

Precious Metals Or Crypto, Where Should I Invest?*

A Historical Analysis of the Two Major Asset Categories 2017-Present

Yi Fei Pang

18 April 2024

Abstract

This paper utilizes and compares datasets of the two most held precious metals and the two most held cryptocurrencies. A few simple price analyses were implemented to determine which assets were more profitable along with range formulas to determine volatility. Observations show that in the recent years, crypto has been a much more profitable investment. However, precious metals are much less volatile and consistent. The importance of this analysis can be very beneficial today due to the economic turmoil and investors asking: Do I want an asset that's profitable, consistent, or both?

Table of contents

1	Introduction	3
2	Data	4
2.1	Data Description	4
2.2	Price Data	4
2.3	Volatility Data	5
2.4	Data Visualization	6
3	Model	7
3.1	Model set-up	7
3.2	Model Justification	7
4	Results	8
4.1	Price Results	8
4.2	Volatility Results	9

*Code and data supporting this analysis is available at: <https://github.com/apang00/investment-comparison>

5	Discussion	10
5.1	Precious Metals As An Investment	10
5.2	Cryptocurrencies As An Investment	10
5.3	Different Stroke For Different Folks	10
5.4	Biases and Weaknesses	11
5.5	Next Steps	11
5.6	Closing Remarks	11
	References	12

1 Introduction

Throughout history, human currency has always been evolving alongside our civilization. From the archaic days of the bartering systems where people traded raw materials, coins and precious metals emerged, then came paper money. As humans evolved even further, electronic banking with credit card emerged and now finally, cryptocurrencies. At every stage of society, humans have tied a value on an economic instrument as a way of wealth storage and wealth exchange.

Gold and silver has been an asset since the ancient civilizations of Egyptians and Incas. Both metals are malleable and therefore can easily be stamped into coins or molded into jewelry. Furthermore, pure gold and silver does not corrode or tarnish, thus making them timeless assets (Michael Bromerg 2023). Thousands of years later, in our modern era, gold and silver still remain as solid assets because of their durability, liquidity, and stability. Through economic turmoil, precious metals have proven to be an asset that not only holds its value but has been significantly outperforming the stock markets since the turn of the millennium (Brian Domitrovic 2023). In the recent decade, a new category of asset has emerged and performed tremendously well. That is the cryptocurrency. Originally developed as a method of making untraceable transactions and used almost exclusively by the Dark Web crowd, this technology has quickly gained popularity and has transformed into more of an investment rather than to obfuscate transactions. Cryptocurrencies such as Bitcoin and Ethereum has seen growths of $\sim 20,000\%$ and $\sim 35,000\%$ respectively at their peaks.

Since both precious metals and cryptocurrencies have been performing exceptionally well, this paper will analyse asset is a better hold depending on the goal of the investor. I will not only focus on the trends for the separate assets through price charts, but also evaluate correlations between the different category of assets through regression. Moreover, ranges will be calculated as a method to assess risk and volatility and compared between the two asset categories. Overall, it was evident precious metals tend to grow consistently over the year without being significantly affected by the economy or the introduction of other assets. In contrast, cryptocurrencies are much more volatile, seeing massive price ranges. However, cryptocurrencies tend to grow at much higher rates. Over the past decade, both precious metals and cryptocurrencies have been phenomenal assets and looks to continue to rise in value in the foreseeable future.

In the data section of the paper, there will be an introduction regarding where the data came from, and for what period the data was extracted. Furthermore, the data cleaning and visualization process will be detailed for creating the price, volatility, and regression charts. Next, the model section will explore the linear models used, why they were used, and how they represent the correlations. Following that, the results will be discussed includes elements such as the R-square values and p-values. To conclude, we will figure out potential weaknesses of the analysis along with the next steps and improvements.

