

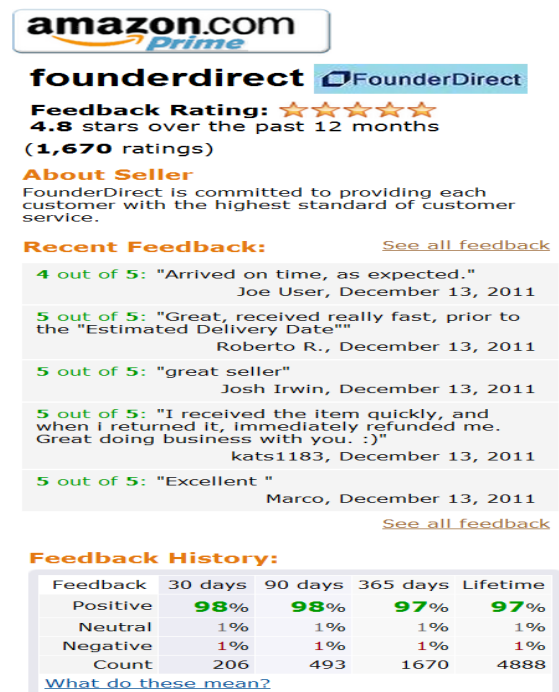
SENTIMENT-BASED MODEL FOR REPUTATION SYSTEMS IN AMAZON

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1. INTRODUCTION

When buyers purchase products from an online retailer such as Amazon, they assess and pay not only for the product they want but also for packaging, delivery, and the extent to which the product description matches the actual product. On the other hand, the premium price a merchant can demand for a product (relative to the other merchants selling the same product) is highly correlated to the product reviews. With the growing number of websites such as Amazon and eBay that allow users to express their experience, customer reviews will play a more significant role in the reputation of the merchants.

With fast growth of online retailers, developing tools to quantify the semantics of product reviews and deriving the polarity of opinions are attracting significant attention over the last few years. One approach to evaluate the strength of an opinion is using reviews with numeric



amazon.com Prime

founderdirect FounderDirect

Feedback Rating: ★★★★★
4.8 stars over the past 12 months
(1,670 ratings)

About Seller
FounderDirect is committed to providing each customer with the highest standard of customer service.

Recent Feedback: [See all feedback](#)

- 4 out of 5:** "Arrived on time, as expected."
Joe User, December 13, 2011
- 5 out of 5:** "Great, received really fast, prior to the "Estimated Delivery Date""
Roberto R., December 13, 2011
- 5 out of 5:** "great seller"
Josh Irwin, December 13, 2011
- 5 out of 5:** "I received the item quickly, and when I returned it, immediately refunded me. Great doing business with you. :)"
kats1183, December 13, 2011
- 5 out of 5:** "Excellent "
Marco, December 13, 2011

[See all feedback](#)

Feedback History:

Feedback	30 days	90 days	365 days	Lifetime
Positive	98%	98%	97%	97%
Neutral	1%	1%	1%	1%
Negative	1%	1%	1%	1%
Count	206	493	1670	4888

[What do these mean?](#)

ratings and training (semi-)supervised learning algorithms to classify reviews as positive or negative [1]. However, these techniques are not able to fully incorporate the sentiment of the reviews. In another approach in [2], the semantic orientation and strength of a review is predicted by tracing the changes in the associated economic variables of a merchant. More specifically, the scheme used in [2] assigns a dollar value to each opinion phrase by evaluating the effect of the phrases on econometrics like premium price a merchant can ask over the period of time. [2] assigns a score to the modifiers that the buyers used in the reviews and characterizes a merchant using a vector of reputation dimensions representing its ability on each of dimensions (i.e. shipping, packaging and so on).

In this project, we used two different binary classifiers (i.e. Naïve Bayes and semi-supervised recursive auto-encoder) to predict the premium price of a product. The sentiment analysis algorithm (i.e. RAE) was deployed to obtain the semantics of the product reviews and provided a model for the premium prices. In the rest of the report, details of the two classifiers are provided followed by the simulation results and a comparison of the two.

2. DATA COLLECTION

We used the data set provided by [2]. The data set includes details of the 9,500 transactions that took place on Amazon.com for 280 different software products. The data set collected from publicly available information at Amazon.com by using Amazon

Web Services over a period of 180 days, between October 2004 and March 2005. The data set used in this project is available at <http://economining.stern.nyu.edu>.

