**Deep Learning Approach in Predicting Stock Price and A Comparison with Traditional Machine Learning Algorithms**

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Abstract

Prediction of the stock price is a challenging research topic. Factors like supply and demand in the market, market sentiment and investor’s expectations, economic and political shocks can affect stock prices. All these factors make stock prices volatile and noisy. Machine learning techniques have the capacity to insights the unseen and derive hidden patterns from features of data like the latest reports about a company, their opening and closing price, etc. These can be used to predict stock prices with minimum error. But it is extremely hard to come up with one method with consistent results. Deep learning, a subfield of machine learning concerned with Artificial Neural Network(ANN) algorithms which contain more than one hidden layer to extract pattern inspired by the structure and thinking process of the brain. This report will compare the prediction results of three traditional machine learning algorithms; K-Nearest Neighbors (KNN), Support Vector Regression (SVR), Random Forest Regression and two statistical method; Linear Regression and Auto-Regressive Integrated Moving Average (ARIMA) with four deep learning algorithms; Deep Neural Network (DNN), Long-Short Term Memory (LSTM), Bidirectional LSTM and Gated Recurrent Unit (GRU). For each model, standard errors are calculated by analyzing historical data from 2014 to 2017 as the training set and 2018 to 2019 as testing set of five stocks that are based on Dhaka Stock Exchange (DSE).

Key Words: Stock markets, Deep learning, Machine learning, price, Recurrent Neural Net

1. **Introduction**

Stock prices change every day by market forces. By this we mean that share prices change because of supply and demand. If more people want to buy a stock (demand) than sell it (supply), then the price moves up. Conversely, if more people wanted to sell a stock than buy it, there would be greater supply than demand, and the price would fall. Stock markets are today a large part of world’s financial system and the stock markets have a large impact on economy of a country. Correctly predicting price of stock markets carries obvious economic benefits. But the most accurate way to predict the outcome of the stock market is a frequently discussed matter. It is extremely difficult to take into consideration all those factors that can influence a stock (Ida Vainionpää 2014). For example, internal development, world events, inflation and interest rates, exchange rates and lastly hype (Wolski 2014). However, the most important variable that are highly correlated with next day’s stock prices are “A day’s avg. price, A day’s change in absolute terms, A day’s change in %, Day’s high, Day’s low, Year high, YTD change (%), Earnings yield at current price in %, P/E ratio etc. (Mbeledogu.N. N 2012). Using computational intelligence, machine learning and data mining to find correlations in large data sets that humans are not capable of finding, can now be used as a prediction method in finance as well as the fields of medicine and biology (Alexander, 1998).

There are currently several methods used in predicting stock prices. These are including various statistical method; machine learning algorithms and deep learning algorithms are often used by traders. This project follows mainly deep learning approach and compared with traditional machine learning algorithm and statistical method, in which algorithms are presented with historical stock data. The algorithms use information from historical data to train a model that is expected to infer future prices given recent price information. The common machine learning algorithms considered include: K-Nearest Neighbors(KNN), Support Vector Regression(SVR), Decision tree and Random Forest, Linear Regression, Auto-Regressive Integrated Moving Average(ARIMA) and deep learning algorithms considered include: Deep Neural Network(DNN), Gated Recurrent Unit (GRU), Long-Short Term Memory (LSTM) and a mixed model Bidirectional LSTM. The models are trained on daily stock exchange data, to make short-term predictions for one day ahead.

* 1. **Problem Statement**

The problem statement of this project follows the hypothesis that Deep Learning algorithm is a more precise way of predicting next day’s stock prices than the common Machine Learning algorithm. The problem is formulated below as:

Is using Deep Learning algorithm a more precise way of predicting the next day’s prices of stock market than using common Machine learning algorithm?

**2 Background**

**2.1 Stock Markets**

A *stock market* is a financial market where company shares are traded. While the stock market is an abstract term, the actual trades may be executed over the counter, at a stock exchange, an electronic communication network or similar. Trades that are executed through stock exchanges are easily tracked, because of the centralized and transparent nature of the exchange.

**2.1.1 Stock Exchanges**

A *stock exchange* is a common hub for buyers and sellers to find each other and fulfill trades. Oxford dictionary defines it as a market where securities are bought and sold, although note that the word *market* in this setting refers to a physical place, unlike stock markets. Activity at the exchange is visible to other participants, which in turn will drive the price. It is the principle of supply and demand, put into action

**2.1.2 Market Positions**

From the moment, someone buys shares in a company, they have *entered* the market and are exposed to price changes. If the stock value goes up, then they have earned a *profit* equal the total price difference. Profits are realized when the trader decides to sell the shares back at the higher price. In this case, we say the trader entered the market in a *long* position, because the trader bought shares expecting the price to rise.

**2.1.3 Indices**

An *index* is a collection of stocks, which value is based on the underlying share prices. Exactly how much a given stock affects the index price varies, but the calculation usually involves the number of shares and their price.

Since stock indices represent the aggregation of multiple stocks, they are often consulted to sample the stock market as a whole. For example, consider a publicly listed company and an index from the same market. If both the index and stock fall in value, the decline is likely caused indirectly by something outside of the company. Similarly, the index would react mildly if only one of its stocks fell in value. In other words, peculiarities local to individual stocks are rendered insignificant in the index, and the general market value is retained.

**2.2 Machine Learning**

**2.3 Deep Learning**

**3 Research Design**

**3.1 Research Data**

|  |  |  |  |
| --- | --- | --- | --- |
| Name of Stock | Total Dataset | Number of Training data | Number of Testing data |
| Beximco | 2014-2019 | 1064 | 342 |
| Square | 2014-2019 |  |  |
| Orion | 2016-2019 |  |  |

To conduct the study and verify our proposed hypothesis, we collect the data set from Dhaka stock exchange (DSE), Bangladesh. There are 4 attributes of this data set. They are open price, high price, low price and close price. We separate our data set into training set and testing set groups. Table 1 shows the test-train-split of closing price of dataset.

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