Short Term Stock Market Analysis

An Interactive Qualifying Project Report

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Abstract

The stock market has always been compared to a living being. It goes up and down just as an organism breathes and moves. Therefore, it always been said that predicting the stock market is impossible. But is that really true? With the advanced technology available today, there has to be a way to project short term closing prices for individual stocks. This IQP explores various methods for predicting the behavior of individual stocks through the use of the MatLab program language.

Executive Summary

Everyone knows that stocks and bonds can be amazing investments to anybody that understands them and is just a little bit “lucky”. Or they can be a major liability for anyone who lacks that certain luck. Is it really true, however, that the stock market cannon be predicted? I think not. Any my advisor, Professor Mayer Humi agrees. We hypothesize that certain stocks taken on an individual basis can be predicted or even calculated for a short term span. We do this by looking at moving averages and taking the historical data and trying to extrapolate what the current data is.

A moving average is an indicator used by many stock market analysts to show upward and downward trends in stocks. A short term moving average is the average price of a stock on a particular day of the stocks prices a certain previous number of days. For example, if we wanted to know the 5-day moving average of a stock on day number 526, we would take the average price of days 521-526. This can be calculated for any period of time as long as there are enough data points to sustain the average. The easiest way to calculate a moving average is through a math program such as MatLab. We will then use MatLab to perform more analysis on the individual stocks

Using MatLab, we will perform signal analysis on the historical data in order to project what we think the price of the stock will be a short time from now. We treat the closing prices of the past 361 trading days as discrete time values. We begin by downloading the information of the 361 data points of 11 stocks. We then use MatLab to calculate the “line of best fit.” In our case, the line of best fit can be a polynomial of degrees 1-3. We then find a Fourier Transform of the stocks and clean the noise from the signal in order to more accurately describe future data. After cleaning the signal, we can perform an Inverse Fourier Transform to get a signal similar to our original signal. We can then try to extrapolate the signal for an extended period of time by adding an extrapolation to the original line of best fit. This can be constituted as “predicting” the stock.

Between the moving averages and extrapolation of data, we got a lot of information about the stocks. On one hand, the moving averages told us that a stock was a good long-term investment, and on the other, the extrapolation told us that the price of the stock would fall slightly. The extrapolations actually proved fairly accurate for the most part. Visual approximation of the error led us to believe that the extrapolation was correct to within 10% of the actual stock for a period of about 60 days.

Unfortunately, there has been little groundbreaking work done with this IQP. It turns out that the market is incredibly difficult to predict. There are simply too many factors that must be taken into account that have an impact on the price of the stock. All in all, I believe that I have learned something about stock market prediction, and even though I have had only moderate success with this project, I have laid a foundation of understanding on which I may build better ideas.

Introduction

This project is important to me because I often worry about the wellbeing of Americans in the future. Between a slowing national economy, pollution, global warming, high oil prices and increasing overpopulation, the future of the United States seems all but bleak. There is no miracle cure to fix everything that is wrong with an entire country; all there is, is lots of hard work done by good people. This project will give me the opportunity to work on and come up with ideas to solve one of the major problems: Social Security. After all, the most basic job of an engineer is to solve problems. Using my knowledge of computers and MatLab programming, I can help devise a way to predict the stock market using the previous stock market data.

There is no possible way that a person would be able to function in today's society without the use of computers. Let alone, have a positive impact on society. Computers help us to manipulate numbers and equations millions of times faster than even the fastest human calculator. Being an Electrical and Computer Engineering Major, the understanding of computers and programming will help me take in large amounts of stock market data and manipulate it in order to better understand and ultimately, predict it.

This type of data manipulation and interpretation using computers and MatLab programming is quite similar to the type of work that engineers will be doing. Just as I read the individual closing prices of a stock over a period of time, so might a mechanical engineer read the temperature of a brake disk caliper over a period of time in order to properly test that caliper, or might an aerospace engineer read information about the amount of drag measured by an airfoil in order to reach the most efficient design. These scenarios are good examples of signal analysis. I plan on being an electrical engineer and the study of possible recursions in the stock market and the hope to find a pattern that will accurately and efficiently find those recursions is similar to my desire to accurately and efficiently come up with ways to design digital circuits and analyze signals. Hopefully, by learning to research and think outside of the box with this school project, I can gain valuable experience in the professional world in order to better qualify me as a professional engineer.

This project is best qualified as an Interactive Qualifying Project (IQP) because it very well follows the guidelines of an IQP at WPI. This project will answer the question of how science and technology can help society. I will be using very sophisticated mathematic programming techniques to help the United States as a society avoid the dangers of financial bankruptcy at old age.

The ultimate goal of this project is to come up with a possible permanent solution to the problem of the underfunding of the United States social security program and researching the various techniques of short term stock market analysis. Ideally, by the end of the IQP, I will have found a way to make myself and everyone else in the United States who is eligible for Social Security a millionaire. Realistically however, my ideas will not be used directly to influence national Social Security policy; rather, I will have learned about the subject and will apply that knowledge to the next election, so that I may make my voice heard on the subject of Social Security reform. I will also have learned enough about the stock market to at least make some money.

The results of this project will best be shared through the internet. There are a plethora of forums and websites dedicated to the idea of Social Security reform. Perhaps someone of political importance will stumble upon my research and think it the perfect solution to an ever increasing threat. Perhaps I can make a difference.

Research and Preface

The research that needs to be done for this IQP is that on the subject of stock market analysis and the United States Social Security system. Both subjects will have a massive amount of information on them including literature and the internet. Because so much information is available on the two subjects, the difficult part of this project will be sorting through all of the sources and picking the best.

Preface on Social Security

In 1935, President Theodore Franklin Roosevelt signed Social Security act into law. The Act provided benefits to retirees, the unemployed, the disabled, and a lump-sum benefit to family survivors at death [(2)]. Today, these benefits are known simply as Social Security. Social Security is the single largest expense in the United States federal budget, and by dollars paid, the U.S. Social Security program is the largest national program in the world. According to the Fiscal Year 2007 Budget Press Release, the estimated money paid to beneficiaries was estimated at about $500 billion. This is about 600 times the amount paid to beneficiaries in 1950 and close to 15,000 times the amount paid to beneficiaries in 1940 [(3)]. Shown in the figure below, is a graph that details the steep incline in the dollars paid to social security beneficiaries. The reasons for the increase in benefits include inflation, increased senior citizen population, longer life expectancy and many others.

Although the idea behind Social Security is wonderful, it is a huge price to pay. After all, the money has to come from somewhere. Payments to retirees are financed by a payroll tax on current workers' wages. It’s funded by a flat tax of 12.4 percent of each worker's wage income, split evenly between employers and employees. About four out of five of those tax dollars go immediately to current beneficiaries, and the remaining dollar or two is used to purchase U.S. Treasury securities held in the system's trust funds.

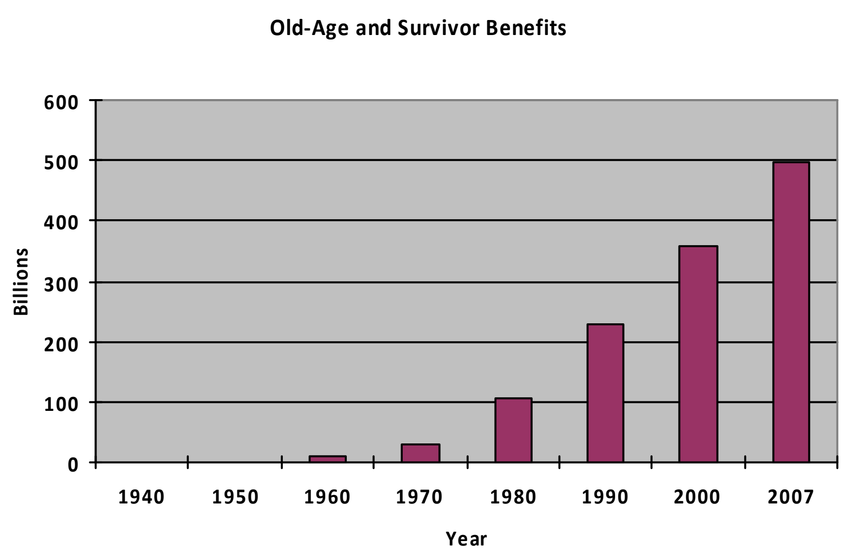

Figure 1

According to the Summary of the 2008 Annual Reports released by the Social Security and Medicare Boards of Trustees, "the financial condition of the Social Security and Medicare programs remains problematic."[4]. The problem with Social Security will become effective in approximately 2018, when the huge generation of baby boomers born in the 1950's and 60's begin to retire. Those retirees will require that a portion of general income tax revenues pay the interest and eventually the principal on the bonds to fully finance benefits. Eventually, the Social Security reserve fund will grow smaller and smaller, until there is no money left. At that point, Social Security benefits will have to be paid entirely by current payroll taxes. By that time, there will be only 2 workers that will be paying the benefits of 1 retiree; whereas, in 1950, there were 16 workers paying benefits per retiree.

The predicament that politicians forecast for the Social Security program will not arise until the Social Security Trust Fund shrinks to zero and benefits are paid entirely from workers. This is predicted to be anywhere from early 2040 to early 2050. Figure 2 shows a graph of the Estimated Operations of Trust Funds showing the income, outcome, and the change in the fund between 2008 and 2017 unless adjustments are made. The graph shows a slight increase in the Fund until 2013 when it begins to fall. The important thing to realize is that unless Social Security is changed or updated, Social Security faces imminent long-term financing challenges, and the longer we wait to adjust the system, the more the system will have to be adjusted, the more burdensome to future generations, and the more hurtful on the general US economy. Today, the most promising answer to this problem seems to be the privatization of the US Social Security System. This means that rather than the US government telling people what to do with their money, individuals will be allowed to invest in the stock market.

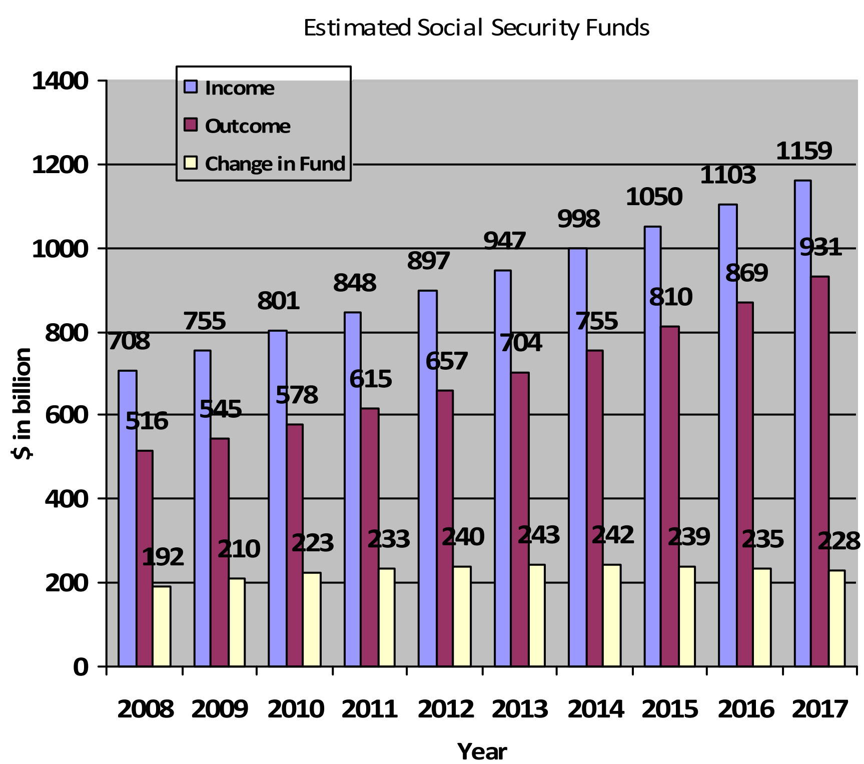

Figure 2

Preface on Stock Market

The stock market that we know today seems to be an incredibly complex machine. The reality however is that, at its core, the concept of owning a stock market share of a company is just that, owning a part of the company. The idea is that if a company does well, and profits, that all of the shareholders will profit as well. However, if the company does not do well, and the company loses money, the shareholder's stock price will go down and the shareholder will lose money.

The eternal question quickly becomes: how can an individual pick a company that will do well and make profits. This is the question that a person asks when investing in a company. Statistics show that the majority of companies fail. This does not seem to make sense, but the reality is that most companies are like living organisms; most of them have a lifespan and at the end of that lifespan, they die. The number of companies that are still in business today is quite small compared to the number of companies that been created since the beginning of commerce. The reason that most companies die is that the company ceases to be profitable. Profitability is arguably the single most important aspect of a company.

It seems like a pretty daunting task to pick a single company out of thousands that will be profitable, and not go under. This is why stock market analysts and financial advisors spend years in school to answer the eternal question: how can one make money from the stock market? The simplest answer, in terms of buying and selling shares of a company is that one should buy shares of a company at a lower price than when he or she sells them. This is a deceptive simplification of the stock market, but it is, in fact, the most important aspect of it. But this evokes another important question: how can a person know at which price to buy a stock and at which price to sell it?

The widespread belief is that the stock market cannot be predicted. It is said that there are simply too many things that impact the price of a stock to be able to know what its price will be in the future. This may be true, but it may not. There are many people in the world, notably people that work on Wall Street in the United States who make quite a handsome living from trading on the stock market. It is simply not possible for every single person who has profited from trading on the stock market to have been just lucky. If those people just got lucky, then the whole notion of going to college to study the market would be ridiculous. There are many tools and techniques at the disposal of the average person today, many more than ever before. Tools such as Moving Average Convergence/Divergence (MACD) graphs (shown below), Relative Strength Index's (RSI's), and multitudes of other graphs can now be computed with the use of personal computers. These tools help analysts make trading decisions based on the previous data of the market.

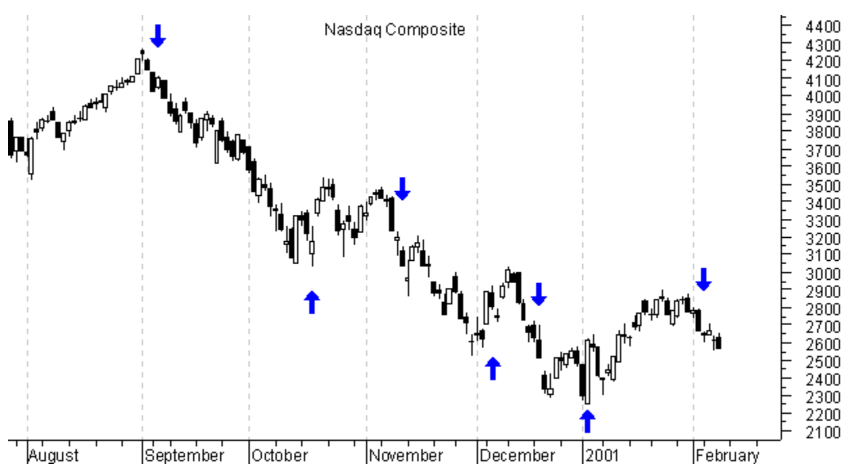

Figure 3: MACD Graph of NASDAQ Composite (courtesy of Trade10.com)

Solutions to Problems

The Solutions to the Social Security Problem

There are a multitude of ideas for solving the problem with Social Security including privatization, adjusting benefits or taxes, or even raising the retirement age.

Privatizing Social Security

One thing for certain though is the need for extensive Social Security reform.

One of the most the most popular ideas for solving the financing troubles of Social Security is privatization. The idea behind privatizing Social Security is that instead of a person paying the government during his or her entire working life and getting everything back when that person retires, that the person use the money to invest in their own individual private retirement account. These funds would be invested in stocks, bonds and real assets that would fund the workers' retirement and other benefits covered by Social Security. In the case of death, private account balances would become part of the deceased's estate.

There are many arguments for and against the privatization of Social Security. The problem is that there are so many people that just don't understand what privatization is. This is actually one of the arguments against privatization. It is said that the general public simply does not know enough about stocks and bonds. Studies by Yale economist Robert J. Shiller and others have demonstrated that individual investors are far more likely to do worse than the market generally, even excluding the cost of commissions and administrative expenses of privatization. Moreover, a number of surveys show that most people lack the knowledge to make even basic decisions about investing.

On the other hand, it is said that the privatization of Social Security has already worked in a number of other countries, such as Chile and other South American countries. This offsets the idea that a laymen cannot make decisions about where to invest. If citizens of third world countries can effectively invest in their own futures, why, with the aid of computers and the internet, can't US citizens.

Another argument against privatized Social Security states that the benefits received by a person through a private program would be too dependent on the state of the stock market when that person retired. For example, a worker who invested his or her retirement fund in a portfolio that matched the S&P 500 index and retired in March 2000 would have a nest egg about 30% larger than someone who retired just a year later using the exact same investment strategy. Clearly, some workers would do much better than others based simply on when they happened to retire. This would be a major change from today's system.

Adjusting Benefits or Taxes

Another, slightly less popular, idea for avoiding the social security crisis involves adjusting the benefits to recipients and the taxes on workers. According to the Trustees Report, an immediate increase of 14 percent in the payroll tax would alleviate the impending deficit. This corresponds to raising the current tax of 12.4 percent (half paid by the employee and half paid by the employer) and raising it to 14.1 percent. Conversely, an immediate drop of 12 percent in benefits is said to achieve the same goal.

Raising the Age of Retirement

Steps have already been taken by congress to help alleviate the financial problems faced by Social Security. The “full-retirement” or “normal retirement” age is slowly increasing. For every year after 1937 the retirement age is raised 2 months until 1942. For people born between 1943 and 1954, the retirement age is 66. Beginning in 1955, every year, the retirement age will increase again 2 months until 1960. People born in 1960 or later can retire at age 67. The scheme seems like a good idea, but it will have little effect on the Social Security’s problems. In order to make a significant impact, the retirement age must be raised to over 70 just to keep up.

The Solution to Stock Market Prediction Problem

We begin our analysis of the stock market by researching a number of stocks. While researching, we are looking for a good diversification with respect to the price at which the stocks are traded at, and on which exchange they are traded. To do this, we choose 11 stocks: 3 of which are components of the Dow Jones Industrial Average, 3 random stocks with an average closing value of 10-20 dollars, 3 random stocks with an average closing value between 1 and 5 dollars, and 2 stocks that are traded on the NASDAQ.

Method of Moving Averages

We can see in the chart below the 30-Day, 100-Day and 200-day moving averages of the stocks as of July 18, 2008. These charts will help shows us the diversity of the stock closing prices and will help us with future analysis.

