

The University of Southern Mississippi
The Aquila Digital Community

Honors Theses

Honors College

5-2020

Analysis of True Risk Lab's Price Prediction Algorithm in Relation to Market Results

Chris F. Hua

Follow this and additional works at: https://aquila.usm.edu/honors_theses



Part of the [Finance and Financial Management Commons](#)

Recommended Citation

Hua, Chris F., "Analysis of True Risk Lab's Price Prediction Algorithm in Relation to Market Results" (2020).
Honors Theses. 718.
https://aquila.usm.edu/honors_theses/718

This Honors College Thesis is brought to you for free and open access by the Honors College at The Aquila Digital Community. It has been accepted for inclusion in Honors Theses by an authorized administrator of The Aquila Digital Community. For more information, please contact Joshua.Cromwell@usm.edu, Jennie.Vance@usm.edu.

The University of Southern Mississippi

Analysis of True Risk Lab's Price Prediction Algorithm in Relation to Market Results

by

Chris Hua

A Thesis
Submitted to the Honors College of
The University of Southern Mississippi
in Partial Fulfillment
of Honors Requirements

May 2020

Approved by

Kimberly Goodwin, Ph.D., Thesis
Adviser Professor of Finance

Kimberly Goodwin, Ph.D.,
Director
School of Finance

Ellen Weinauer, Ph.D., Dean
Honors College

Abstract

The concept of beating the stock market is one of the main goals of financial investors and analysts. However, seasoned analysts and investors cannot perfectly predict the movements within the stock market. Machine learning (ML) is one prediction method that has intrigued the financial industry as a means of accurately predicting the market. Though the current prediction algorithms do not grasp every change in the stock markets, the models do provide a means of looking towards stock trends as a means to hedge an investor's or fund's portfolio against market declines by looking at the artificial intelligence (AI) results. This study focused on the accuracy of True Risk Lab's machine learning model for predicting stock price trends. Each of the 11 companies selected for analysis represents significant sectors of the S&P 500, according to the Global Industry Classification Standard (GCIS). By analyzing the price trends from 2013-2018, the True Risk models performed well at forecasting the average stock price and direction for mature companies. However, the models resulted in higher errors for high-growth companies. These results infer that ML models may not adequately forecast the actual price of companies with high volatility due to unprecedented growth.

Key Words: machine learning, hedge, artificial intelligence, stock price trends, Global Industry Classification Standard, mature companies, high-growth companies

Acknowledgements

True Risk Labs provided the necessary data for this project. Without their support, this study would not be possible. I hope this study provides insight that can help True Risk Labs improve and grow as I have through this project.

I want to express my gratitude to Dr. Kimberly Goodwin for giving me advice and supporting me through the thesis process. She gave me support, connected me with True Risk Labs, and guided me throughout the process, giving me my first step into the financial world. Her help was fundamental in completing this project. Thank you for allowing me to be your thesis advisee.

I would also like to thank the USM Honors College for allowing me to test myself as a researcher. This project is one of the many experiences that I will remember as a time that tested my financial and academic skills. The keystone program provided me a means to check all my skills as a student. It helped me establish my foundations for my career ahead.

Table of Contents

List of Tables	viii
List of Graphs	ix
List of Abbreviations	x
Introduction.....	1
Literature Review.....	2
Research Questions and Hypothesis	4
Methodology	4
Results.....	6
Discussion.....	8
Conclusions.....	10
References.....	12
Appendices.....	13
Appendix A: Graph of T-Statistic of 11 GCIS Companies.....	13
Appendix B: Tables	14
Appendix C: AMT Descriptive Statistics.....	18
Appendix D: AMZN Descriptive Statistics.....	21
Appendix E: APD Descriptive Statistics.....	24
Appendix F: BA Descriptive Statistics.....	27

Appendix G: CVX Descriptive Statistics	30
Appendix H: JNJ Descriptive Statistics.....	33
Appendix I: MSFT Descriptive Statistics.....	35
Appendix J: NEE Descriptive Statistics	38
Appendix K: T Descriptive Statistics	41
Appendix L: WFC Descriptive Statistics	44
Appendix M: WMT Descriptive Statistics	47

List of Tables

Table 1: Sample Companies According to Their GCIS Sectors.....	5
Table 2: t-Test Results of 11 GCIS Companies.....	7
Table 3: Predicted Price in 3 Months - Mean and Standard Deviation from 2013-2018 ...	14
Table 4: Actual Price in 3 Months - Mean and Standard Deviation from 2013-2018.....	15
Table 5: 3-Month Volatility - Mean and Standard Deviation from 2013-2018.....	16
Table 6: Percent Prediction Error - Mean and Standard Deviation from 2013-2018	17

List of Graphs

Graph 1: T-Statistics of 11 GCIS Companies..... 13

List of Abbreviations

ML	Machine Learning
S&P	Standards & Poor
GICS	Global Industry Classification Standard
ETF	Exchange Traded Funds
ANN	Artificial Neural Networks
GA	Genetic Algorithms
AMT	American Towers Corp.
AMZN	Amazon
APD	Air Products & Chemicals Inc.
BA	Boeing Company
CVX	Chevron Corp.
JNJ	Johnson & Johnson
MSFT	Microsoft Corp.
NEE	NextEra Energy
WFC	Wells Fargo
WMT	Wal-Mart

Introduction

The equity market, also known as the stock market, attracts all types of investors to trade stocks to generate a profit. Although the stock market is one of the most significant financial systems available, it is also unpredictable. Many investors and analysts cannot guarantee the movement of the stock market. The financial industry has started to employ machine learning (ML) to help analysts and investors identify market patterns and behaviors. By harnessing the modeling automation, ML can take high volumes of different variables into account to calculate the results of the stock price movement. There are pitfalls with the machine learning approach to investing as the models have produced mixed results, such as the Eurekahedge AI Hedge Fund Index, who reported a seven percent return, which is lower than the thirteen percent yield of the S&P500 (Asmudsson 2019). In comparison, the BUZZ US Sentiment Leaders ETF produced a 21 percent return compared to the industry average (Asmudsson 2019). Though there is a range of results for ML, the potential for significant returns is present. ML integration is an inevitable change in the financial sector, in which further research of its range of applications is necessary.

True Risk Labs is one company looking to apply ML algorithms for market forecasting. The company uses multiple linear, non-linear, and deep learner methods to forecast the changes in stock prices over 3-month, 6-month, and 1-year time horizons. This study will analyze the performance of the True Risk Labs' ML results on stock predictions to test their algorithms' application towards investment decisions. The purpose of the study is to test the accuracy of the company's predictions compared to the actual result over five years.

Literature Review

Both artificial neural networks (ANN) and genetic algorithms (GA) of machine learning are most suited towards time-based data analysis, such as stock movement data that changes rapidly. This enormous data set is difficult for analysts to accurately and efficiently sort and interpret this information to make predictions on stock movement. True Risk Labs is one financial analysis company aiming to solve this data issue. Their ML algorithms provide a means to interpret historical stock performance to predict future stock movements. This study aims to test the accuracy of their models to predict the actual trading price for companies on the S&P500.

Financial analysts have placed great emphasis on understanding technical analysis of stock prediction methods compared to fundamental analysis. The stock market data volume increases continually, which makes a comprehensive data analysis difficult. Much of the data that comes from the stock market is considered non-stationary or continuously changing (Ince & Trafalis, 2017). Both ANN and GA are well-suited towards the data processing for analysts since they derive correlations from this non-linear data. Genetic algorithms are highly accurate with large data sets, while relatively accessible to anyone with computer access (Kaboudan, 1999). Thus, technical analysis is far easier for financial analysts to perform compared to the early years of the stock market. Investors can improve their existing prediction models by implementing ML techniques, or hiring companies specializing in them, to improve their strategies.

The purpose of ML algorithms in a financial analysis should focus on the accuracy of stock market predictions. Many of the current models aim to return the daily price movement of an individual stock or to track the movement of the market (Lee & Tzeng, 2013; Cocianu & Grigoryan, 2016; Kumar et al., 2011). A focus on multiple ML methods

provides a more accurate image of the stock closing price rather than relying on a single model (Cocianu & Grigoryan, 2016). Instead of multiple models, a hybrid model also yields a precise closing stock price with genetic algorithms and time-series analysis (Kumar et al., 2011). Models that include three or more different machine learning models provide more accurate tracking of stock movement (Wang & Que, 2018). Although these methods yield improved results as compared to traditional ones, the predictions have not captured the exact closing price. The stock market varies depending on multiple variables that investors cannot grasp to perfection. However, these models can precisely track stock trends. Investors can use them to track the performance of specific stocks to trade accordingly.

Studies have also found improvements in predicting market movements by researching market indexes. Moon and Kim (2019) evaluated the performance of deep learning in stock markets and found that index-based models were more accurate compared to volatility-based models. Some variables, such as volatility, remain challenging to predict. According to Lee and Tzeng (2013), neural network trend prediction for market indexes yielded higher returns than other methods that rely on traditional methods of buy-and-hold. They found that basing the models on a moving average and multiple indicators in their algorithms resulted in higher results than single indicator models. However, the use of multiple indicators may reduce precision if they create noise, confusing the data. Financial analysts face the task of determining the optimal model from a multitude of potential indicators. Where testing each model and combination of variables once exceeded the limits of human computation, machine learning makes such analysis achievable.

Research Questions and Hypothesis

Do the True Risk Lab's ML algorithms accurately predict the 3-month stock price of each of the primary industry sectors?

Ho: The means of both the predicted stock price in 3 months and the actual stock price in 3 months are the same.

Ha: The means of both the predicted stock price in 3 months and the actual stock price in 3 months are different.

Volatility is another factor that must be analyzed to determine if higher volatility will result in more significant errors in the ML models. High-growth companies are unpredictable in their exponential growth, which could affect the prediction results. In contrast, mature companies should result in fewer errors due to their consistent performance. True Risk Labs provided a 3-month volatility measurement with its price predictions.

One issue with ML models is the level of accuracy when compared to the market results. The models should result in less errors on average for price predictions as they process data.

Methodology

In order to capture a clear representation of the US stock market, this analysis focused on 11 companies that had the most significant weight on the S&P 500. Global Industry Classification Standard (GCIS) was the benchmark for determining each of the companies for the sample. Table 1 shows the breakdown of each company from its respective sectors of the economy.

Table 1: Sample Companies According to Their GCIS Sectors

Company	Stock Ticker	Sector
American Tower Corp.	AMT	Real Estate
Amazon	AMZN	Consumer Discretionary
Air Products & Chemicals Inc.	APD	Materials
Boeing Company	BA	Industrials
Chevron Corp.	CVX	Energy
Johnson & Johnson	JNJ	Health Care
Microsoft Corp.	MSFT	Information Technology
NextEra Energy	NEE	Utilities
AT&T	T	Communication Services
Wells Fargo	WFC	Financials
Wal-Mart	WMT	Consumer Staples

Since the stock market covers a vast majority of companies, a broad look at the ML algorithm's performance may determine if it has a higher prediction accuracy in a specific sector. These companies were selected based on their weights since the higher a company's weight, the more it impacts the overall market. The sample population included a mix of both mature and growth companies to see the effect of volatility on stock predictions. The timeline for the companies was from 2013-2018, excluding weekends and federal holidays due to a lack of trading data. The predicted prices were compared to the last trading prices at the end of each trading day for each GCIS company.

