

# Stock Price Trend Forecasting using Supervised Learning Methods

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# Problem Statement

The aim of the project is to examine a number of different forecasting techniques to predict future stock returns based on past returns and numerical news indicators to construct a portfolio of multiple stocks in order to diversify the risk. We do this by applying supervised learning methods for stock price forecasting by interpreting the seemingly chaotic market data.



# Motivation



The fluctuation of stock market is violent and there are many complicated financial indicators. However, the advancement in technology, provides an opportunity to gain steady fortune from stock market and also can help experts to find out the most informative indicators to make better prediction. The prediction of the market value is of paramount importance to help in maximizing the profit of stock option purchase while keeping the risk low.

# The Solution

1. Preprocessing and Cleaning
  2. Feature Extraction
  3. Twitter Sentiment Analysis and Score
  4. Data Normalization
  5. Analysis of various supervised learning methods
  6. Conclusions
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# Structure of Data

We have taken these Historical Daily Stock Market Data for 500 companies of S&P 500 Market since the company came into existence.

The base features in this data that we collected were :

Open, High, Low, Close, Volume, Adjusted Close for each company and S&P index.

# Feature Selection

To prune out less useful features, in Feature Selection, we selected features according to the  $k$  highest scores, with the help of a linear model for testing the effect of a single regressor, sequentially for many regressors. (SelectKBest Algorithm, with `f_regression` as the scorer used)

This is done in 3 steps:

1. Start with a constant model,  $M_0$
2. Try all models  $M_1$  consisting of just one feature and pick the best according to the F statistic.
3. Try all models  $M_2$  consisting of  $M_1$  plus one other feature and pick the best ...

A [F-test \(Wikipedia\)](#) is a way of comparing the significance of the improvement of a model, with respect to the addition of new variables.

# Twitter Sentiment Score as new feature

Social media plays important role in predicting the stock market return values.

So, we then appended our data with one more feature -

Twitter's Daily Sentiment Score for each company based upon the user's tweets about that particular company and also the tweets on that company's page.

Once we were ready with complete set of features, we normalized our data for better results.

# Models Used

We have used the following regression models for forecasting and comparison :

1. Neural Networks
2. Bagging Regressor
3. Random Forest Regressor
4. Gradient Boosting Regressor
5. Adaboost Regressor
6. K Neighbour Regressor