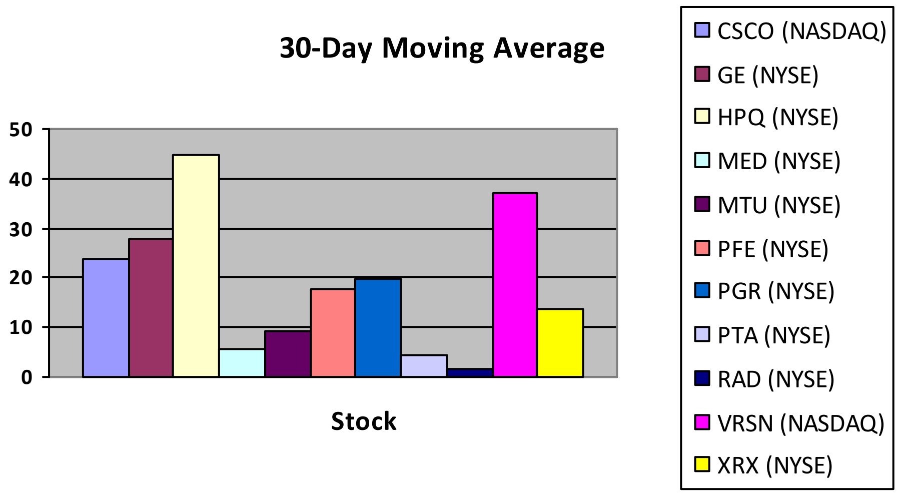

Figure 4

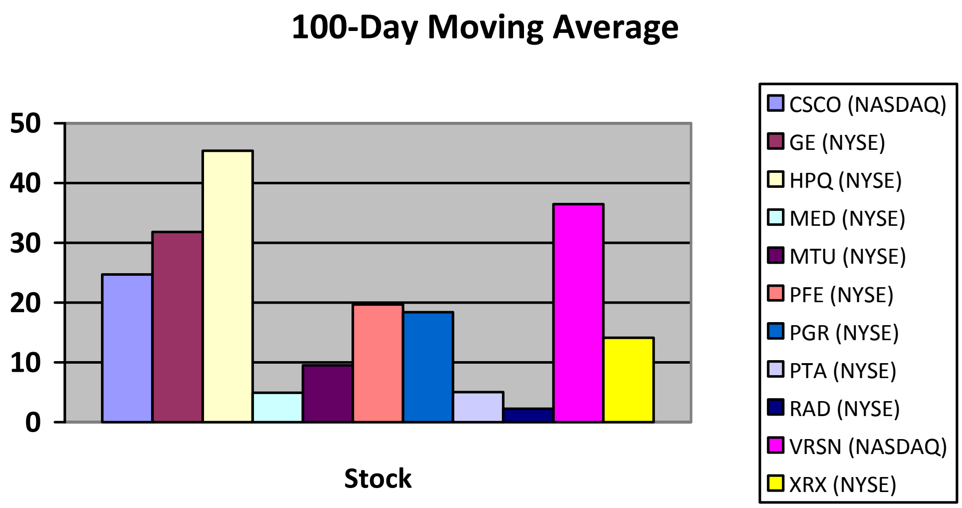

Figure 5

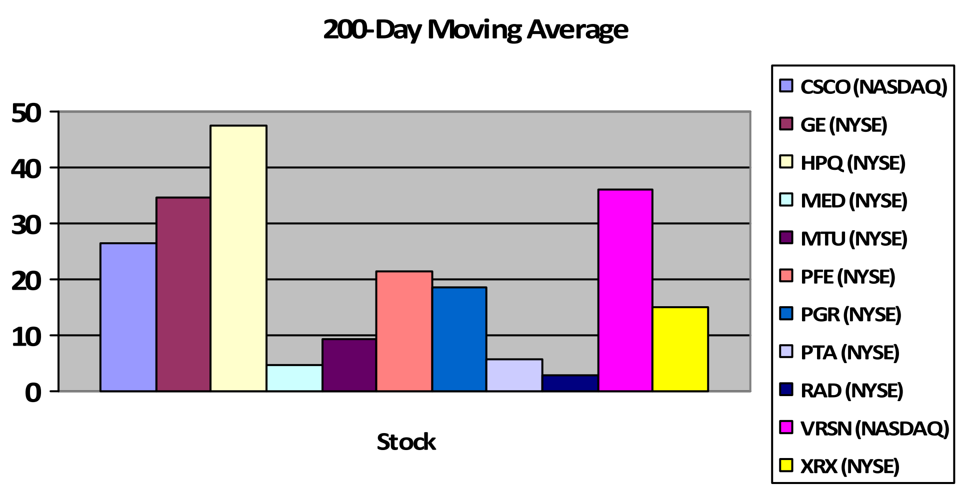

Figure 6

These moving averages are created by taking the average of a stock over a given timeframe. They are used to emphasize the course of the stock and show us the smoothed trend of a stock. These averages are a good way of filtering out the "noise" that occurs from daily fluctuations of price and volume; this filtering will make it easier to interpret what the stock is doing. Typically, the crossing over of a short-term average with a long-term average is associated with an upward trend. [5]

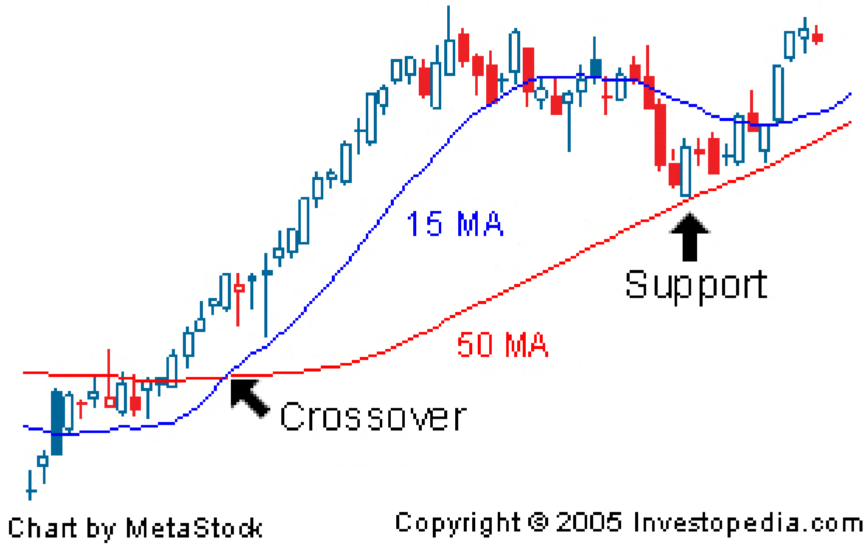

Figure 7: Courtesy of Investopedia.com

The problem with calculating a moving average, especially when calculating larger moving averages like a 100-day or 200-day moving average is the sheer number of values we must use. Even if we were to use a graphing calculator, calculation would take us hours. Luckily, we have MATLAB. MATLAB provides us with the ability to read data files with our stock information and manipulate the information as we please. Using MATLAB, we create a program that calculates the moving average of a stock automatically, with very little time and very little actual work on our part. Shown below is part of the MATLAB code we used to calculate the 5-day moving averages of all 11 stocks. To plot the 10-day, 30-day, 100-day, and 200-day moving averages, we copy the code and replace the value in the variable "intval" with the desired value of moving average.

```
%% loading data
load XRX.dat
%% Find 5 day Moving average

intval=5
xx=(1:1:361);

for i=1:361-intval
FiveDayMA(i)=0;
for j=i:i+intval-1
FiveDayMA(i)=FiveDayMA(i)+XRX(j,5);
end
FiveDayMA(i)=FiveDayMA(i)/intval;
end

plot (FiveDayMA, 'r');

hold on
```

Figure 8

Below, are the moving averages calculated for all of our stocks by a program similar to the one above. We see by the graphs that there are a number of points that the averages intersect. This is evidence of either a downward or an upward trend. An upward trend signifies that a stock has been going up for a certain period of time: either for the short term (1-6 weeks), mid term, (1-3 months), or long term (2.5 months or more). This may also signify that the stock is ripe for investment.

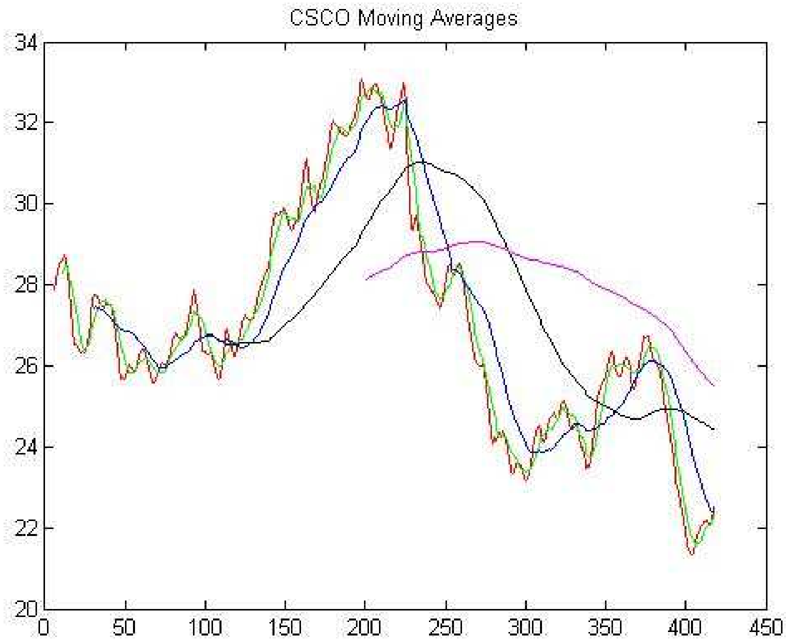

Figure 9: CSCO Moving Averages

The MAs for CSCO tell us that it would be a good idea to invest in the stock for the short-term; this is because the 5 and 10 day averages cross above the 30-day average. It might not be a good idea to invest for the medium term however because the 30 day average crosses below the 100 day average. It's also probably a bad idea to invest in the long term because the 100 day average falls below the 200 day average.

The MAs for GE tell us similar things as those of CSCO. It might be a good idea to invest in the stock for the short term, but a bad idea to invest in the medium and long term. Both of these stocks confuse us because different MAs tell us different things. It is important to realize that MAs should only be used as an indicator of trends. They are only part of the puzzle that is short-term stock market analysis.

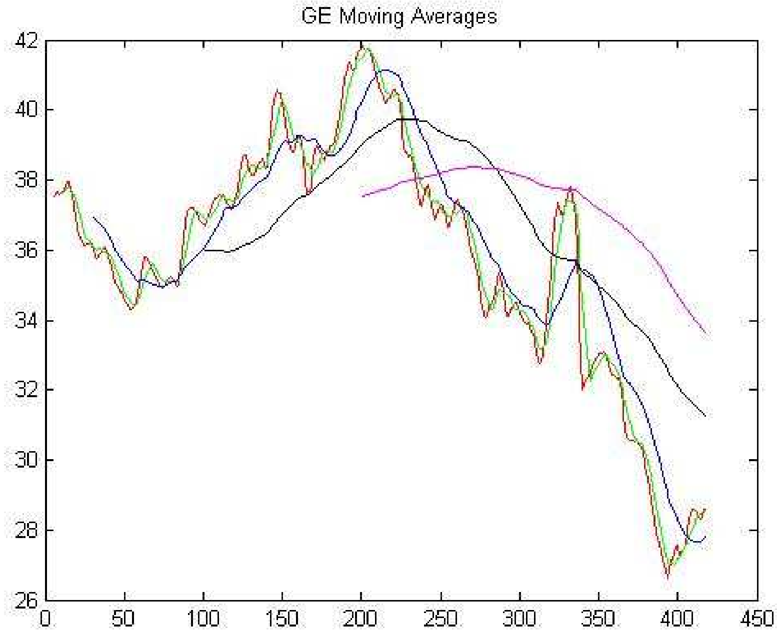

Figure 10: GE Moving Averages

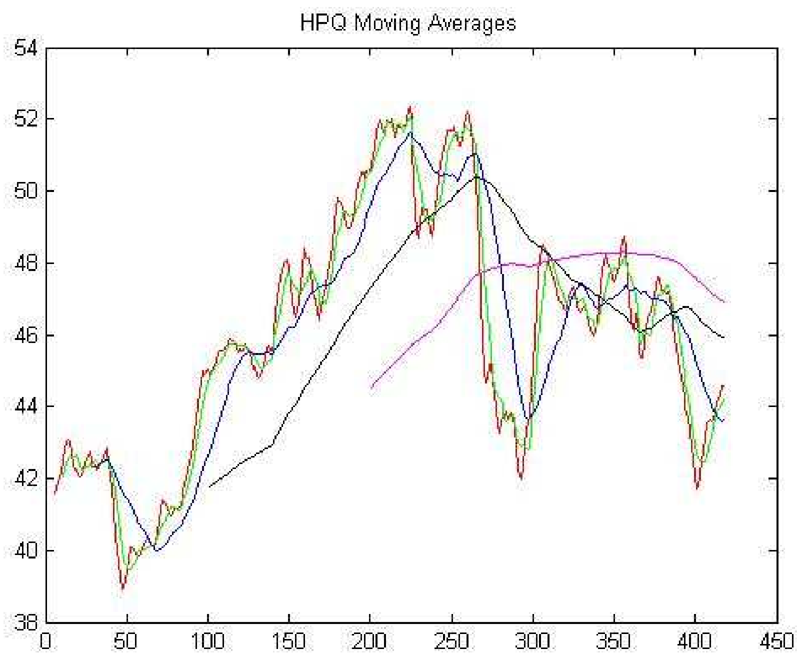

Figure 11: HPQ Moving Averages

If we look at the MAs for HPQ, we get slightly confused. The graphs look very mystifying, but if we pay close attention, we will see that the 5 and 10 day MAs cross above the 30 day average. This again shows us that there is a short term upward trend in the stock and it is likely to go up in the short term. We see however, that the 30 day passes below the 100 day and that the 100 day passes below the 200 day MA. This indicates that mid term and long term investing is a bad idea. In choosing to invest in a stock it is important to pick a stock that is likely to go up in the short term, mid term and long term. We therefor choose not to invest in this stock unless there is other evidence to offset the trend analysis.

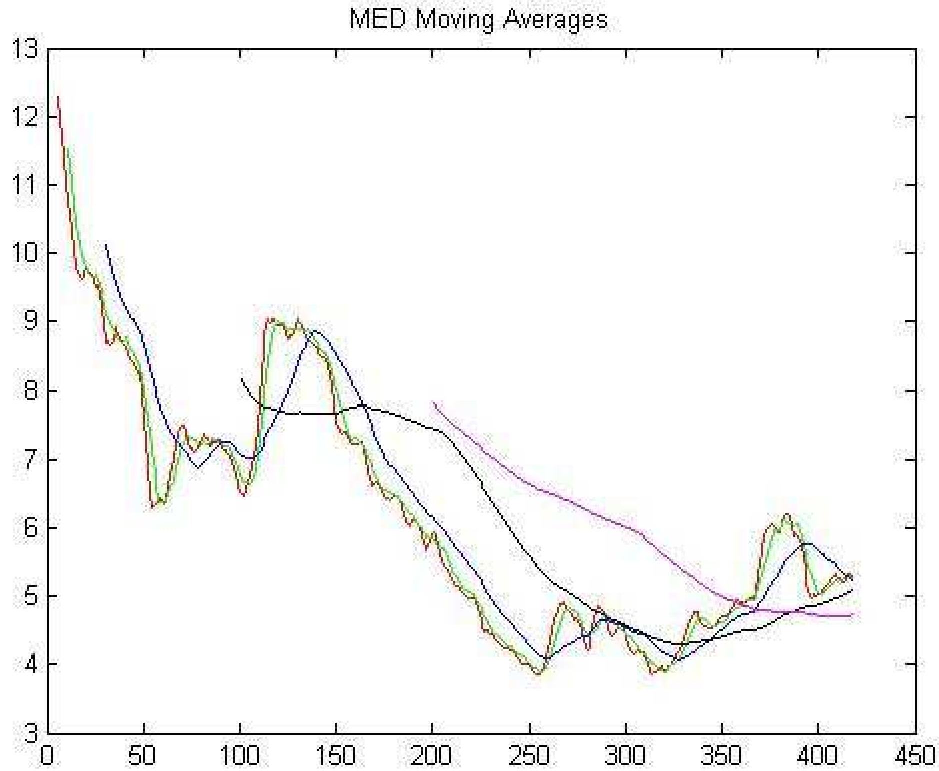

Figure 12: MED Moving Averages

MED is a good example of a stock that has upward trends in both the mid term and long term. The short term trend analysis is complex, at best, to understand. It seems as though if we were to look at the stock in the next few weeks that the 5 and 10 day averages might cross above the 30 day average, but only time can tell. This stock may be a good candidate for investment, but more analysis is necessary.

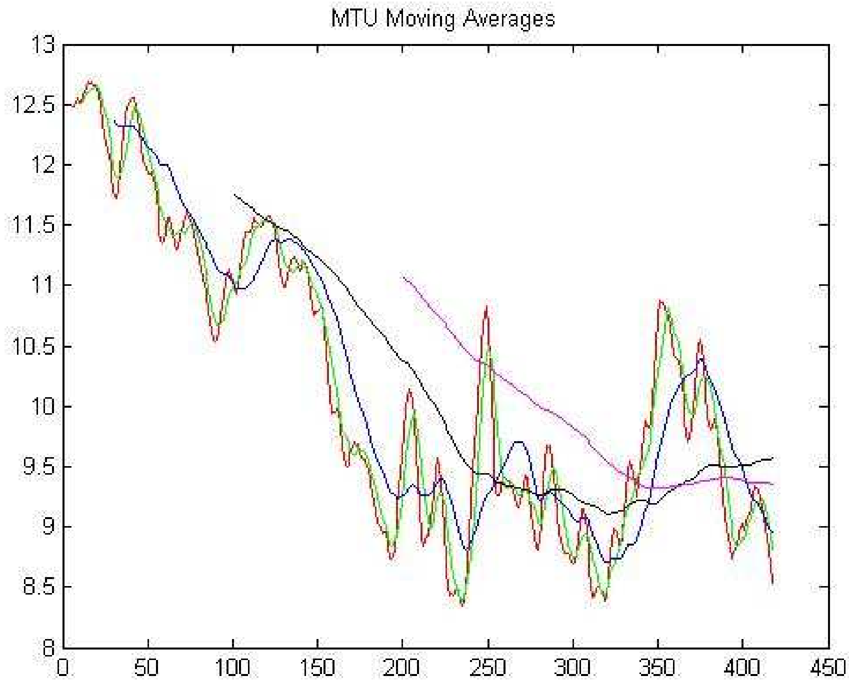

Figure 13: MTU Moving Averages

Both MTU and PFE are stocks that have awful looking MA's. Awful meaning they just keep going down. There is hope however in both stocks. It seems as though there are short term upward trends in both. These indicators mean there might be a shift in trends and investment might not be a bad idea.

