

TERM PAPER

Decision support from financial disclosures with deep neural networks and transfer learning

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Abstract:

Company disclosures greatly aid in the process of financial decision-making; therefore, they are consulted by financial investors and automated traders before exercising ownership in stocks. While humans are usually able to correctly interpret the content, the same is rarely true of computerized decision support systems, which struggle with the complexity and ambiguity of natural language. A possible remedy is represented by deep learning, which overcomes several shortcomings of traditional methods of text mining. For instance, recurrent neural networks, such as long short term memories, employ hierarchical structures, together with a large number of hidden layers, to automatically extract features from ordered sequences of words and capture highly non-linear relationships such as context-dependent meanings. However, deep learning has only recently started to receive traction, possibly because its performance is largely untested. Hence, this paper studies the use of deep neural networks for financial decision support.

Introduction:

A decision support system rate the content of such disclosures in order to identify which stock prices are likely to surge or decrease. In other words, the system must quantify whether a financial disclosure conveys positive or negative content. For example, a prediction engine can forecast the expected price change subsequent to a disclosure. Afterwards, the trading engine decides whether to invest in a stock given the market environment. The resulting financial performance of the portfolio largely depends upon the accuracy of the prediction engine, which constitutes the focus of this manuscript.

This paper utilizes recent advances in deep learning or, more precisely, sequence modeling based on deep neural networks.

Methods:

This section introduces our methodology, to predict stock price movements on the basis of financial disclosures. In brief, we compare naïve machine learning using bag-of-words with novel deep learning techniques. We specifically experiment with (a) classification, where we assign the direction of the stock price movement - up or down - to a financial disclosure, and (b) regression, where we predict the magnitude of the change. In both cases, we study price changes in terms of both nominal returns and abnormal returns. The latter corrects returns for confounding market movements and isolates the effect of the news release itself.

Following are the tools which have been used in our project:

❖ Environment:

- Spyder

❖ Libraries:

- Scikit-learn
- TensorFlow
- Theano

Deep learning architectures:

We first introduce the RNN, followed by its extension, the LSTM, which can better memorize information [17]. Both network architectures iterate over sequential data of arbitrary length. The input vector consists of the words (or stems) in one-hot encoding. Mathematically this specifies a vector consisting of zeros.

This yields high-dimensional but sparse vectors as input. In addition, we experiment with word embeddings in the case of the LSTM.