The price prediction error is an improvement indicator, in which a declining percent error should occur across the time horizon. For each of the companies, the percent error calculations followed the formula:

$$\text{Price Prediction Error} = \frac{3 \text{ Months Predicted Price} - 3 \text{ Months Actual Price}}{3 \text{ Months Predicted Price}}$$

The descriptive statistics for each company were calculated using the predicted price in 3 months, the actual price in 3 months, the 3-month volatility prediction, and the percent prediction error. These statistics covered the entire five-year period and each year from 2013-2018 (Appendix 1-11). After collecting the summary statistics, the mean and standard deviation for each company were sorted into each of the four variables (Tables 3-6). The 3-month volatility measure was compared against the percent prediction error to see if the ML models' performance is profoundly affected by volatility, the riskiness of the price fluctuations. The percent difference in the standard deviations of the percent prediction errors is used to indicate the performance and improvements of the models as they process more data over time.

A t-Test: Paired Two Sample for Means was conducted for each of the companies using the predicted and actual stock prices. An alpha level of 0.10 was the benchmark for confirming if the means are statistically the same. The t-statistic, whether positive or negative, confirmed which sectors that ML models over- or under-predicted over the 3-month prediction period for each year.

Results

Looking at the p-values for the companies, 10 out of the 11 companies had p-values less than 0.10, in which for these companies, True Risk Labs ML algorithms' prediction results were statistically different from the actual stock prices. However, for AMZN, the ML models returned a p-value of 0.3296, which indicates that the means of the distributions were statistically the same. The algorithms did not correctly predict the exact

trading price in relation to the last trading price of the day for most of the population.

Although the means of the predicted and actual price distributions do not meet the threshold for being considered statistically the same, Table 2 also shows that the mean of the predicted is fairly close to the actual mean. The means may only differ by \$1-2. This level of accuracy may surpass many individual analyst forecasts. When referring to Table 2, the means for the predicted and actual stock prices ranged with prediction errors from 6.52% and 0.33% for the upper and lower bounds, respectively.

Table 2: t-Test Results of 11 GCIS Companies

Company's Ticker	Mean of Predicted	Mean of Actual	T-Stat	P(T<=t) two-tail
AMT	109.5582059	105.1109829	19.5164551	7.20046E-75
AMZN	676.708044	674.4762489	0.97520342	0.329635246
APD	136.1256418	129.9680202	21.39371293	1.31365E-87
BA	158.4284163	168.7510946	-16.18815762	5.6145E-54
CVX	112.1695396	110.7402465	5.319483361	1.218E-07
JNJ	107.3157159	108.7777778	-8.23908172	4.309E-16
MSFT	53.93564758	55.66455212	-12.39005077	1.85001E-33
NEE	111.2341334	114.9227848	-19.46449165	1.58879E-74
T	35.93738138	36.19140655	-2.833446765	0.004673808
WFC	50.55072973	51.2016468	-5.334830113	1.12144E-07
WMT	74.34183999	76.55570365	-14.39092544	8.94802E-44

AMT, AMZN, APD, and CVX had positive t-statistics signifying that the models over-estimated the prices for the real estate, consumer discretionary, material, and energy sectors. In comparison, BA, JNJ, MSFT, NEE, T, WFC, and WMT had negative t-statistics indicating that the predictions were below the actual prices for the industrials, health care, information technology, utilities, communication services, financials, and consumer staples sectors. Graph 1 illustrates the valuation positions in relation to the t-statistics.

The standard deviation of the percent prediction error indicates the accuracy of the price forecasting models as they continued to process data from each company. From

2013-2018, the standard deviation for the samples decreased by 1.81% to 8.67% for 10 out of the 11 companies. WFC of the financial sector had an increase in its prediction error by 2.33% over the 5-year time frame.

AMZN had the highest 3-month volatility of the sample with 12.41 points with BA and MSFT following at 11.05 points and 10.55 points, respectively. However, Table 5 and 6 indicates that the average percent prediction error for AMZN (1.18%) was significantly lower than BA (7.76%) and MSFT (4.86%).

Discussion

The results of the study confirm that True Risk Labs' ML models, on average, predicted prices that were statistically different from actual prices for many of the companies in the sample population. However, as seen in Table 2, the mean of the predicted prices in 3 months was similar to the mean of the actual prices in 3 months. The ML models performed adequately to track the price fluctuations, correctly tracing the trend movements of the company to output a proximity result. An investor looking towards trend movements may use this data to confirm his or her assumptions on price movement concerning stock trading. An appreciating value may signal continued price growth, in which holding stock may be the optimal strategy. A depreciating value may indicate a price decline, in which an investor may consider selling the stock.

When considering the volatility factor, the ML models performed well by having a declining standard deviation to percent prediction error. Most companies had declined from 1.81% to 8.67% to indicate that the models had improved as they processed the data over the time horizon. AMZN had the highest volatility but returned a lower prediction error of just 1.18%, in comparison to BA, who had similar volatility but a higher percentage error of 7.76%. Moon and Kim (2019) had similar findings of volatility and its

unpredictable effect on stock market movements. AMZN is considered a high-growth company due to its high volatility and high standard deviation concerning the other companies. The low prediction error for AMZN may indicate that the algorithm may be more suited to predict the future trends for companies with high volatility, which can be seen in the significant price spreads in Tables 3 and 4. However, WFC had an increase in its percent prediction error even though it was a more mature company. At the start of 2014, the algorithms had undervalued the company compared to 2013. This change in valuation may indicate a change in the company structure that the ML models could not efficiently process into its predictions. The effects of the growth and mature phases and volatilities are potential areas of accuracy improvement for the True Risk Labs' models as companies, such as AMZN and WFC, had significant differences from the rest of the data set.

One limitation of the study is the missing data for JNJ for 2018. Although it does reduce the total years to 2017 for this company, the amount of data present was enough that the lack of 2018 would not significantly impact findings. The trends for determining valuation position, interpreting volatility effects, and determining model accuracy remains consistent for 2013-2017. All data processing methods remain the same. Interpretation of the change in percent prediction error references the 2017 results.

Another limitation is the single representations of S&P 500 sectors. For each sector, a high-growth company may not profoundly impact the interpretation of all the companies in each sector. For example, in the industrials sector, BA may not have been the best representation of its entire industry due to its growth volatility impacting the ML predictions. A more mature company, similar to NEE with lower volatility, may infer a different representation of the sector. Future research should incorporate all companies in

the S&P 500 and compare the machine learning predictions with those of individual analysts.

Conclusions

The results of the study indicated that the True Risk Labs ML models predicted prices that were statistically different for the population size with the exclusion AMZN. Growth companies with high volatilities resulted in higher prediction errors compared to mature companies with no low growth. AMZN was an outlier since unlike the rest of other volatile growth companies, the models produced a significantly lower error for it, which may not be an accurate representation of its sector. However, this instance indicated that the ML algorithms might perform better with higher volatility due to a significant price spread. The volatility had not affected the prediction accuracy since many of the companies had a decline in percent error over time. WFC may also have been an outlier since it had a change in valuation from overpriced to underpriced. This output may have indicated an underlying change in the company that affected predictions. From this data set, the ML models seemed to overestimate the values of the real estate, materials, and energy sectors in comparison to the other industries.

Machine learning may not predict the price fluctuations of the stock market to perfection; however, the financial industry continues to implement ML methods. Trend predictions can provide insight into the direction of the specific companies as it relates to stock predictions. If an investor expects the prices to decline, he or she can trade accordingly against further depreciation by referring to the ML models to protect against volatility risks. As the amounts of data increase dramatically, these ML models, such as the ones from True Risk Labs, provide a necessary tool for financial analysts and investors to implement into data analysis. Future studies should look at a larger sample size to see if

there is a consistent performance of the ML models across all GCIS industries with both growth and mature companies present in each sector for analysis. Increasing the accuracy of these models is critical as making ML models more flexible to all types of data expands their applications to account for unlikely occurrences in data.

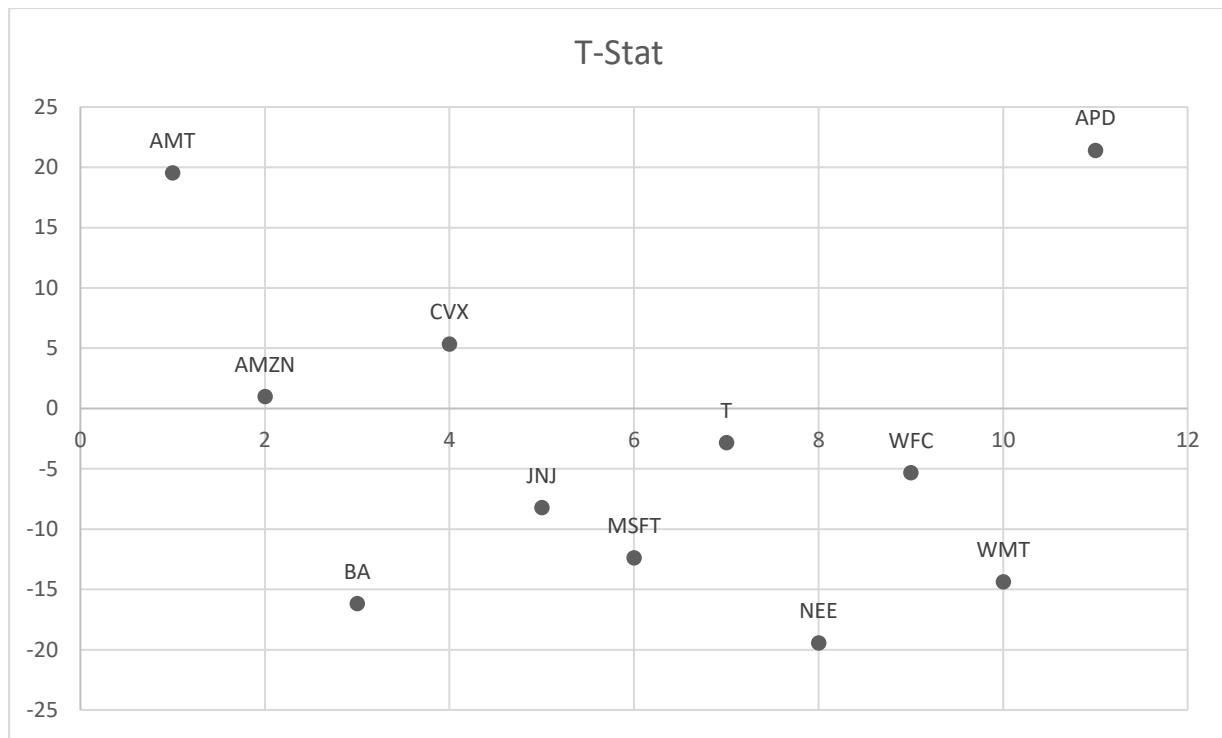
References

- Asmundsson, J. (2018). The big problem with machine learning algorithms. *Bloomberg.Com*, N.PAG-N.PAG.
- Cocianu, C. L., & Grigoryan, H. (2016). Machine Learning Techniques for Stock Market Prediction. A Case Study of Omv Petrom. *Economic Computation & Economic Cybernetics Studies & Research*, 50(3), 63–82.
- Ince, H., & Trafalis, T. B. (2017). A Hybrid Forecasting Model for Stock Market Prediction. *Economic Computation & Economic Cybernetics Studies & Research*, 51(3), 263–280.
- Kaboudan, M. A. (1999). A measure of time series' predictability using genetic programming applied to stock returns. *Journal of Forecasting*, 18(5), 345. [https://doi.org/10.1002/\(SICI\)1099-131X\(199909\)18:5<345::AID-FOR744>3.0.CO;2-7](https://doi.org/10.1002/(SICI)1099-131X(199909)18:5<345::AID-FOR744>3.0.CO;2-7)
- Kumar, L., Pandey, A., Srivastava, S., & Darbari, M. (2011). A Hybrid Machine Learning System for Stock Market Forecasting. *Journal of International Technology & Information Management*, 20(1/2), 39–48.
- Lee, C. T., & Tzeng, J. S. (2013). Trend-Oriented Training for Neural Networks to Forecast Stock Markets. *Asia Pacific Management Review*, 18(2), 181–195. <https://doi.org/10.6126/APMR.2013.18.2.04>
- Moon, K. S., & Kim, H. (2019). Performance of Deep Learning in Prediction of Stock Market Volatility. *Economic Computation & Economic Cybernetics Studies & Research*, 53(2), 77–92. <https://doi.org/10.24818/18423264/53.2.19.05>
- Wang, J., & Que, D. (2018). An Experimental Investigation of Two Hybrid Frameworks for Stock Index Prediction Using Neural Network and Support Vector Regression. *Economic Computation & Economic Cybernetics Studies & Research*, 52(4), 193–210. <https://doi.org/10.24818/18423264/52.4.18.13>