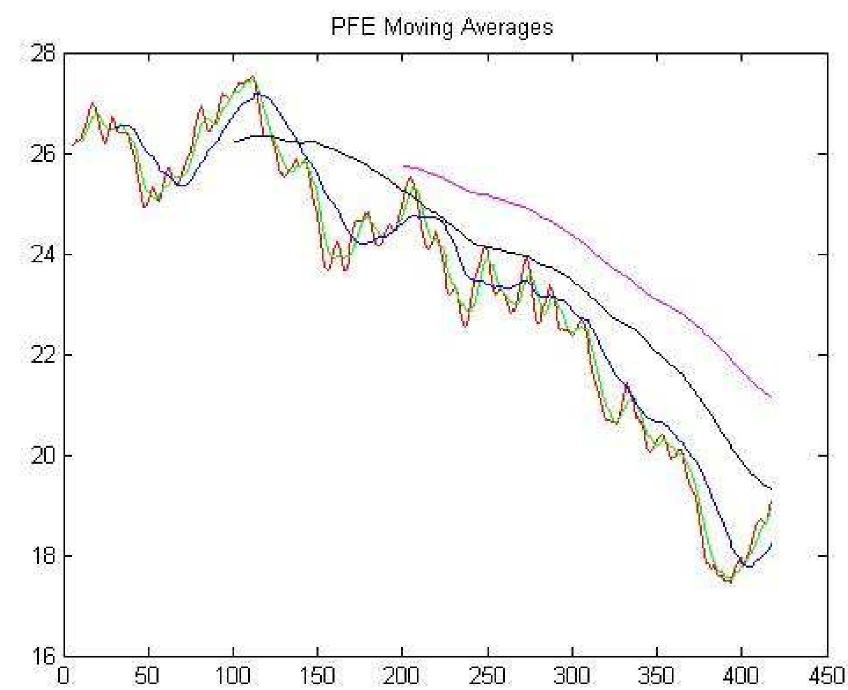

Figure 14: PFE Moving Averages

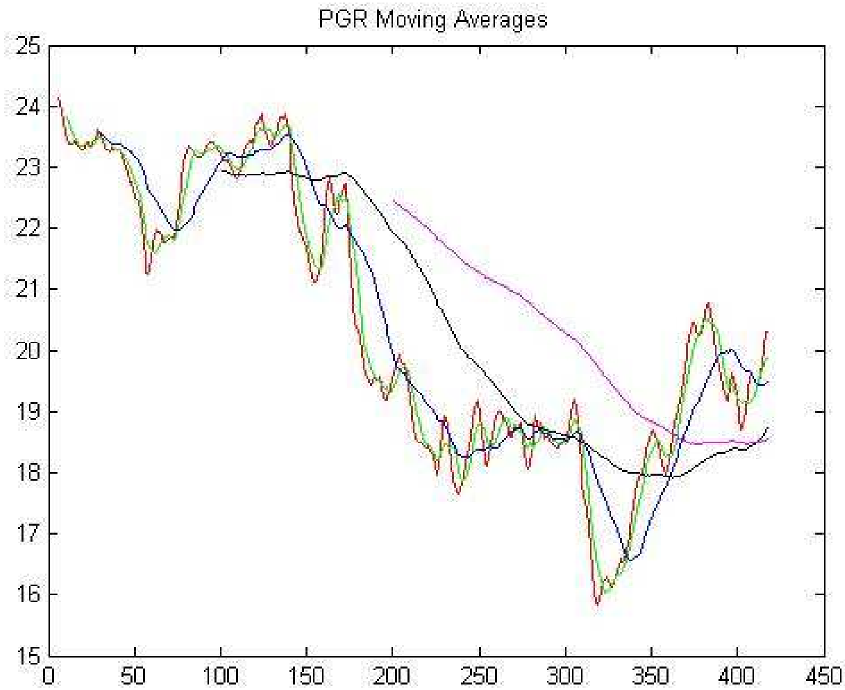

Figure 15: PGR Moving Averages

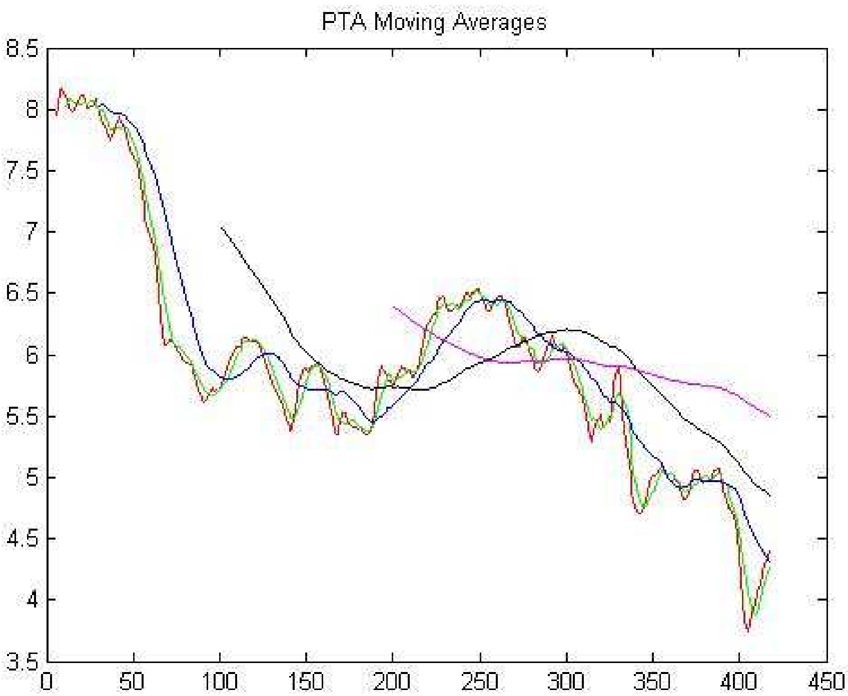

Figure 16: PTA Moving Averages

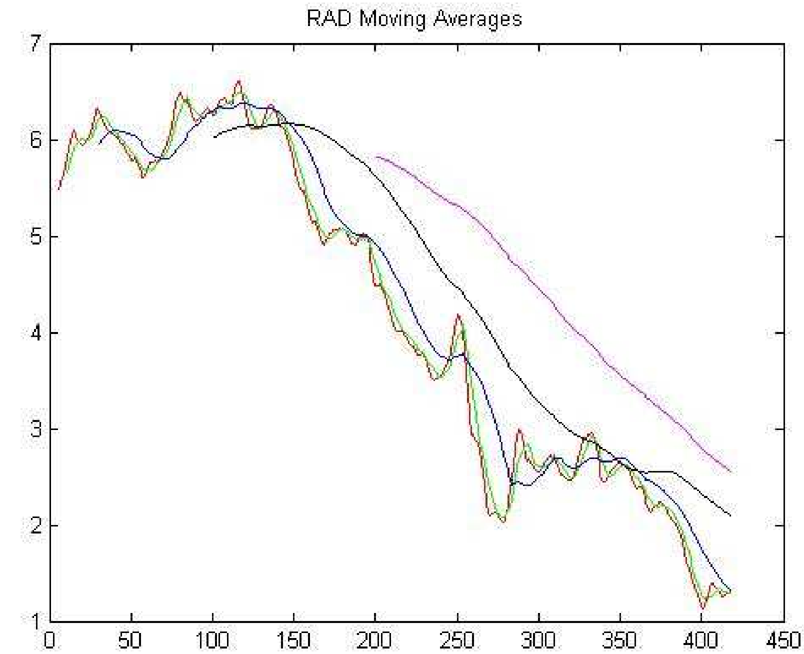

Figure 17: RAD Moving Averages

RAD is a stock whose overall MA's are moving down over almost the entire course of our 400 points of data. We see that after 400 trading days, the stock has averaged out to a closing price of less than a quarter than that of the first day. It doesn't take a genious or a computer program to realize that this stock is in a downward trend. The good news, however, is that a stock can only go down so far before it goes back up (unless the company goes out of business). Therefore, a mid term investment might be a good idea based on common sense.

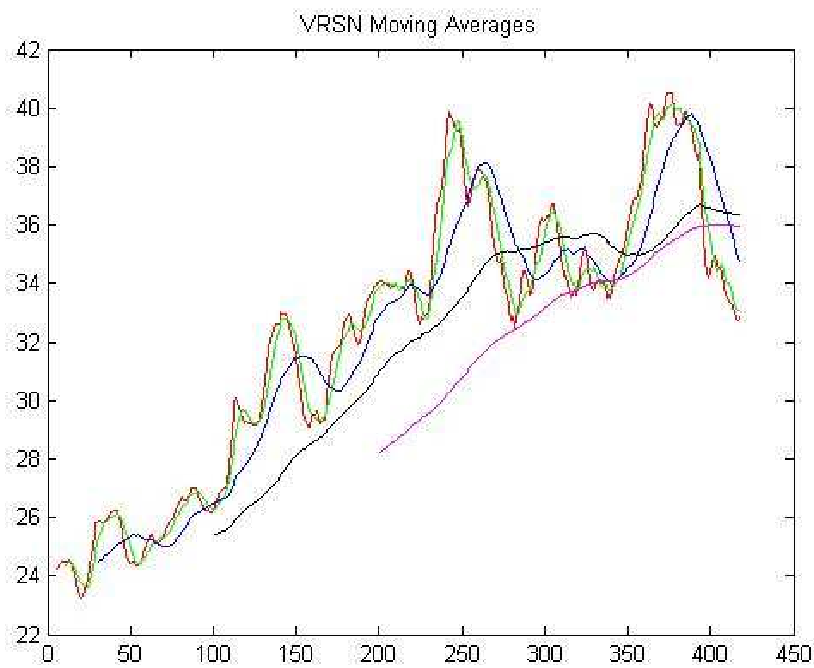

Figure 18: VRSN Moving Averages

VRSN is the first stock we have encountered whose overall MA's over the course of our data shows upward movment. At one point in the averages, we see the average closing price to be almost double that of the closing price on the first day. We do see at the very end of our data; though, that there is a downward trend for the short term. This give us slight hesitation when thinking about investing.

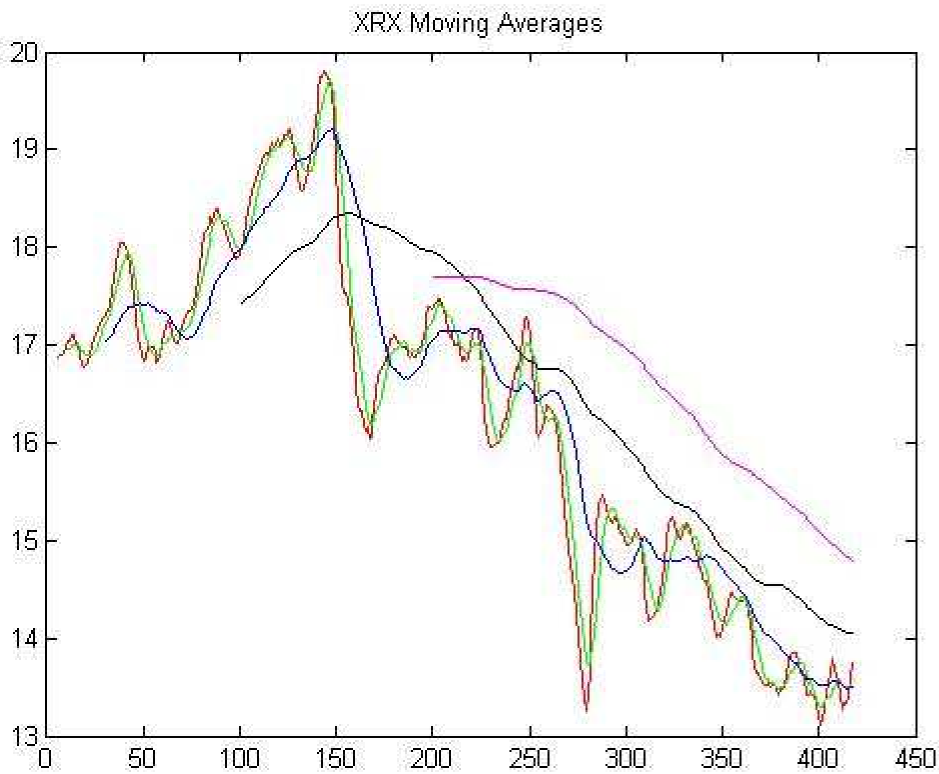

Figure 19: XRX Moving Averages

Method of Extrapolation

Now that we have a background in some of the traditional methods of stock market analysis, we can try other methods. We can now try using Professor Humi's method of extrapolation from previous data. We do this by taking the closing prices from a certain number of trading days (in the initial case, we will choose 361) and setting the first 300 prices as our historical data. We then try to extrapolate that data for 61 days and check it against the actual data. That is the method of extrapolation.

We must first find data to work with. The data will be the closing prices of all 11 of my stocks since January of 2006. This accounts for approximately 350 data points, which will be perfect for use in MATLAB manipulation. Thus, I begin using Professor Humi's method of stock market analysis with a MATLAB program, "Trend.m", given to me by the Professor and shown below.

```
1   %% loading data
2   load apple.dat
3   %% finding the trend
4   for i=1:365
5   x(i)=i;
6   end
7   p1=polyfit(x',apple(1:365,2),2)
8   xx=(1:1:458);
9   pp1=polyval(p1,xx);
10  plot(xx,apple(1:458,2))
11  hold
12  plot(xx,pp1)
13  xlabel('time(days)')
14  ylabel('stock price')
15  title('least squares vs. stock price')
16  print -dpsc2 -r600 apple.ps
17  hold
18
```

Figure 20

This simple, yet elegant program finds us the polynomial of best fit according to the order specified in line 7 of the code. I chose not to exceed 3rd order polynomials on advice from my advisor, as the increased amount of information will make it impossible to generalize a formula for other stocks. I began this phase of analysis by running the program for all 11 stocks specifying a different order polynomial between 1 and 3. As would be expected, different stocks yielded different polynomials, and different stocks were best fit by different orders of polynomials.

The second step was to find the difference between the actual prices of the stocks and the calculated polynomial of best fit. This was done quite easily with the addition of a few simple lines of code that takes the value of the trend and subtracts the actual value of the stock. We call the value of the difference, the "residuals." The smaller the value of the residual, the better approximation of the actual stock the polynomial of best fit is. Shown below are the polynomials of best fit along with their residuals, for each of the 11 stocks. It is important to notice that each stock has its own degree of polynomial that produces the best residual. The figures below show the degree of which the residual is the best.

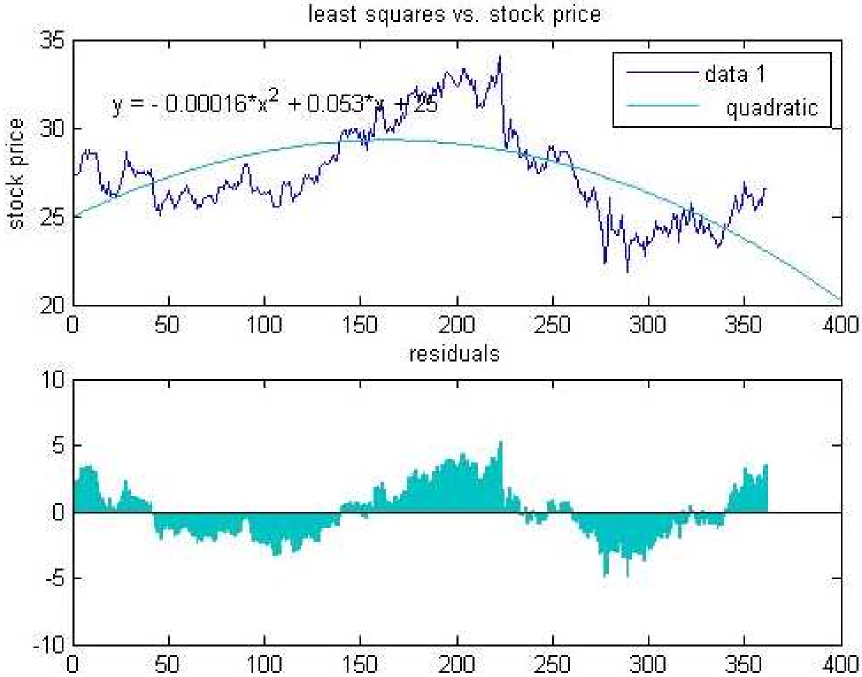

Figure 21: CSCO

The residuals for CSCO are the difference between the actual price of the stock and the "line of best fit" of a 2nd degree polynomial. The 2nd degree residual was chosen because the average difference was smaller than a 1st or 3rd degree polynomial.

The residuals for GE are of a 3rd degree polynomial. This is because the difference is smaller than in a 1st or 2nd degree polynomial. Below the residuals for GE are the residuals for all of the other stocks.

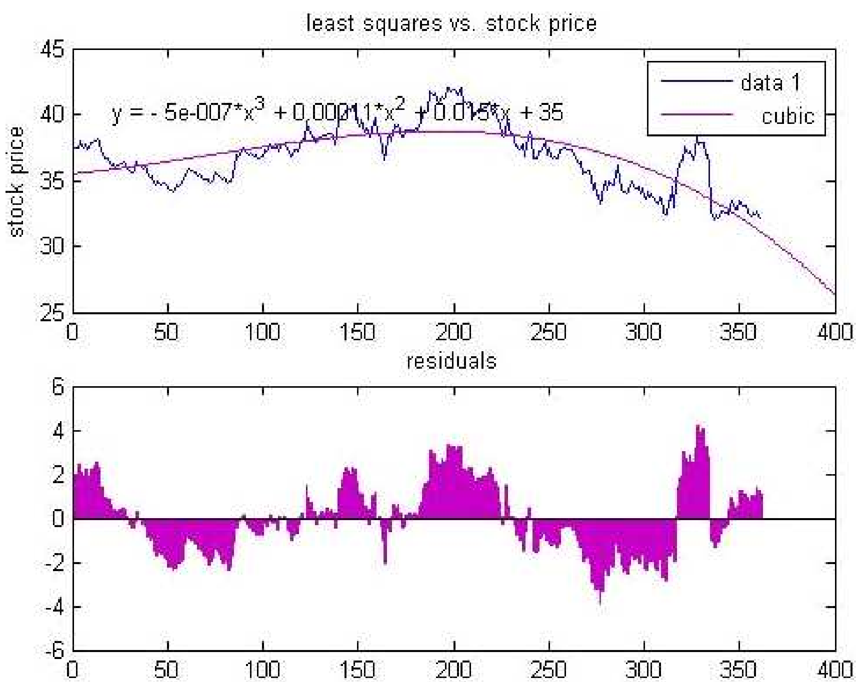

Figure 22: GE

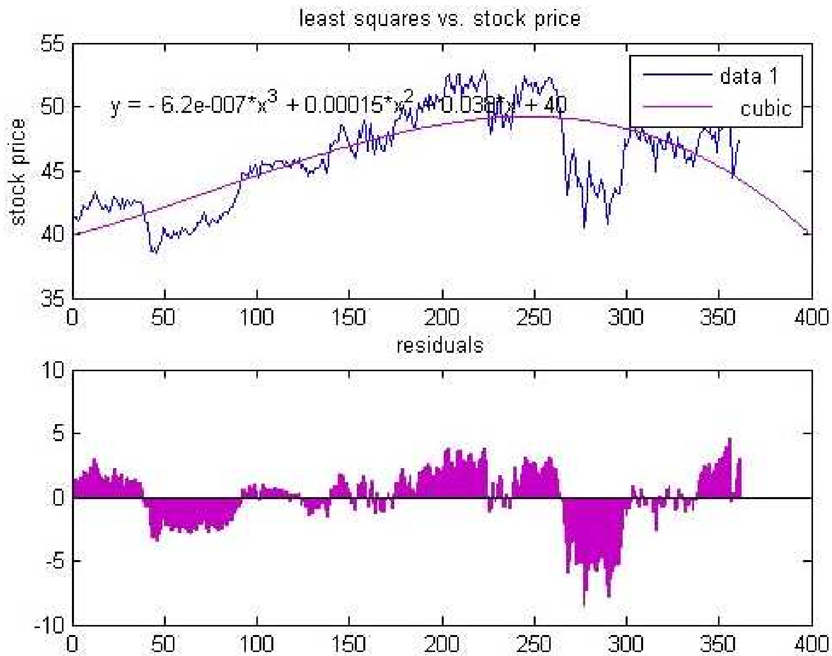

Figure 23: HPQ

MED is the first stock we encountered whose line of best fit is a polynomial of the first degree. This might be because the price of the stock seems to decrease over our time scale.

