Project 2- Analysis of Microsoft and Apple stock prices over a 5 year period.

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Outline

- The best way to model stock performance is an unsolved question with a variety of techniques being proposed.
- In this project we explore long term stock market analysis using the closing values of Apple and Microsoft.
- Stock prices are generally considered a type of time series, with the price on each day being related to the value on the previous day but also influenced by past and anticipated future actions of the company and wider economic conditions.

- We use time series analysis, correlation, and linear regression in 6 month intervals.
- The correlation coefficient, or Pearson's R is a measure of the degree of dependence between two sets. R varies between -1 (meaning a negative correlation) and 1 (meaning a positive correlation)
- We use these regression models for forcasting.

Apple computers had its IPO(initial public offering) on December 12, 1980. It sold 4.6 million share for $22 per share on the Nasdaq market.

Microsoft's initial public offering was on March 13, 1986 selling at $21.00 per share on the first day. As of July 27, 2015 Microsoft had 7,997,980,969 shares outstanding.

The quantmod library in R was used to obtain closing prices from yahoo. We analyzed closing prices on 6 month intervals from 2011 to 2015 inclusive, as well stock data going back to 1985 for an overview.
Plots were created using the ggplot2 package. Linear regression analysis was performed using the "lm" command and correlation was performed using the cor tool against two indexes.

Overview of apple and microsoft stock price fluctuations.

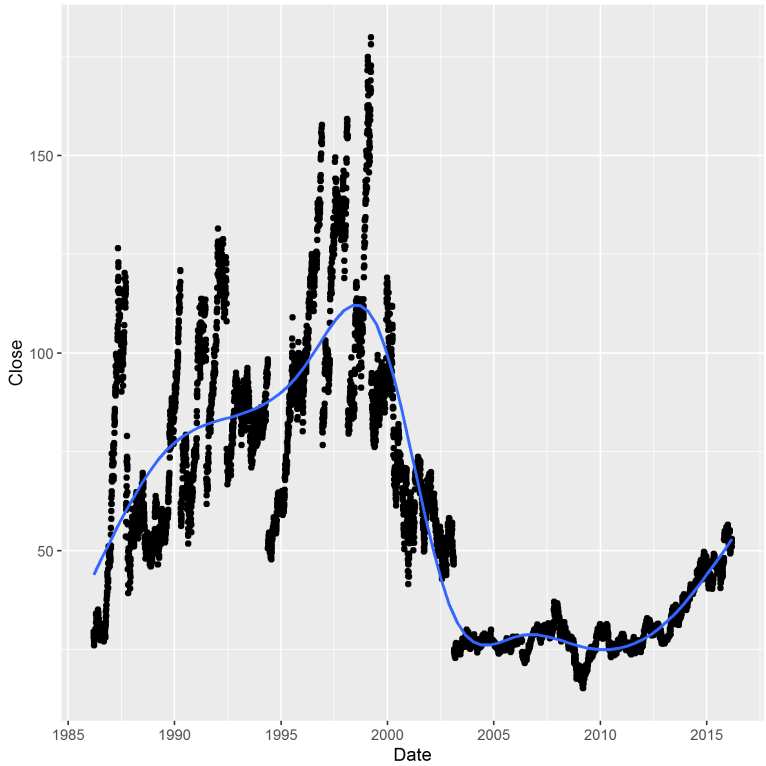

Figure: Microsoft Closing prices from 1986.

