# The Uncertainty of Cryptocurrency: How Bright is Bitcoin's Future?

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**Abstract**

In this report, we looked at the day by day Open, High, Low, and Close prices of Bitcoin from 2012-2020 and tested common ideas about the characteristics of the Cryptocurrency. In particular, we took a look as to whether or not Bitcoin is correlated to the movements of the stock market, and analyzed its movements in relation to the time of year. Using various forms of regression analysis, we found that Bitcoin is very tightly correlated with the stock market. We also found that time of year seems does not seem to have a uniquely large effect of the price movement of Bitcoin.


Figure 1: Bitcoin: a decentralized cryptocurrency. [1]

# Introduction

**The purpose of this dataset is to record historical price data for different cryptocurrencies.**

We will explore different aspects of the historical value of popular cryptocurrencies: Bitcoin (BTC), Etherum (ETH) and Ripple's XRP (XRP). We will explore our data further through technical indicators and compare their prices against other stock indices, including the S&P 500, to see if they're correlated. The ultimate goal is to model predictions of future cryptocurrency prices based on past performance or other indices.

## Bitcoin:

Bitcoin is the first decentralized cryptocurrency [4]. In 2009 an unknown group or person named Satoshi Nakamoto created the Bitcoin network [5]. Since then, over 6,000 altcoins (other cryptocurrencies) have been created. Bitcoin is extremely volatile. For example, in 2017 Bitcoin started under $1,000 but reached it's all-time high of just under $20,000 in December 2017 (a growth of around 2,000%!) before closing out the year under $14,000.

# Data

The main dataset can be found here. This dataset includes every cryptocurrency daily market price from April 2013 to November 2018. This dataset contains the daily price for over 2,000 cryptocurrency tokens during that time frame. We will narrow our focus to the most popular cryptocurrency tokens. That means our important variables are the daily and monthly closing prices for Bitcoin, Ethereum and XRP. We will also use the Pandas Datareader to get historical S&P 500 and Nikkei 225 stock indices from the same timeframe. For all of our price datasets we will drop NA values which signify days where their market wasn't open like holidays or weekends. We will compare the cryptocurrency price trends with the other market indices to look for potential correlation.

# Method

To see if we can use stock market indices to predict future cryptocurrency prices, we will examine the correlation between the two. We will use Bitcoin as our example because it is the most popular cryptocurrency by far. Useful information can also be found if a cryptocurrency like Bitcoin is negatively or not correlated at all, meaning Bitcoin could be a good hedge investment compared to the rest of the market. Whatever the correlation, or lack of correlation, reveals itself to be, the goal is to provide insight as to how Bitcoin will react compared to typical worldwide stock indices.

# Analysis

First, let's take a look at the characteristics of Bitcoin's monthly close in USD, volume (number of buys/sells) and market capitalization ((cost per coin) x (number of coins on the market)) in USD to get a general idea of the dataset.

| | close | volume | market |
|---|---|---|---|
| **count** | 68.00 | 68.00 | 68.00 |
| **mean** | 2259.89 | 1433247807.38 | 37391164696.03 |
| **std** | 3402.07 | 2897740105.03 | 57938723621.10 |
| **min** | 90.51 | 0.00 | 1034233237.90 |
| **25%** | 325.84 | 22409471.45 | 4490314132.87 |
| **50%** | 599.02 | 65755632.97 | 7998871900.98 |
| **75%** | 2548.61 | 1199567066.27 | 41892075301.68 |
| **max** | 15294.27 | 13427350263.74 | 256114969991.48 |

Figure 2: Characteristics of the Bitcoin monthly dataset. We will use the close price as our parameter for interest.

This dataset includes 68 months, essentially six years of data from Spring 2013 to Winter 2018. Just by looking at the mean and median, we appear to be working with a skewed dataset. This is because 2013 was near the beginning of Bitcoin. It took awhile to gain traction but when it blew up it BLEW UP reaching over $15,000 in this fairly short span of time.

Let's visualize our Bitcoin data to see if this is true.

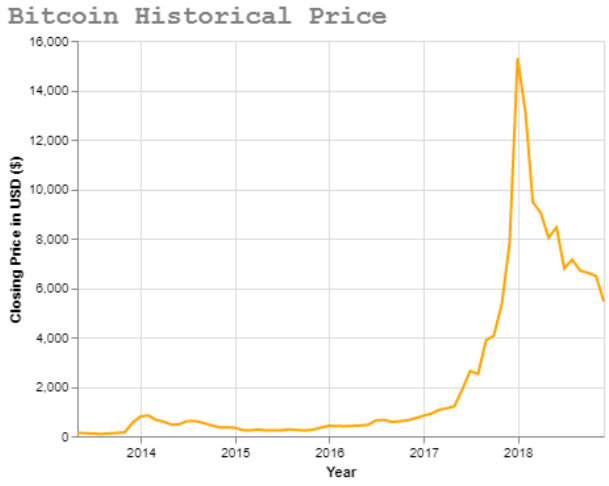


Figure 3: Bitcoin price through the years in USD Follows a quiet four years until growing rapidly in 2017.