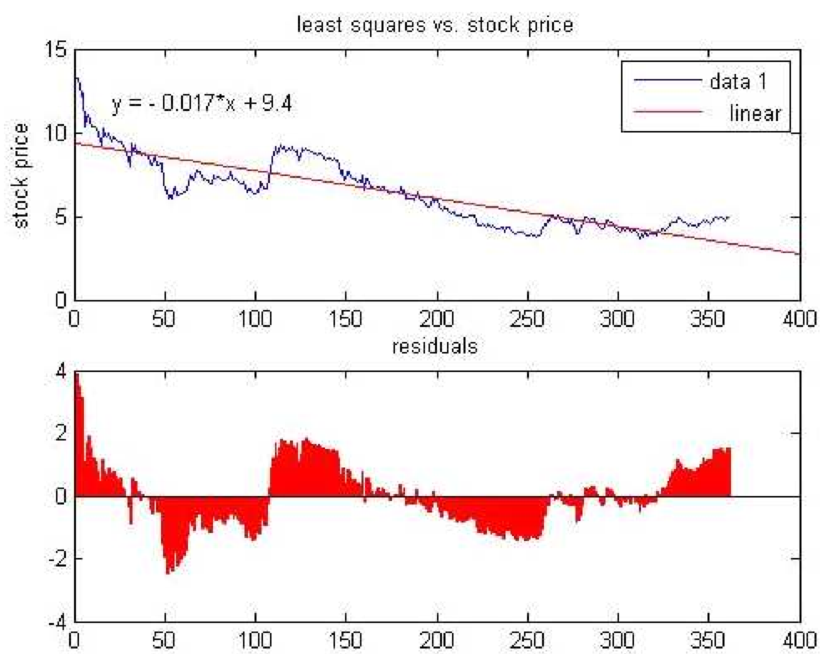

Figure 24: MED

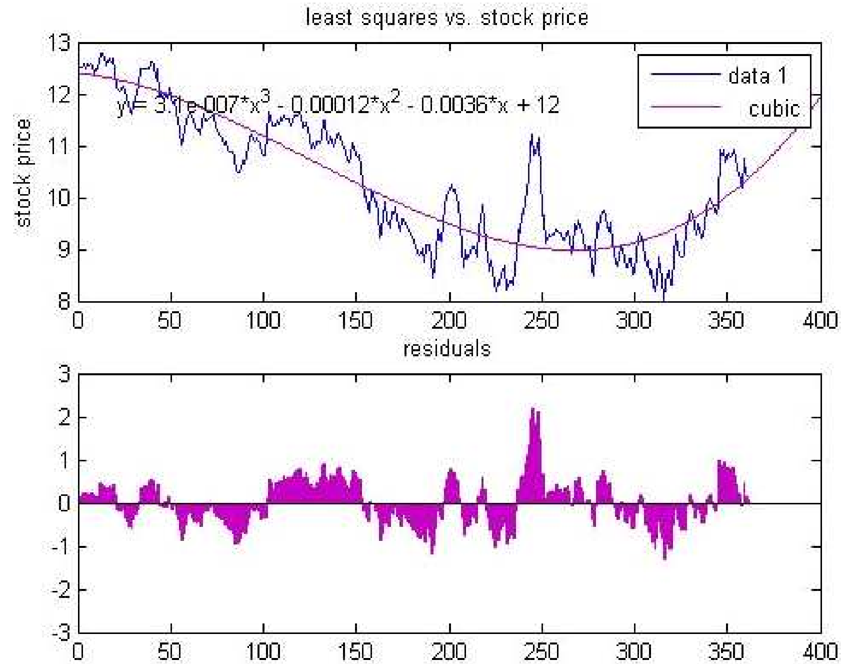

Figure 25: MTU

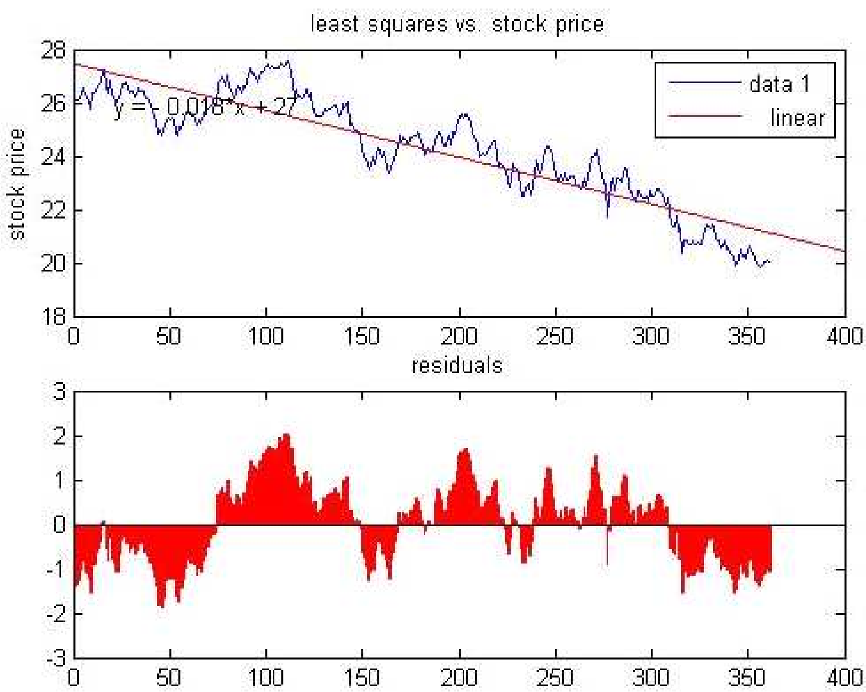

Figure 26: PFE

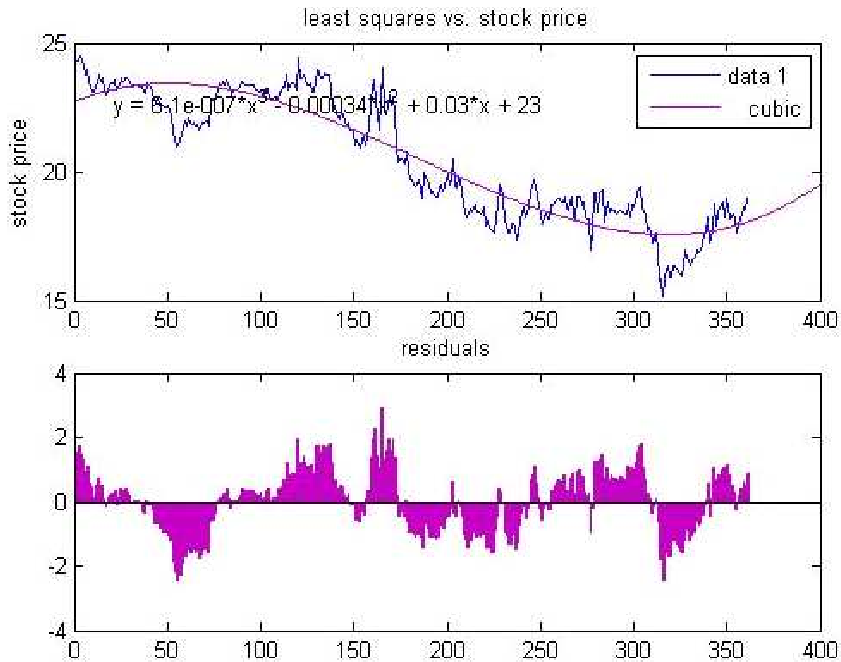

Figure 27: PGR

As we can see from the graphs, we have a huge amount of data to sort through. However, when we look very closely at the residuals of each graph, we see something wonderful: most of the residuals resemble a sinusoidal curve. Sinusoidal curves

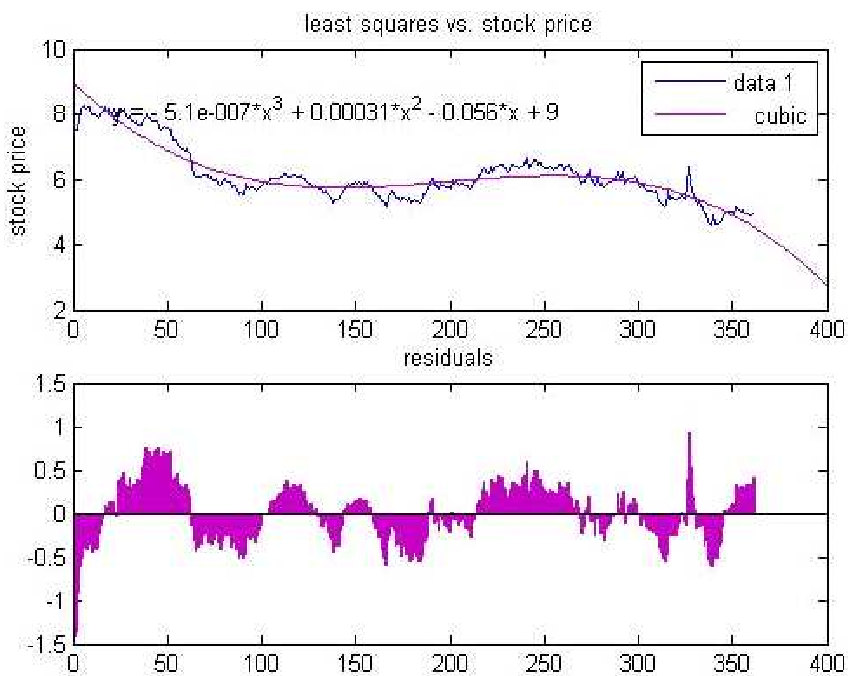

Figure 28: PTA

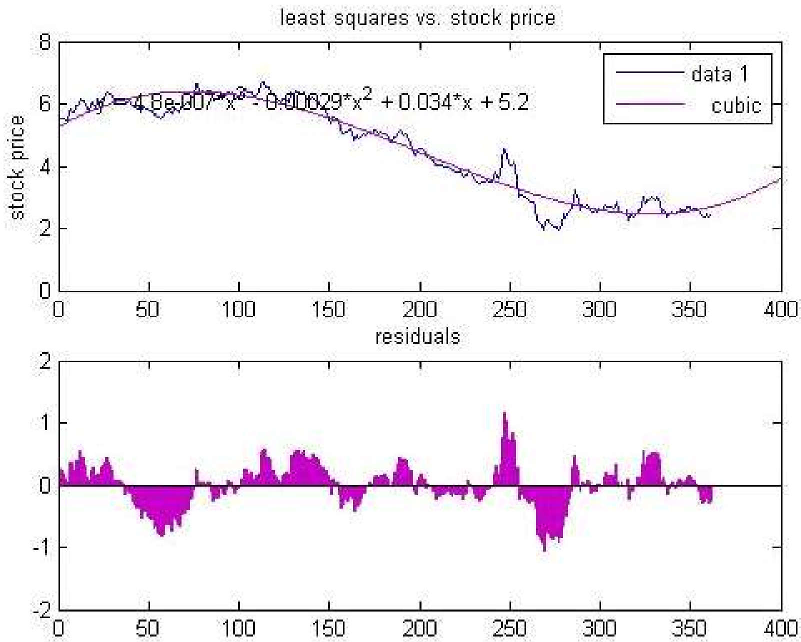

Figure 29: RAD

The sinusoidal curves give us an amazing tool to use for the analysis and prediction of a stock; we call this tool a Fourier Transform.

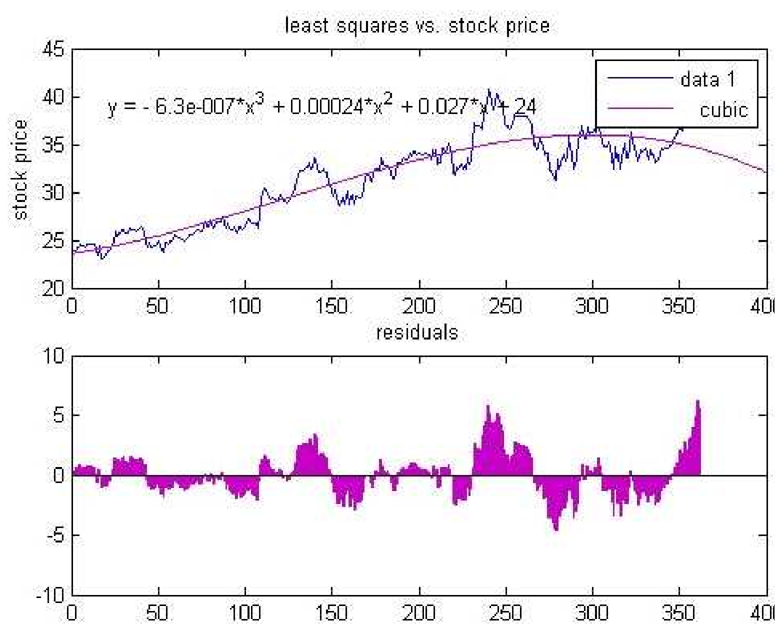

Figure 30: VRSN

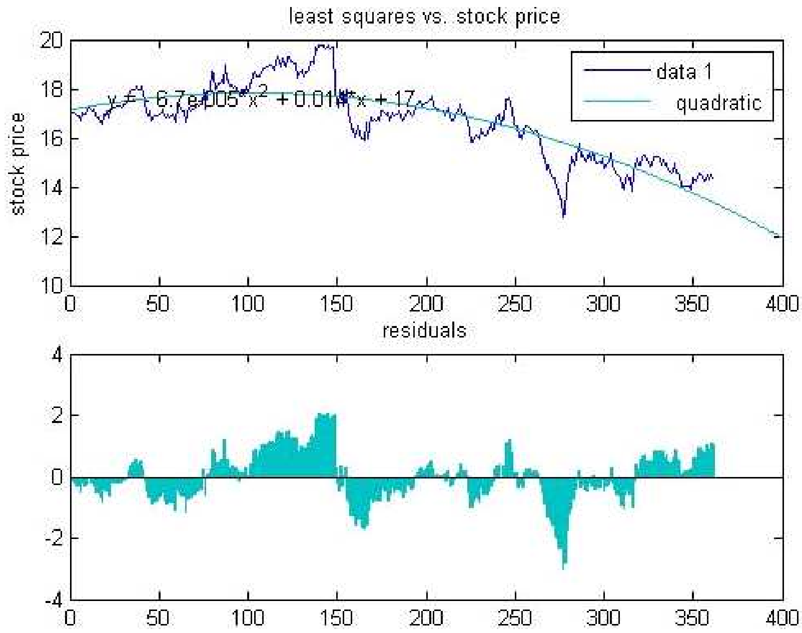

Figure 31: XRX

Fourier Transform allows us break down the sinusoidal residuals into a series of discrete equations. The discrete equations are represented by complex numbers. We will then filter the signal by taking out the signal noise. Signal noise is caused by all sorts of things, but in our application, the noise is caused by day to day activity by stock traders that has no real impact on the price of the stock. The noise is filtered by setting certain values in the signal to zero when the value is small enough to be considered negligible. We set the "cutoff" value for this negligibility to 1% of the original value. Below this, the value is set to zero. After filtering the signal, we will apply a reverse Fourier Transform to get a sinusoidal signal. We then extrapolate the signal from the 300th day of our data to the 361st day of our data. This extrapolation of data is the final result of our analysis. This is the result that hopefully predicts the short term closing price of individual stocks. The figures below represent the ACTUAL price of the stock Vs. the PREDICTED price of the stock as well as the relative error in prediction. The relative error is a better way of representing the actual error because it gives a percentage of error relative to the price of the stock rather than just a number.

Actual Vs. Predicted Closing Prices

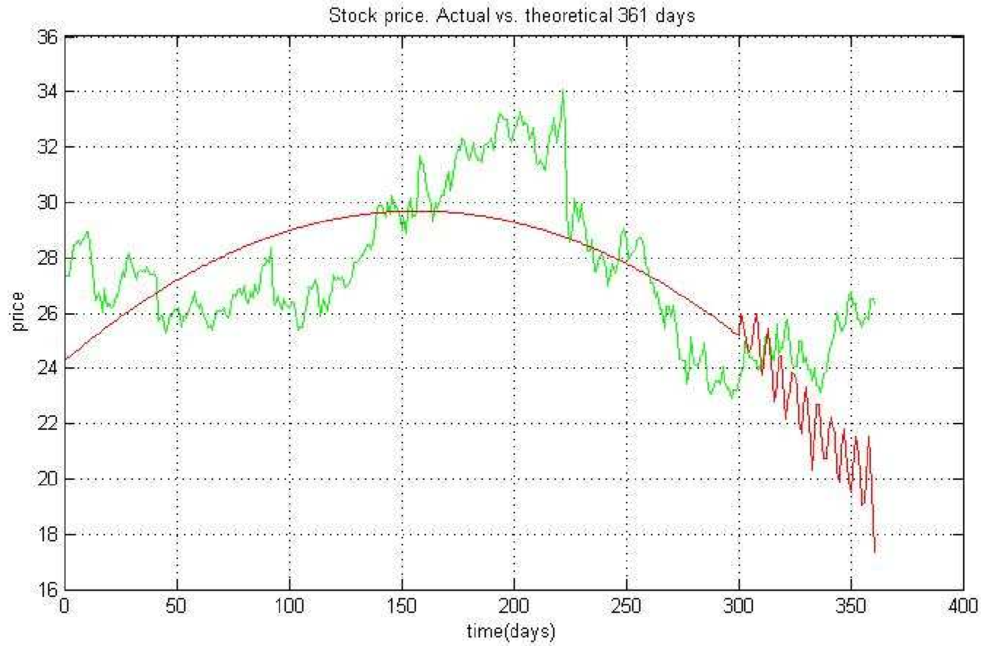

Figure 32: CSCO Actual Vs. Predicted

The figure for CSCO Actual Vs. Predicted price does not seem very promising for our overall progress in predicting the stock market. It seems as though our prediction goes in the completely opposite direction than the actual price of the stock.

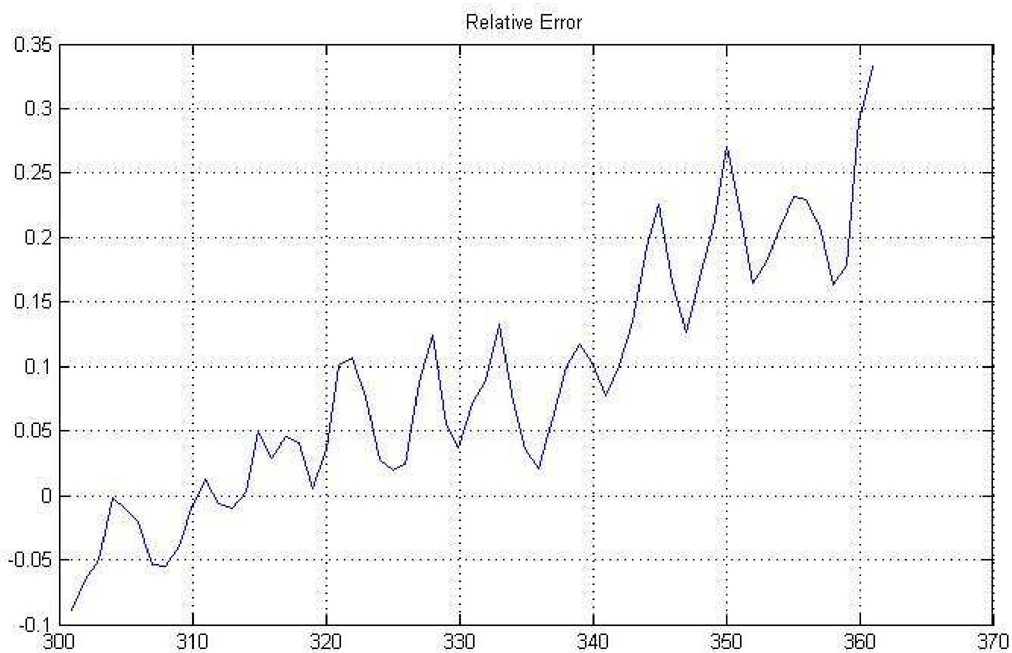

Figure 33: CSCO Relative Error

We see from the CSCO Relative Error that our predication just seems to get worse as time goes by. It starts at around -%5, but by the end of the extrapolation, skyrockets to more than 30% error. This is completely unacceptable.