2 Data

2.1 Data Description

This paper uses four separated datasets from two different sources. The gold (Markets Insider 2024a) and silver (Markets Insider 2024b) raw datasets were sourced from a subsidiary of Business Insider, Market Insider. These two datasets include detailed financial information regarding gold and silver price and volume data starting from late 2017 until present. The other two cryptocurrency datasets for Ethereum (yahoo! finance 2024b) and Bitcoin (yahoo! finance 2024a) come from Yahoo Finance also ranging from late 2017 until present. All four datasets include details such as daily open and closing prices as well as high/lows and volume data. In addition, all prices in the data is in US dollars. The data is sourced from live charts for the daily open, close, and volume recorded on exchanges and recorded at the end of every day. The cleaning, modelling, and analysis of these four datasets will be carried out using the statistical programming language R (R Core Team 2023), using the packages `tidyverse` (Wickham et al. 2019), `here` (Müller 2020), `rstanarm` (Goodrich et al. 2022), `dplyr` (Wickham et al. 2021), and `ggplot2` (Wickham 2016).

2.2 Price Data

The crypto prices and metals prices cleaned datasets feature the closing price points of the two cryptocurrencies `eth_Close` and `btc_Close`, along with the respective close prices for the metals `gold_Close` and `silver_Close`. In addition, there is a date column for the closing prices. These datasets range from November 12, 2017 until the date they were fetched, April 4th, 2024. Though there is data for every single day of the year within the aforementioned range, the cleaned dataset only takes into account the closing balance of the cryptocurrency/precious metal every 15 days, or the 1st and 15th of every month. The purpose is to reduce noise and filters out short term volatility and gives the data a more long term perspective. In addition to the date adjustment, there are adjustments made to the closing prices as well. For readability in graphs, all assets were readjusted to have a present value of in the vicinity of 1 Bitcoin. The adjustments made were 20x Ethereum, 30x Gold (oz.), and 2500x Silver (oz.).

Table 1: A summary table for crypto price data

Date	eth_Close	btc_Close
2017-11-15	6667	7316
2017-12-01	9331	10976
2017-12-15	13689	17707
2018-01-01	15453	13657
2018-01-15	25838	13820

Table 2: A summary table for metal price data

Date	gold_Close	silver_Close
2024-04-01	67526	62775
2024-03-15	64678	62975
2024-03-01	62510	57875
2024-02-15	60121	57325
2024-02-01	61644	57950

2.3 Volatility Data

The volatility data was separated much like the prices datasets. One dataset for crypto volatility and one for metals volatility. In both datasets, volatility was calculated by using a normalized average true range.

First, the true range was calculated with:

$$TR = \text{Max} [(H - L), |H - Cp|, |L - Cp|]$$

Where:

H = Today's high

L = Today's low

Cp = Yesterday's closing price

Max = Highest value of the three terms

Source: (Adam Hayes 2023a)

Then the average true range was calculated with and represented by (asset)_ATR in Figure 1:

$$(1/n) * \Sigma(TR_i)$$

Where: TR_i = Particular true range for each period (e.g., first day's TR, second day's TR, etc.)

Σ = Summation symbol (summing up all the individual TR_i values)

n = Number of periods (15 in the data to match the price data)

Source: (Adam Hayes 2023a)

In the final step, the normalized average true range was calculated by normalizing the ATR value with the closing price of the asset and represented by (asset)_ATR_norm in Figure 1:

$$ATR/Cp$$

Where:

ATR = The ATR of the asset

Cp = Current day's closing price

2.4 Data Visualization

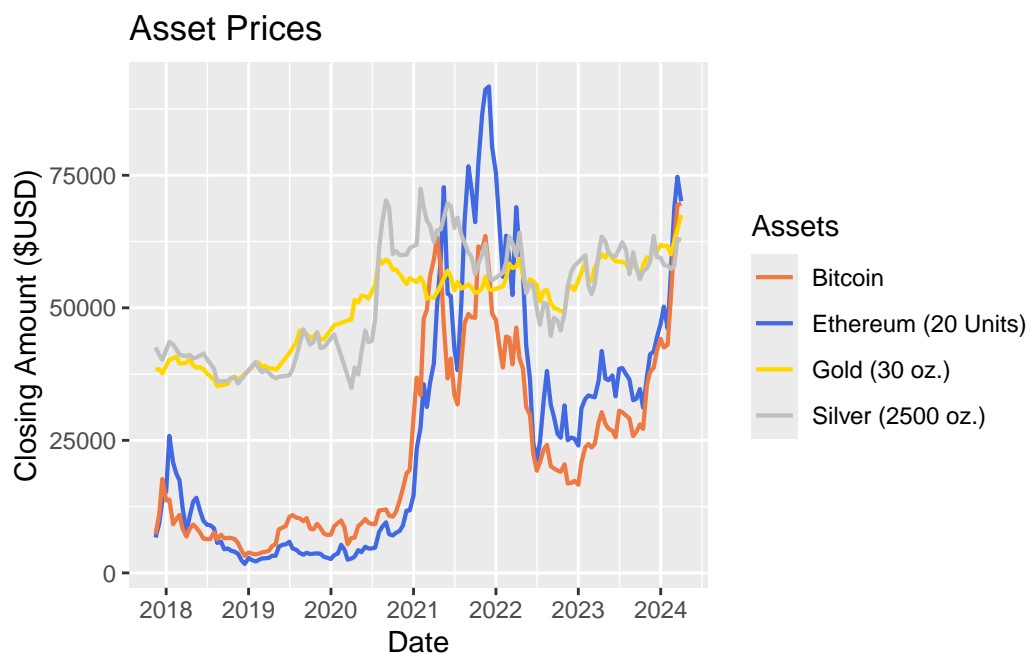


Figure 1: Price Comparison All Assets 2017 to Present

The figure above shows the trends of all four separate assets. Over the past 7 years, it's evident that all the assets have increased in value significantly. Gold tends to have the least fluctuations and grew from close to 38,000 USD per 30 oz. to around 66,000 USD. Both precious metals are more stable than the cryptos. However, both cryptocurrencies began at less than 10,000 (1 btc and 20 units of eth) and ended up well over 66,000 USD, resulting in a much more drastic return.

3 Model

The goal of my model is to analyse the correlation between crypto prices and precious metals prices. Through observing the previous price chart, there can be a perception of linear correlation between the two asset categories over 2017-2024 since all 4 assets show an increasing trend. Therefore, to represent this relationship, I will choose a linear regression model.

3.1 Model set-up

The model will be linear where:

Define y_b as the Bitcoin price and y_e as the Ethereum price. Then x_g and x_s will be the price of gold and silver respectively.

$$y_e + y_b = b_0 + b_1(x_g + x_s) + c$$

This can be simplified if the metals were aggregated into $y_i = y_e + y_b$ and $x_i = x_g + x_s$.

$$y_i = b_0 + b_1x_i + c$$

Where:

- y_i is the aggregated representation of the prices of the two major cryptocurrencies
- x_i is the aggregated representation of the prices of the two major precious metals
- b_0 is the intercept where the price of the precious metals would be equal to zero
- b_1 is the slope coefficient/estimated rate of change for cryptos for every one unit of change for metals
- c is the error variable that accounts for deviations from the predicted value

3.2 Model Justification

Both precious metals and cryptocurrencies have been used historically as a way to hedge against inflation, so when the economy doesn't do well, investors look to buy up these assets as a way to preserve the value of their cash. Furthermore, these assets follow a similar integrity where they are mined, either digitally or physically, and there is a decreasing supply if the more they are mined. Considering all factors aforementioned, a linear regression model is a reasonable framework for assessing the relationship between the two assets.