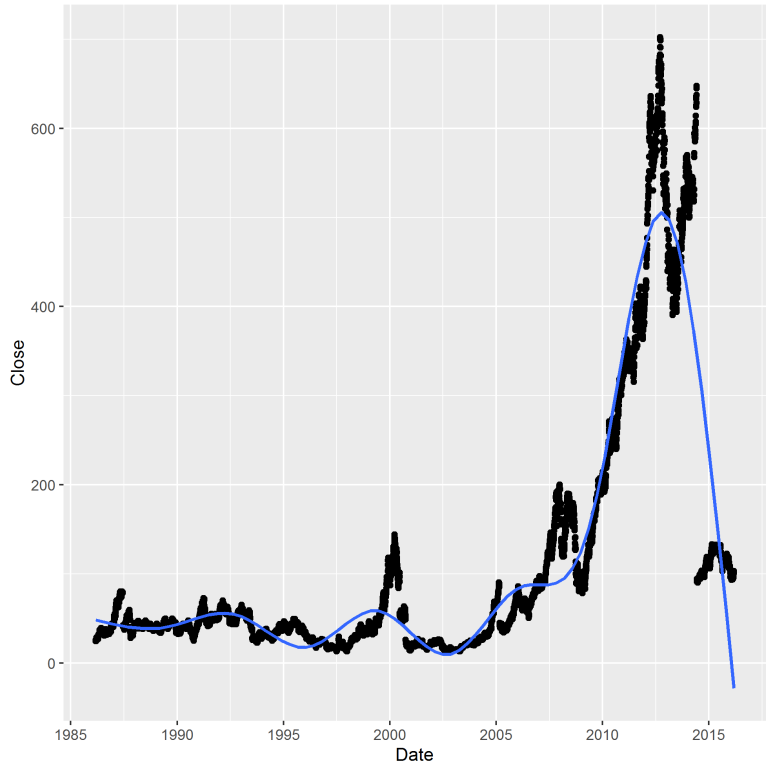

Figure: Apple Closing prices from 1986.

Combining Microsoft's and Apple's stock plot.

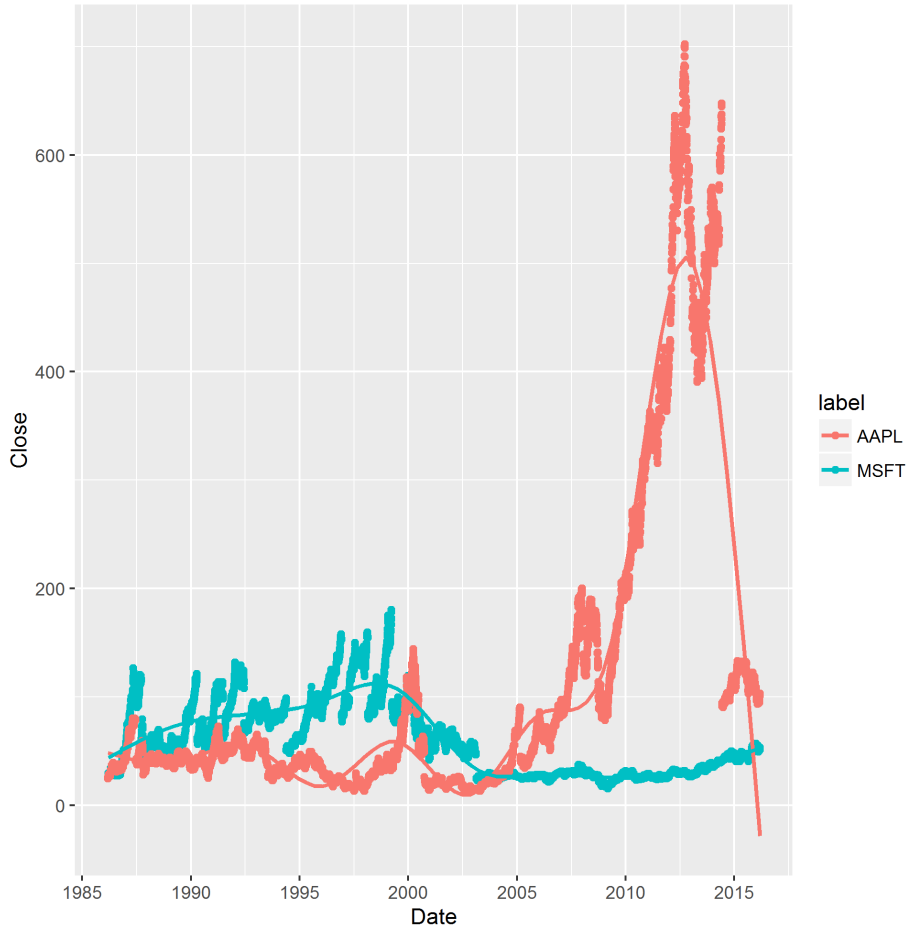

Figure: Superimposed graph showing apple and microsoft closing prices

Correlation between Microsoft and Apple closing prices agianst two Nasdaq indexes from March 1st, 1986 to March 7th, 2016.

	MSFT	AAPL	IXIC	NDX
MSFT	1.0000000	-0.4116887	-0.3309249	-0.2437307
AAPL	-0.4116887	1.0000000	0.5085121	0.3361954
IXIC	-0.3309249	0.5085121	1.0000000	0.8902717
NDX	-0.2437307	0.3361954	0.8902717	1.0000000

Time Series Analysis - Focus on 2014 stock split

Scatter plots of closing prices for apple and microsoft.