Appendices

Appendix A: Graph

Graph 1: T-Statistics of 11 GCIS Companies



Appendix B: Tables

Table 3: Predicted Price in 3 Months - Mean and Standard Deviation from 2013-2018

Ticker		All Years	2013	2014	2015	2016	2017	2018
AMT	Mean	109.55821	82.57076	96.02841	104.2025	108.9453	140.7187	157.4007
	Standard Deviation	23.423163	3.255226	7.803597	3.835495	7.337613	11.22988	2.17925
AMZN	Mean	676.70804	318.1299	369.7118	535.423	807.2775	1073.495	1530.654
	Standard Deviation	361.82537	30.55208	37.23692	139.1027	40.23053	112.7194	118.7145
APD	Mean	136.12564	94.00236	126.9088	140.2903	148.6502	153.7221	188.683
	Standard Deviation	27.112176	8.896098	16.16666	13.90289	3.502577	10.35766	4.540985
BA	Mean	158.33438	108.0223	130.8183	120.6763	148.232	220.8114	353.8566
	Standard Deviation	68.050233	25.76929	11.35941	17.96098	15.57029	42.02252	31.01563
CVX	Mean	112.16954	121.6828	122.6769	91.35892	98.94176	120.3534	129.8454
	Standard Deviation	14.954537	7.472099	3.661195	8.341557	7.963025	2.687588	3.631193
JNJ	Mean	107.31572	84.87066	101.9546	102.9042	115.2232	131.9494	0
	Standard Deviation	16.822653	9.627438	2.950475	3.045591	5.964109	7.186557	0
MSFT	Mean	53.935648	29.55682	45.17034	45.68239	60.90855	75.86041	92.70251
	Standard Deviation	18.784068	3.342166	3.879302	6.733723	1.37163	6.636264	3.18183
NEE	Mean	111.23413	72.50174	94.22051	101.3385	123.0851	147.0259	167.3558
	Standard Deviation	29.183934	2.898114	5.604207	7.238015	2.182758	9.894994	2.86423
T	Mean	35.937381	32.11506	34.7676	33.39844	38.43831	40.29678	38.01918
	Standard Deviation	3.5944092	1.395312	1.312831	2.645083	1.63649	2.526019	0.573958
WFC	Mean	50.55073	37.59204	48.78625	56.24574	51.46153	56.35722	57.829
	Standard Deviation	7.2661259	2.358562	2.49942	2.247849	1.819776	2.083684	2.094613
WMT	Mean	74.34184	75.63951	79.13718	63.58497	65.87778	81.70402	92.06856
	Standard Deviation	9.6712902	3.559114	1.985839	7.100258	2.574922	7.155747	3.905488

Table 4: Actual Price in 3 Months - Mean and Standard Deviation from 2013-2018

Ticker		All Years	2013	2014	2015	2016	2017	2018
AMT	Mean	105.11098	77.67711	94.33024	94.8978	109.8536	137.7768	139.8241
	Standard Deviation	22.062323	4.320284	5.402202	3.886404	5.02541	7.008256	2.847736
AMZN	Mean	674.47625	323.2503	327.7958	530.1626	763.486	1114.3	1632.732
	Standard Deviation	394.19899	47.53392	26.03847	87.12569	66.81174	201.8305	124.9166
APD	Mean	129.96802	96.32577	124.5107	127.5107	138.1164	153.1746	162.0546
	Standard Deviation	21.646634	9.159182	10.76653	7.568092	5.124409	9.912533	4.489014
BA	Mean	168.6081	115.5757	132.0814	138.3066	144.406	256.3064	345.1553
	Standard Deviation	71.816971	16.34396	9.660645	10.24308	17.21649	57.05385	12.88969
CVX	Mean	110.74025	120.2829	118.1924	91.63572	105.8774	113.2768	124.2099
	Standard Deviation	12.893227	3.739064	9.142916	9.561394	6.166682	7.601858	3.429441
JNJ	Mean	108.77778	89.82684	103.011	100.1768	117.4711	133.6694	0
	Standard Deviation	15.836117	3.875147	2.967776	3.833426	4.652507	6.047239	0
MSFT	Mean	55.664552	34.84728	43.91557	48.87214	58.1066	78.74514	98.78463
	Standard Deviation	18.925326	2.716629	2.832968	4.334829	4.836715	9.086287	4.581519
NEE	Mean	114.92278	84.13846	100.0628	104.0691	122.8334	148.0041	163.1987
	Standard Deviation	25.179602	4.76563	4.763463	5.791367	4.966001	8.158793	4.067217
T	Mean	36.191407	34.92525	34.6812	34.52256	40.49202	37.39193	32.85927
	Standard Deviation	2.8583118	1.56193	0.991412	1.667246	1.843133	1.696267	1.438887
WFC	Mean	51.201647	42.8344	52.16689	53.56508	50.86328	55.62333	54.3372
	Standard Deviation	5.4058019	2.9893	2.02375	3.198479	4.373637	3.619579	1.896812
WMT	Mean	76.555704	76.343	79.70398	67.75756	70.33166	85.75783	85.6522
	Standard Deviation	8.7418781	2.091425	4.482098	6.640054	2.093148	9.916863	1.763305

Table 5: 3-Month Volatility - Mean and Standard Deviation from 2013-2018

Ticker		All Years	2013	2014	2015	2016	2017	2018
AMT	Mean	9.5991698	11.17326	9.268805	10.17998	10.01846	7.716024	8.408415
	Standard Deviation	2.1687501	2.618706	1.511789	2.263675	1.180011	1.496684	0.685012
AMZN	Mean	12.410317	10.37953	12.9894	13.8649	15.58685	10.04506	9.853855
	Standard Deviation	3.3192542	1.947866	3.243217	2.455409	2.742878	2.134234	2.422315
APD	Mean	9.1784177	9.452016	9.300618	10.12178	10.46283	6.785361	8.402988
	Standard Deviation	1.6238098	0.997616	1.236263	1.053488	1.162449	0.65489	0.54502
BA	Mean	11.052347	12.04172	13.20647	11.61218	12.04812	6.77272	9.625964
	Standard Deviation	3.2883534	2.159939	3.300548	3.399955	1.329634	1.545265	1.460855
CVX	Mean	9.7147059	8.566996	7.994582	11.1374	13.98136	7.499157	7.736951
	Standard Deviation	2.7010391	1.111269	0.895168	1.357028	1.44639	1.380178	0.824566
JNJ	Mean	6.7328016	6.869209	6.889462	8.04452	7.314249	4.516486	0
	Standard Deviation	1.6125291	1.454114	0.865938	0.832756	1.087306	1.145209	0
MSFT	Mean	10.554691	10.46543	11.32032	11.2337	12.92302	6.76247	10.6872
	Standard Deviation	2.8809146	1.577849	2.039548	3.051982	1.745749	1.048653	3.101898
NEE	Mean	7.5279337	6.66249	7.666813	9.12532	8.870316	5.595201	6.614024
	Standard Deviation	1.5727482	1.152076	0.400896	1.171905	0.470751	0.986402	0.389464
T	Mean	7.7475205	8.265059	7.805956	7.72664	7.479921	6.9599	9.261463
	Standard Deviation	0.9856537	1.049768	0.756293	1.029046	0.345616	0.767892	0.370605
WFC	Mean	8.9671647	9.390595	7.441633	8.26112	11.18579	8.280602	9.753049
	Standard Deviation	1.4729705	0.657396	0.67227	0.95812	0.710985	0.711906	0.643213
WMT	Mean	8.1443783	7.771739	6.439163	8.55456	10.54994	6.66012	10.32628
	Standard Deviation	1.9429784	0.987322	1.104218	1.086228	0.962601	1.684157	0.906395

Table 6: Percent Prediction Error - Mean and Standard Deviation from 2013-2018

Ticker		All Years	2013	2014	2015	2016	2017	2018
AMT	Mean	-0.0376883	-0.0581	-0.01353	-0.08802	0.013271	-0.01764	-0.11153
	Standard Deviation	0.0748922	0.060038	0.07188	0.05143	0.08638	0.050971	0.020486
AMZN	Mean	-0.0118024	0.014991	-0.10121	0.023764	-0.05514	0.032919	0.06726
	Standard Deviation	0.125142	0.107212	0.142173	0.152264	0.05616	0.097741	0.030607
APD	Mean	-0.0362424	0.026354	-0.01353	-0.08625	-0.07044	-0.00236	-0.1404
	Standard Deviation	0.0712899	0.060117	0.053592	0.060128	0.038637	0.047098	0.037384
BA	Mean	0.0775986	0.098015	0.020493	0.165378	-0.01893	0.155019	-0.01671
	Standard Deviation	0.1473288	0.135131	0.145011	0.150639	0.12063	0.076864	0.100162
CVX	Mean	-0.0064518	-0.00717	-0.03598	0.005405	0.074797	-0.05746	-0.04249
	Standard Deviation	0.0899476	0.076074	0.077142	0.086888	0.080944	0.078282	0.042082
JNJ	Mean	0.0181743	0.068475	0.01096	-0.02548	0.02186	0.01444	0
	Standard Deviation	0.0667382	0.093647	0.034366	0.05063	0.059289	0.041845	0
MSFT	Mean	0.0486023	0.1874	-0.02362	0.084861	-0.04611	0.036124	0.065355
	Standard Deviation	0.1195351	0.109765	0.067242	0.129788	0.074561	0.042344	0.023084
NEE	Mean	0.0477331	0.16018	0.065953	0.029209	-0.00186	0.007908	-0.0248
	Standard Deviation	0.0783735	0.037586	0.081887	0.051315	0.040861	0.032515	0.019491
T	Mean	0.0133268	0.08946	-0.0008	0.040006	0.055261	-0.06958	-0.13587
	Standard Deviation	0.0934935	0.067102	0.053139	0.095379	0.065312	0.055724	0.031399
WFC	Mean	0.0228899	0.139483	0.070681	-0.04685	-0.00977	-0.01262	-0.05833
	Standard Deviation	0.0932134	0.038382	0.040429	0.058033	0.09908	0.058839	0.061641
WMT	Mean	0.0347166	0.012098	0.007512	0.068209	0.069343	0.050746	-0.06832
	Standard Deviation	0.0740291	0.06489	0.05692	0.052828	0.054632	0.091103	0.037467

