars	I am a 65 year old man and for 20 years I have...	{NEGATIVE: 0.046, NEUTRAL: 0.777, POSITI...
...				
236	naomi	1.0 out of 5 stars	It feels sticky even hours after applying. It...	{NEGATIVE: 0.0, NEUTRAL: 1.0, POSITI...
237	Stacy S.	5.0 out of 5 stars	I love Avene products and use nothing else...	{NEGATIVE: 0.0, NEUTRAL: 0.588, POSITI...
238	Saurabh	3.0 out of 5 stars	I am satisfied with moisturizer but bottle bu...	{NEGATIVE: 0.329, NEUTRAL: 0.579, POSITI...
239	swapna	2.0 out of 5 stars	Product was delivered with defective . Since...	{NEGATIVE: 0.0, NEUTRAL: 1.0, POSITI...
240	Amazon Customer	5.0 out of 5 stars	A very very good product, leaves absolutely n...	{NEGATIVE: 0.032, NEUTRAL: 0.795, POSITI...

241 rows x 4 columns

Figure.4. Distribution of sentiments of quality category level

	Name	Rating	Review	polarity
0	Customer	1.0 out of 5 stars	The product is good but this time when I got i...	{NEGATIVE: 0.0, NEUTRAL: 0.862, POSITI...
1	VonZIP	5.0 out of 5 stars	I've had kidney stones for a while and they ma...	{NEGATIVE: 0.051, NEUTRAL: 0.872, POSITI...
2	Rosa	5.0 out of 5 stars	I use this literally every day. I'm a doctor a...	{NEGATIVE: 0.022, NEUTRAL: 0.9, POSITI...
3	Tripp Cadry	5.0 out of 5 stars	I have seasonal dry skin and this is the one i...	{NEGATIVE: 0.121, NEUTRAL: 0.834, POSITI...
4	Ariana	2.0 out of 5 stars	This product took 2 weeks to even though it w...	{NEGATIVE: 0.183, NEUTRAL: 0.797, POSITI...
...				
201	Amazon Customer	1.0 out of 5 stars	Found it please don't again thank you	{NEGATIVE: 0.224, NEUTRAL: 0.531, POSITI...
202	Star B.	5.0 out of 5 stars	Fast . Good product for extremely dry skin	{NEGATIVE: 0.0, NEUTRAL: 0.674, POSITI...
203	amazonaccount	5.0 out of 5 stars	Good quality moisturizing cream. Fast	{NEGATIVE: 0.0, NEUTRAL: 0.58, POSITI...
204	The Zoro	2.0 out of 5 stars	My wife had been using this product for severa...	{NEGATIVE: 0.098, NEUTRAL: 0.878, POSITI...
205	Tris007	5.0 out of 5 stars	I love this product! I have it on auto . It wo...	{NEGATIVE: 0.072, NEUTRAL: 0.817, POSITI...

206 rows x 4 columns

Figure.5. Distribution of sentiments of shipping category level

As sentiment intensity refers to the repetition of same words in cluster so it can be identified by applying below formula in current data.

$$\text{Sentiment intensity or frequency of words} = (\text{Total number of count}) * (\text{weight of polarity})$$

Let's see the Fig.6 which represents the frequency with respect to polarity of each category level.

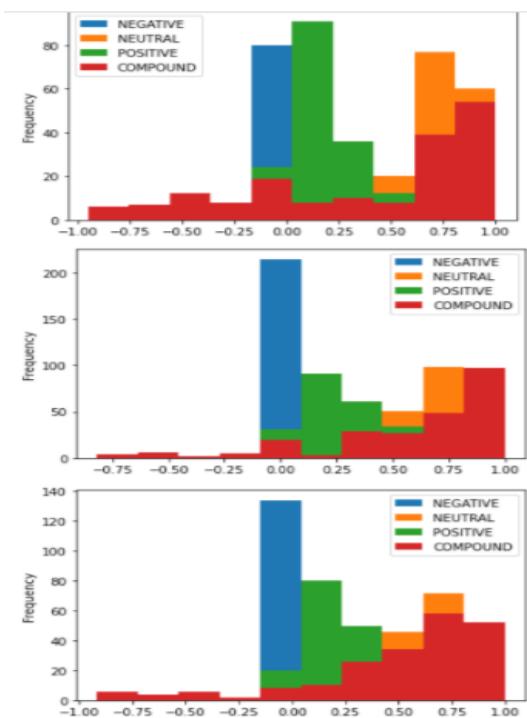


Figure.6. Frequency of polarities occurring in real-time (Top to Bottom) Packing, Quality and Shipment and respectively

4. Results and Analysis

In order to analyze and do future prediction and make proper planning and strategies, and taking appropriate steps and right decision, we have formulate positive, negative, neutral and compound responses of customer's reviews using model development with the help of machine learning techniques and methods and train the data model effectively to meet accuracy and reduce errors. We evaluated by strip plot angle as shown in Fig.7, Fig. 8, Fig.9.