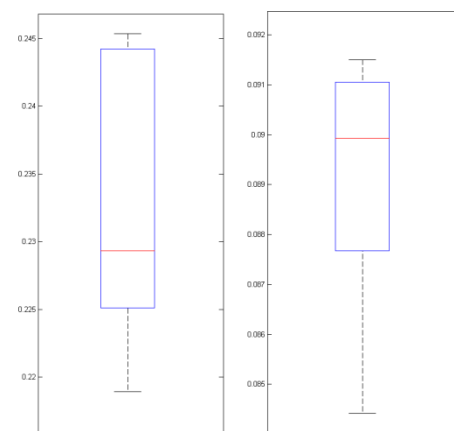
The data set includes two parts, transaction history and reputation data. The first part consists of transaction IDs for each product and the price at which the products were sold. The second part of data set includes the reputation history of each merchant that had a product for sale during the period which the data set was collected. Additionally, for each of the competing listings for identical products, we have the listed price along with the competitors' reputation.

3. NAÏVE BAYES

First, **multivariate Bernoulli event model** with **Laplace smoothing** is used to build a model for premium prices based on the merchant reputation.

Bag-of-words representation of the product reviews is used for Naïve Bayes model.

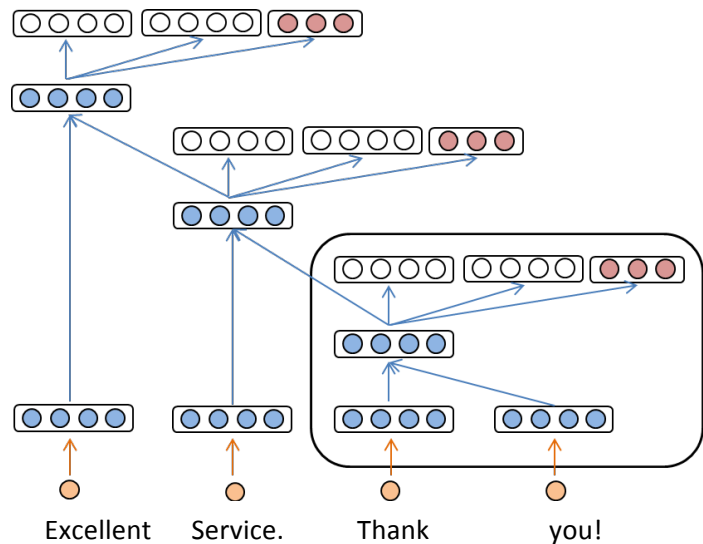
For evaluating the performance of the classifier 6-fold cross validation is used. The average accuracy of **77%** is achieved by Naïve Bayes method.



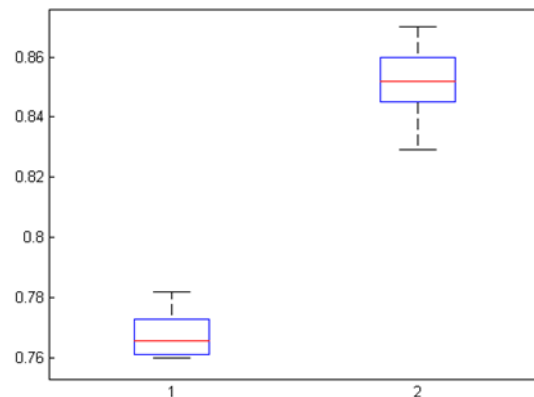
4. SEMI-SUPERVISED RECURSIVE AUTO-ENCODER

In order to exploit hierarchical structure of each review, Semi-supervised Auto-Encoder (RAE) is used. Illustration of RAE architecture, which learns semantic vector representations of phrases, is given in the following figure.

In RAE method word indices are first mapped into a semantic vector space. Then they are recursively merged by the same auto-encoder network into a fixed length sentence representation. The vectors at each node are used as features to predict a distribution over sentiment labels.



Similar to the other method cross validation method is used to evaluate the performance of RAE. As it shown in the following figure the average accuracy of **85%** is achieved by RAE which outperforms Naïve Bayes by almost 10%. Due to the lack of time we used the same optimal weight as in [3].



Another benefit of RAE is that rather than limiting sentiment to a positive/negative scale, multi-dimensional distribution over several sentiments can be predicted. This property could be used to predict whether the merchant is likely to sell the product or not.

CONCLUSION

We used different binary classification models to accurately predict the polarity of the premium price that a merchant get based on the costumer reviews. Our evaluation shows that RAE can predict these distributions more accurately than other models.

ACKNOWLEDGMENTS

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REFERENCES

- [1] B. Pang and L. Lee. 2005. Seeing stars: Exploiting class relationships for sentiment categorization with respect to rating scales. *In ACL 2005*.
- [2] A. Ghose, P. Ipeirotis, and A. Sundararajan, "Opinion Mining Using Econometrics: A Case Study on Reputation Systems", Proceedings of the 45th Annual Meeting of the Association for Computational Linguistics (ACL 2007)
- [3] Richard Socher, Jeffrey Pennington, Eric Huang, Andrew Y. Ng, and Christopher D. Manning, "Semi-Supervised Recursive Auto-encoders for Predicting Sentiment Distributions". EMNLP 2011