Appendix C: AMT Descriptive Statistics

All Years							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	109.5582059	Mean	9.599169769	Mean	105.1109829	Mean	-0.037688269
Standard Error	0.639156975	Standard Error	0.059179528	Standard Error	0.602023197	Standard Error	0.002043613
Median	104.257	Median	9.875	Median	99.14	Median	-0.034643134
Mode	81.9674	Mode	10.51	Mode	96.95	Mode	#N/A
Standard Deviation	23.42316291	Standard Deviation	2.168750061	Standard Deviation	22.06232267	Standard Deviation	0.074892214
Sample Variance	548.6445605	Sample Variance	4.703476825	Sample Variance	486.7460816	Sample Variance	0.005608844
Range	82.4289	Range	10.48	Range	84.36	Range	0.392207506
2013							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	82.57076403	Mean	11.17326087	Mean	77.67711462	Mean	-0.058099708
Standard Error	0.204654335	Standard Error	0.164636665	Standard Error	0.271613934	Standard Error	0.003774547
Median	81.4246	Median	11.575	Median	78.58	Median	-0.054901704
Mode	81.9674	Mode	8.255	Mode	79	Mode	#N/A
Standard Deviation	3.255226476	Standard Deviation	2.618706465	Standard Deviation	4.320284104	Standard Deviation	0.060037839
Sample Variance	10.59649941	Sample Variance	6.857623551	Sample Variance	18.66485474	Sample Variance	0.003604542
Range	13.4441	Range	8.095	Range	16.28	Range	0.261562469
2014							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	96.02840717	Mean	9.268804781	Mean	94.33023904	Mean	-0.013532128
Standard Error	0.492558649	Standard Error	0.095423271	Standard Error	0.340983952	Standard Error	0.004537023
Median	93.1026	Median	10.125	Median	95.63	Median	0.002817117
Mode	#N/A	Mode	8.28	Mode	98.6	Mode	#N/A
Standard Deviation	7.803596585	Standard Deviation	1.511788929	Standard Deviation	5.402201768	Standard Deviation	0.071879965
Sample Variance	60.89611967	Sample Variance	2.285505766	Sample Variance	29.18378394	Sample Variance	0.005166729
Range	26.1602	Range	5.86	Range	24.46	Range	0.268139804

2015							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	104.202504	Mean	10.17998	Mean	94.8978	Mean	-0.088020919
Standard Error	0.242578016	Standard Error	0.143167373	Standard Error	0.245797752	Standard Error	0.003252731
Median	104.27	Median	9.985	Median	95.07	Median	-0.09349443
Mode	104.016	Mode	10.63	Mode	94.6	Mode	#N/A
Standard Deviation	3.835495207	Standard Deviation	2.263674932	Standard Deviation	3.886403697	Standard Deviation	0.051430196
Sample Variance	14.71102348	Sample Variance	5.124224196	Sample Variance	15.10413369	Sample Variance	0.002645065
Range	17.9926	Range	8.2	Range	20.4	Range	0.215079214
2016							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	108.9452862	Mean	10.0184585	Mean	109.8536364	Mean	0.013270609
Standard Error	0.461311804	Standard Error	0.074186651	Standard Error	0.315944789	Standard Error	0.005430652
Median	110.376	Median	10.51	Median	108.51	Median	0.010478825
Mode	114.784	Mode	10.51	Mode	105.71	Mode	#N/A
Standard Deviation	7.337613439	Standard Deviation	1.180010927	Standard Deviation	5.025409505	Standard Deviation	0.086379808
Sample Variance	53.84057097	Sample Variance	1.392425789	Sample Variance	25.25474069	Sample Variance	0.007461471
Range	23.7689	Range	4.33	Range	20.69	Range	0.335613105
2017							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	140.7187149	Mean	7.716024096	Mean	137.7768273	Mean	-0.017640264
Standard Error	0.711664463	Standard Error	0.094848485	Standard Error	0.444130179	Standard Error	0.003230147
Median	140.014	Median	7.005	Median	138.75	Median	-0.01488106
Mode	117.649	Mode	7.4	Mode	140	Mode	#N/A
Standard Deviation	11.22987582	Standard Deviation	1.496683853	Standard Deviation	7.008256017	Standard Deviation	0.050970853
Sample Variance	126.1101108	Sample Variance	2.240062556	Sample Variance	49.11565239	Sample Variance	0.002598028
Range	41.7	Range	5.185	Range	32.08	Range	0.238554895
2018							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	

Mean	157.4006585	Mean	8.408414634	Mean	139.8241463	Mean	-0.111530195
Standard Error	0.240657957	Standard Error	0.075646908	Standard Error	0.314479872	Standard Error	0.002262348
Median	157.344	Median	8.13	Median	138.975	Median	-0.108205237
Mode	#N/A	Mode	7.615	Mode	138.52	Mode	#N/A
Standard Deviation	2.17925049	Standard Deviation	0.685011885	Standard Deviation	2.847736355	Standard Deviation	0.02048643
Sample Variance	4.749132697	Sample Variance	0.469241283	Sample Variance	8.109602349	Sample Variance	0.000419694
Range	8.584	Range	1.845	Range	10.71	Range	0.081694424

Appendix D: AMZN Descriptive Statistics

All Years							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	676.7080	Mean	12.41031669	Mean	674.4762489	Mean	-0.011802424
Standard Error	9.8769	Standard Error	0.090607521	Standard Error	10.76066844	Standard Error	0.003416072
Median	611.4765	Median	12.255	Median	563.355	Median	-0.011904594
Mode	735.3820	Mode	8.98	Mode	312.01	Mode	#N/A
Standard Deviation	361.8253	Standard Deviation	3.319254158	Standard Deviation	394.1989908	Standard Deviation	0.125142045
Sample Variance	130917.5957	Sample Variance	11.01744817	Sample Variance	155392.8443	Sample Variance	0.015660531
Range	1426.878	Range	12.835	Range	1615.38	Range	0.717934911
2013							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	318.1298735	Mean	10.37952569	Mean	323.2503439	Mean	0.014990614
Standard Error	1.920792876	Standard Error	0.122461292	Standard Error	2.988431665	Standard Error	0.006740366
Median	315.513	Median	10.425	Median	310.889	Median	-0.022170374
Mode	#N/A	Mode	11.275	Mode	361.08	Mode	#N/A
Standard Deviation	30.55208101	Standard Deviation	1.947866092	Standard Deviation	47.53391553	Standard Deviation	0.10721208
Sample Variance	933.4296543	Sample Variance	3.794182314	Sample Variance	2259.473126	Sample Variance	0.01149443
Range	120.588	Range	6.195	Range	158.82	Range	0.402811479
2014							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	369.7118048	Mean	12.98940239	Mean	327.7958127	Mean	-0.101206358
Standard Error	2.35037349	Standard Error	0.204710031	Standard Error	1.643533405	Standard Error	0.008973901
Median	390.111	Median	13.9	Median	323.81	Median	-0.152917719
Mode	#N/A	Mode	14.965	Mode	302.86	Mode	#N/A
Standard Deviation	37.23691907	Standard Deviation	3.243216835	Standard Deviation	26.03846607	Standard Deviation	0.142173335
Sample Variance	1386.588141	Sample Variance	10.51845544	Sample Variance	678.0017152	Sample Variance	0.020213257

Range	123.332	Range	11.93	Range	100.88	Range	0.50673092
2015							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	535.423	Mean	13.8649004	Mean	530.1626494	Mean	0.023763654
Standard Error	8.780086429	Standard Error	0.154984064	Standard Error	5.499324498	Standard Error	0.009610791
Median	509.34	Median	14.05	Median	532.92	Median	0.067587242
Mode	#N/A	Mode	17.035	Mode	488.1	Mode	#N/A
Standard Deviation	139.1027295	Standard Deviation	2.455409353	Standard Deviation	87.12568538	Standard Deviation	0.152263558
Sample Variance	19349.56934	Sample Variance	6.02903509	Sample Variance	7590.885053	Sample Variance	0.023184191
Range	463.4	Range	8.055	Range	323.715	Range	0.717934911
2016							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	807.2775039	Mean	15.58685039	Mean	763.4860236	Mean	-0.055140007
Standard Error	2.524287691	Standard Error	0.172103453	Standard Error	4.192141287	Standard Error	0.003523822
Median	820.653	Median	16.655	Median	766.9	Median	-0.06282792
Mode	735.382	Mode	14.93	Mode	#N/A	Mode	#N/A
Standard Deviation	40.23052572	Standard Deviation	2.742877683	Standard Deviation	66.81173802	Standard Deviation	0.056160487
Sample Variance	1618.4952	Sample Variance	7.523377985	Sample Variance	4463.808338	Sample Variance	0.003154
Range	167.402	Range	10.03	Range	300.4	Range	0.289527823
2017							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	1073.49478	Mean	10.04506	Mean	1114.29996	Mean	0.032918572
Standard Error	7.128999649	Standard Error	0.134980824	Standard Error	12.76487961	Standard Error	0.006181711
Median	1078.625	Median	10.105	Median	1002.585	Median	0.035493177
Mode	1087.25	Mode	12.175	Mode	961.35	Mode	#N/A
Standard Deviation	112.7193817	Standard Deviation	2.134234223	Standard Deviation	201.8304682	Standard Deviation	0.097741431
Sample Variance	12705.659	Sample Variance	4.554955719	Sample Variance	40735.53789	Sample Variance	0.009553387

Range	457.566	Range	6.805	Range	713.72	Range	0.378483873
2018							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	1530.654458	Mean	9.853855422	Mean	1632.732229	Mean	0.067259743
Standard Error	13.03060679	Standard Error	0.265883586	Standard Error	13.71137661	Standard Error	0.003359595
Median	1579.61	Median	11.71	Median	1624.89	Median	0.065236257
Mode	#N/A	Mode	11.71	Mode	#N/A	Mode	#N/A
Standard Deviation	118.7144776	Standard Deviation	2.422314747	Standard Deviation	124.9165859	Standard Deviation	0.030607366
Sample Variance	14093.1272	Sample Variance	5.867608735	Sample Variance	15604.15344	Sample Variance	0.000936811
Range	403.1	Range	5.985	Range	491.62	Range	0.129282557