Packing category contains three variables and get total print count is 157 with frequency value of 5.8% by applying on name convention only as shown in the Fig.7.

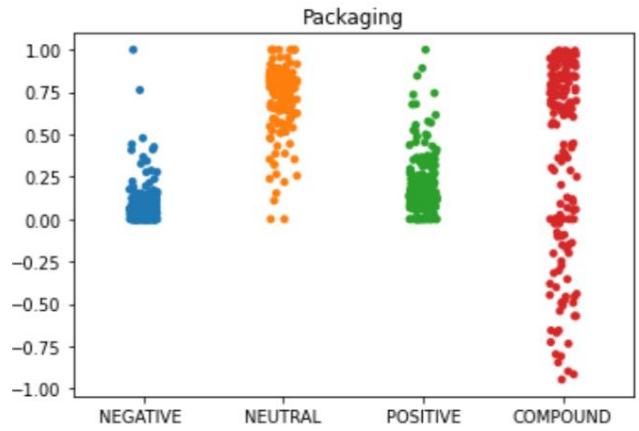


Figure.7. Strip plot of Packing demonstrate opinion of customers inclined towards positive side

Quality category also contains overall three variables and get total print count is 341 with frequency value of 9.1% which highest in all three categories by applying on name convention only as shown in the Fig.8.

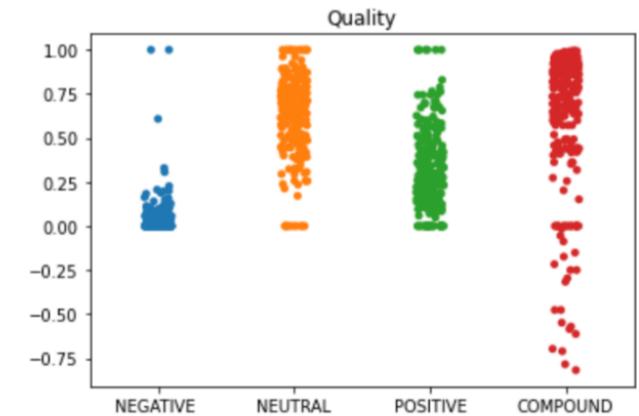


Figure.8. Strip plot of Quality demonstrate opinion of customers inclined towards negative an neutral side

Shipment category also contains overall three variables and get total print count is 12 with frequency value of 5.8% which very minimum in all categories by applying on name convention only in the Fig.9.

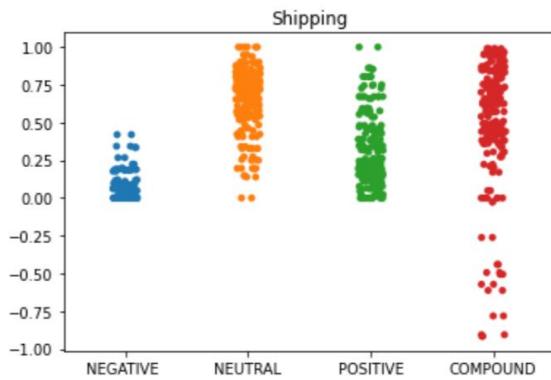


Figure.9. Strip plot of Shipment demonstrate opinion of customers inclined towards negative side

By observing above category wise strip plotting, the results shows that neutral perspective of customers have high values in each category while negative perspective of customer have lowest value in all categories. Ideally, it should be negligible to get customer's interest and attraction and become pioneer in online shopping business. Overall positive ratio is also reasonable but need to improve more quality, services and packaging to lead in the market.

By observing this data into another angle by visualizing it into swarm plotting, we observe that same result reflects as shown in Fig.10, 11 and 12.

This indicates the packing category contains print count is 81 with frequency value of 4.7% which very minimum in all categories by applying on rating convention while review variable convention print count is 17 with frequency value of 4% which very maximum in all categories by applying on rating and review variable convention in the Fig.10.

