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Boom or Bust: An Analysis of Crypto Currencies between 2018 and 2023

In 2009, an anonymous programmer known only by the pseudonym Satoshi Nakamoto released the first decentralized cryptocurrency, Bitcoin (Pinkerton). Since its release, cryptocurrency, more commonly referred to as “crypto”, has become a source of wonder and skepticism. Through its many successes and scams, it has become a gold mine or a ticking time bomb for eager investors looking to cash in on the blockchain. This report will attempt to resolve the predictability and volatility of cryptocurrencies based on crypto data collected over 5 years. The data set used in this analysis covers the opening price, daily high, daily low, closing price, adjusted closing price, and coin volume of various cryptocurrencies from 2018 to 2023 (Farahmandfar). This information is becoming significantly more critical as inflation continues to rise, and Americans are doubtful about their financial future (Bradley). Determining safe ways to invest in this potentially booming industry can allow many to escape poverty.

Background

This essay will tackle cryptocurrency's questionable safety and reliability by judging it on long-term growth and volatility. The long-term growth rate of cryptocurrencies is the best metric for potential economic gains for investors. To standardize results, percentage change will be used, since cryptocurrencies like Bitcoin have a much higher cost per coin than a coin like

Tether. The question that will be analyzed to determine the long-term growth will be, “What is the long term growth potential of crypto coins?” The second measure of the success of crypto is its volatility. Coinbase, a major platform for trading cryptocurrencies, defines volatility as “the measure of how much the price of an asset has moved up or down over time”. Volatility is normally used to measure risk. The larger the magnitude of changes in the price of a coin, the higher the risk for the buyer; however, the high volatility also offers a chance for large gains. In general, this also means that a coin is less predictable. Two questions will be asked to measure the volatility of various coins. First, “Can algorithms be used to predict the gains or losses of Bitcoin?” Second, “What is the spread of the daily change in coin value of the three most popular crypto coins?”

Before analyzing each question, it is important to understand each part of the data frame. The data frame was found on a website called kaggle.com, a repository of datasets including the one used in this project. Within this dataset, there are the following columns:

1) Type: This column recorded the type of cryptocurrency. There were 12 different coins, those being: Bitcoin, BNB, Cardano, Dogecoin, Ethereum, EUR, GBP, Litecoin, Polkadot, Tether, Tron, and XRP.
2) Date: This column contained the date from which the data was taken between January 1st, 2018, and January 1st, 2023.
3) Open: This column described the price of the coin when the market opened on the specific date from which the data was taken.
4) High: This column describes the highest price of the coin on the day when the data was taken.
5) Low: Like high, except it measured the lowest price of the coin.

6) Close: This column was similar to open, except it measured the price of the coin at the end of the day.
7) Adj Close: This column reflects the closing price of a coin in addition to the dividends and splits that each coin provides. This is oftentimes a more accurate measure of a coins success than the closing price displayed in the Close column, so this column was used more often throughout the paper.
8) Volume: The total amount of a certain crypto currency at a given time.

Question 1

As mentioned previously in the background section of this report, the first question that was asked was, "What is the long-term growth potential of crypto currency?" I believed that this question was important because this question would show whether or not there is any legitimacy to crypto coins. If there was a pattern of long-term growth throughout many of the coins, it would paint them as a better economic investment. To give a fair comparison to other investments, the five year growth of these coins will be compared to the Standard and Poor (S&P) 500, which is an index of the stocks of the 500 largest US companies and is normally used as a "barometer" for the stock performance of the market (Fidelity). An analysis by Yahoo revealed that over the past 5 years the S&P 500 had grown by 91.22%. This amount should serve as a good metric for whether someone should invest in crypto as the stock exchange is generally considered to be the safer investment of the two. If it can be shown that there is higher long-term growth in crypto than there is in the S&P 500, then there is a potential argument for the recommendation of crypto currency for investing.

To analyze the long-term growth of cryptocurrencies, the csv file for the cryptocurrency data was imported into Excel, a Microsoft application with notoriously easy data summarization,

leading to it being an industry standard in data science. To ensure that there were no misleading numbers about growth, percentage change was used to standardize the measure of each coin. Since some coins like Bitcoin can change price by tens of thousands of dollars in a given day but only change a couple of percentages while coins like Doge can change only a dollar yet can have a potential percentage increase in the hundreds, percentages would give a good standardization between coins. This would also give a fair comparison to the S&P 500 which not only had decades of time to grow over the crypto coins, but also was worth more than many of them.