Appendix E: APD Descriptive Statistics

All Years							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	136.1256418	Mean	9.178417722	Mean	129.9680202	Mean	-0.036242397
Standard Error	0.739820504	Standard Error	0.044309532	Standard Error	0.590680136	Standard Error	0.001945315
Median	144.289	Median	9.27	Median	133.2119	Median	-0.034489982
Mode	148.146	Mode	8.9	Mode	120.879	Mode	#N/A
Standard Deviation	27.11217569	Standard Deviation	1.623809827	Standard Deviation	21.64663392	Standard Deviation	0.071289884
Sample Variance	735.0700704	Sample Variance	2.636758355	Sample Variance	468.5767603	Sample Variance	0.005082248
Range	116.5535	Range	5.975	Range	96.0828	Range	0.448461846
2013							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	94.00235929	Mean	9.45201581	Mean	96.32576957	Mean	0.026354469
Standard Error	0.559292901	Standard Error	0.062719603	Standard Error	0.575832816	Standard Error	0.003779542
Median	94.5063	Median	9.58	Median	98.7001	Median	0.031365105
Mode	102.642	Mode	9.58	Mode	99.0237	Mode	#N/A
Standard Deviation	8.896098191	Standard Deviation	0.997616349	Standard Deviation	9.159181642	Standard Deviation	0.060117293
Sample Variance	79.14056302	Sample Variance	0.995238381	Sample Variance	83.89060835	Sample Variance	0.003614089
Range	28.3935	Range	4.145	Range	35.3438	Range	0.335387662
2014							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	126.9087729	Mean	9.30061753	Mean	124.5107211	Mean	-0.013531917
Standard Error	1.020430704	Standard Error	0.078032211	Standard Error	0.679577086	Standard Error	0.00338267
Median	121.541	Median	9.755	Median	123.07	Median	-0.010523417
Mode	114.782	Mode	9.975	Mode	108.278	Mode	#N/A
Standard Deviation	16.16666274	Standard Deviation	1.236262722	Standard Deviation	10.76652585	Standard Deviation	0.053591571

Sample Variance	261.3609841	Sample Variance	1.528345517	Sample Variance	115.918079	Sample Variance	0.002872056
Range	57.672	Range	4.405	Range	39.7445	Range	0.246304533
2015							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	140.290304	Mean	10.12178	Mean	127.5106592	Mean	-0.086251317
Standard Error	0.879295852	Standard Error	0.066628435	Standard Error	0.478648195	Standard Error	0.003802836
Median	141.6755	Median	10.5125	Median	127.25345	Median	-0.105157075
Mode	#N/A	Mode	11.065	Mode	135.1533	Mode	#N/A
Standard Deviation	13.90288814	Standard Deviation	1.053488054	Standard Deviation	7.568092466	Standard Deviation	0.060128117
Sample Variance	193.2902987	Sample Variance	1.10983708	Sample Variance	57.27602358	Sample Variance	0.00361539
Range	53.912	Range	3.645	Range	33.8831	Range	0.288699832
2016							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	148.6502174	Mean	10.46282609	Mean	138.1164083	Mean	-0.070443908
Standard Error	0.220205155	Standard Error	0.07308257	Standard Error	0.322168809	Standard Error	0.002429102
Median	147.799	Median	10.96	Median	137.7419	Median	-0.075382992
Mode	145.004	Mode	8.85	Mode	131.9268	Mode	#N/A
Standard Deviation	3.502577412	Standard Deviation	1.162449443	Standard Deviation	5.124408611	Standard Deviation	0.038637234
Sample Variance	12.26804853	Sample Variance	1.351288708	Sample Variance	26.25956361	Sample Variance	0.001492836
Range	14.199	Range	3.12	Range	24.9983	Range	0.169491919
2017							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	153.7221446	Mean	6.785361446	Mean	153.1745783	Mean	-0.00236203
Standard Error	0.656389862	Standard Error	0.041501987	Standard Error	0.628181229	Standard Error	0.002984737
Median	148.534	Median	6.925	Median	151.53	Median	0.00083225
Mode	151.05	Mode	7.38	Mode	160.94	Mode	#N/A
Standard Deviation	10.35765731	Standard Deviation	0.654890312	Standard Deviation	9.91253259	Standard Deviation	0.047098352

Sample Variance	107.281065	Sample Variance	0.42888132	Sample Variance	98.25830234	Sample Variance	0.002218255
Range	36.443	Range	2.32	Range	39.7	Range	0.214471326
2018							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	188.6829756	Mean	8.402987805	Mean	162.0546341	Mean	-0.140395465
Standard Error	0.50146793	Standard Error	0.060187393	Standard Error	0.495728614	Standard Error	0.004128385
Median	188.41	Median	8.72	Median	163	Median	-0.129290316
Mode	#N/A	Mode	8.96	Mode	166.29	Mode	#N/A
Standard Deviation	4.540985244	Standard Deviation	0.545020024	Standard Deviation	4.489013528	Standard Deviation	0.037384113
Sample Variance	20.62054699	Sample Variance	0.297046827	Sample Variance	20.15124246	Sample Variance	0.001397572
Range	15.709	Range	1.44	Range	15.57	Range	0.132118322

Appendix F: BA Descriptive Statistics

All Years							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	158.3343801	Mean	11.05234724	Mean	168.6080999	Mean	0.077598577
Standard Error	1.857604954	Standard Error	0.089764005	Standard Error	1.960427675	Standard Error	0.004021715
Median	139.8655	Median	11.395	Median	137	Median	0.079857334
Mode	100.117	Mode	9.645	Mode	134.72	Mode	#N/A
Standard Deviation	68.0502333	Standard Deviation	3.288353367	Standard Deviation	71.81697078	Standard Deviation	0.14732877
Sample Variance	4630.834253	Sample Variance	10.81326786	Sample Variance	5157.677292	Sample Variance	0.021705766
Range	313.0136	Range	16.735	Range	287.47	Range	1.02931759
2013							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	108.0222589	Mean	12.04171937	Mean	115.5756917	Mean	0.098015371
Standard Error	1.620101139	Standard Error	0.13579418	Standard Error	1.027535745	Standard Error	0.008495607
Median	101.997	Median	11.7	Median	117.51	Median	0.122545331
Mode	100.117	Mode	14.455	Mode	106.7	Mode	#N/A
Standard Deviation	25.76928615	Standard Deviation	2.159938663	Standard Deviation	16.34395656	Standard Deviation	0.135130905
Sample Variance	664.0561086	Sample Variance	4.665335028	Sample Variance	267.1249159	Sample Variance	0.018260362
Range	79.0766	Range	8.585	Range	60.28	Range	0.502411458
2014							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	130.8182629	Mean	13.2064741	Mean	132.0813944	Mean	0.020492904
Standard Error	0.716999897	Standard Error	0.208328717	Standard Error	0.609774523	Standard Error	0.009153025
Median	131.264	Median	13.19	Median	129.02	Median	-0.042305969
Mode	136.02	Mode	12.115	Mode	127.38	Mode	#N/A
Standard Deviation	11.35941468	Standard Deviation	3.300547594	Standard Deviation	9.660645281	Standard Deviation	0.145011184
Sample Variance	129.036302	Sample Variance	10.89361442	Sample Variance	93.32806725	Sample Variance	0.021028243

Range	40.842	Range	12.885	Range	39.97	Range	0.554908764
2015							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	120.6762604	Mean	11.61218	Mean	138.30656	Mean	0.165378365
Standard Error	1.135951925	Standard Error	0.215032049	Standard Error	0.647829308	Standard Error	0.009527257
Median	123.235	Median	10.645	Median	142.335	Median	0.127558848
Mode	137.228	Mode	10.545	Mode	142.8	Mode	#N/A
Standard Deviation	17.96097697	Standard Deviation	3.399955225	Standard Deviation	10.24308074	Standard Deviation	0.150639156
Sample Variance	322.5966938	Sample Variance	11.55969553	Sample Variance	104.920703	Sample Variance	0.022692155
Range	73.07	Range	13.89	Range	45.94	Range	0.776427247
2016							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	148.2319759	Mean	12.04812253	Mean	144.4060079	Mean	-0.018928396
Standard Error	0.978895512	Standard Error	0.083593344	Standard Error	1.082391579	Standard Error	0.007583967
Median	146.305	Median	12.55	Median	134.66	Median	0.002269461
Mode	160.651	Mode	9.645	Mode	134.72	Mode	#N/A
Standard Deviation	15.57028629	Standard Deviation	1.329633532	Standard Deviation	17.21649201	Standard Deviation	0.120630381
Sample Variance	242.4338152	Sample Variance	1.76792533	Sample Variance	296.4075971	Sample Variance	0.014551689
Range	85.9951	Range	4.495	Range	61.21	Range	0.686580536
2017							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	220.811356	Mean	6.77272	Mean	256.3064	Mean	0.155019182
Standard Error	2.657737714	Standard Error	0.097731149	Standard Error	3.60840214	Standard Error	0.004861321
Median	205.3675	Median	6.8525	Median	255.61	Median	0.14693634
Mode	#N/A	Mode	6.87	Mode	182.39	Mode	#N/A
Standard Deviation	42.022523	Standard Deviation	1.545265148	Standard Deviation	57.05384739	Standard Deviation	0.076864228
Sample Variance	1765.892439	Sample Variance	2.387844379	Sample Variance	3255.141502	Sample Variance	0.00590811
Range	132.351	Range	4.765	Range	189.02	Range	0.300248941

2018							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	353.8566265	Mean	9.625963855	Mean	345.1553012	Mean	-0.016710647
Standard Error	3.404407697	Standard Error	0.16034971	Standard Error	1.414827554	Standard Error	0.01099417
Median	364.179	Median	9.52	Median	342.46	Median	-0.049511155
Mode	#N/A	Mode	9.52	Mode	#N/A	Mode	#N/A
Standard Deviation	31.0156302	Standard Deviation	1.460855383	Standard Deviation	12.88969245	Standard Deviation	0.10016166
Sample Variance	961.9693167	Sample Variance	2.13409845	Sample Variance	166.1441716	Sample Variance	0.010032358
Range	104.359	Range	4.225	Range	49.12	Range	0.406687136

Appendix G: CVX Descriptive Statistics

All Years							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	112.1695396	Mean	9.714705882	Mean	110.7402465	Mean	-0.006451789
Standard Error	0.408070272	Standard Error	0.073704306	Standard Error	0.351822509	Standard Error	0.002454435
Median	118.478	Median	9.01	Median	112.58	Median	-0.011370206
Mode	119.784	Mode	9.01	Mode	124.14	Mode	#N/A
Standard Deviation	14.95453674	Standard Deviation	2.701039094	Standard Deviation	12.89322698	Standard Deviation	0.089947591
Sample Variance	223.6381692	Sample Variance	7.29561219	Sample Variance	166.2353019	Sample Variance	0.008090569
Range	59.5464	Range	10.475	Range	64.83	Range	0.447843195
2013							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	121.6827905	Mean	8.566996047	Mean	120.2829289	Mean	-0.007173599
Standard Error	0.469766841	Standard Error	0.069864898	Standard Error	0.235072953	Standard Error	0.004782739
Median	121.364	Median	8.43	Median	120.55	Median	-0.011079128
Mode	121.171	Mode	8.67	Mode	116.57	Mode	#N/A
Standard Deviation	7.472099034	Standard Deviation	1.111269235	Standard Deviation	3.739064219	Standard Deviation	0.076074124
Sample Variance	55.83226398	Sample Variance	1.234919313	Sample Variance	13.98060123	Sample Variance	0.005787272
Range	28.844	Range	3.21	Range	18.24	Range	0.303925839
2014							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	122.6769124	Mean	7.994581673	Mean	118.1923506	Mean	-0.0359801
Standard Error	0.231092578	Standard Error	0.056502531	Standard Error	0.577095736	Standard Error	0.004869155
Median	122.818	Median	7.91	Median	118.53	Median	-0.064870747
Mode	119.95	Mode	7.4	Mode	118.8	Mode	#N/A
Standard Deviation	3.661194986	Standard Deviation	0.895168433	Standard Deviation	9.142915927	Standard Deviation	0.077141919
Sample Variance	13.40434873	Sample Variance	0.801326524	Sample Variance	83.59291165	Sample Variance	0.005950876
Range	17.328	Range	2.835	Range	33.99	Range	0.308935117