Figure: Scatter plot with graph of Apple stock

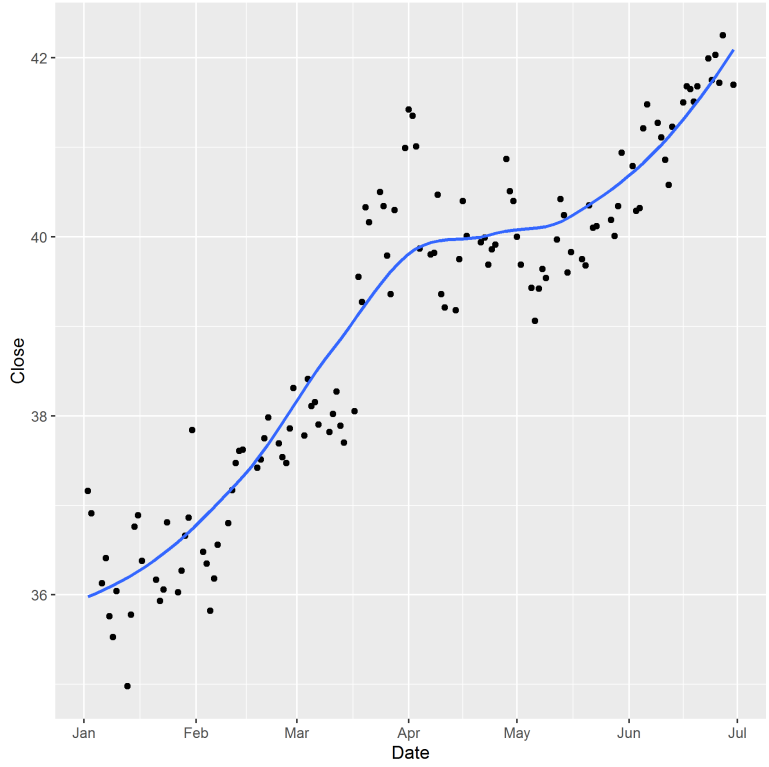

Figure: Scatter plot with graph of Microsoft stock

Time Series Analysis - Focus on 2014

Scatter plot adjusted for apple stock split.