Looking at the columns listed in the Background section, the immediate realization of many would be that there is no percentage change column. So the first step to answer this question was to make a daily percentage change in price column. However, there were multiple steps to do so. Before a percentage change in price could be calculated, the standard numerical change in price had to be calculated. This was done by subtracting the Adj Close column and the Open column in a new column labeled Change in Price. Then this column was divided by the Open column to calculate the percentage change in crypto coin price in the formula below.

$$\frac{(New - Old)}{Old} \rightarrow \frac{Change\ in\ Price}{Open}$$

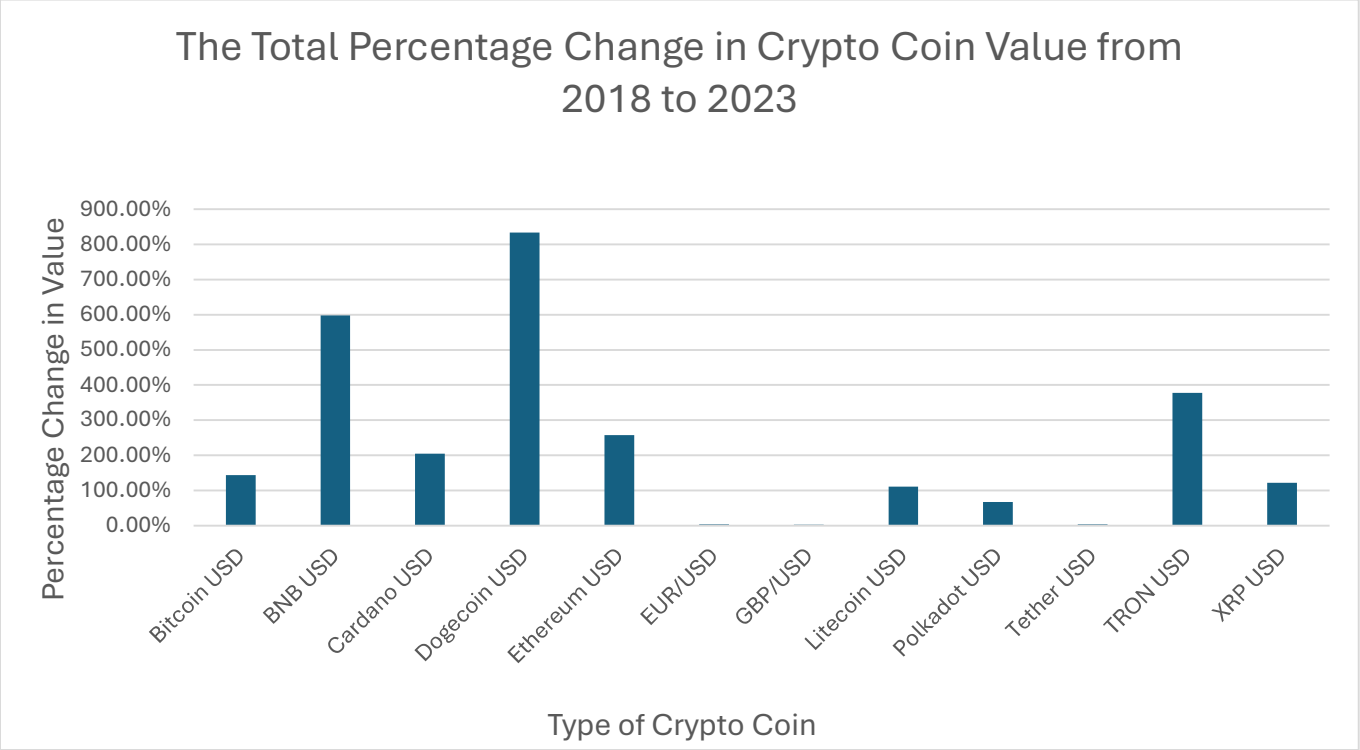
This formula takes the regular percentage change formula and substitutes it in with Adj Close as the value for new and Open as the value for old. Then all that had to be done was to turn the column data type from number to percentage. Now that this column was created, the next step was to summarize the annual percentage changes in a pivot table. A Year column was added on to the data set in order to make a more robust pivot table that displayed the change in percentage over time in addition to the percentage change over five years. Below in Figure 1, the pivot table with all twelve crypto coins and their annual percentage change in price is displayed:

Figure 1. Pivot Table of the Annual Percentage Change in Crypto Coin Value

The Annual Percentage Change in Crypto Coin Valuie	Crypto Coin Types											
Year	Bitcoin USD	BNB USD	Cardano USD	Dogecoin USD	Ethereum USD	EUR/USD	GBP/USD	Litecoin USD	Polkadot USD	Tether USD	TRON USD	XRP USD
2018	-102.08%	35.87%	-205.61%	-40.44%	-127.25%	0.34%	0.71%	-154.29%	0.00%	2.59%	78.42%	-106.52%
2019	91.12%	110.75%	17.75%	5.84%	29.59%	0.62%	0.68%	73.21%	0.00%	-1.44%	11.94%	-35.75%
2020	166.72%	142.02%	235.70%	139.89%	220.47%	1.54%	1.11%	157.92%	0.00%	2.41%	120.07%	76.60%
2021	70.04%	355.61%	281.11%	760.32%	210.44%	1.07%	0.13%	71.02%	206.39%	0.27%	175.38%	241.05%
2022	-81.63%	-45.90%	-124.23%	-31.77%	-75.28%	0.05%	-0.03%	-37.17%	-139.26%	-0.03%	-7.87%	-53.20%
Grand Total	144.17%	598.35%	204.73%	833.84%	257.96%	3.61%	2.62%	110.68%	67.13%	3.81%	377.93%	122.17%

Then to make the results more visually appealing, the percentage change in price over five years for each of the twelve crypto currencies was put into a bar graph shown below in Figure 2. The reason a bar graph was used was because it provided a solid way to compare all twelve coins in one chart in an easy-to-understand way. On the x-axis the crypto currency types were labelled and on the y axis, the percentage change was measured.

Figure 2. Bar Graph of the Percentage Change in Crypto Coin's Value from 2018 to 2023



What was immediately interesting was that almost all of the coins exceeded the percentage change of the S&P 500 with all but EUR, GBP, and Tether coin having growth above 100%. Now the important caveat with these growths is that many of these coins, in particular Dogecoin are worth less than a dollar. This means that even a one cent change in price looks like a massive change in percentage value. This graph shows that many of these coins could make solid investments, but it is important to note that these coins have only been out for less than a decade and do not have a century worth of reliability backing them like stocks do. However, it does highlight that there may be potential for economic gains over time should someone diversify their income by investing in crypto.

Question 2

Next, as mentioned in the Background section, this paper will move on to attempting to measure the predictability of cryptocurrencies. This section will address the question, “Can algorithms be used to predict the gains or losses of Bitcoin?” To do so a machine learning algorithm was used to predict whether Bitcoin would experience gains or losses with the K-Nearest-Neighbors algorithm also known as KNN. KNN essentially predicts the classification of Bitcoin as either a Gain or a Loss based on the classification of a certain number of a particular datapoints nearest neighbors.

Before using the KNN algorithm, the data cleaning had to be done to set up the data in a way that would allow it to be processed by the sci-kit library, the library that the KNN algorithm was imported from. The KNN algorithm predicts using columns selected under the X variable. These columns can only have an integer data type. So, using the .astype(int) command the Open, High, and Volume columns were converted to integer data types. Then by using an iterated loop to categorize the Change in Price column into Gains or Losses shown in Figure 3, then converting this data into categorical data, the Gain or Loss column was prepped for the y variable.

Figure 3. Iterated Loop

```
#This assigned each daily change in price to either a gain or loss category
gains_cat=[]
for gains in crypto_data["Change in Price"]:
    if gains < 0:
        gains_cat.append("Loss")
    elif gains == 0:
        gains_cat.append("No Change")
    else:
        gains_cat.append("Gain")

#Adds column with categories
crypto_data["Gain or Loss"] = gains_cat
```

Then to finish preparing for the KNN test, the data set was broken into a training and a testing set, with 15% of the data set aside for testing. Then the algorithm was run with the 3 nearest neighbors being used to determine the Gain of Loss classification of the unknown datapoints. After being trained, the machine was then run on the y_test set where it was only around 50.73% accurate. Below in Figure 4, a visual representation of the accuracy of the machine is displayed where it displayed a roughly 50/50 success rate of correctly predicting daily gains and losses of Bitcoin. Then to make a more accurate estimation, hyperparameter training was used, however as shown in Figure 5, the highest accuracy was hardly more than 52% showing that there was no real improvement.