2015							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	91.358916	Mean	11.1374	Mean	91.63572	Mean	0.005405139
Standard Error	0.527566386	Standard Error	0.085825985	Standard Error	0.604715645	Standard Error	0.005495293
Median	89.27205	Median	10.45	Median	90.455	Median	0.008518063
Mode	#N/A	Mode	10.45	Mode	100.42	Mode	#N/A
Standard Deviation	8.341556976	Standard Deviation	1.35702798	Standard Deviation	9.561393868	Standard Deviation	0.086888206
Sample Variance	69.58157279	Sample Variance	1.84152494	Sample Variance	91.42025269	Sample Variance	0.00754956
Range	36.8734	Range	3.91	Range	41.71	Range	0.39777255
2016							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	98.94176008	Mean	13.98136364	Mean	105.8774308	Mean	0.074797457
Standard Error	0.500631075	Standard Error	0.090933735	Standard Error	0.387695959	Standard Error	0.005088904
Median	98.8892	Median	14.735	Median	103.42	Median	0.074172585
Mode	#N/A	Mode	11.145	Mode	101.27	Mode	#N/A
Standard Deviation	7.963024729	Standard Deviation	1.4463896	Standard Deviation	6.166681734	Standard Deviation	0.080943974
Sample Variance	63.40976283	Sample Variance	2.092042875	Sample Variance	38.02796361	Sample Variance	0.006551927
Range	33.9344	Range	4.275	Range	26.1	Range	0.314207132
2017							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	120.3533775	Mean	7.499156627	Mean	113.2768273	Mean	-0.057459935
Standard Error	0.170318959	Standard Error	0.087465202	Standard Error	0.4817482	Standard Error	0.004960896
Median	119.92	Median	7.275	Median	112.98	Median	-0.071190303
Mode	118.454	Mode	8.35	Mode	117.18	Mode	#N/A
Standard Deviation	2.687587847	Standard Deviation	1.380177602	Standard Deviation	7.601858377	Standard Deviation	0.078281616
Sample Variance	7.223128438	Sample Variance	1.904890213	Sample Variance	57.78825078	Sample Variance	0.006128011
Range	11.148	Range	5.065	Range	30.56	Range	0.315345807
2018							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	

Mean	129.8453537	Mean	7.73695122	Mean	124.209878	Mean	-0.042494957
Standard Error	0.400998231	Standard Error	0.091058083	Standard Error	0.378718401	Standard Error	0.004647217
Median	129.9535	Median	7.13	Median	124.255	Median	-0.04544881
Mode	#N/A	Mode	7.13	Mode	123.85	Mode	#N/A
Standard Deviation	3.631193418	Standard Deviation	0.824566012	Standard Deviation	3.429440977	Standard Deviation	0.042082337
Sample Variance	13.18556564	Sample Variance	0.679909109	Sample Variance	11.76106542	Sample Variance	0.001770923
Range	15.084	Range	2.075	Range	15.91	Range	0.153900647

Appendix H: JNJ Descriptive Statistics

All Years							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	107.3157159	Mean	6.732801587	Mean	108.7777778	Mean	0.018174282
Standard Error	0.473924559	Standard Error	0.04542786	Standard Error	0.446132051	Standard Error	0.001880134
Median	104.384	Median	6.975	Median	103.98	Median	0.016992056
Mode	103.52	Mode	6.885	Mode	103.22	Mode	#N/A
Standard Deviation	16.822653	Standard Deviation	1.61252906	Standard Deviation	15.83611683	Standard Deviation	0.066738153
Sample Variance	283.0016539	Sample Variance	2.600249969	Sample Variance	250.7825962	Sample Variance	0.004453981
Range	76.8138	Range	7.14	Range	67.03	Range	0.372814264
2013							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	84.87066364	Mean	6.869209486	Mean	89.82683794	Mean	0.068474694
Standard Error	0.605271844	Standard Error	0.09141937	Standard Error	0.243628394	Standard Error	0.005887563
Median	86.1148	Median	7.655	Median	90.17	Median	0.038024942
Mode	#N/A	Mode	4.845	Mode	91.11	Mode	#N/A
Standard Deviation	9.627438045	Standard Deviation	1.45411409	Standard Deviation	3.875146833	Standard Deviation	0.093647429
Sample Variance	92.68756331	Sample Variance	2.114447785	Sample Variance	15.01676298	Sample Variance	0.008769841
Range	29.9576	Range	4.26	Range	17.12	Range	0.336288751
2014							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	101.9545713	Mean	6.889462151	Mean	103.010996	Mean	0.010959781
Standard Error	0.186232316	Standard Error	0.054657551	Standard Error	0.187324362	Standard Error	0.002169192
Median	102.616	Median	6.885	Median	102.52	Median	0.010649731
Mode	103.536	Mode	6.92	Mode	103.22	Mode	#N/A
Standard Deviation	2.950474775	Standard Deviation	0.865938456	Standard Deviation	2.967776037	Standard Deviation	0.034366471
Sample Variance	8.705301395	Sample Variance	0.74984941	Sample Variance	8.807694604	Sample Variance	0.001181054

Range	11.3844	Range	3.6	Range	12.53	Range	0.130733224
2015							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	102.904154	Mean	8.04452	Mean	100.1768	Mean	-0.025484859
Standard Error	0.192620084	Standard Error	0.052668097	Standard Error	0.24244717	Standard Error	0.003202139
Median	103.2165	Median	7.62	Median	100.285	Median	-0.031527749
Mode	102.489	Mode	8.73	Mode	99.64	Mode	#N/A
Standard Deviation	3.045590941	Standard Deviation	0.832755725	Standard Deviation	3.833426351	Standard Deviation	0.050630269
Sample Variance	9.275624182	Sample Variance	0.693482098	Sample Variance	14.69515759	Sample Variance	0.002563424
Range	11.8282	Range	3.07	Range	18.41	Range	0.21603742
2016							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	115.2232055	Mean	7.314249012	Mean	117.4710672	Mean	0.021860179
Standard Error	0.374960292	Standard Error	0.068358326	Standard Error	0.292500631	Standard Error	0.003727454
Median	116.318	Median	7.775	Median	116.46	Median	0.042449286
Mode	110.535	Mode	6.82	Mode	112.69	Mode	#N/A
Standard Deviation	5.964108554	Standard Deviation	1.087305734	Standard Deviation	4.652507351	Standard Deviation	0.059288784
Sample Variance	35.57059084	Sample Variance	1.182233759	Sample Variance	21.64582465	Sample Variance	0.00351516
Range	22.715	Range	3.815	Range	20.37	Range	0.212742372
2017							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	131.9494418	Mean	4.516485944	Mean	133.6694378	Mean	0.014439949
Standard Error	0.455429537	Standard Error	0.072574699	Standard Error	0.38322821	Standard Error	0.002651817
Median	132.791	Median	4.055	Median	132.86	Median	0.023052873
Mode	126.695	Mode	3.21	Mode	132.63	Mode	#N/A
Standard Deviation	7.186556883	Standard Deviation	1.14520943	Standard Deviation	6.047239147	Standard Deviation	0.041844967
Sample Variance	51.64659983	Sample Variance	1.311504638	Sample Variance	36.5691013	Sample Variance	0.001751001
Range	30.743	Range	3.935	Range	26.77	Range	0.202188627

Appendix I: MSFT Descriptive Statistics

All Years							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	53.93564758	Mean	10.55469099	Mean	55.66455212	Mean	0.048602281
Standard Error	0.51256819	Standard Error	0.078612639	Standard Error	0.516422755	Standard Error	0.003261802
Median	49.6483	Median	10.815	Median	50.48	Median	0.036210859
Mode	28.1048	Mode	9.795	Mode	62.3	Mode	#N/A
Standard Deviation	18.78406822	Standard Deviation	2.880914586	Standard Deviation	18.92532632	Standard Deviation	0.119535125
Sample Variance	352.8412189	Sample Variance	8.29966885	Sample Variance	358.1679763	Sample Variance	0.014288646
Range	73.6199	Range	11.54	Range	82.27	Range	0.686732679
2013							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	29.55681897	Mean	10.46543478	Mean	34.84727668	Mean	0.187400028
Standard Error	0.210120161	Standard Error	0.099198546	Standard Error	0.170793029	Standard Error	0.006900858
Median	28.1022	Median	11.16	Median	34.92	Median	0.194702173
Mode	28.1048	Mode	10.245	Mode	28.79	Mode	#N/A
Standard Deviation	3.342165753	Standard Deviation	1.577849466	Standard Deviation	2.716629426	Standard Deviation	0.109764863
Sample Variance	11.17007192	Sample Variance	2.489608937	Sample Variance	7.380075439	Sample Variance	0.012048325
Range	12.642	Range	5.705	Range	12.43	Range	0.457341382
2014							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	45.17034462	Mean	11.32031873	Mean	43.91556773	Mean	-0.023622952
Standard Error	0.244859345	Standard Error	0.12873512	Standard Error	0.178815325	Standard Error	0.004244281
Median	46.4852	Median	10.94	Median	43.855	Median	-0.010660473
Mode	#N/A	Mode	10.42	Mode	40.4	Mode	#N/A
Standard Deviation	3.879301591	Standard Deviation	2.039547866	Standard Deviation	2.832967534	Standard Deviation	0.067242051
Sample Variance	15.04898083	Sample Variance	4.159755498	Sample Variance	8.025705049	Sample Variance	0.004521493
Range	14.649	Range	7.695	Range	10.55	Range	0.316131704

2015							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	45.6823888	Mean	11.2337	Mean	48.87214	Mean	0.084860782
Standard Error	0.425878048	Standard Error	0.193024316	Standard Error	0.27415868	Standard Error	0.008208495
Median	44.4725	Median	11.75	Median	47.59	Median	0.101659943
Mode	#N/A	Mode	9.795	Mode	47.58	Mode	#N/A
Standard Deviation	6.733723186	Standard Deviation	3.051982404	Standard Deviation	4.334829351	Standard Deviation	0.129787709
Sample Variance	45.34302795	Sample Variance	9.314596596	Sample Variance	18.7907455	Sample Variance	0.016844849
Range	25.6233	Range	9.86	Range	16.26	Range	0.52283426
2016							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	60.90854585	Mean	12.92302372	Mean	58.10660079	Mean	-0.04610844
Standard Error	0.086233611	Standard Error	0.109754288	Standard Error	0.304081684	Standard Error	0.004687619
Median	60.6854	Median	13.59	Median	57.89	Median	-0.033407639
Mode	#N/A	Mode	13.32	Mode	62.3	Mode	#N/A
Standard Deviation	1.371629557	Standard Deviation	1.745748818	Standard Deviation	4.836715269	Standard Deviation	0.074561138
Sample Variance	1.881367641	Sample Variance	3.047638936	Sample Variance	23.39381459	Sample Variance	0.005559363
Range	6.2902	Range	5.605	Range	17.43	Range	0.297696261
2017							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	75.86041285	Mean	6.76246988	Mean	78.74514056	Mean	0.036123741
Standard Error	0.420556154	Standard Error	0.066455705	Standard Error	0.575820019	Standard Error	0.002683459
Median	76.3773	Median	6.72	Median	75.16	Median	0.03570332
Mode	#N/A	Mode	6.81	Mode	65.73	Mode	#N/A
Standard Deviation	6.636264182	Standard Deviation	1.048653334	Standard Deviation	9.086286641	Standard Deviation	0.042344263
Sample Variance	44.04000229	Sample Variance	1.099673815	Sample Variance	82.56060492	Sample Variance	0.001793037
Range	22.4127	Range	4.34	Range	31.82	Range	0.1712646
2018							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	