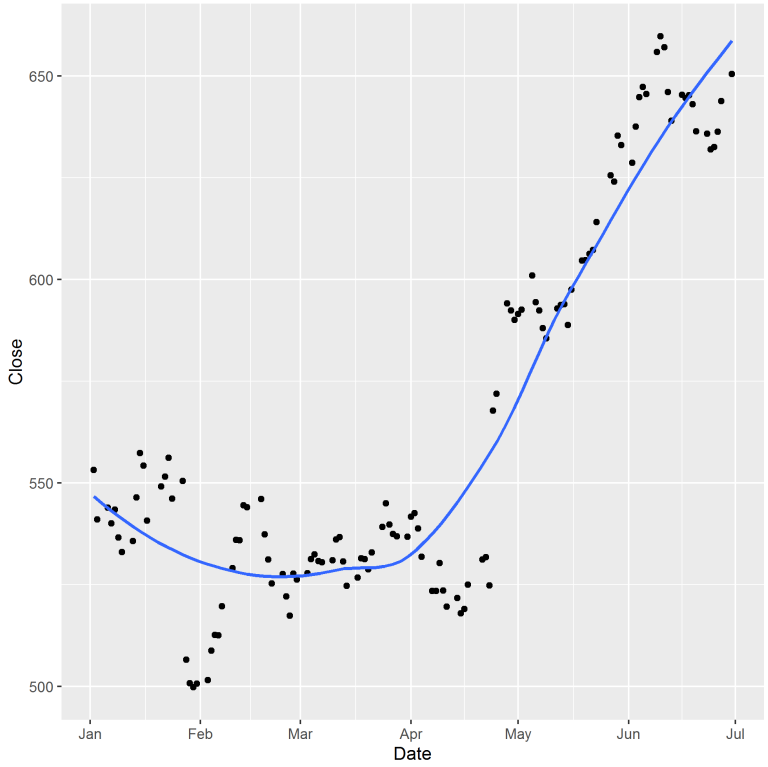

Figure: Scatter plot with graph of Apple stock

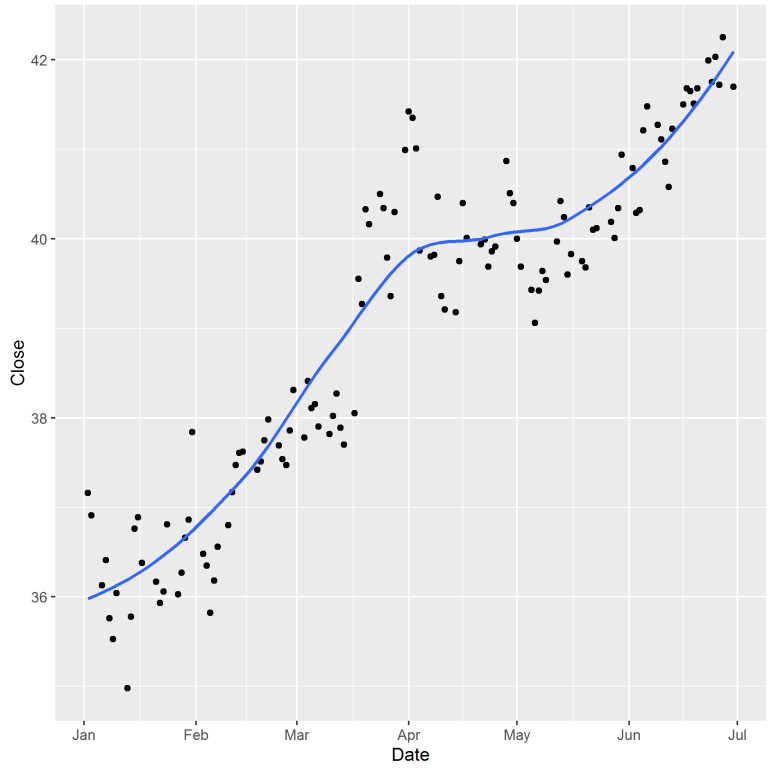

Figure: Scatter plot with graph of Microsoft stock

Apple and Microsoft stock prices were strongly positively correlated after adjustment for apple's stock split.

	MSFT	AAPL	IXIC	NDX
MSFT	1.0000000	-0.4096498	0.3273532	0.5376690
AAPL	-0.4096498	1.0000000	-0.5364466	-0.5781071
IXIC	0.3273532	-0.5364466	1.0000000	0.9294151
NDX	0.5376690	-0.5781071	0.9294151	1.0000000

adj	MSFT	AAPL	IXIC	NDX
MSFT	1.0000000	0.6719981	0.3273532	0.5376690
AAPL	0.6719981	1.0000000	0.3854136	0.6745036
IXIC	0.3273532	0.3854136	1.0000000	0.9294151
NDX	0.5376690	0.6745036	0.9294151	1.0000000

Regression lines for MS and apple without adjustment

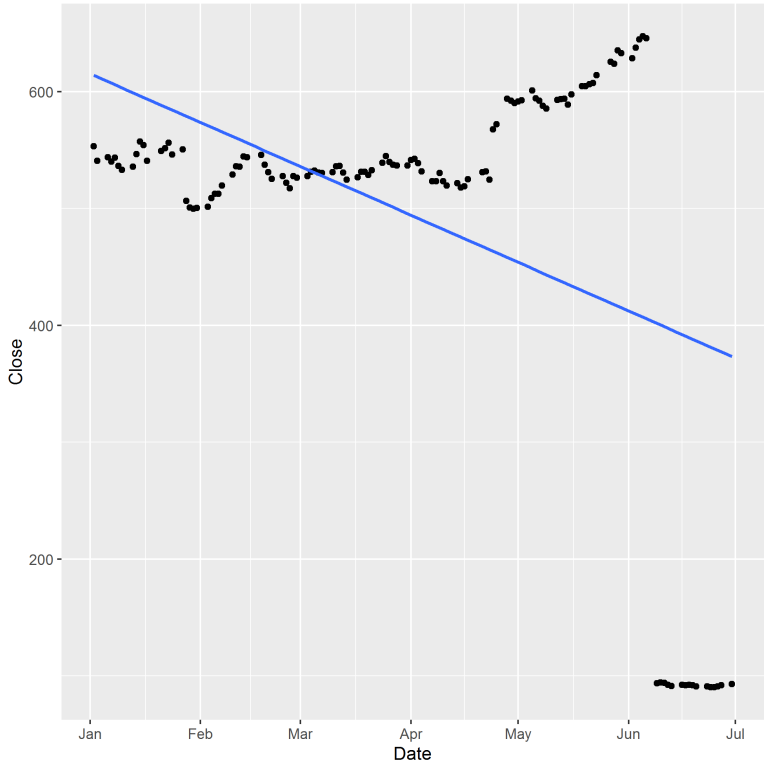

Figure: Linear regression line of Apple closing prices.