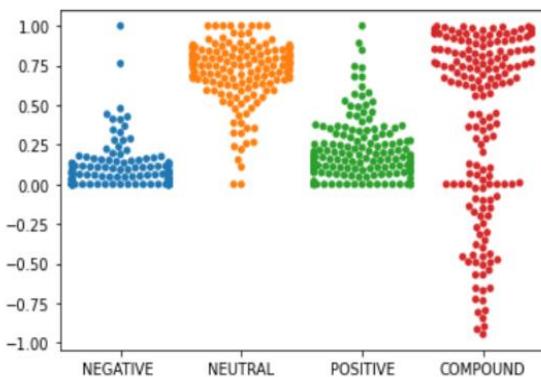


Figure.10. Swarm plot showing polarities for the packing aspect

Quality category contains print count is 6 with frequency value of 2.5% which very minimum in all categories by applying on rating convention while review variable convention print count is 3 with frequency value of 1.2% which very minimum in all categories by applying on rating and review variable convention shown in the Fig.11.

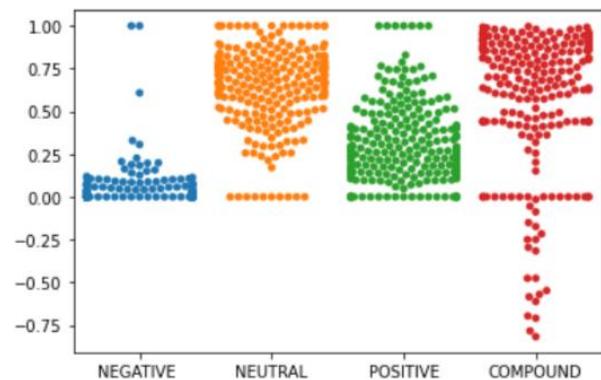


Figure.11. Swarm plot showing polarities for the quality aspect

In the Fig.12 It shows shipment category contains print count is 12 with frequency value of 5.8% which very minimum in all categories by applying on rating convention while review variable convention print count is 26 with frequency value of 12.6% as shown in the Fig. 13

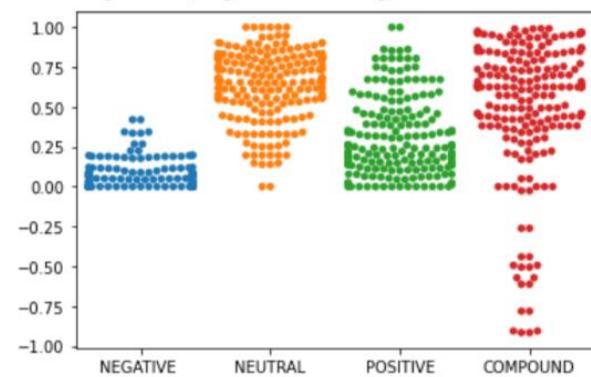


Figure.12. Swarm plot showing polarities for the shipping aspect

In order to analyze the overall dataset without any categorization, there's also same result observed. It means that accuracy level is high in each and every step from data collection to calculate density, there's negligible error persist if any. The Fig.13 explains the overall analysis of dataset.

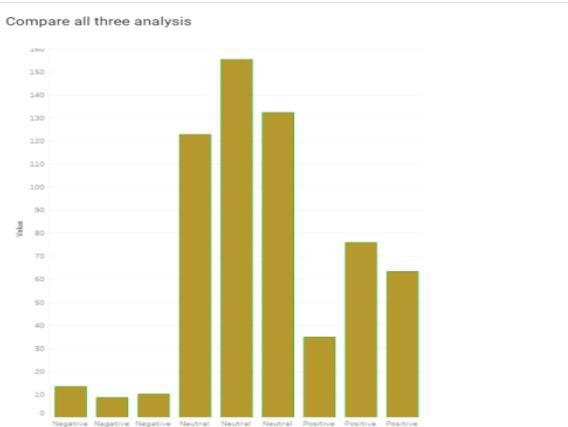


Figure.13. Comprehensive bar-graph for aspect-based results

5. Conclusion

The sentiment analysis has been successfully performed on the reviews obtained from Amazon.com of cosmetic product. We observed these three aspects on polarity base and concluded that most highly rated category is Quality (87%) and shipment(72%) but POOR stars was given to packing (47%), Hence issue is only in packing of product which needs to do major improvements to support e-commerce business. If want to be a pioneer in online shopping, then it is necessary to show excellence in all categories. So, don't need to do all focus only on packing, just take right decision as per need for improvement of overall online shopping domain. So, customer enjoy and happy in shopping with your online shopping application.