Mean	92.70251463	Mean	10.68719512	Mean	98.78463415	Mean	0.065354557
Standard Error	0.351374391	Standard Error	0.342547338	Standard Error	0.505944137	Standard Error	0.002549172
Median	93.42515	Median	10.815	Median	98.5	Median	0.061960379
Mode	#N/A	Mode	15.245	Mode	95	Mode	#N/A
Standard Deviation	3.181830437	Standard Deviation	3.101898075	Standard Deviation	4.58151902	Standard Deviation	0.023083735
Sample Variance	10.12404493	Sample Variance	9.621771665	Sample Variance	20.99031653	Sample Variance	0.000532859
Range	11.2292	Range	7.795	Range	21.12	Range	0.117023436

Appendix J: NEE Descriptive Statistics

All Years							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	111.2341334	Mean	7.52793373	Mean	114.9227848	Mean	0.047733116
Standard Error	0.796353381	Standard Error	0.042916194	Standard Error	0.68708561	Standard Error	0.002138608
Median	104.38	Median	7.69	Median	106.56	Median	0.032814614
Mode	120.142	Mode	5.63	Mode	97.99	Mode	#N/A
Standard Deviation	29.183934	Standard Deviation	1.572748229	Standard Deviation	25.1796019	Standard Deviation	0.078373496
Sample Variance	851.7020036	Sample Variance	2.47353699	Sample Variance	634.0123519	Sample Variance	0.006142405
Range	103.0231	Range	8.08	Range	94.69	Range	0.359431622
2013							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	72.50173755	Mean	6.662490119	Mean	84.1384585	Mean	0.160180206
Standard Error	0.182202853	Standard Error	0.072430424	Standard Error	0.299612589	Standard Error	0.002363027
Median	71.4397	Median	6.29	Median	83.73	Median	0.164619764
Mode	#N/A	Mode	5.63	Mode	79.84	Mode	#N/A
Standard Deviation	2.898113789	Standard Deviation	1.152076423	Standard Deviation	4.765629965	Standard Deviation	0.037586253
Sample Variance	8.399063533	Sample Variance	1.327280084	Sample Variance	22.71122896	Sample Variance	0.001412726
Range	12.4377	Range	3.615	Range	20	Range	0.180476448
2014							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	94.22051116	Mean	7.666812749	Mean	100.0628287	Mean	0.06595291
Standard Error	0.3537344	Standard Error	0.025304362	Standard Error	0.300667123	Standard Error	0.00516867
Median	94.2852	Median	7.71	Median	98.68	Median	0.077432127
Mode	#N/A	Mode	8.125	Mode	97.24	Mode	#N/A
Standard Deviation	5.604206849	Standard Deviation	0.400896496	Standard Deviation	4.763463064	Standard Deviation	0.08188714
Sample Variance	31.40713441	Sample Variance	0.160718001	Sample Variance	22.69058037	Sample Variance	0.006705504
Range	23.3669	Range	1.635	Range	19.84	Range	0.308978826

2015							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	101.3384788	Mean	9.12532	Mean	104.06912	Mean	0.029208687
Standard Error	0.457772258	Standard Error	0.074117797	Standard Error	0.366278219	Standard Error	0.003245475
Median	97.7891	Median	8.78	Median	102.785	Median	0.022749707
Mode	#N/A	Mode	7.6	Mode	103.15	Mode	#N/A
Standard Deviation	7.238014924	Standard Deviation	1.171905263	Standard Deviation	5.791367141	Standard Deviation	0.051315467
Sample Variance	52.38886003	Sample Variance	1.373361945	Sample Variance	33.53993336	Sample Variance	0.002633277
Range	26.6746	Range	4.37	Range	24.39	Range	0.212510657
2016							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	123.0851462	Mean	8.870316206	Mean	122.8333992	Mean	-0.001864516
Standard Error	0.137228809	Standard Error	0.029595832	Standard Error	0.312209794	Standard Error	0.00256894
Median	122.91	Median	8.925	Median	123.46	Median	0.005323108
Mode	120.142	Mode	9.045	Mode	118.9	Mode	#N/A
Standard Deviation	2.182757825	Standard Deviation	0.470750518	Standard Deviation	4.966000785	Standard Deviation	0.040861496
Sample Variance	4.764431721	Sample Variance	0.22160605	Sample Variance	24.6611638	Sample Variance	0.001669662
Range	10.075	Range	2	Range	19.89	Range	0.155718201
2017							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	147.0259438	Mean	5.595200803	Mean	148.0041365	Mean	0.0079077
Standard Error	0.627069751	Standard Error	0.062510705	Standard Error	0.517042483	Standard Error	0.002060547
Median	145.561	Median	5.46	Median	149.87	Median	0.01594204
Mode	164.095	Mode	5.505	Mode	146.74	Mode	#N/A
Standard Deviation	9.894993774	Standard Deviation	0.986402289	Standard Deviation	8.158792763	Standard Deviation	0.032514877
Sample Variance	97.91090178	Sample Variance	0.972989476	Sample Variance	66.56589935	Sample Variance	0.001057217
Range	38.256	Range	4.155	Range	34.4	Range	0.159008731
2018							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	

Mean	167.3557805	Mean	6.61402439	Mean	163.1986585	Mean	-0.024802793
Standard Error	0.316301323	Standard Error	0.043009127	Standard Error	0.449149008	Standard Error	0.002152425
Median	167.3015	Median	6.91	Median	162.93	Median	-0.020944464
Mode	#N/A	Mode	6.91	Mode	160.22	Mode	#N/A
Standard Deviation	2.864230296	Standard Deviation	0.389464209	Standard Deviation	4.067217255	Standard Deviation	0.019491042
Sample Variance	8.203815186	Sample Variance	0.15168237	Sample Variance	16.5422562	Sample Variance	0.000379901
Range	9.66	Range	0.95	Range	14.91	Range	0.071338917

Appendix K: T Descriptive Statistics

All Years							
3 Month Price Prediction		3 Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	35.93738138	Mean	7.747520477	Mean	36.19140655	Mean	0.013326806
Standard Error	0.098082046	Standard Error	0.026895918	Standard Error	0.077995867	Standard Error	0.002551193
Median	35.9077	Median	7.61	Median	35.46	Median	0.006893702
Mode	31.0505	Mode	7.96	Mode	34.35	Mode	#N/A
Standard Deviation	3.594409241	Standard Deviation	0.98565374	Standard Deviation	2.858311776	Standard Deviation	0.09349348
Sample Variance	12.91977779	Sample Variance	0.971513296	Sample Variance	8.16994621	Sample Variance	0.008741031
Range	16.7207	Range	4.58	Range	13.22	Range	0.453456601
2013							
3 Month Price Prediction		3 Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	32.11505613	Mean	8.265059289	Mean	34.92525296	Mean	0.089460134
Standard Error	0.087722483	Standard Error	0.065998341	Standard Error	0.098197711	Standard Error	0.004218656
Median	32.0165	Median	7.61	Median	34.95	Median	0.072644256
Mode	31.0505	Mode	7.19	Mode	35.07	Mode	#N/A
Standard Deviation	1.395311502	Standard Deviation	1.049767877	Standard Deviation	1.561930213	Standard Deviation	0.067101826
Sample Variance	1.946894189	Sample Variance	1.102012596	Sample Variance	2.439625991	Sample Variance	0.004502655
Range	5.5522	Range	3.075	Range	7.14	Range	0.277232538
2014							
3 Month Price Prediction		3 Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	34.76760398	Mean	7.805956175	Mean	34.68119522	Mean	-0.000804055
Standard Error	0.082865183	Standard Error	0.047736798	Standard Error	0.062577345	Standard Error	0.003354104
Median	34.8655	Median	7.68	Median	34.84	Median	-0.020724533
Mode	32.3236	Mode	7.79	Mode	34.5	Mode	#N/A
Standard Deviation	1.312831402	Standard Deviation	0.756293119	Standard Deviation	0.991411603	Standard Deviation	0.053139009
Sample Variance	1.723526291	Sample Variance	0.571979282	Sample Variance	0.982896966	Sample Variance	0.002823754

Range	5.0833	Range	3.02	Range	4.6	Range	0.215612166
2015							
3 Month Price Prediction		3 Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	33.3984352	Mean	7.72664	Mean	34.52256	Mean	0.040005805
Standard Error	0.167289725	Standard Error	0.065082602	Standard Error	0.105445878	Standard Error	0.006032296
Median	34.59015	Median	7.96	Median	34.27	Median	0.007946258
Mode	#N/A	Mode	6.78	Mode	32.69	Mode	#N/A
Standard Deviation	2.645082793	Standard Deviation	1.029046284	Standard Deviation	1.667245717	Standard Deviation	0.095378977
Sample Variance	6.996462983	Sample Variance	1.058936255	Sample Variance	2.77970828	Sample Variance	0.009097149
Range	9.5969	Range	3.715	Range	7.65	Range	0.344056096
2016							
3 Month Price Prediction		3 Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	38.43830791	Mean	7.479920949	Mean	40.49201581	Mean	0.055261191
Standard Error	0.102885258	Standard Error	0.021728689	Standard Error	0.115876778	Standard Error	0.004106112
Median	38.371	Median	7.325	Median	40.88	Median	0.04826091
Mode	39.0907	Mode	7.325	Mode	42.77	Mode	#N/A
Standard Deviation	1.636490217	Standard Deviation	0.345615958	Standard Deviation	1.843132978	Standard Deviation	0.065311706
Sample Variance	2.678100231	Sample Variance	0.119450391	Sample Variance	3.397139174	Sample Variance	0.004265619
Range	6.4231	Range	1.155	Range	7.34	Range	0.274305444
2017							
3 Month Price Prediction		3 Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	40.29678032	Mean	6.959899598	Mean	37.39192771	Mean	-0.069583726
Standard Error	0.160079923	Standard Error	0.048663155	Standard Error	0.107496575	Standard Error	0.003531348
Median	39.3885	Median	6.96	Median	37.62	Median	-0.071192996
Mode	40.7512	Mode	6.2	Mode	38.59	Mode	#N/A
Standard Deviation	2.52601858	Standard Deviation	0.767891627	Standard Deviation	1.696267338	Standard Deviation	0.055723732
Sample Variance	6.380769868	Sample Variance	0.58965755	Sample Variance	2.877322882	Sample Variance	0.003105134
Range	8.3219	Range	2.375	Range	8.83	Range	0.262892447