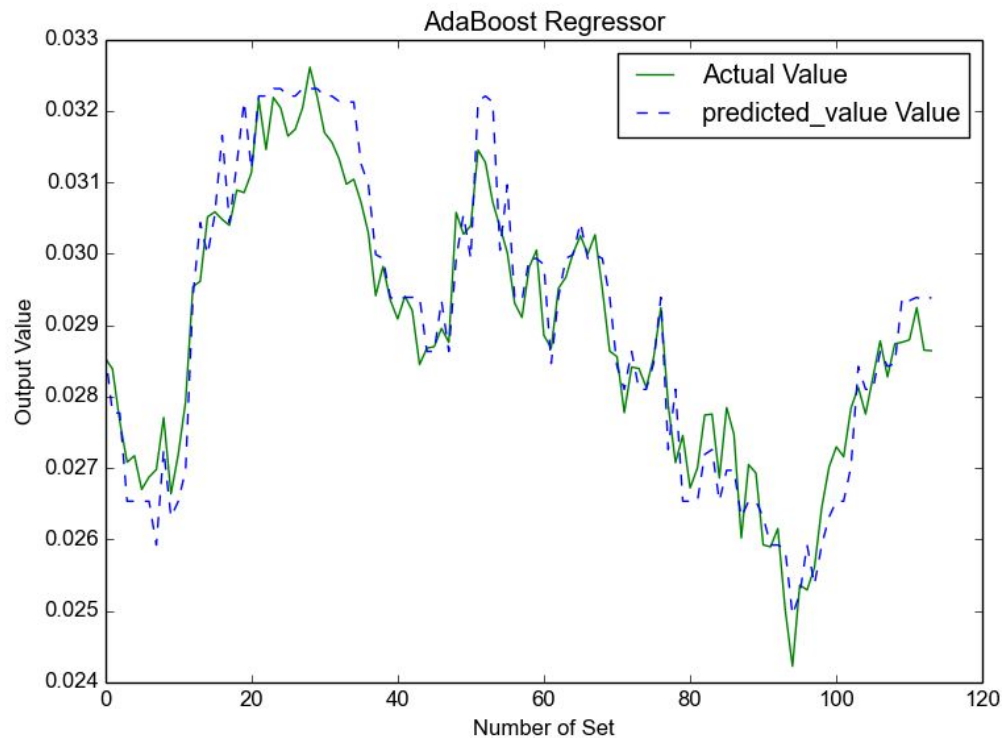


# Results : AdaBoost Regressor

American Airlines Group (AAL)