4 Results

4.1 Price Results

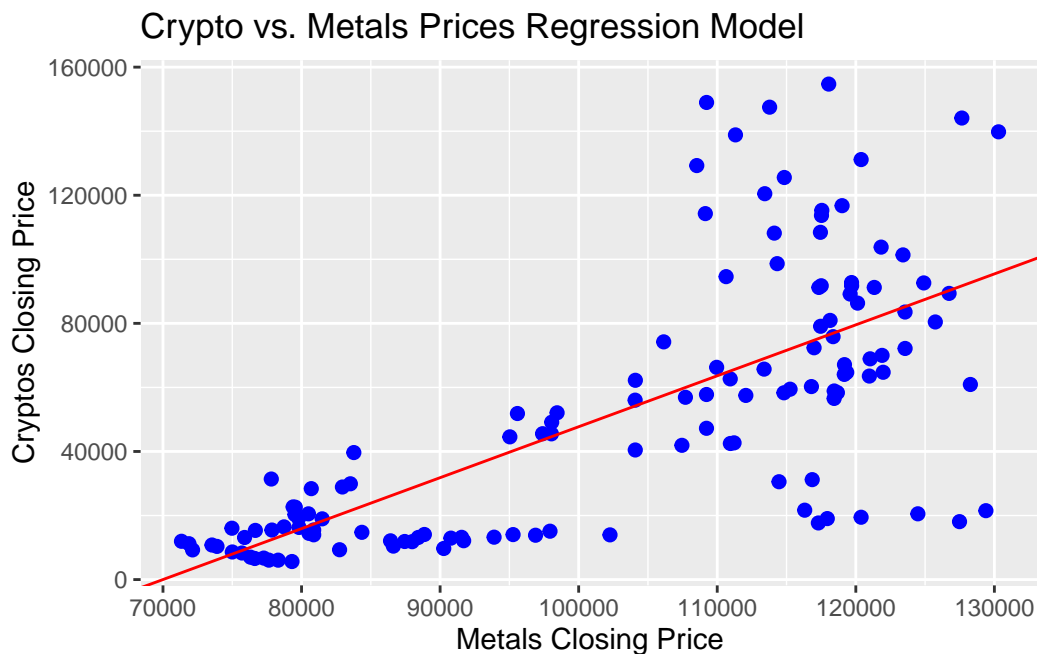


Figure 2: Model showing relationship between metals prices and crypto prices

Figure 2 suggests that the prices of aggregated metals (gold and silver) and that of aggregated cryptos (Bitcoin and Ethereum) have a positive and strong relationship. This is reinforced when observing the summary data below. There is a positive coefficient at 1.6 for totalm (aggregated metals). In other words, as the price of the aggregated metals increase by 1 unit, the model predicts an increase in aggregated crypto by 1.6 units on average. The correlation analysis concludes an r value of ~ 0.71 . The aforementioned information suggest a moderately strong and positive relationship between precious metals aggregate price and crypto aggregate prices. Though there is a positive correlation between the price factors of these asset categories, there is no implication of causation.

```
stan_glm
family:      gaussian [identity]
formula:     totalc ~ totalm
observations: 129
predictors:  2
-----
              Median    MAD_SD
(Intercept) -111328.4   14071.6
totalm       1.6       0.1

Auxiliary parameter(s):
      Median MAD_SD
sigma 28637.1 1832.6
-----
* For help interpreting the printed output see ?print.stanreg
```



```
* For info on the priors used see ?prior_summary.stanreg
```

```
[1] "-----"
```

```
[1] "Correlation:"
```

```
[1] 0.7074446
```

4.2 Volatility Results

The volatility results strongly suggests that cryptocurrencies are much more unstable compared to precious metals. I use normalized average true range as a measure because it takes the average range between high and low prices over a specific period. Higher ATR values suggest higher volatility because there is a greater shift in prices. The normalized ATR is the ATR normalized over the closing price of that day as a way to balance and fairly judge the ATR of the four individual assets. Figure 3 shows evidently that the normal ATR values of Bitcoin and Ethereum dwarfs those of gold and silver. Gold is the most consistent with a normalized ATR resting consistently at 0.01, silver is the second most stable coming in at around 0.02. The two cryptocurrencies see way higher normalized ATR values I would estimate to be around 0.05 on average and a much more turbulent trend line. This data is congruent with our price chart Figure 1 where gold had the most stable price rise followed by silver and then the cryptos. Because the normalized ATR for the cryptocurrencies are many times higher than that of precious metals, we can assume that they are also significantly more volatile.