As we can see, bitcoin's price has spent all of 2013-2017 below $2,000 but saw extreme growth in the middle of 2017. This growth has led to apprehensive feelings toward cryptocurrency's volatility from many financial investors. It turns out that other popular cryptocurrency tokens, Ethereum and XRP, show a similar price history as Bitcoin. This means that we can assume that some of the other crypto tokens seem to behave similar to how Bitcoin does.

How does Bitcoin's price history look compared to the S&P 500?

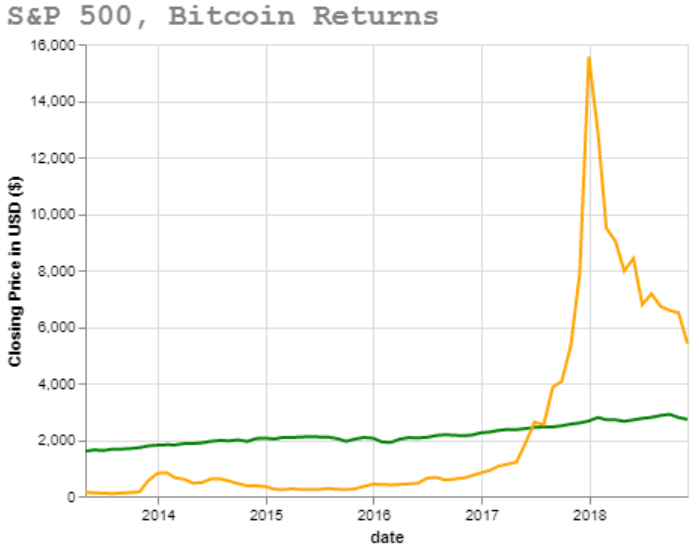


Figure 4: S&P 500 Stock Market Index (Green) and Bitcoin (Orange) Monthly Closings display the irregularity of Bitcoin's past.

Bitcoin's volatility is extremely noticeable when compared against the S&P 500. They both actually have a similar mean around $2,200 but they way they get there couldn't be more different. There does seem like there's a possibility for correlation there, though. Bitcoin and the S&P seem to start rising and start falling around similar times. Let's run some correlation tests and visualize to find out.

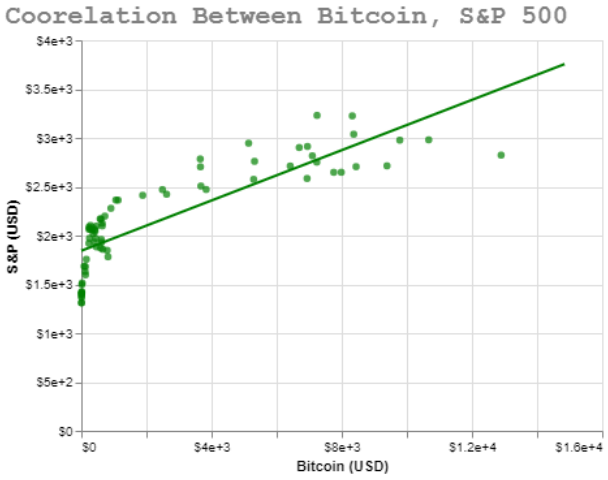


Figure 5: Pearson correlation test between Bitcoin and S&P 500 monthly closings

A positive quality of the bitcoin asset would a lack of correlation with the stock market. "Uncorrelated assets" like these are incredibly useful because they are immune to the financial turmoil that seems to govern almost all financial products. Unfortunately, bitcoin does not seem to be this.

We found the Pearson correlation to be just over 0.84, leading us to believe that there is a pretty strong correlation between Bitcoin and the S&P 500. We also tested the correlation between Bitcoin and the Nikkei 225, a Tokyo stock exchange index, but they only returned a 0.7 correlation coefficient. This could mean that Bitcoin is more correlated to American markets than Japanese markets or could just represent the global popularity of the American economy. Still, we see a strong correlation between Bitcoin and popular, general indicators in traditional finance, which affirms that Bitcoin is not an uncorrelated correlated asset.