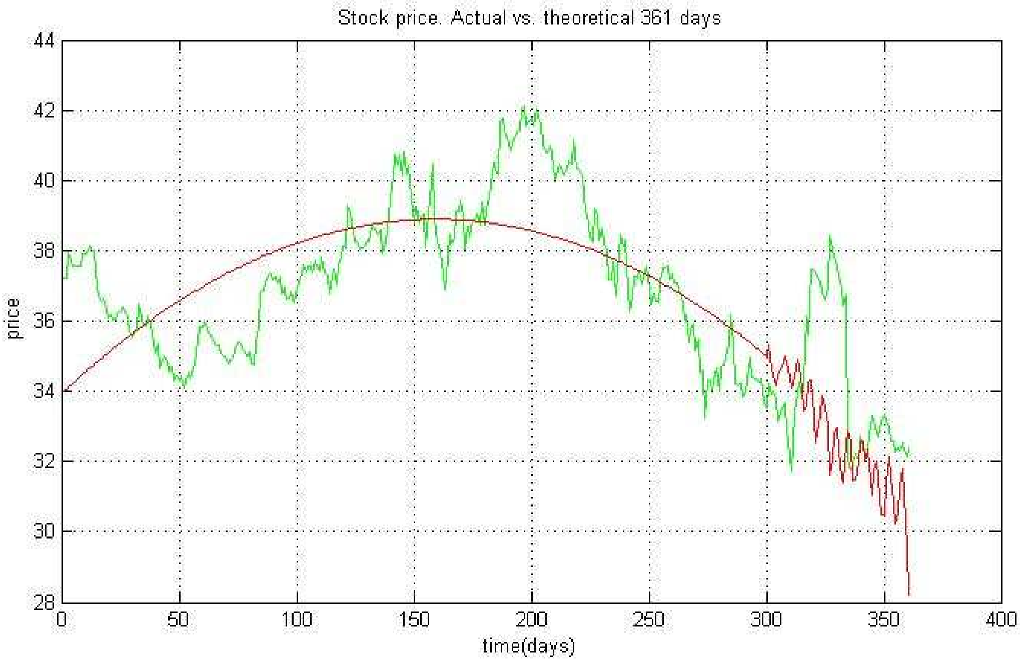

Figure 34: GE Actual Vs. Predicted

Our predicted values for GE seem to be much better than those for CSCO. We can see in the graph that at some points the values were exact. The GE Relative Error also shows much progress. The average value of the relative error is between 0 and 5%. This is quite the accomplishment.

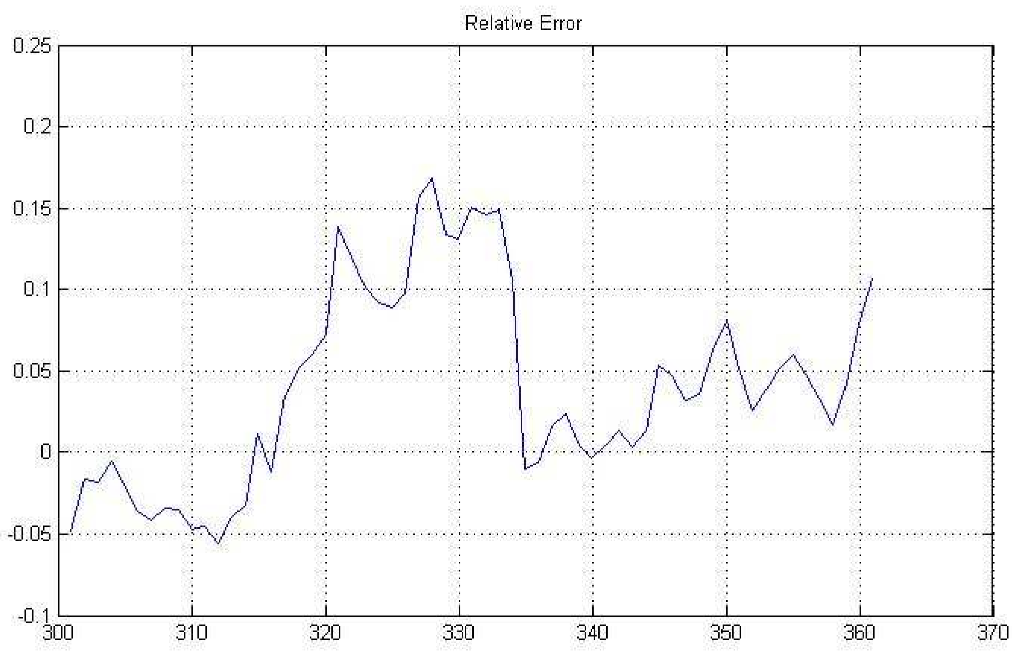

Figure 35 GE Relative Error Relative Error Relative Error

It is important to notice we did not necessarily use the same polynomial for the line of best fit as we did to calculate the predicted closing price of the stocks.

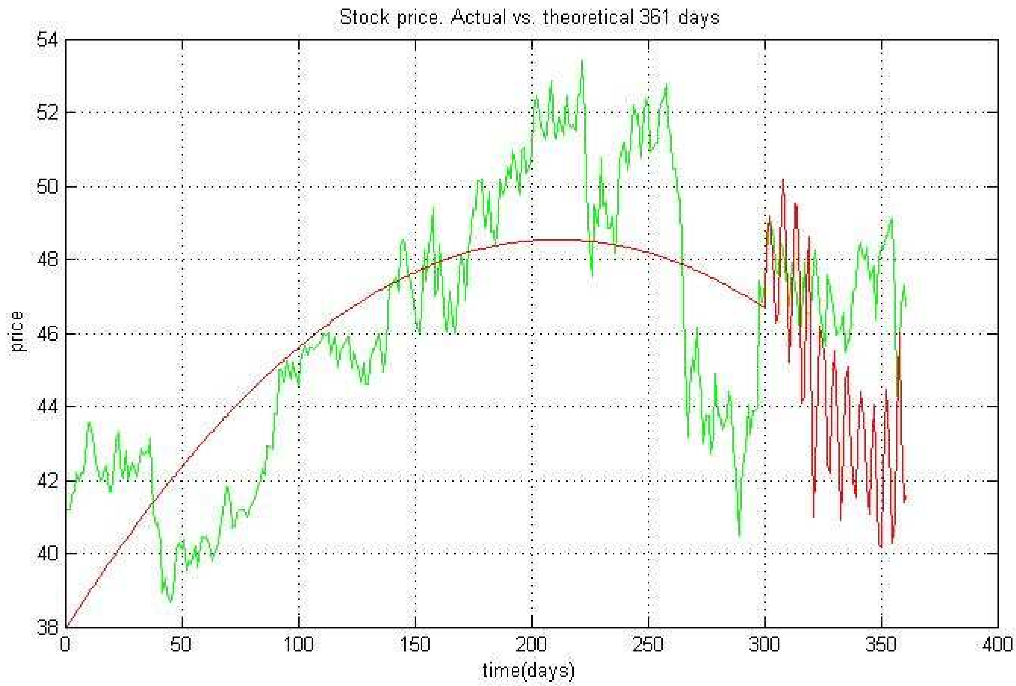

Figure 36: HPQ Actual Vs. Predicted

Our predication for HPQ is also much better than for CSCO. We can see once again that some of the values are quite close.

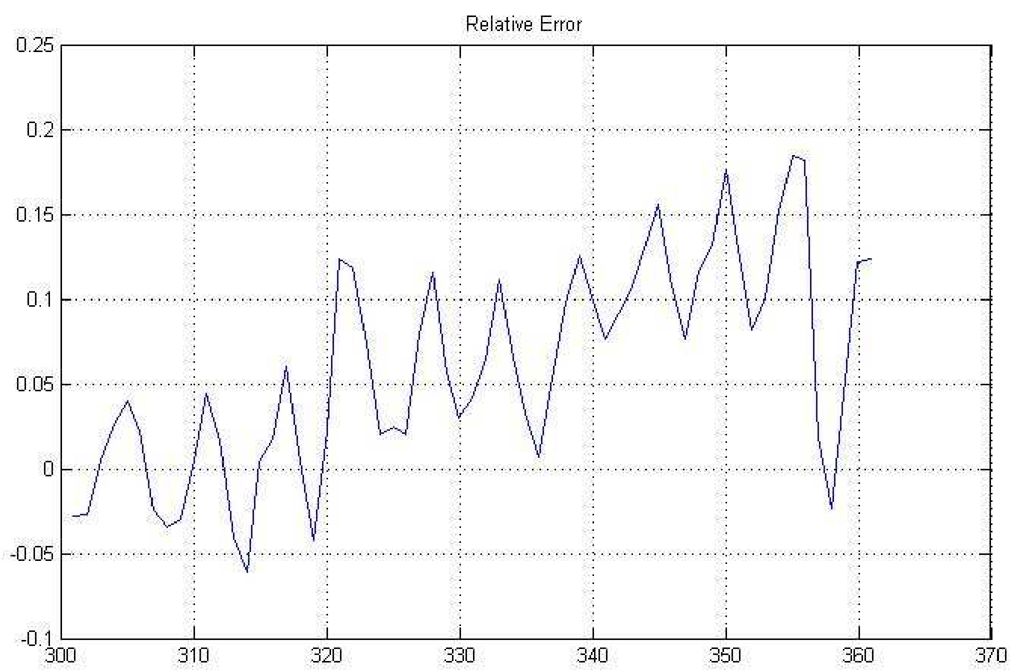

Figure 37: HPQ Relative Error

The HPQ Relative Error confirms this. The average seems to be between 5% and 10%. This is quite good.

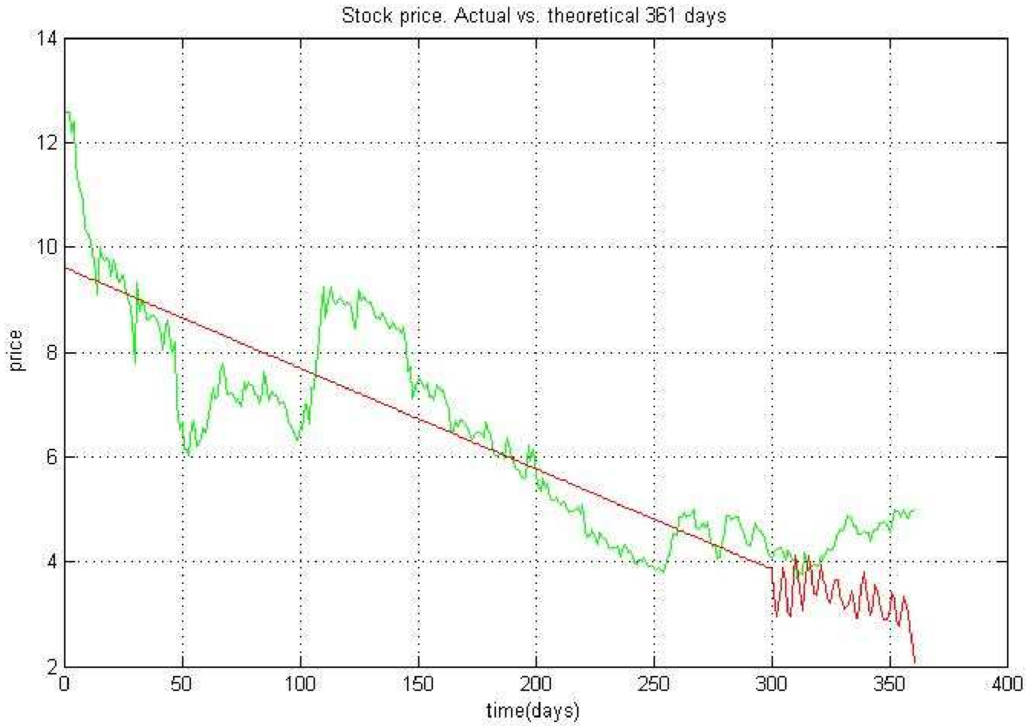

Figure 38: MED Actual Vs. Predicted

Unfortunately, we run into another very bad prediction with MED. The prediction sees the stock dropping, whereas the actual price remains relatively constant.

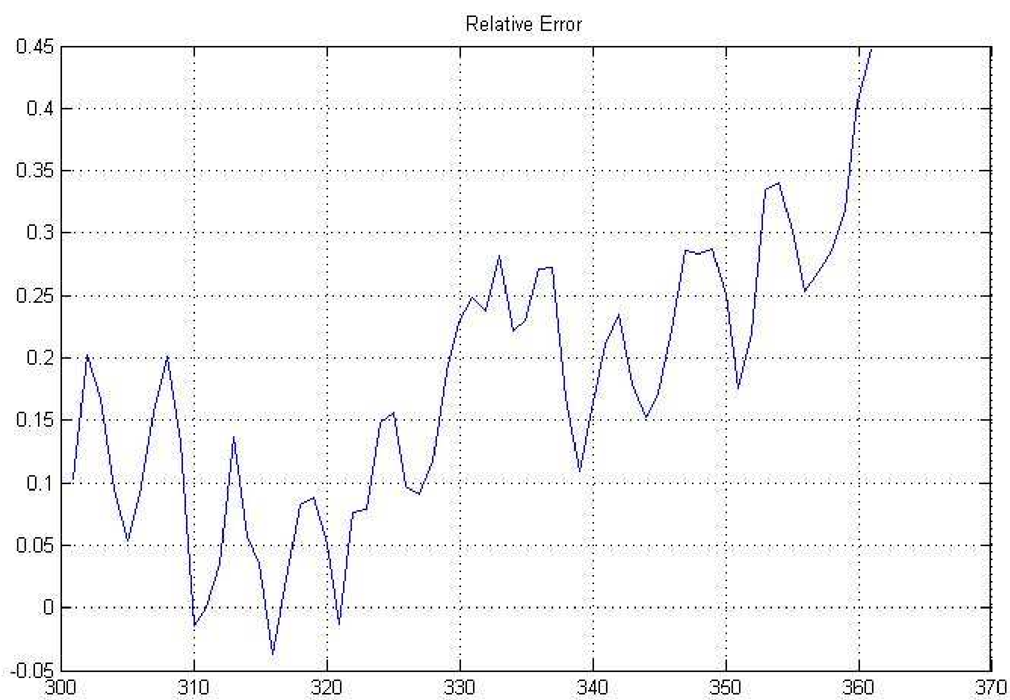

Figure 39: MED Relative Error

The Relative Error for MED is possibly the highest of any of the other stocks. It is safe to say that we have not accurately predicted the stock in any way. This may be a result of the degree of the polynomial of best fit.

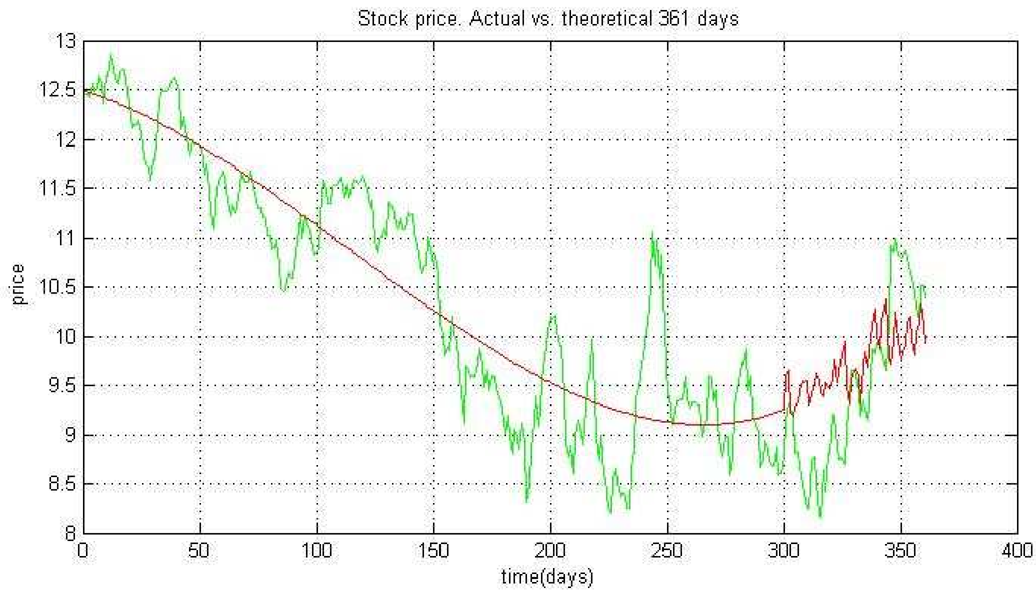

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Figure 40: MTU Actual Vs. Predicted

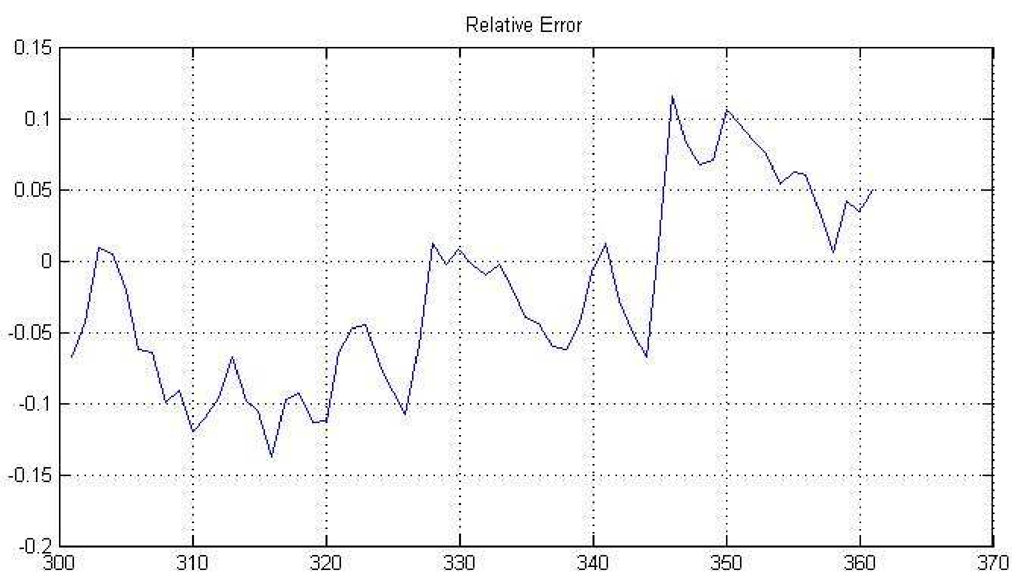

Figure 41: MTU Relative Error

The prediction and relative error we see in MTU about the best we could expect. There is little fluctuation in the relative error (about 10% either way) and the average relative error comes out close to 0. If we were to extrapolate the data for this stock on the 300th day of data, we would see that the stock would go up in the next 2 months, and we would probably invest. Our prediction would be correct and in 2 short months we would profit approximately 10% of our investment.