References

- [1] J. Jabbar, I. Urooj, W. JunSheng and N. Azeem, "Real-time Sentiment Analysis On E-Commerce Application", 2019 IEEE 16th International Conference on Networking, Sensing and Control (ICNSC), 2019..
- [2] D. Hussein, "A survey on sentiment analysis challenges", Journal of King Saud University - Engineering Sciences, vol. 30, no. 4, pp. 330-338, 2018..
- [3] M. Trupthi, S. Pabboju and G. Narasimha, "Sentiment Analysis on Twitter Using Streaming API", 2017 IEEE 7th International Advance Computing Conference (IACC), 2017.
- [4] X. Fang and J. Zhan, "Sentiment analysis using product review data", Journal of Big Data, vol. 2, no. 1, 2015..
- [5] [6]P. D. Turney, "Thumbs up or thumbs down?: semantic orientation applied to unsupervised classification of reviews," in Proceedings of the 40th annual meeting of the association for computational linguistics", Dec. 2002, pp. 417-424. <https://arxiv.org/abs/cs/0212032>.
- [6] S. De, "Sentiment analysis on product purchase through e commerce", International Journal of Scientific Research and Management, 2017.
- [7] "Advanced Petition Filing Web Application with Sentiment Analysis", International Journal of Recent Trends in Engineering and Research, vol. 4, no. 1, pp. 121-126, 2018.
- [8] H. Choi, "Sentiment Analysis of E-commerce Review Data and Adaptable Sentiment Lexicon", The Korean Society of Culture and Convergence, vol. 42, no. 1, pp. 357-378, 2020.
- [9] K. Kelly Isyanta, "Application of Multilayer Perceptron for Digital Society Sentiment Analysis towards Indonesia Biggest E-commerce Platforms", International Journal of Advanced Trends in Computer Science and Engineering, vol. 9, no. 4, pp. 5364-5369, 2020.
- [10] A. K and V. J, "Aspect Based Sentiment Analysis for E-Commerce Using Classification Techniques", SSRN.
- [11] "Sentiment Analysis Based Product Selection for Enhancing E-Commerce", International Journal of Innovative Technology and Exploring Engineering, vol. 9, no. 3, pp. 389-394, 2020.
- [12] W. Chang and J. Wang, "Mine is yours? Using sentiment analysis to explore the degree of risk in the sharing economy", Electronic Commerce Research and Applications, vol. 28, pp. 141-158, 2018.
- [13] Y. Basani, H. Sibuea, S. Ida PatonaSianipar and J. PreslySamosir, "Application of Sentiment Analysis on Product Review E-Commerce", Journal of Physics: Conference Series, vol. 1175, p. 012103, 2019.
- [14] M. Nakayama and Y. Wan, "The cultural impact on social commerce: A sentiment analysis on Yelp ethnic restaurant reviews", Information & Management, vol. 56, no. 2, pp. 271-279, 2019.
- [15] R. Muchhal, "Investigation of Ambiguity based Sentiment Analysis for Product Recommendation on E-Commerce Portal", International Journal for Research in Applied Science and Engineering Technology, vol. 6, no. 3, pp. 1225-1229, 2018.
- [16] [A. Thakkar, "Trustworthiness and Analysis of Sentiment of users Semantic Feedbacks in E-Commerce", International Journal on Recent and Innovation Trends in Computing and Communication, vol. 3, no. 2, pp. 767-768, 2015.
- [17] S. Gong and Q. Sheng, "Research on Review Spam Detection Based on Sentiment Analysis in Electronic Commerce", Applied Mechanics and Materials, vol. 602-605, pp. 2101-2104, 2014
- [18] H. Zhou and G. Wu, "Research on Sentiment Analysis of Chinese E-Commerce Comments Based on Deep Learning", Journal of Physics: Conference Series, vol. 1237, p. 022002, 2019
- [19] "Aspect Based Sentiment Analysis for E-Commerce Websites with Visualization through Machine Learning Algorithm", International Journal of Innovative Technology and Exploring Engineering, vol. 9, no. 5, pp. 1020-1024, 2020.
- [20] S. Olaleye, I. Sanusi and J. Salo, "Sentiment analysis of social commerce: a harbinger of online reputation management", International Journal of Electronic Business, vol. 14, no. 2, p. 85, 2018.
- [21] Sanusi, J. Salo and S. Olaleye, "Sentiment analysis of social commerce: a harbinger of online reputation management", International Journal of Electronic Business, vol. 14, no. 2, p. 85, 2018.
- [22] D. Rai, "Mining E-commerce Websites to Provide Efficient Methodology for Sentiment Analysis", International Journal for Research in Applied Science and Engineering Technology, vol. 6, no. 4, pp. 4110-4116, 2018.
- [23] "Sentiment Analysis on E-commerce Product using Machine Learning and Combination of TF-IDF and Backward Elimination", International Journal of Recent Technology and Engineering, vol. 8, no. 6, pp. 2862-2867, 2020.
- [24] Z. Saldaña, "Sentiment Analysis for Exploratory Data Analysis", The Programming Historian, no. 7, 2018.

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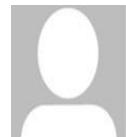
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