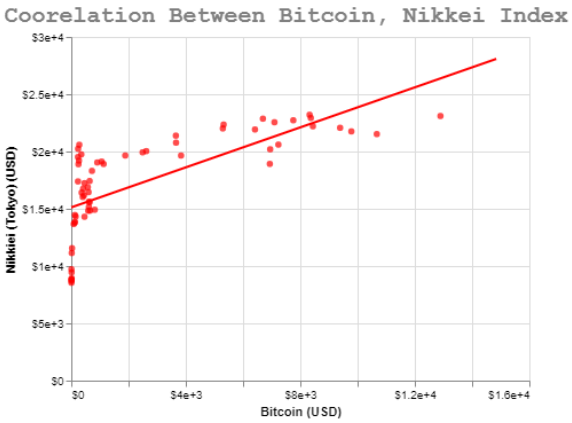


Figure 6: Correlation between Bitcoin and Nikkei 225 is not as strong as it is with the S&P 500

It may also be interesting to compare bitcoin's variation in price based on the given month.

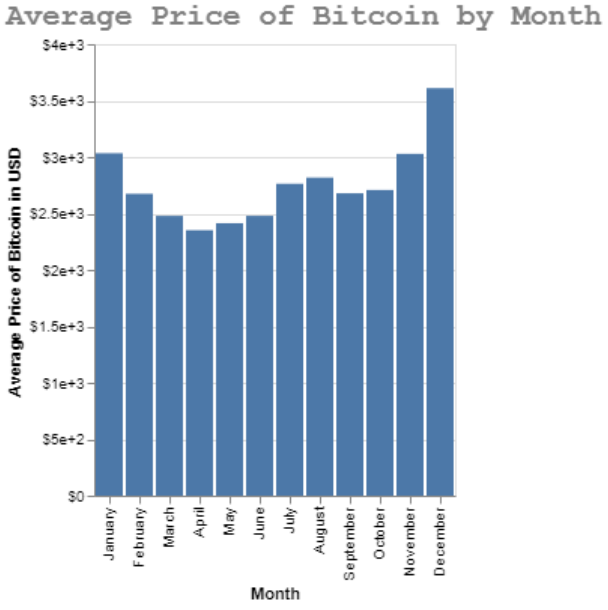


Figure 7: Bitcoin Average Price by Month shows higher average prices in the three month span of November, December, January.

It seems that Bitcoin's value is highest in winter months (January, November, December) and seems to dip in mid Spring. Some of this may be a function of the fact that our data starts in January and continues upward for several years. Therefore, in a given year's data, November will be higher than October, December higher than November, and so forth. This doesn't explain January's high average price, but high stock performance in January is a ubiquitous and well-documented phenomenon[3].

The existence of such a high correlation leads us to believe that a simple regression model could be made to predict the price based on the values of stock indices, as well as a few other variables. We will also use the Volume of Bitcoin traded on that day as a parameter. Using one-hot encoding, we can also incorporate Months of the year.

| Timestamp | ones | Volume_(BTC) | Volume_(Currency) | S&P500 | Nikkiei | Month |
|---|---|---|---|---|---|---|
| 2012-01-04 | 1.0 | 11.914807 | 63.119577 | 1277.30 | 8560.11 | January |
| 2012-01-05 | 1.0 | 4.514373 | 27.987370 | 1281.06 | 8488.71 | January |
| 2012-01-06 | 1.0 | 2.420196 | 15.914659 | 1277.81 | 8390.35 | January |
| 2012-01-10 | 1.0 | 2.076333 | 13.773469 | 1292.08 | 8422.26 | January |
| 2012-01-11 | 1.0 | 2.194978 | 15.479409 | 1292.48 | 8447.88 | January |
| ... | ... | ... | ... | ... | ... | ... |
| 2020-04-16 | 1.0 | 11.130005 | 77496.548247 | 2799.55 | 19290.20 | April |
| 2020-04-17 | 1.0 | 6.121590 | 43287.908348 | 2874.56 | 19897.26 | April |
| 2020-04-20 | 1.0 | 8.077476 | 56419.883448 | 2823.16 | 19669.12 | April |
| 2020-04-21 | 1.0 | 3.996382 | 27413.523629 | 2736.56 | 19280.78 | April |
| 2020-04-22 | 1.0 | 0.014436 | 98.896906 | 2799.31 | 19137.95 | April |

Figure 8: Snapshot of Training Data

Note that Y is the correct price, and Y_hat is the predicted price.