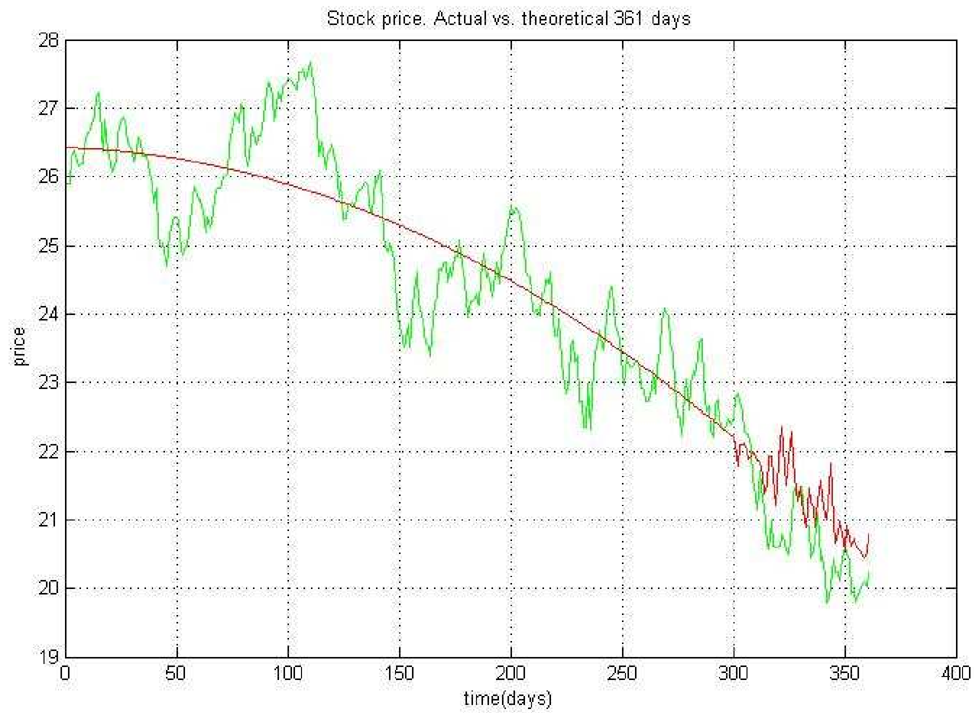

Figure 42: PFE Actual Vs. Predicted

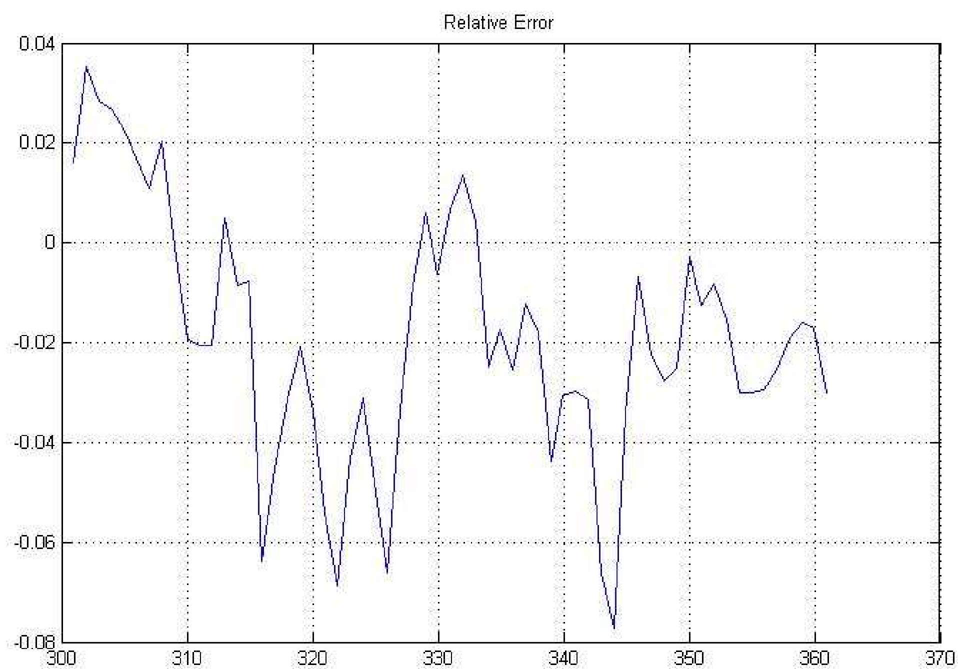

Figure 43: PFE Relative Error

PFE is a good example of our extrapolation program doing its job and telling us when not to invest in a company. We see from our extrapolation that the price of the stock will fall by almost 10% in the next 2 months, based on that we would not invest on day 300. On day 361, we would see that our decision was correct, and we would have saved our money.

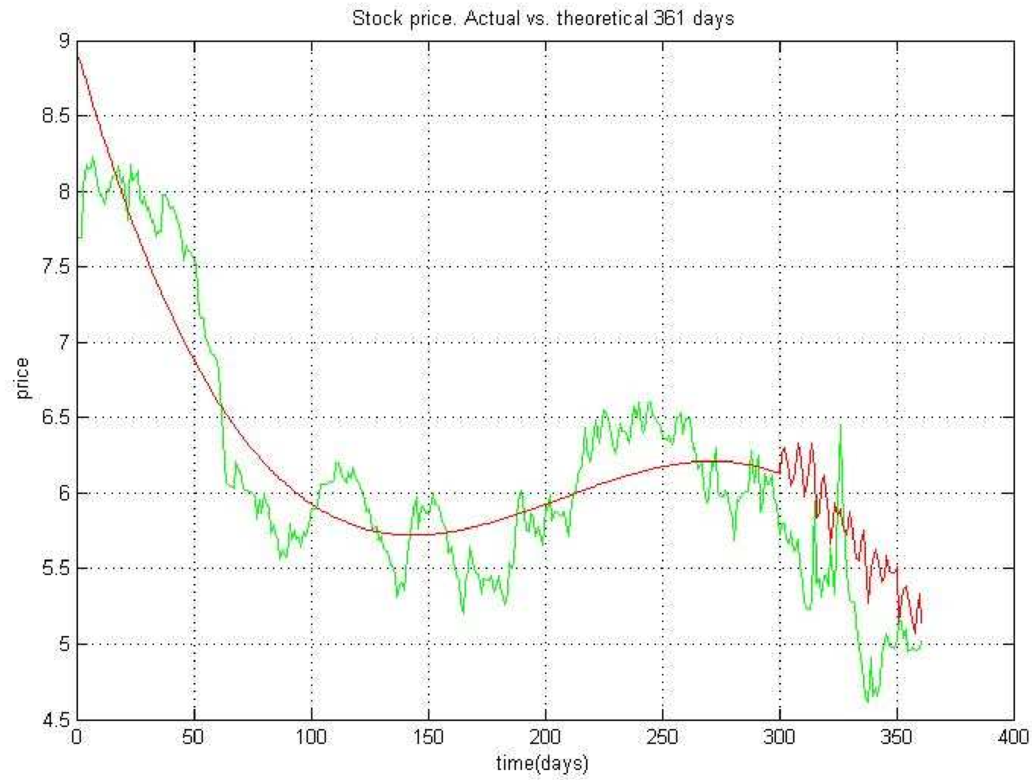

Figure 44: PTA Actual Vs. Predicted

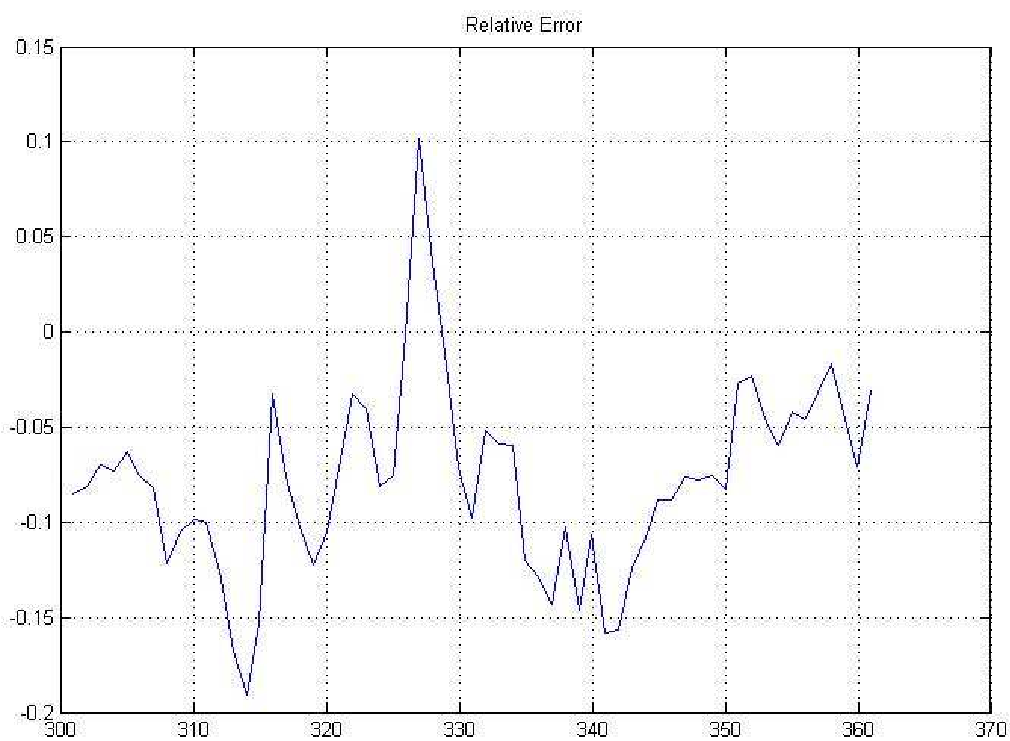

Figure 45: PTA Relative Error

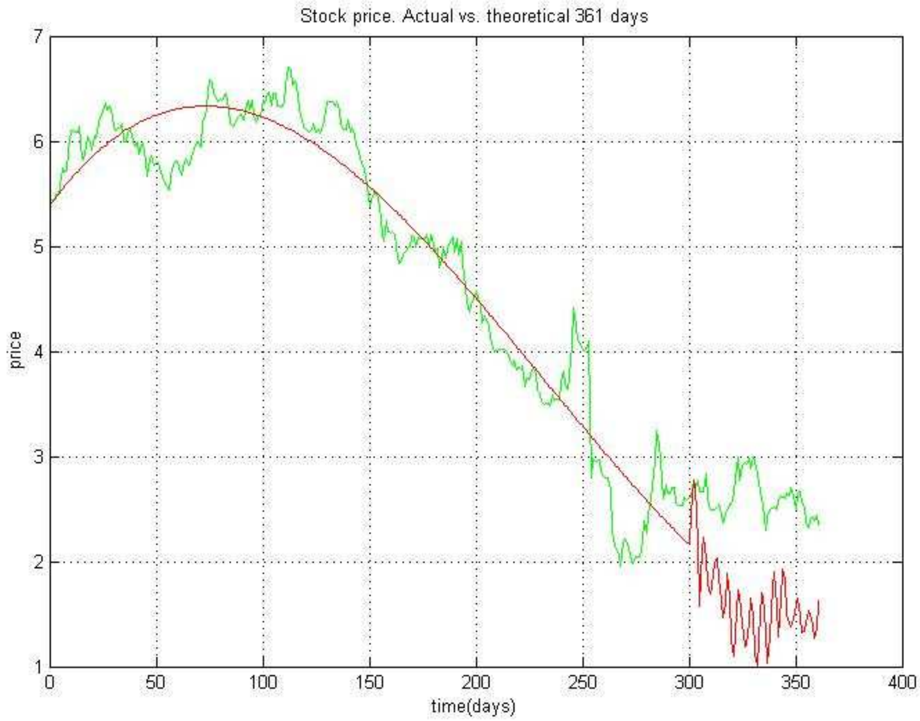

Figure 46: RAD Actual Vs. Predicted

The prediction for RAD is another good example of a failure to predict the stock price accurately. The extrapolation told us that the price of the stock would drop by almost 50% in the next 2 months. Based on common sense, this prediction is not very realistic anyway. We see from the actual price that the stock does drop slightly, but not nearly as much as was predicted.