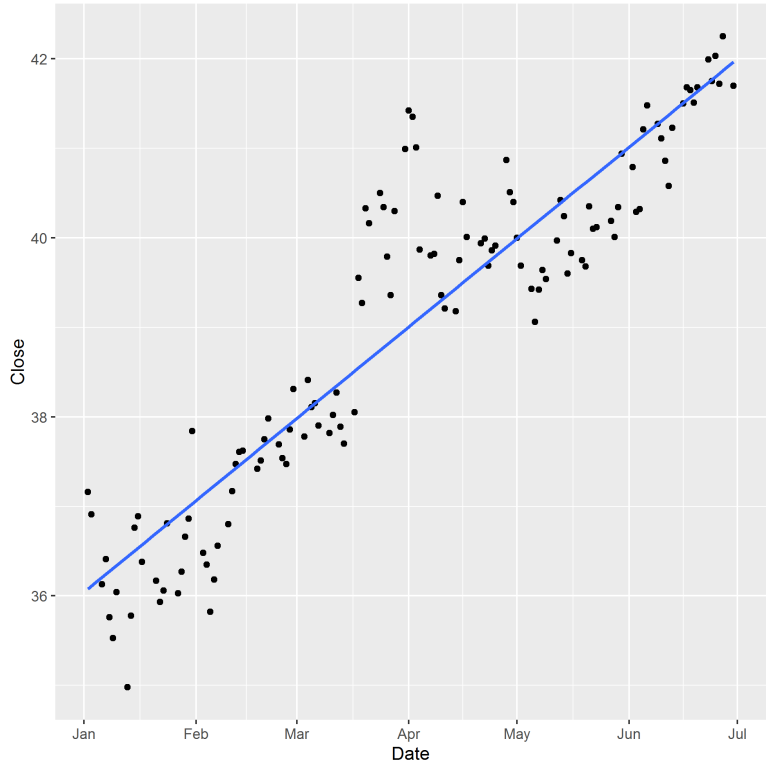

Figure: Linear regression line of Microsoft closing prices.

Regression lines for MS and apple with adjustment for stock split.

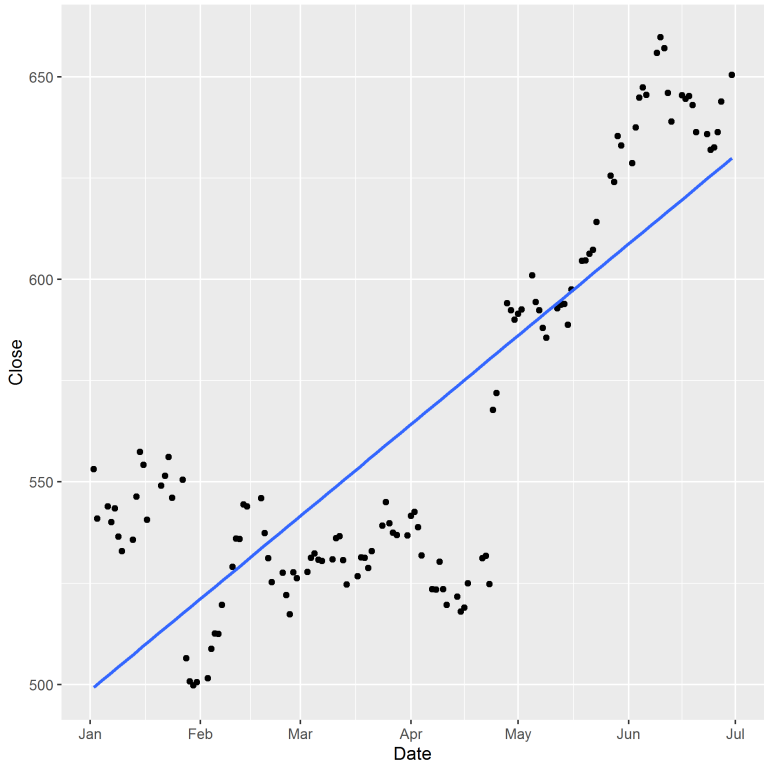

Figure: Linear regression line of Apple closing prices adjusted for stock split.