2018							
<i>3 Month Price Prediction</i>		<i>3 Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	38.01917805	Mean	9.261463415	Mean	32.85926829	Mean	-0.135870042
Standard Error	0.063383037	Standard Error	0.040926441	Standard Error	0.158898533	Standard Error	0.003467463
Median	38.1646	Median	9.415	Median	32.36	Median	-0.147564803
Mode	#N/A	Mode	9.595	Mode	32.19	Mode	#N/A
Standard Deviation	0.573957815	Standard Deviation	0.370604684	Standard Deviation	1.438887414	Standard Deviation	0.03139921
Sample Variance	0.329427574	Sample Variance	0.137347832	Sample Variance	2.070396989	Sample Variance	0.00098591
Range	3.0371	Range	0.945	Range	5.89	Range	0.125682582

Appendix L: WFC Descriptive Statistics

Appendix 10: WFC Descriptive Statistics							
All Years							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	50.55072973	Mean	8.96716468	Mean	51.2016468	Mean	0.022889868
Standard Error	0.198347468	Standard Error	0.040208491	Standard Error	0.147565171	Standard Error	0.002544498
Median	52.37405	Median	8.75	Median	52.16	Median	0.020239215
Mode	50.1742	Mode	8.67	Mode	52.56	Mode	#N/A
Standard Deviation	7.266125904	Standard Deviation	1.472970459	Standard Deviation	5.405801856	Standard Deviation	0.093213407
Sample Variance	52.79658566	Sample Variance	2.169641974	Sample Variance	29.22269371	Sample Variance	0.008688739
Range	27.2757	Range	6.105	Range	29.66	Range	0.425081876
2013							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	37.59203849	Mean	9.390595238	Mean	42.83440476	Mean	0.139482926
Standard Error	0.148575438	Standard Error	0.04141203	Standard Error	0.188308186	Standard Error	0.002417809
Median	37.40955	Median	9.145	Median	42.84	Median	0.136158032
Mode	#N/A	Mode	8.895	Mode	41.25	Mode	#N/A
Standard Deviation	2.358561966	Standard Deviation	0.657395594	Standard Deviation	2.989299783	Standard Deviation	0.038381531
Sample Variance	5.562814549	Sample Variance	0.432168967	Sample Variance	8.93591319	Sample Variance	0.001473142
Range	9.0543	Range	2.055	Range	13.47	Range	0.195966099
2014							
<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	48.78624661	Mean	7.441633466	Mean	52.16689243	Mean	0.070681154
Standard Error	0.157762009	Standard Error	0.042433276	Standard Error	0.127737952	Standard Error	0.002551868
Median	49.075	Median	7.72	Median	52.04	Median	0.070975438
Mode	50.1742	Mode	7.72	Mode	52.1	Mode	#N/A
Standard Deviation	2.499420277	Standard Deviation	0.67226953	Standard Deviation	2.023749763	Standard Deviation	0.0404292
Sample Variance	6.247101723	Sample Variance	0.451946321	Sample Variance	4.095563104	Sample Variance	0.00163452

Range	10.7232	Range	2.815	Range	8.46	Range	0.164925446
2015							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	56.2457376	Mean	8.26112	Mean	53.56508	Mean	-0.046854372
Standard Error	0.142166459	Standard Error	0.060596856	Standard Error	0.202289595	Standard Error	0.003670333
Median	55.468	Median	7.7	Median	54.365	Median	-0.038830192
Mode	53.5334	Mode	7.47	Mode	54.81	Mode	#N/A
Standard Deviation	2.247849093	Standard Deviation	0.958120412	Standard Deviation	3.198479338	Standard Deviation	0.058033063
Sample Variance	5.052825546	Sample Variance	0.917994724	Sample Variance	10.23027007	Sample Variance	0.003367836
Range	8.0332	Range	2.935	Range	13.36	Range	0.224147276
2016							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	51.46153241	Mean	11.18579051	Mean	50.86328063	Mean	-0.009769715
Standard Error	0.114408353	Standard Error	0.044699257	Standard Error	0.274968232	Standard Error	0.006229093
Median	51.397	Median	11.44	Median	49.4	Median	-0.029077823
Mode	#N/A	Mode	11.94	Mode	48.27	Mode	#N/A
Standard Deviation	1.819776253	Standard Deviation	0.710985209	Standard Deviation	4.373637465	Standard Deviation	0.099079794
Sample Variance	3.311585611	Sample Variance	0.505499968	Sample Variance	19.12870467	Sample Variance	0.009816806
Range	7.0598	Range	2.505	Range	15.98	Range	0.333818686
2017							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	56.35721647	Mean	8.28060241	Mean	55.62333333	Mean	-0.012624312
Standard Error	0.132048099	Standard Error	0.045115208	Standard Error	0.229381499	Standard Error	0.003728761
Median	56.3787	Median	8.635	Median	54.79	Median	-0.018948881
Mode	58.4429	Mode	8.67	Mode	54.54	Mode	#N/A
Standard Deviation	2.083683859	Standard Deviation	0.711905977	Standard Deviation	3.619579002	Standard Deviation	0.058838854
Sample Variance	4.341738426	Sample Variance	0.50681012	Sample Variance	13.10135215	Sample Variance	0.003462011
Range	7.6113	Range	2.63	Range	16.35	Range	0.285349475
2018							

<i>Predicted Price in 3 Months</i>		<i>3-Month Volatility Prediction</i>		<i>Actual Price in 3 Months</i>		<i>Percent Prediction Error</i>	
Mean	57.82900244	Mean	9.75304878	Mean	54.33719512	Mean	-0.058325144
Standard Error	0.23131136	Standard Error	0.07103097	Standard Error	0.209467879	Standard Error	0.00680716
Median	57.4852	Median	10.08	Median	54.49	Median	-0.045735928
Mode	60.6298	Mode	10.08	Mode	51.54	Mode	#N/A
Standard Deviation	2.09461345	Standard Deviation	0.643212787	Standard Deviation	1.896812319	Standard Deviation	0.061641454
Sample Variance	4.387405506	Sample Variance	0.413722689	Sample Variance	3.597896974	Sample Variance	0.003799669
Range	6.7924	Range	1.72	Range	8.24	Range	0.216823114

Appendix M: WMT Descriptive Statistics

All Years							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	74.34183999	Mean	8.144378258	Mean	76.55570365	Mean	0.034716601
Standard Error	0.263904264	Standard Error	0.05301881	Standard Error	0.238543034	Standard Error	0.002020062
Median	76.2151	Median	8.015	Median	75.86	Median	0.031231667
Mode	66.9103	Mode	8.04	Mode	78.03	Mode	#N/A
Standard Deviation	9.671290185	Standard Deviation	1.942978446	Standard Deviation	8.741878092	Standard Deviation	0.074029129
Sample Variance	93.53385385	Sample Variance	3.775165243	Sample Variance	76.42043257	Sample Variance	0.005480312
Range	44.0375	Range	7.54	Range	53.13	Range	0.381446734
2013							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	75.63950514	Mean	7.77173913	Mean	76.34300395	Mean	0.012097554
Standard Error	0.223759591	Standard Error	0.06207242	Standard Error	0.131486773	Standard Error	0.00407961
Median	77.0491	Median	7.8	Median	76.33	Median	0.004468317
Mode	#N/A	Mode	8.13	Mode	77.87	Mode	#N/A
Standard Deviation	3.55911418	Standard Deviation	0.987322286	Standard Deviation	2.091425159	Standard Deviation	0.064890164
Sample Variance	12.66729375	Sample Variance	0.974805297	Sample Variance	4.374059194	Sample Variance	0.004210733
Range	11.8772	Range	3.75	Range	9.34	Range	0.242696943
2014							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	79.13718486	Mean	6.439163347	Mean	79.70398406	Mean	0.007511518
Standard Error	0.125345063	Standard Error	0.069697608	Standard Error	0.282907517	Standard Error	0.003592741
Median	79.5573	Median	5.995	Median	77.56	Median	0.00373171
Mode	#N/A	Mode	5.975	Mode	83.57	Mode	#N/A
Standard Deviation	1.98583926	Standard Deviation	1.104217776	Standard Deviation	4.482097998	Standard Deviation	0.056919718
Sample Variance	3.943557566	Sample Variance	1.219296897	Sample Variance	20.08920246	Sample Variance	0.003239854
Range	9.1344	Range	3.445	Range	17.13	Range	0.237229309

2015							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	63.584974	Mean	8.55456	Mean	67.75756	Mean	0.068208916
Standard Error	0.449059774	Standard Error	0.068699088	Standard Error	0.419953874	Standard Error	0.003341114
Median	60.37495	Median	8.045	Median	66.71	Median	0.066193486
Mode	#N/A	Mode	8.045	Mode	79.24	Mode	#N/A
Standard Deviation	7.100258455	Standard Deviation	1.086227955	Standard Deviation	6.640053773	Standard Deviation	0.052827645
Sample Variance	50.41367012	Sample Variance	1.179891171	Sample Variance	44.0903141	Sample Variance	0.00279076
Range	24.3753	Range	3.035	Range	24.61	Range	0.249011908
2016							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	65.87777945	Mean	10.54994071	Mean	70.33166008	Mean	0.069342839
Standard Error	0.161883967	Standard Error	0.060518207	Standard Error	0.131595089	Standard Error	0.003434692
Median	66.3676	Median	10.6	Median	70.44	Median	0.067038021
Mode	66.9103	Mode	9.65	Mode	69.86	Mode	#N/A
Standard Deviation	2.574922126	Standard Deviation	0.962601003	Standard Deviation	2.093148027	Standard Deviation	0.054632117
Sample Variance	6.630223956	Sample Variance	0.926600691	Sample Variance	4.381268662	Sample Variance	0.002984668
Range	10.782	Range	3.695	Range	11.15	Range	0.212955496
2017							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	
Mean	81.70402369	Mean	6.660120482	Mean	85.75783133	Mean	0.050745866
Standard Error	0.453477029	Standard Error	0.106729141	Standard Error	0.628455637	Standard Error	0.00577344
Median	82.2339	Median	6.94	Median	80.7	Median	0.047296355
Mode	#N/A	Mode	9.245	Mode	75.05	Mode	#N/A
Standard Deviation	7.155746827	Standard Deviation	1.684157438	Standard Deviation	9.916862681	Standard Deviation	0.09110335
Sample Variance	51.20471265	Sample Variance	2.836386276	Sample Variance	98.34416544	Sample Variance	0.00829982
Range	26.2246	Range	5.09	Range	38.12	Range	0.349186397
2018							
Predicted Price in 3 Months		3-Month Volatility Prediction		Actual Price in 3 Months		Percent Prediction Error	

Mean	92.06856341	Mean	10.32628049	Mean	85.65219512	Mean	-0.068323499
Standard Error	0.431288964	Standard Error	0.100094536	Standard Error	0.194724462	Standard Error	0.004137587
Median	89.8042	Median	10.96	Median	85.92	Median	-0.066900234
Mode	#N/A	Mode	10.96	Mode	87.9	Mode	#N/A
Standard Deviation	3.905487679	Standard Deviation	0.906394571	Standard Deviation	1.763304995	Standard Deviation	0.037467448
Sample Variance	15.25283401	Sample Variance	0.821551118	Sample Variance	3.109244505	Sample Variance	0.00140381
Range	12.2155	Range	2.305	Range	6.06	Range	0.125998446