R-squared :  $2.988 \times 10^{-7}$

RMSE : 0.909

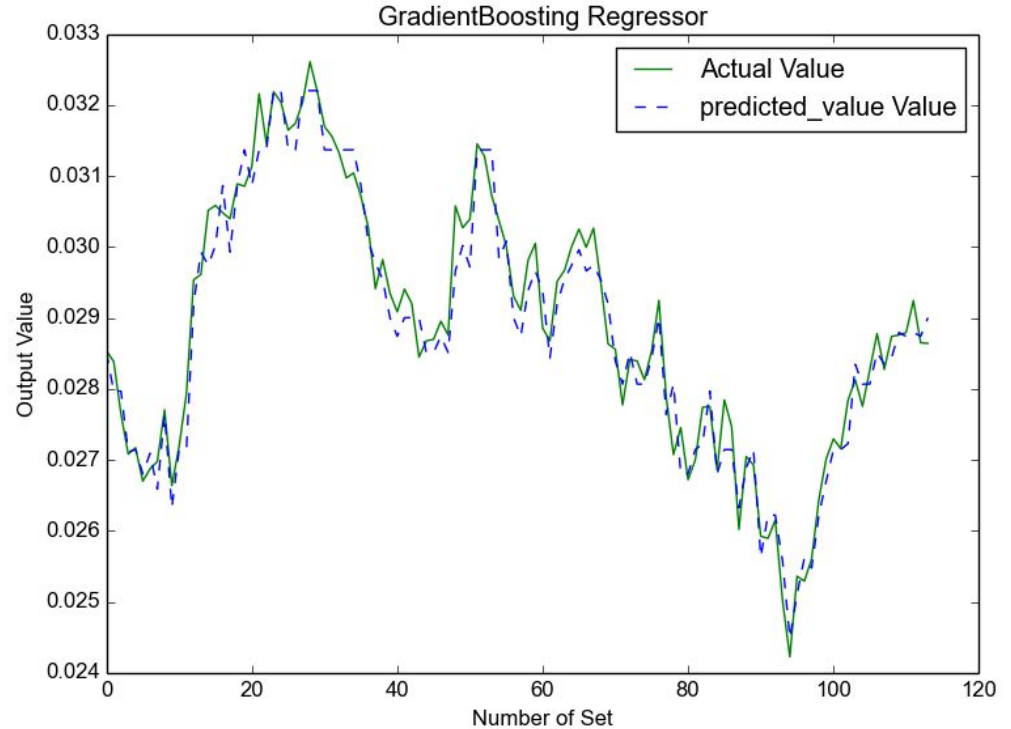


# Results : Gradient Boosting Regressor

## American Airlines Group (AAL)

R-squared :  $1.275 \text{ e-}07$

RMSE : 0.961

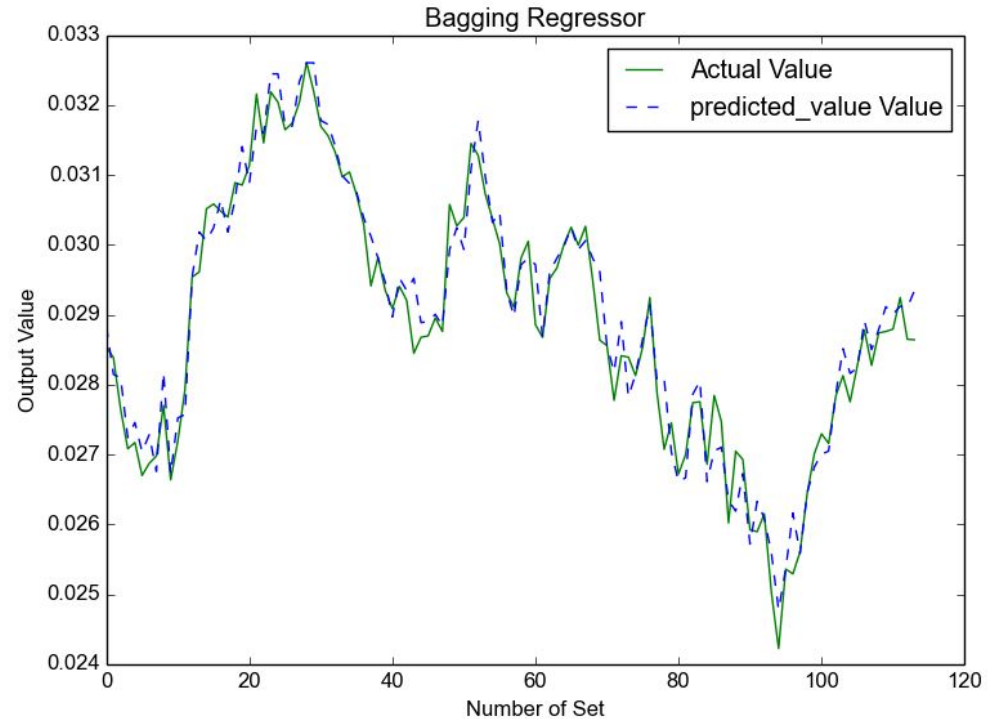


# Results : Bagging Regressor

## American Airlines Group (AAL)

R-squared :  $1.329 \times 10^{-7}$

RMSE : 0.959

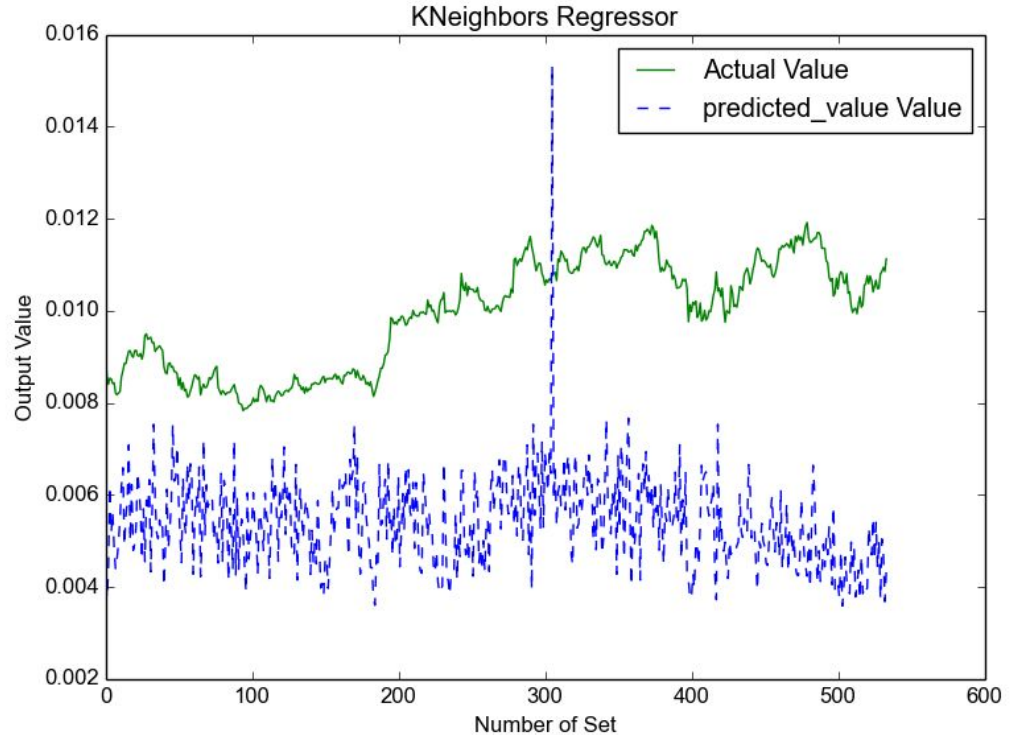


# Results : K Neighbours Regressor

## American Airlines Group (AAL)

R-squared : 0.00039

RMSE : Too High

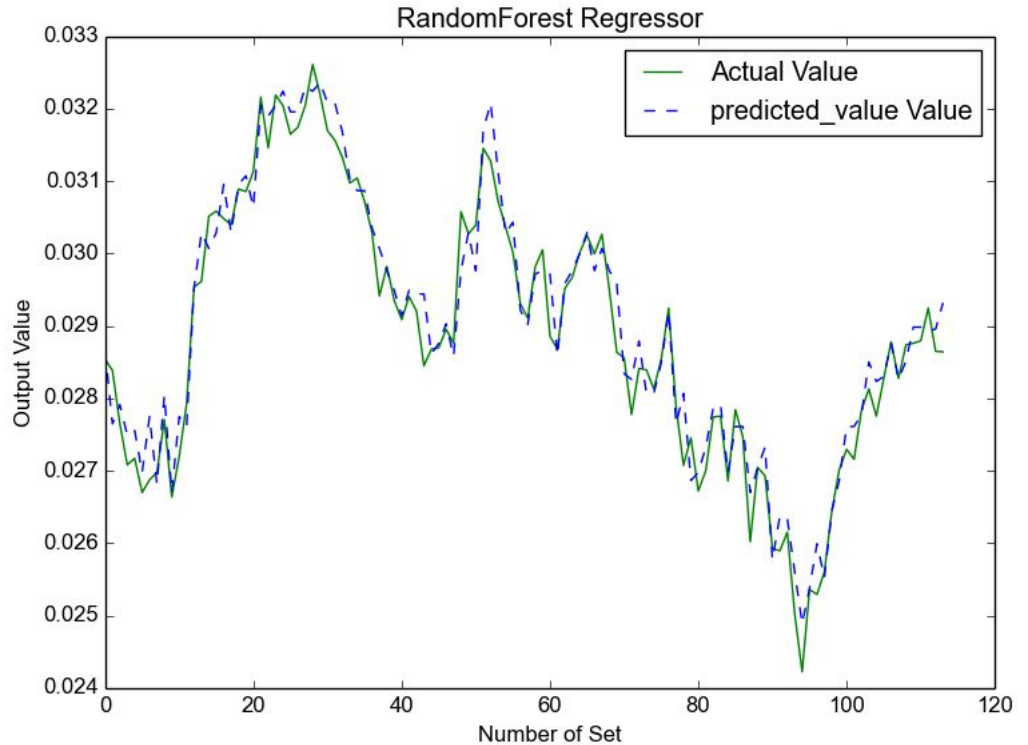


# Results : Random Forest Regressor

American Airlines Group (AAL)

R-squared :  $1.432 \times 10^{-7}$

RMSE : 0.956



# Results

- Gradient Descent Regressor: Gradient Descent + Boosting
- Bagging Regressor is found to perform well as Bagging (Bootstrap sampling) relies on the fact that combination of many independent base learners will significantly decrease the error.
- Therefore we want to produce as many independent base learners as possible.
- Each base learner is generated by sampling the original data set with replacement.