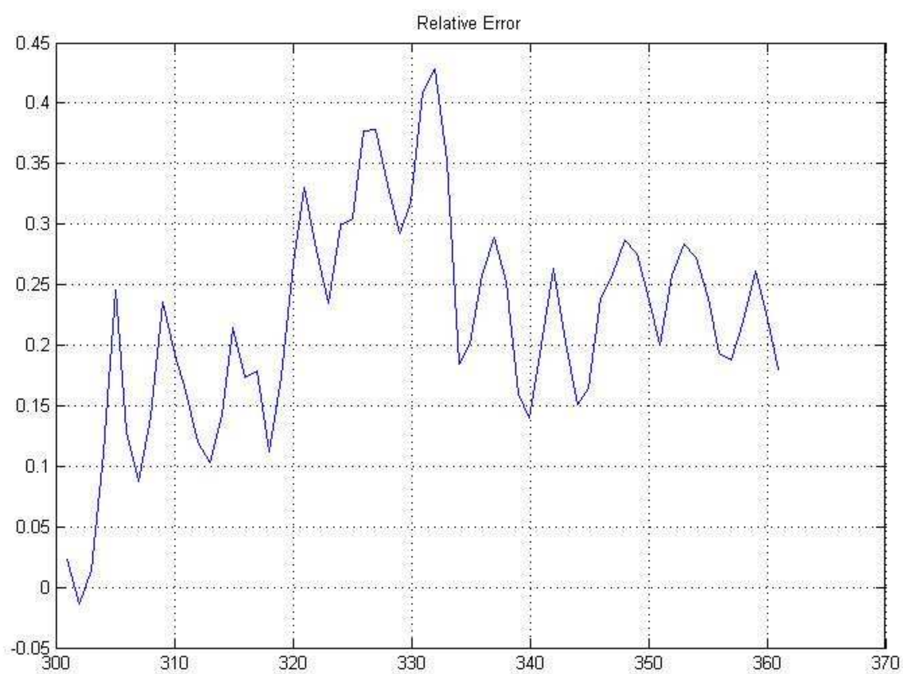

Figure 47: RAD Relative Error

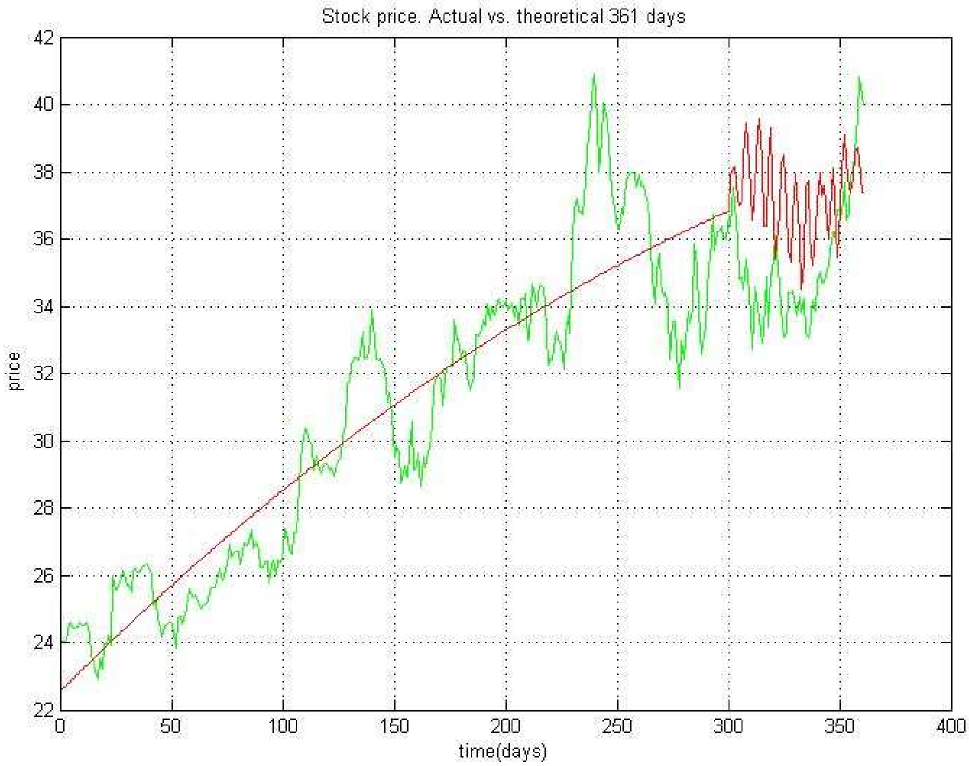

Figure 48: VRSN Actual Vs. Predicted

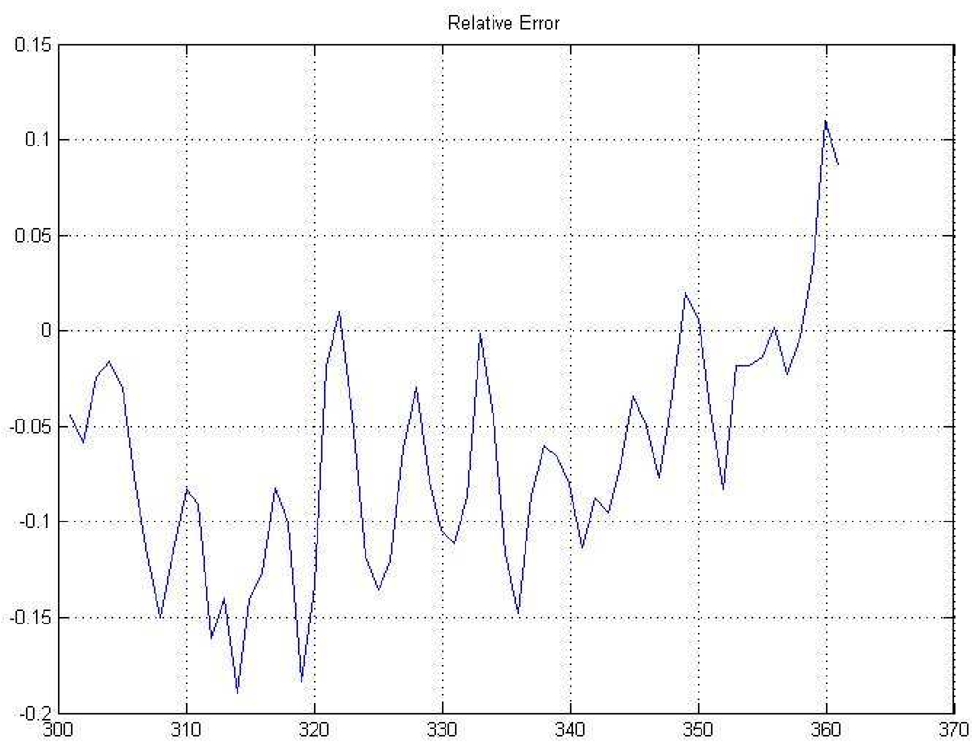

Figure 49: VRSN Relative Error

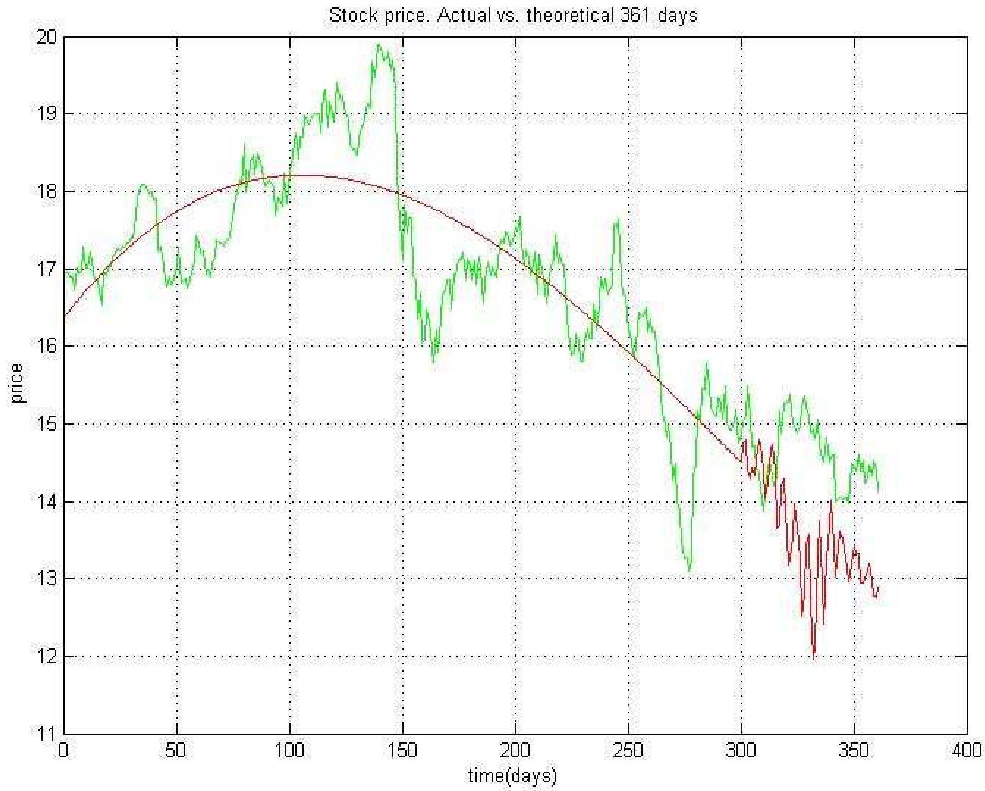

Figure 50: XRX Actual Vs. Predicted

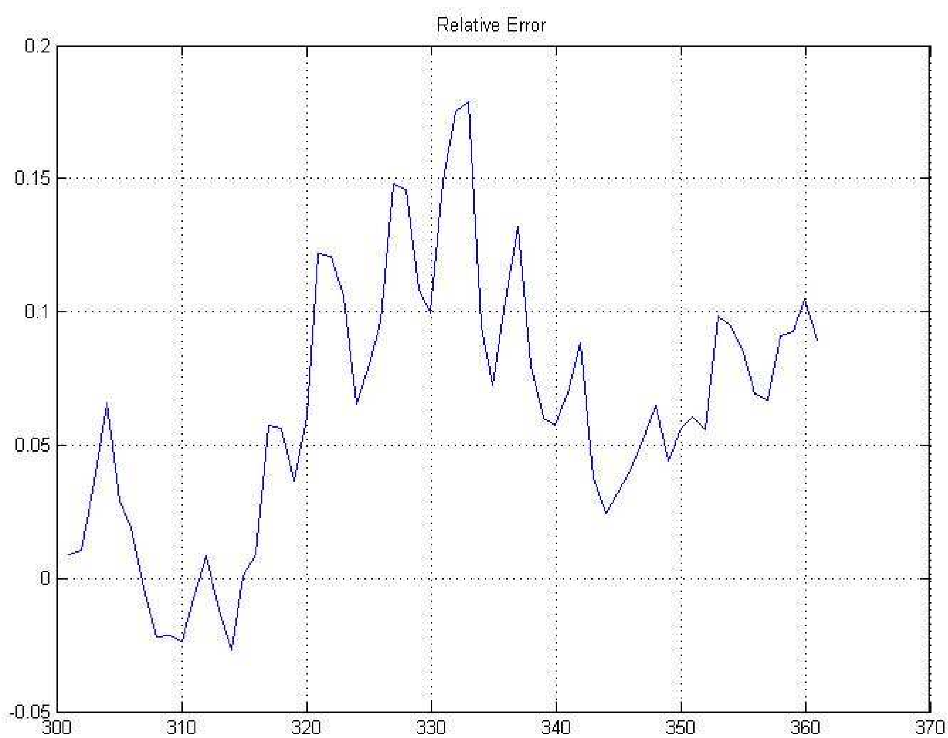

Figure 51: XRX Relative Error

Positive and Negative Extrapolation

An odd thing about the program that we used to extrapolate our data is that we used the Fourier transform to add or subtract from the line of best fit. Because of this we have two versions of the extrapolation. We can call them the “positive” and the “negative” extrapolation. The extrapolation of some of the stocks works better (more accurately) with the positive extrapolation and with negative extrapolation with others. The fact that one stock is better predicted with a positive or a negative extrapolation is hypothesized to be a one of the stocks permanent traits. It is therefore reasonable to think that a stock that is best predicted with a negative extrapolation will always be best predicted with a negative extrapolation, regardless of amount of data provided. This is also thought to be so with stocks that “prefer” positive extrapolation.

In a test to properly gauge how professor Humi’s method of stock market prediction works, we would like to see if a stock will best be predicted by a negative extrapolation or positive extrapolation with 361 data points, then with 417 data points. We will compare the results and if the stocks are best projected by the same type of extrapolation for the two data sets, then we know that the program works well and that we can use it for any data set, as long as we test it first to see what type of extrapolation works best. If the results are not the same, then it will be much harder to project the price of a stock accurately because we will have two distinct results. Below, is a table of stocks with 361 points of data, and the degree of the polynomial of best fit as well as the preference to either a positive or negative extrapolation.

Analysis With 361 Data Points		
STOCK	**Polynomial Degree**	**Extrapolation**
CSCO	2	Negative
GE	2	Negative
RAD	3	Negative
XRX	3	Negative
HPQ	2	Negative
PFE	2	Negative
VRSN	2	Positive
MED	1	Positive
MTU	3	Positive
PGR	3	Positive
PTA	3	Positive