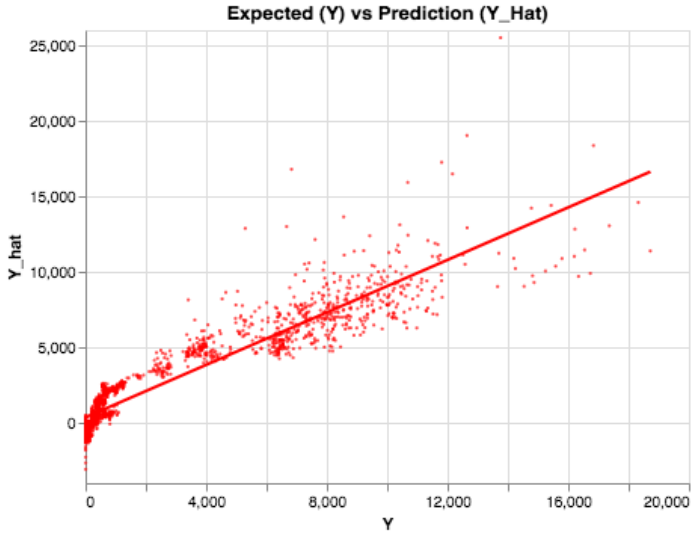


Figure 9: Result of Regression, predictions between $6,000-$10,000 seem to be more accurate.

Our regression seems to well fit, but seems to systematically over-predict. It may be interesting to see what bad predictions tend to correspond with in our dataset. We have defined a bad prediction as a prediction whose squared loss is worse than average.

Let's see how accurate our model was for each month of the year.

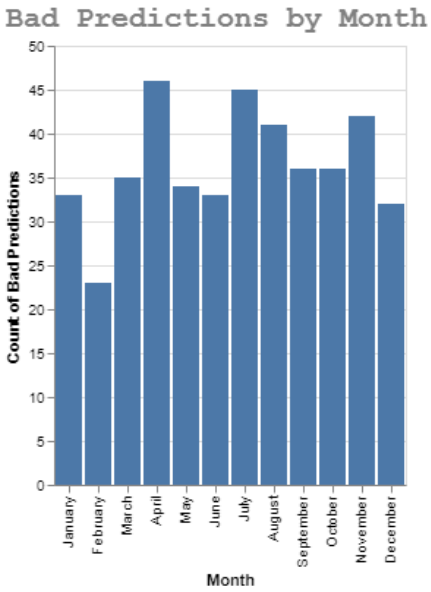


Figure 10: Bad Predictions by Month (Predictions with a loss greater than the average loss)

January seems to be a well predicted month in our model, but grouping bad predictions by date does not seem to give us much insight into the model's failures. Bad predictions are essentially uniformly distributed across most Months. The months with the highest concentration of bad predictions are April, July, and November, which are not collocated or otherwise near to each other.

We can also sort these predictions by year.

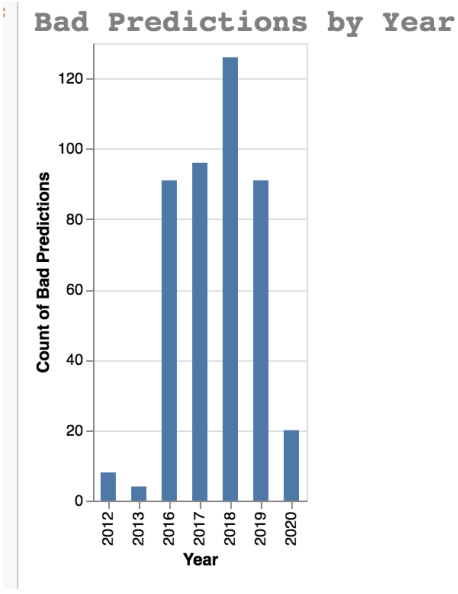


Figure 11: Bad Predictions by Year show the prediction struggled from 2016-2019.

Visualizing the number of bad predictions by year, we see that almost all of these predictions occurred from 2016-2019. These are the same years where bitcoin's meteoric rise occurred. It makes sense that the Linear Model fails precisely when the model becomes non-linear.

# Conclusion

Cryptocurrency has seen itself propelled onto the global stage thanks to the overwhelming popularity and success of Bitcoin. Crypto is a riskier investment than a stock index like the S&P 500. Bitcoin's volatility, especially from 2013 - 2019, makes it extremely difficult to predict. Maybe predictions could be better made by finding other market indices with a higher correlation to crypto or other outside factors that are closely related to crypto price trends.

Cryptocurrency is still a new and exciting technology whose future still remains in doubt. Many are excited by its peer-to-peer, decentralized transactions and think it's the future of money, but others have been critical because of its common usage on the dark web. Countries like Egypt and Pakistan have made Bitcoin illegal, while countries like are placing strict regulation that essentially outlaws people from mining or trading Bitcoin[2]. We found that Bitcoin is generally correlated to how popular markets like the S&P 500 perform. We weren't able to accurately predict its price as we would've liked but that's how it often is with new technologies like cryptocurrency, its future is anything but certain.

# References

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