Figure 4. Confusion Matrix

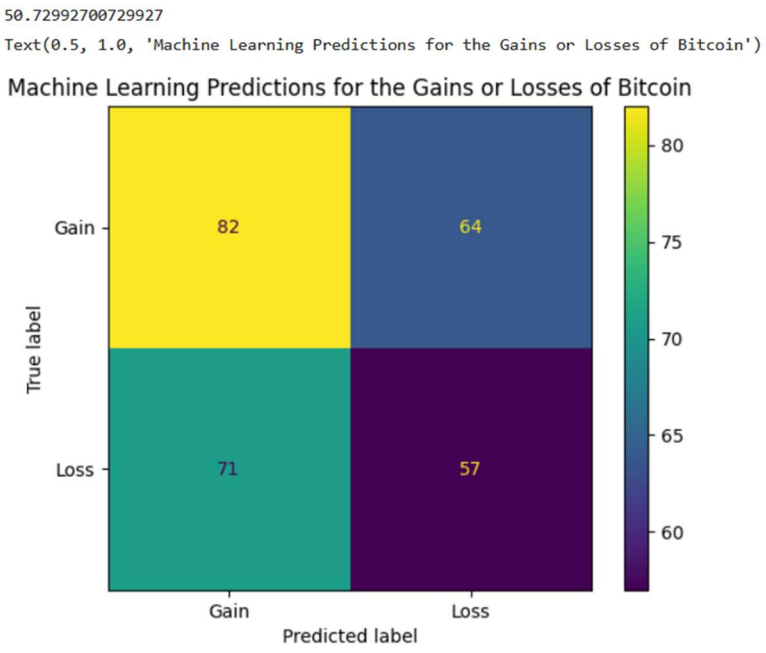
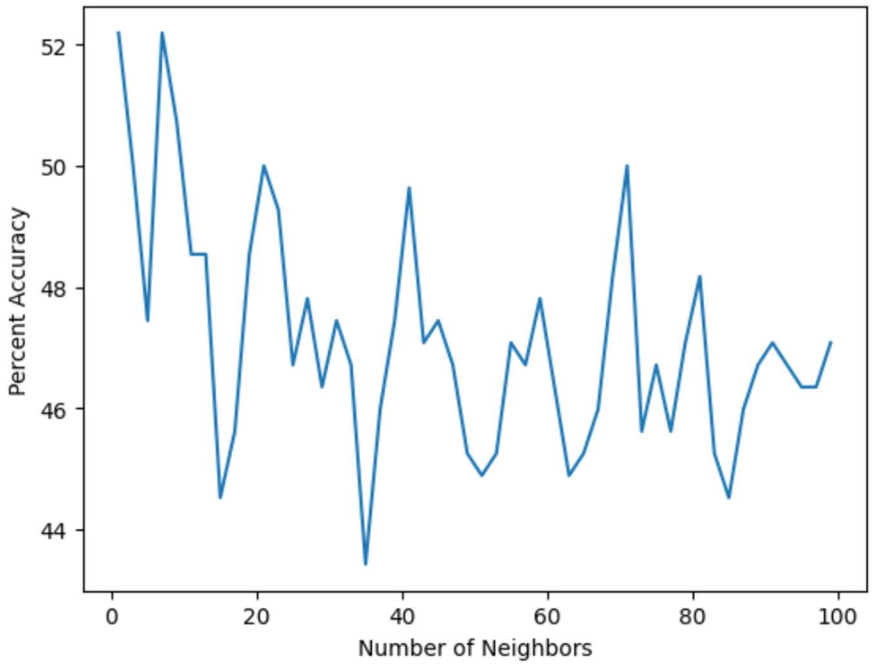