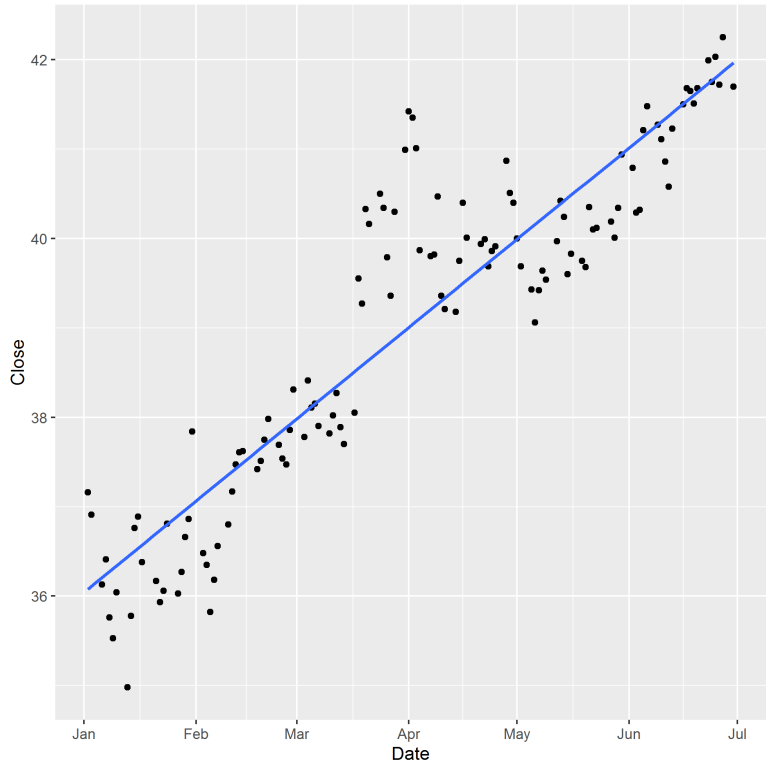

Figure: Linear regression line of Microsoft closing prices.

Forcasting and Analysis

We use the discovered best fit line from the 11 linear regression models to predict stock prices for Microsoft and Apple. Each of the models are for a 6 month time period beginning with the start date shown with the exception of the first model (which used data from 3/1/1986 to march 8, 2016).

Table: Predicted stock prices for Microsoft and Apple using 11 different linear models)

Start date	**MSFT predicted**	**AAPL predicted**
3/1/1986	25.76549	272.1967
1/1/2011	-19.60977	202.9293
7/1/2011	19.90085	621.4313
1/1/2012	35.2761	1918.646
7/1/2012	-0.698968	-153.916
1/1/2013	95.0161	-38.50871
7/1/2013	66.7254	1250.436
1/1/2014	66.01087	-609.2786
7/1/2014	65.49856	181.776
1/1/2015	52.01497	166.34
7/1/2015	68.80454	101.6902
Mean	**43.154922**	**355.7947445**
Median	**52.01497**	**181.776**

- We performed correlation, regression, and time series analysis on the closing prices of Microsoft and apple stocks over a 5 year period.
- We used our regression models to predict future prices and compared these predictions, finding that both the median and the mean seem to predict more realistic outcomes than most of the models individually.
- Correlation analysis indicated that although Microsoft and apple tend to be only weekly correlated, they correlate more with each-other than they do with the index.

- Apple's closing prices were heavily impacted by a 1:7 stock split which may explain much of the observed volatility.
- Adjusting for this by multiplying the prices after the split by 7 produces more stable data points for correlation and regression analysis which would be less impacted by the split.

- Our linear prediction models, individually, did not tend to produce very realistic predictions, however the median predictions seem to be more reasonable.
- When we used the models to predict the stock price for march 9, 2016, we found that the average was more accurate than all but one model.
- This suggests that future work on using such linear models may find success employing a voting strategy, whereby models for many time series are generated and used to predict prices on a single date with the median or mean chosen as a final prediction.