Figure 52: Analysis Table

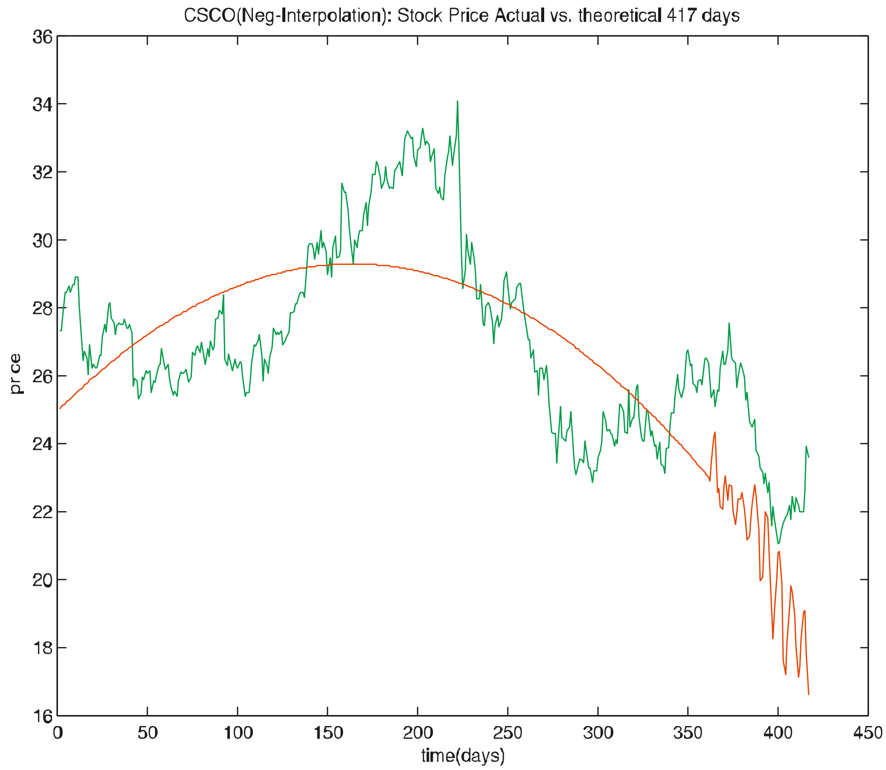

Figure 53: CSCO (Negative Interpolation) Actual Vs. Predicted

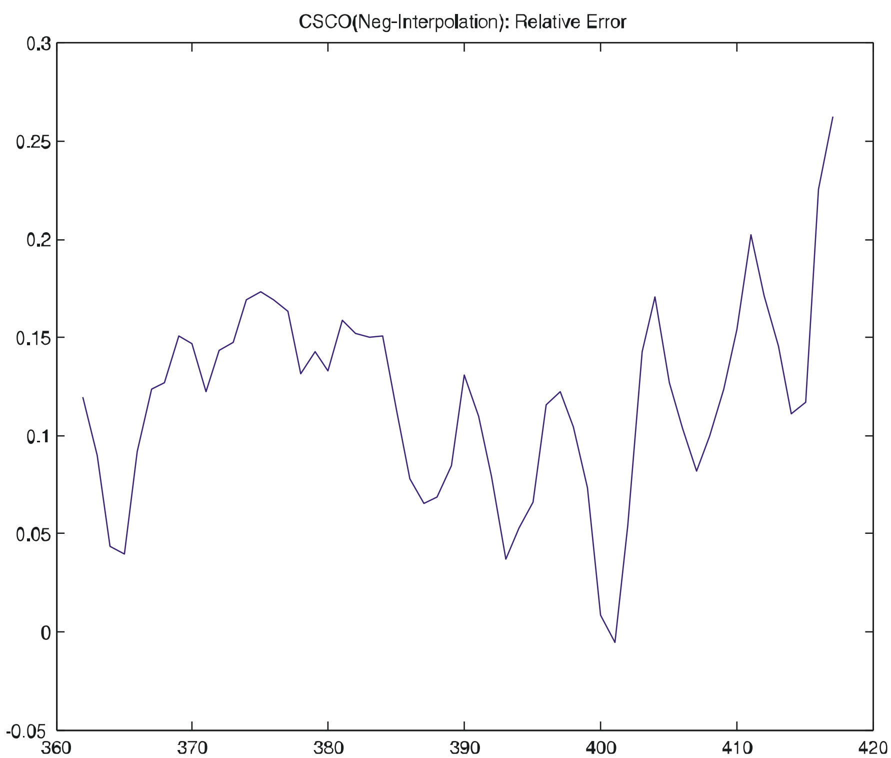

Figure 54: CSCO (Negative Interpolation) Relative Error

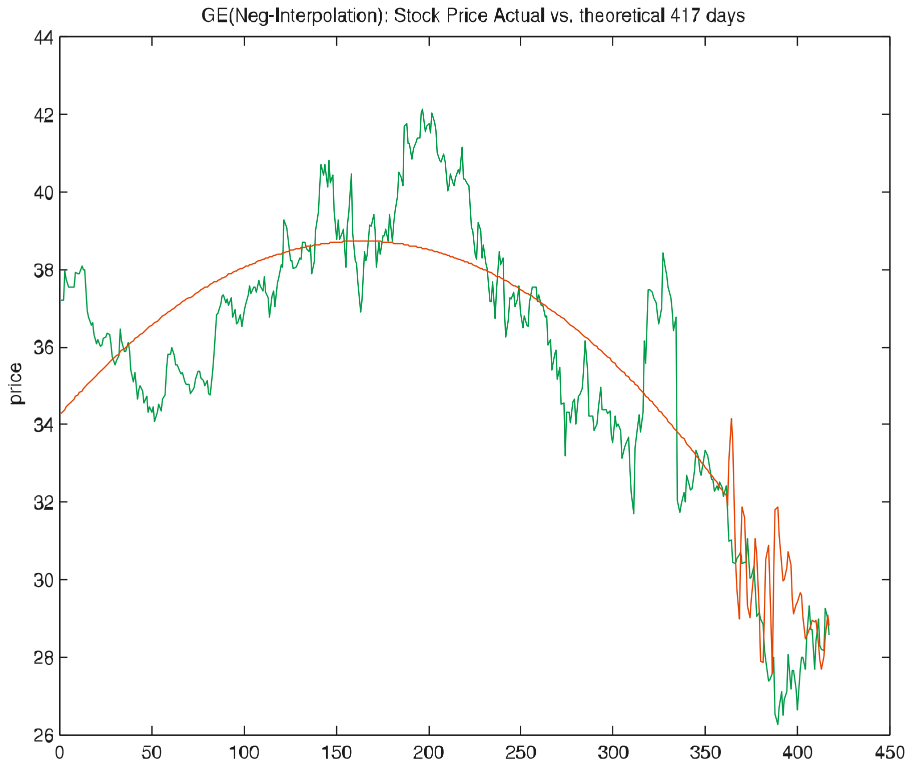

Figure 55: GE (Negative Interpolation) Actual Vs. Predicted

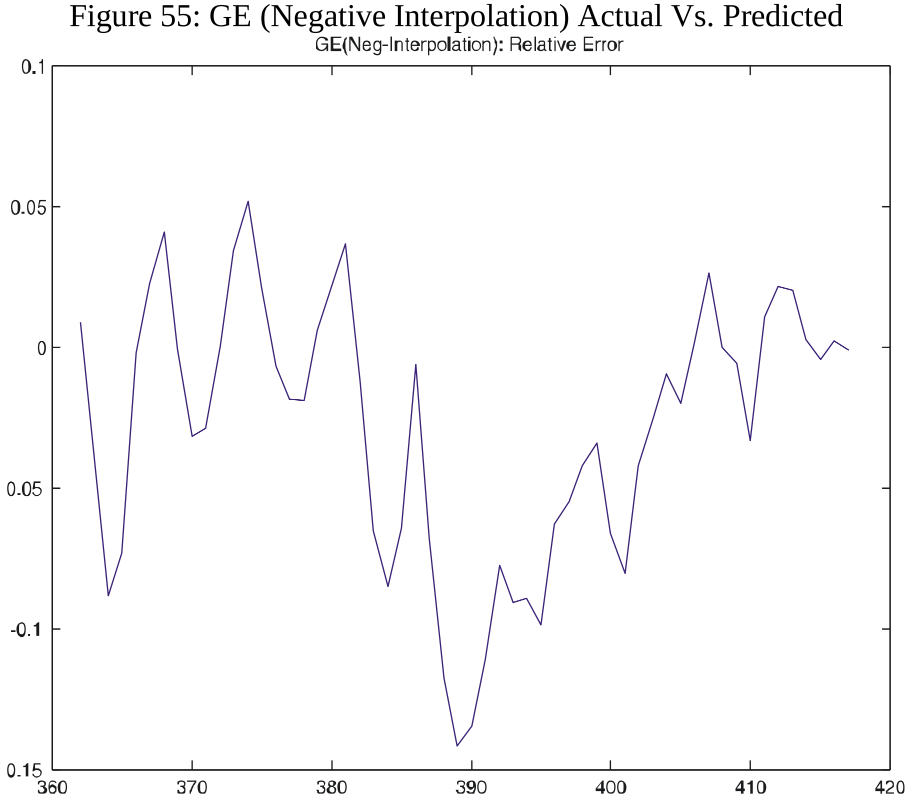

Figure 56: GE (Negative Interpolation) Relative Error

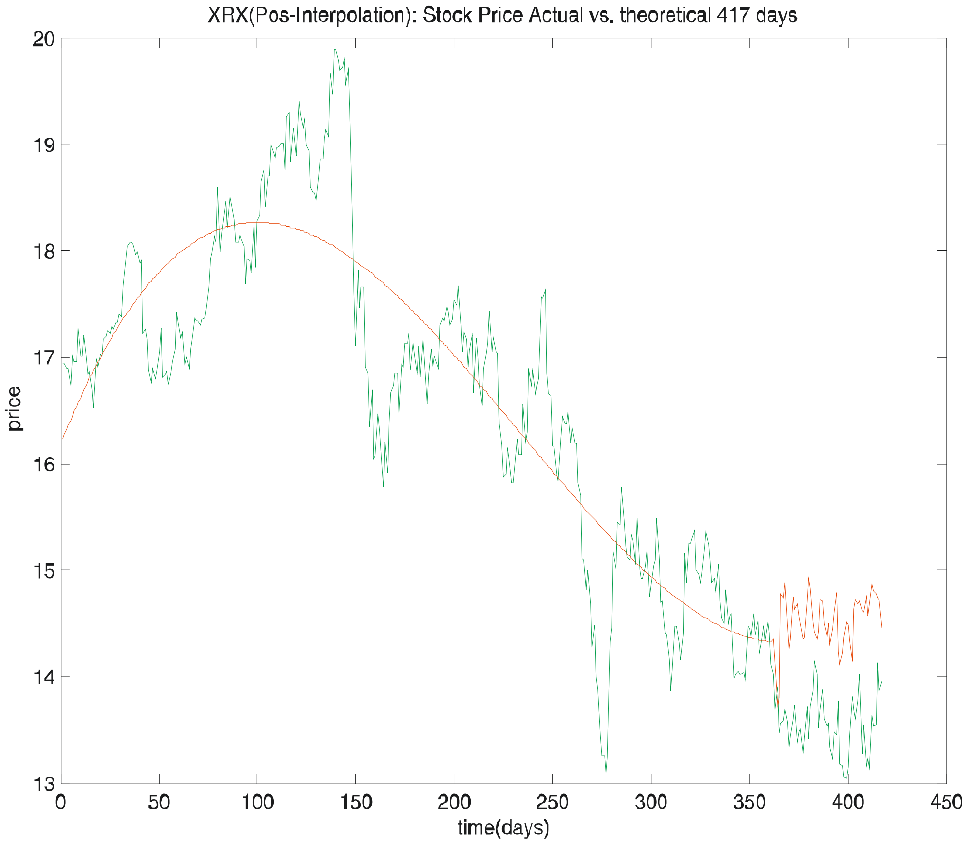

Figure 57: XRX (Positive Interpolation) Actual Vs. Predicted

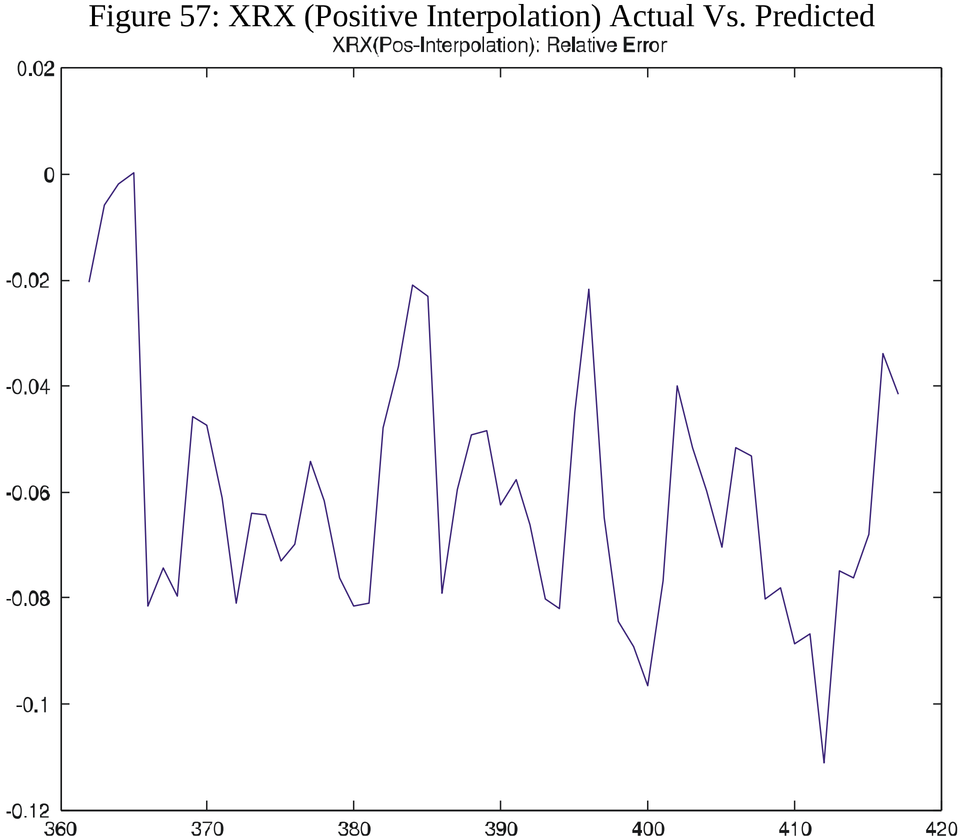

Figure 58: XRX (Positive Interpolation) Relative Error

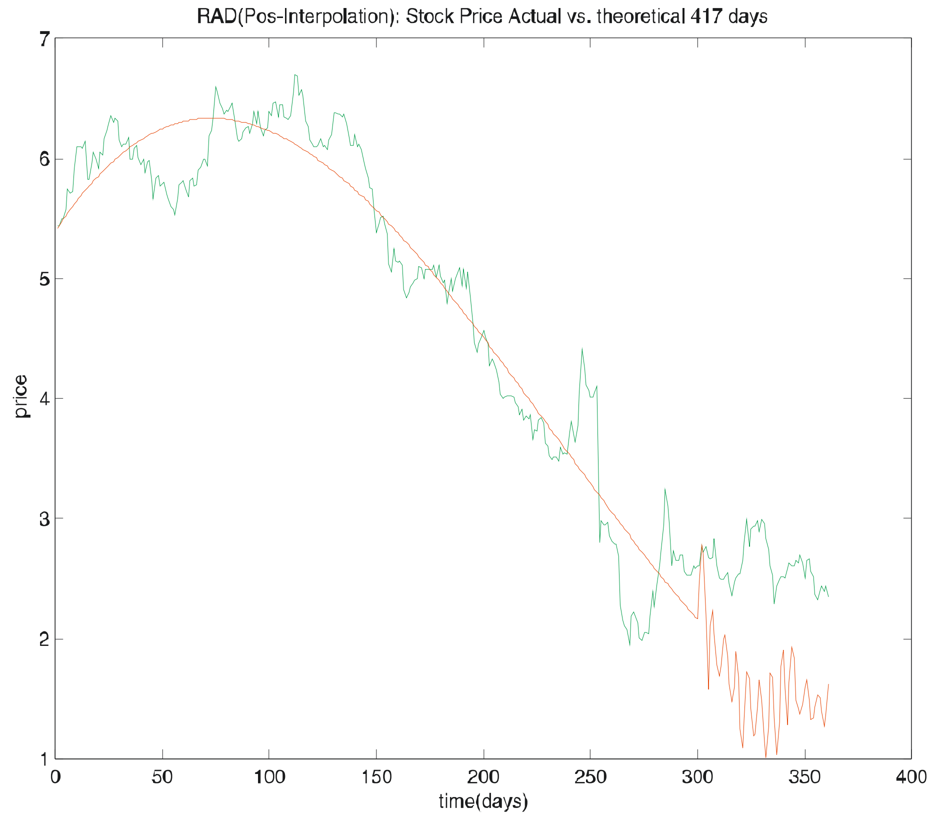

Figure 59: RAD (Positive Interpolation) Actual Vs. Predicted

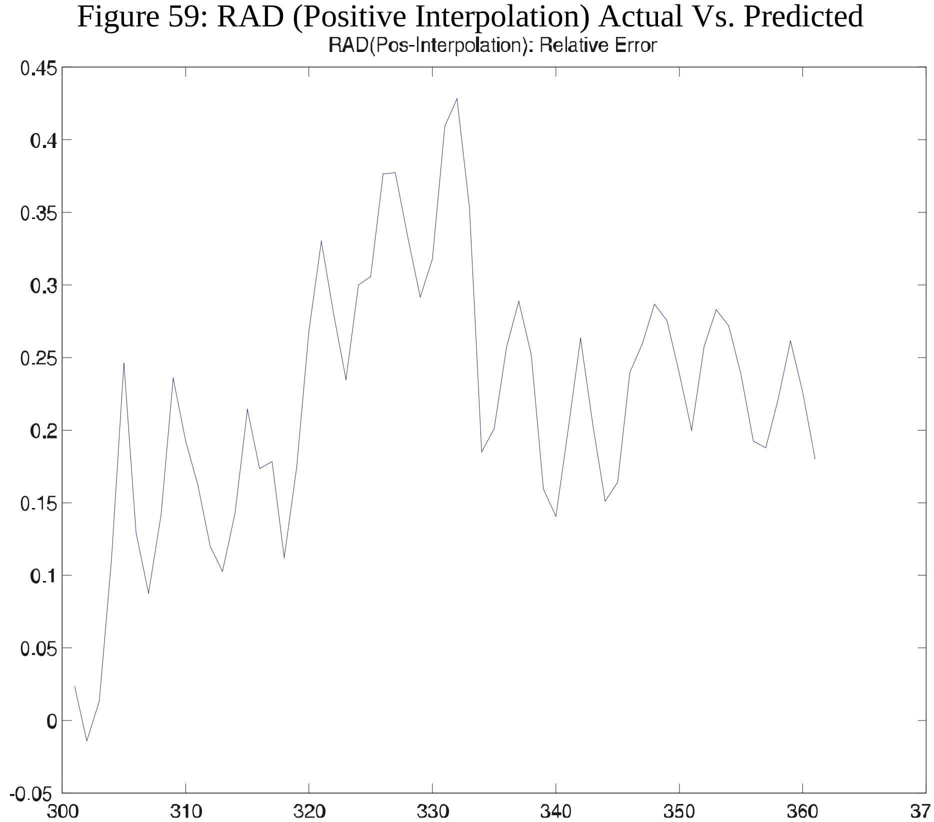

Figure 60: RAD (Positive Interpolation) Relative Error

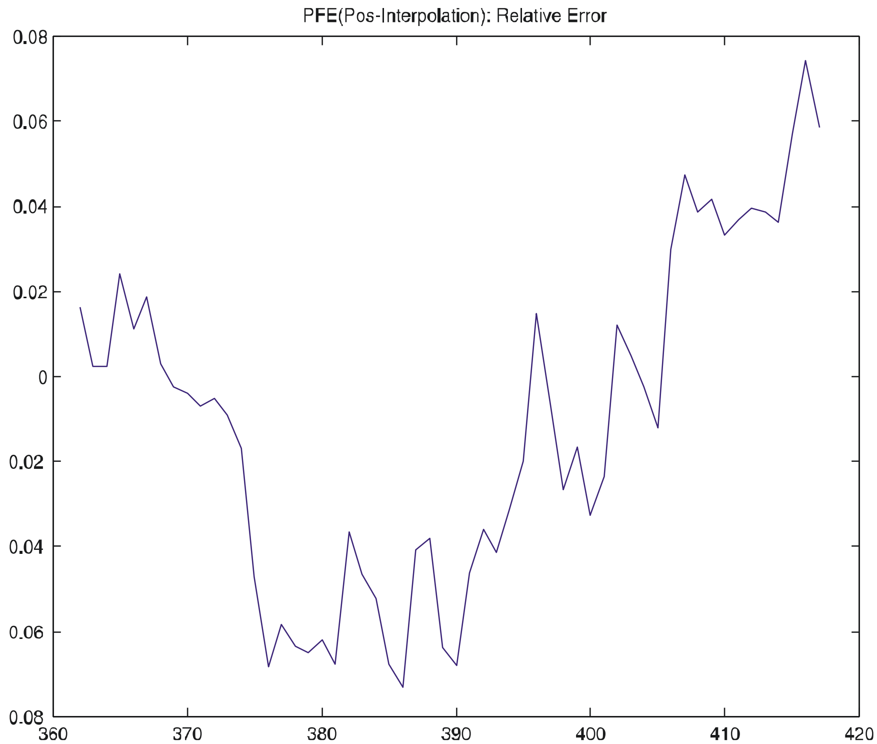

Figure 61: PFE (Positive Interpolation) Relative Error

We see here that the relative errors for the positive and negative extrapolations for PFE look almost identical. This was definitely not the case when we were extrapolating to 361 data points. This leads us to believe that there is no correlation between a stock and its preference for a positive or negative extrapolation.

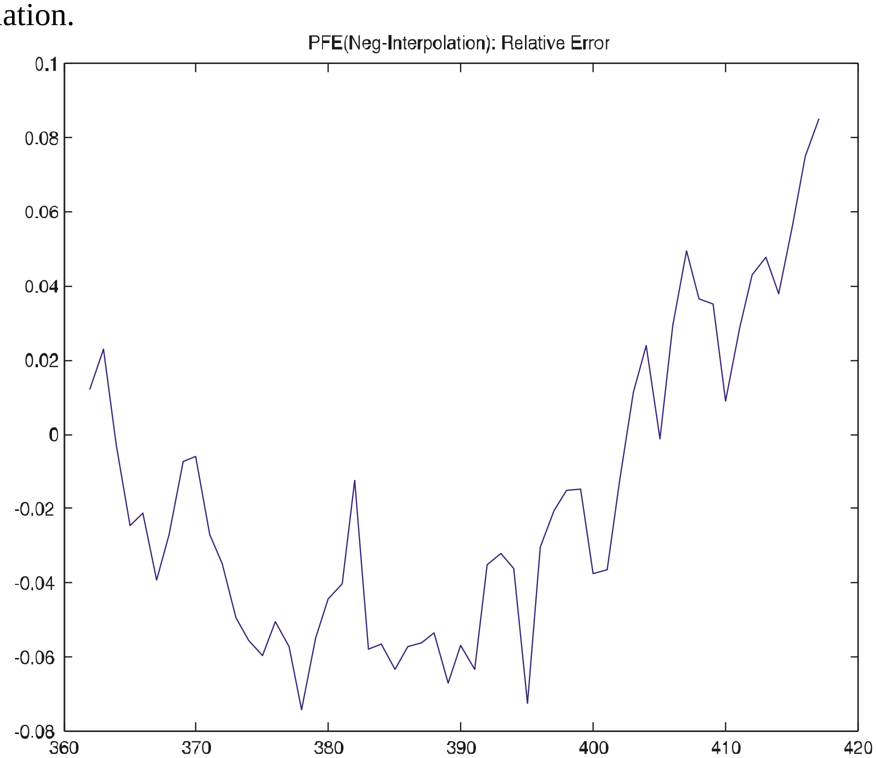

Figure 62: PFE (Negative Interpolation) Relative Error

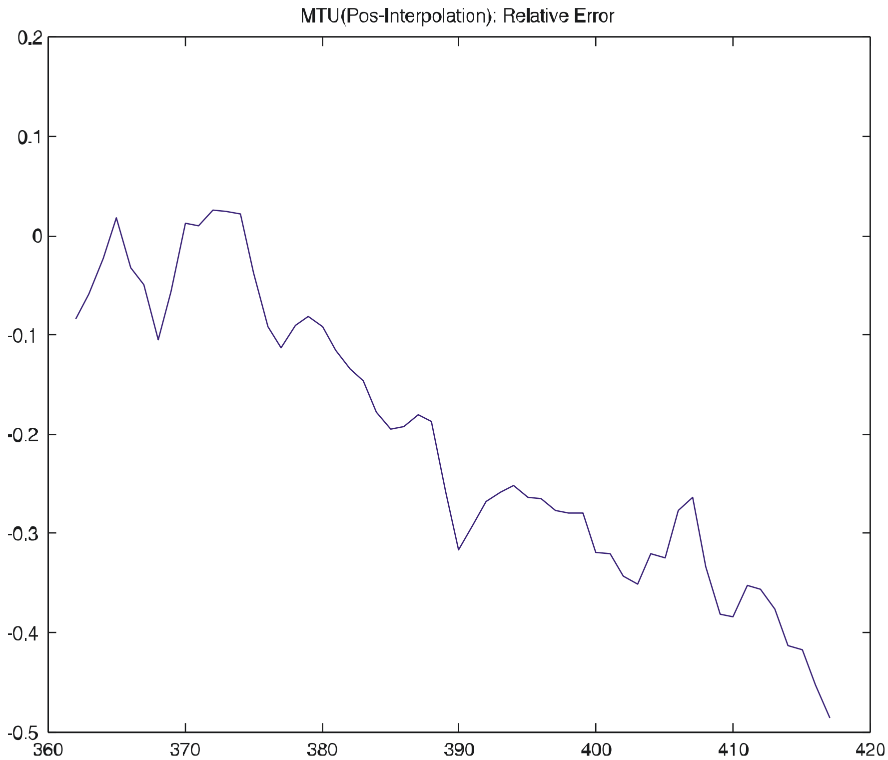

Figure 63: PFE (Positive Interpolation) Relative Error

The relative error charts for MTU is further evidence that there is no innate correlation between a stock and its ability to be projected by a positive or negative extrapolation. Given this evidence, we can reasonably assume that positive or negative extrapolation is not based on the stock, but rather the data that represents the stock.

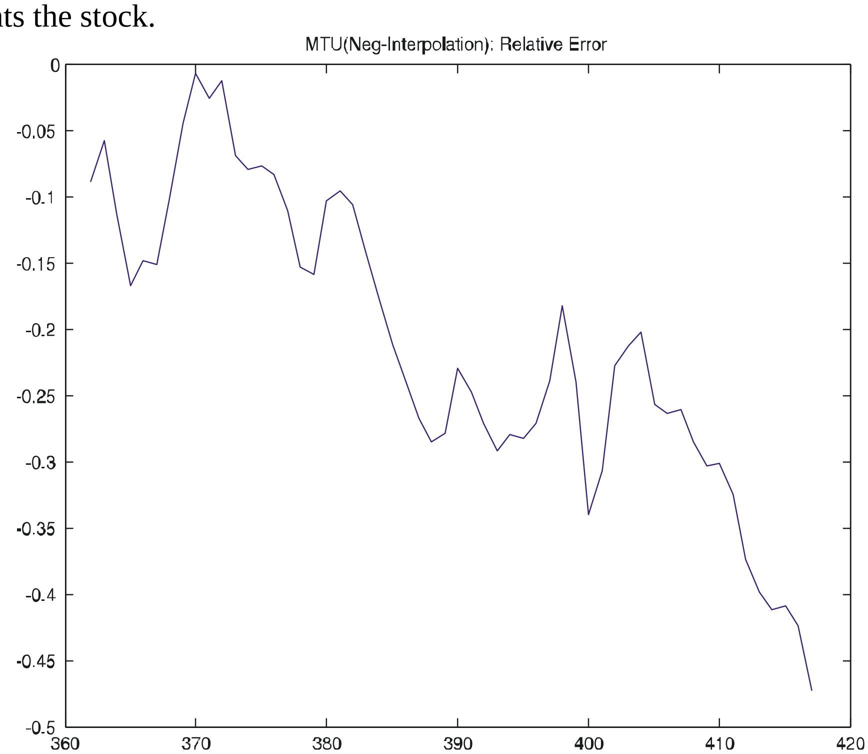

Figure 64: PFE (Negative Interpolation) Relative Error

Analysis With 417 Data Points		
STOCK	**Polynomial Degree**	**Extrapolation**
CSCO	2	Negative
GE	2	Negative
RAD	2	Positive
XRX	3	Positive
HPQ	2	Negative
PFE	2	Negative
VRSN	2	Negative
MED	1	Positive
MTU	3	Positive/Negative
PGR	3	Negative
PTA	3	Positive

Figure 65: Extrapolation Table

The table above is a table of our stocks with 417 points of data. Once again, the table contains the degree of the polynomial of best fit as well as the preference to either a positive or negative extrapolation. The highlighted stocks are the stocks that preferred either positive or negative extrapolation when there were only 361 points of data, but switched to their respective opposite when more data was added.

As we can plainly see, 4 out of the 11 stocks switched to respective opposite when we extrapolated with 417 points of data. This means that there is no permanent correlation between a stock and its preference for positive or negative extrapolation. It seems that the correlation is in the numbers rather than in the stock itself. This is bad news for the overall effectiveness of the program. It means that if we wanted to predict a stock, we would have two extrapolations of data that we could follow and there would be no way to tell which extrapolation would be a better projection of future price of the stock.

Conclusion

As we have seen from all of the evidence provided, prediction of the stock market is not as easy as it seems. It turns out that the old adage is true and that the stock market really acts like a living organism. Our attempt to predict the stock market through the use of modern computer software proved not to work as well as we had hoped. We used MatLab to write programs that calculated moving averages and extrapolated data in order to help us project what the price of a stock will be roughly 60 days from the date of extrapolation.

The program to graph the moving averages worked perfectly. Unfortunately, by definition, it gave no new information when it came to making decisions on whether or not to invest in a stock. It only told us what the stock has already been doing. Moving averages are calculated by taking the average of a certain number of trading days before the day on which you wish to find the moving average. We then plot those days one after the other. Moving averages are only meant to used in coordination with other methods of stock market analysis. For example, we used it with our method of extrapolation. If we found, through the study of moving averages, that a particular stock is on a short term upward trend and our extrapolation method gave us the same advice, we would be likely to invest in the stock because we now have two indicators of growth.

The major part of this project was the method of extrapolation. The hope was that given a certain amount of historical data, we would be able to extrapolate new data and forecast the price of the stock. We did this by taking the Fourier Transform of the data and cleaning the noise that is produced on a day-to-day basis by investors. MatLab is incredibly efficient in doing taking transforms because it only takes a few lines of code to do what might take hours of hand-written work. In this way, we treat the price of the stock like a signal, and we are performing a signal analysis on it. After cleaning the "signal" we take the inverse Fourier Transform to obtain a similar but smother version of our original stock market data. We then extrapolate about 60 new points of data. This extrapolation is the most important part of the IQP. The extrapolation is our prediction of the price of the stocks. When we plotted the predicted price of the stock with the actual price of the stock, and then subtracted to difference, and then found the relative error in our prediction in order to gauge the programs effectiveness. We found that the program correctly predicted the price of the stock at an average of within 10% of the correct price, with a high of about 50% above and low of about 25% below the actual price. This is not a bad approximation, but it's not a great one either. Ideally, the approximation would average within 5% of the actual price and with highs and lows no more than 10 – 15%.

It's extremely difficult to write a program that will accurately predict the prices of such a wide variety of stocks. If we had more time and resources, we may have chosen to pick stocks that are similarly priced or companies within the same industry. If we were to do that, we could fine tune our extrapolation program to predict stocks to within our ideals. We could have different versions of our program with different parameters for different industries or price ranges. Perhaps that is another project for another person.

This project provided me with good exposure to the stock market and ignited my interest in the subject. Although I did not necessarily learn how to beat the stock market, I have found a new interest and a new topic to study and gain knowledge on.

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