Figure 5. Hyperparameter Training Visulazation in Scatter Plot



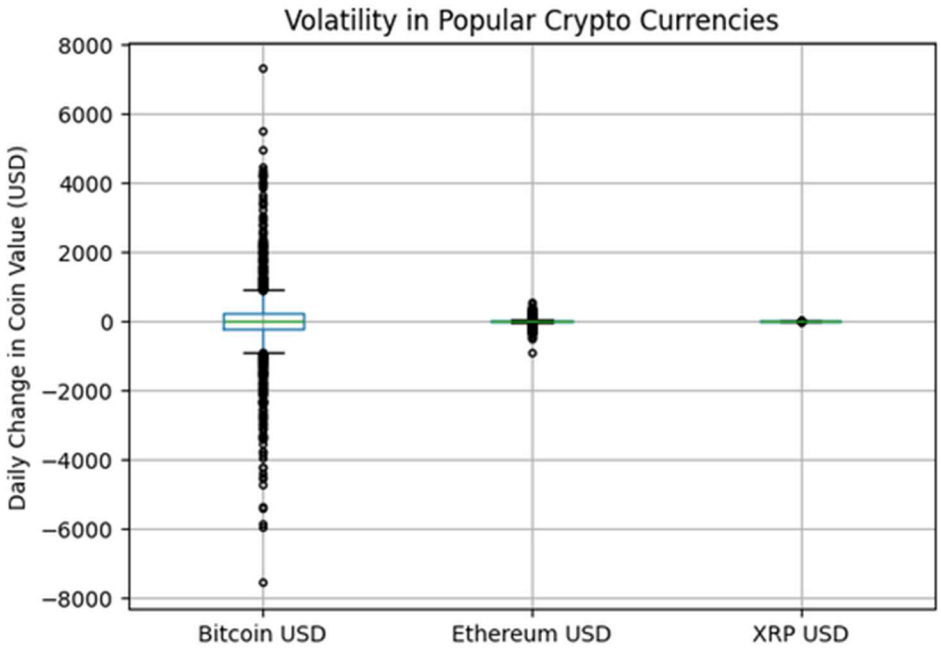
The above graphs show the machine learning results from trying to predict whether Bitcoin prices would increase, or decrease based on the opening price, high price, and volume of the coin display that the machine was largely unsuccessful, with only a 50% accuracy. This displays that crypto is not easily predictable, especially Bitcoin. This means that people, who don't have the luxury of the computational speed of a machine algorithm, should be very careful when investing in any notoriously volatile coins such as Bitcoin to minimize loss. While volatile coins allow for great wins, they also allow for great losses, and when investing for financial security, sometimes all the treasure in the world isn't worth the chance of losing it.

Question 3

The last question that was asked was "What is the spread of the daily change in coin value of the three most popular crypto coins?" This analysis was made to observe a smaller group of coins which were selected based on the popularity of the coins. The reason that only three were chosen, were because these would be the likely investments of any eager crypto

investors, as clearly reflected by the Volume columns of each of these coins. In order to measure the volatility and spread of the daily change in price, box plots were used as they are good for spreading as they not only show where a majority of data lies, but also where outliers, or data that is much higher or lower than most data, lie. Since most of the data cleaning needed for these were performed while analyzing the second question, all that needed to be done was isolating the data for Bitcoin, Ethereum, and XRP which was done by using the filter data command. Then box plots, with the type of coin on the x axis and the daily change in price of the coin on the y axis were plotted below in Figure 6.

Figure 6. Box Plots Showing the Volatility in Popular Crypto Currencies



In these graphs the further the spread, the more volatile the coin. This graph shows that Bitcoin is significantly more volatile than Ethereum or XRP. If an investor wants to make a safer buy, a coin like Etherium or XRP, which both have little to no outliers and very small spread between their quartiles compared to Bitcoin, would be a good choice. However buyers looking

for a go big or go broke approach should consider investing in Bitcoin since it can shoot up a max of almost $8000 in one day.

Conclusion

Throughout this report, this paper attempted to determine whether or not crypto currency was a solid investment for those looking to make safe long-term investments or making quick cash. The answer seems to be both yes and no. While these coins show larger returns than many of the companies in the stock market, they also pose the risk of volatility, dropping even faster than they grow. It is very important that investors take a deep dive into the data of every crypto coin they plan on investing in as they can potentially lose all of their money. With all of the controversy behind large crypto scams and theft, it is more important than ever to stay vigilant with informing oneself on what they are investing in so that they do not fall into the same trap that so many before them did. This is the reason that this paper analyzed cryptocurrency, a potential boom or bust depending on the luck of the player.

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