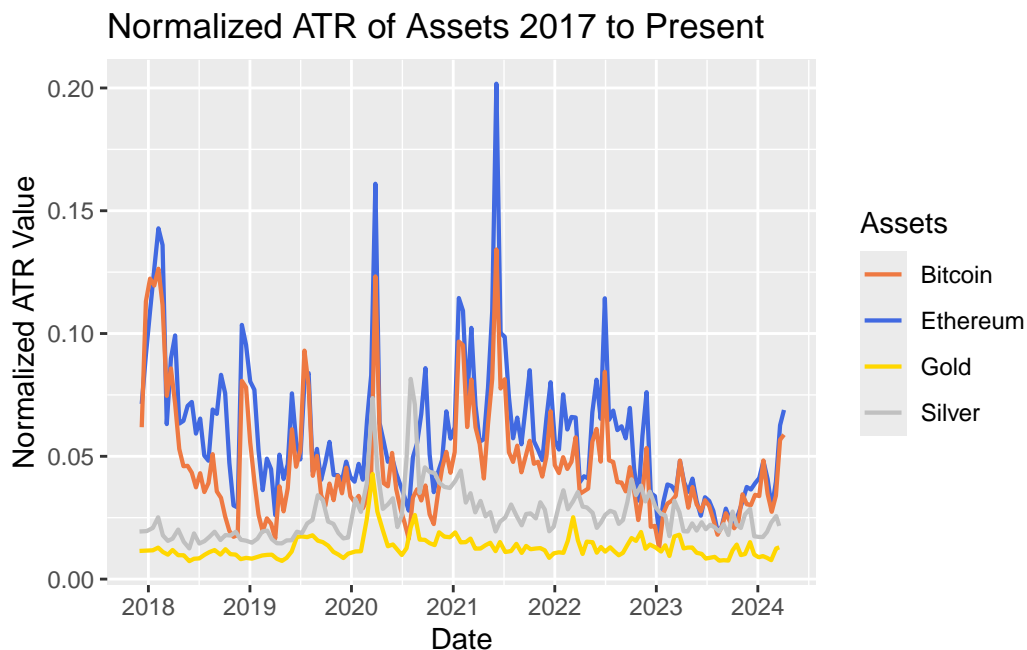


Figure 3: Volatility Chart Observed Through Normalized Average True Range

5 Discussion

5.1 Precious Metals As An Investment

As the world enters a recession, we can confidently look at historical data for precious metals near and far and identify that it would do well to hold its value and steadily rise through economic failures and inflation. As shown in Figure 1, precious metals, especially gold is almost unaffected by the recession caused by Covid-19. In addition, Figure 2 demonstrates that the normalized average true range values for precious metals tend to be significantly lower than that of cryptocurrencies. That is suggestive that precious metals are stable investments and can be treated as very stable investments. As my previous models predict, precious metals will continue to increase in value in the future. As an investor, if you are looking to invest in precious metals the two most common options will be to either invest in derivative contracts or through gold mutual funds (Adam Hayes 2023b). The second option would be to buy the physical metals in the form of coins or bars, however, this method is much more difficult to keep track of and lack mobility. Overall, precious metals is a great investment to dedicate to for those who wants to hedge against inflation, diversify their portfolio, while maintaining stability.

5.2 Cryptocurrencies As An Investment

Cryptocurrencies is the new wave. Aside from Bitcoin and Ethereum, we have seen the rise of many other successful cryptocurrencies such as Monero, Litecoin, and Stellar Lumens just to name a few. Figure 1 can attest to the substantial growth of cryptocurrencies over the last decade: Bitcoin grew from 7,000 USD to almost 70,000 USD in the span of less than 7 years. Ethereum grew from around 330 USD to over 3500 USD. 10x of an investment over less than 7 years is sensationally high returns. However, Figure 3 shows that even though Bitcoin and Ethereum has been extremely profitable, they are both extremely volatile assets with normalized average true range values many times that of precious metals. Due to the extreme volatility of cryptos, many begin looking at crypto as assets for day trading or short term options. As an investor, cryptocurrencies can be much more appealing, especially towards the newer crowd because investing in crypto is much more straightforward than precious metals. With large crypto exchanges such as Coinbase, Binance, and Kraken gaining popularity buying crypto has never been easier. Moreover, crypto wallets can come in the form of a USB Ledger or even an app on the appstore. This makes the asset extremely lightweight and mobile.

5.3 Different Stroke For Different Folks

Both cryptocurrencies and precious metals are amazing investments. Throughout my analysis, I have concluded that there is a strong positive relationship between the two category of assets, both assets have seen massive growth, and both still have a lot of room to develop in the future. For the readers still asking: Which asset should I invest in? I believe the answer is this:

For those who are looking for something long term to hold onto. For those who want to sit on an asset for medium to long term, precious metals is the better investment. Whether you would want to buy futures, or invest in mutual funds, go for precious metals. This process will involve more time in effort whether it's purchasing or liquidating. Opening a mutual fund or dealing with derivative contracts is not simple and will take days to attain. Similarly, purchasing, carrying, and selling physical metals is also a tedious task. The result however, will be a long term investment that is stable and profitable.