# Bagging vs Boosting

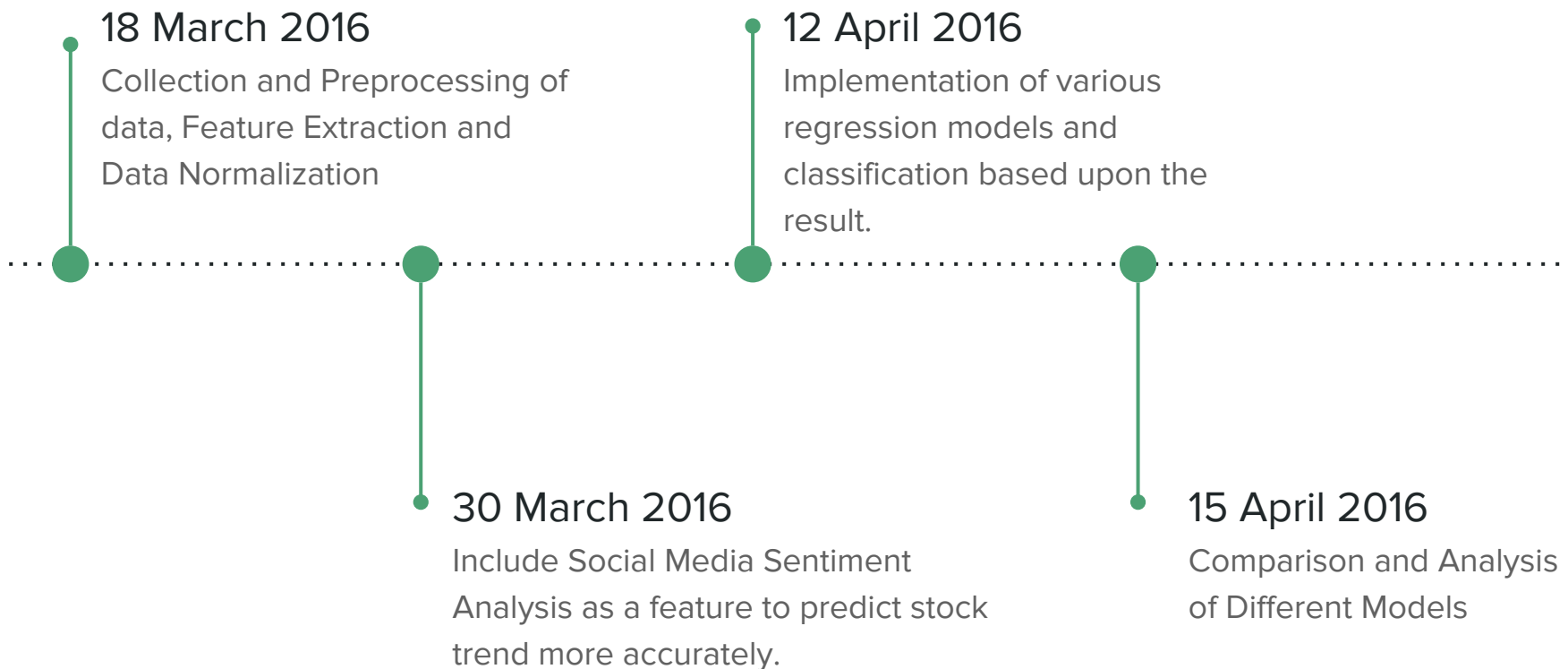
## *Bagging:*

1. **Parallel** ensemble: Each model is built independently
2. Aim to **decrease variance**, not bias
3. Suitable for high variance low bias models (complex models)
4. An example of a tree based method is **random forest**, which develop fully grown trees (note that RF modifies the grown procedure to reduce the correlation between trees)

## *Boosting:*

1. **Sequential** ensemble: try to add new models that do well where previous models lack
2. Aim to **decrease bias**, and not variance
3. Suitable for low variance high bias models
4. An example of a tree based method is **gradient boosting**

# Milestones





A close-up photograph of a person's hand, wearing a dark suit sleeve, adjusting a white slider on a professional audio mixing console. The hand is positioned in the lower-left foreground, with the index finger resting on the slider. The mixing console has various knobs and sliders, some of which are illuminated with red and blue lights. The background is heavily blurred, showing out-of-focus bokeh lights in shades of green, yellow, and red, suggesting a stage or concert environment. The overall lighting is dim, with the primary light source coming from the console's controls and the background bokeh.

Thank You