For those who are looking for something long or short term, and that are more risk-seeking, cryptocurrencies will be your cup of tea. Though seemingly much more profitable in the recent years, these assets are much more volatile and is very dependent on economic climate. Movements such as currencies being delisted from major exchanges or countries enforcing crypto laws can result in massive movements and potentially even the downfall of a cryptocurrency. This potentially tumultuous investment will take significantly more effort when it comes to monitoring activity and making adjustments. However, compared to precious metals,

buying, storing, and selling is a breeze. Cryptocurrencies are assets with a very high potential ceiling and as blockchain technology continues to progress, cryptocurrencies have a very bright future.

5.4 Biases and Weaknesses

The potential bias in my analysis comes from data recording errors from yahoo finance. However, that should be pretty minimal. Another potential bias could result from selection bias that occurs in my data cleaning. I chose to only take the first and fifteenth day of every month when creating my price charts and Normal ATR charts. Though said selection process can help reduce noise and ignore short term variations, I could very well have missed out on certain trends that occur on the days between. Aside from data biases, one incorrect assumption could be that the relationship between crypto and precious metals is linear. In many instances from the price chart Figure 1, there seem to be exponential growth from crypto compared to linear growth from metals and this is observed again in Figure 2 where there is a slight curve in the points suggesting potential an exponential regression model.

One of the greatest weaknesses in my analysis stems from the limited historical data of cryptocurrencies. The value of precious metals can be traced back a century ago and has solidified itself as a strong holding asset while cryptocurrencies such as Ethereum were only introduced in the late 2010s. As a relatively immature market paired with easy influence from outside factors such as technological advancements and crypto laws, there are too many qualitative aspects that need to be accounted for but my analysis can only give a quantitative prediction based on historical prices.

5.5 Next Steps

Some next steps I can take for future developments can be to continue to monitor the price of crypto over the next few decades and see how it reacts to different economic patterns and how that compares to precious metals. Moreover, I can include more assets in my comparisons such as technology stocks or real estate. The overall next step for improving this analysis is to increase the amount of factors

5.6 Closing Remarks

Before investing in anything, nothing beats individual research. An investment should be considered only after sufficient self evaluations.

Ask yourself:

- How much money am I looking to invest?
- What is my tolerance for risk?
- What are my investment goals and objectives?

I have given but a brief overview and analyses of two popular modern day assets. The rest is up for you to discover.

References

- Adam Hayes. 2023a. “Average True Range (ATR) Formula, What It Means, and How to Use It.” <https://www.investopedia.com/terms/a/atr.asp>.
- . 2023b. “The Best Ways to Invest in Gold Without Holding It.” <https://www.investopedia.com/articles/investing/062515/best-ways-invest-gold-without-holding-it.asp>.
- Brian Domitrovic. 2023. “Gold Has Been An Excellent Barometer In The 2000s.” <https://www.forbes.com/sites/briandomitrovic/2023/12/09/gold-has-been-an-excellent-barometer-in-the-2000s/?sh=383131b74443>.
- Goodrich, Ben, Jonah Gabry, Imad Ali, and Sam Brilleman. 2022. “Rstanarm: Bayesian Applied Regression Modeling via Stan.” <https://mc-stan.org/rstanarm/>.
- Markets Insider. 2024a. “Gold Price.” <https://markets.businessinsider.com/commodities/gold-price>.
- . 2024b. “Silver Price.” <https://markets.businessinsider.com/commodities/silver-price>.
- Michael Bromerg. 2023. “Why Has Gold Always Been Valuable?” <https://www.investopedia.com/articles/investing/071114/why-gold-has-always-had-value.asp#:~:text=Beginning%20with%20ancient%20civilization%2C%20from,jewelry%2C%20and%20as%20other%20artifacts>.
- Müller, Kirill. 2020. *Here: A Simpler Way to Find Your Files*. <https://CRAN.R-project.org/package=here>.
- R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. <https://ggplot2.tidyverse.org>.
- Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D’Agostino McGowan, Romain François, Garrett Golemund, et al. 2019. “Welcome to the tidyverse.” *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.
- yahoo! finance. 2024a. “Bitcoin USD.” <https://finance.yahoo.com/quote/BTC-USD/history>.
- . 2024b. “Ethereum USD.” <https://finance.yahoo.com/quote/ETH-USD/history>.