**Cryptocurrency Price Analytics Report**

**To what extent can you use descriptive, diagnostic and predictive analytics to predict future cryptocurrency price trends?**

*A Business & Data Analytics report investigating factors influencing cryptocurrency and blockchain technology adoption.*

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# Introduction to Blockchain: The Trust Machine

An interesting story to turn to when initially familiarising oneself with cryptocurrencies and blockchain technology is that of William Henry Furness III, an American anthropologist who travelled to a miniscule island in the Pacific Ocean called Yap (‘The Forbidden Island’) in 1903. On this secluded island is a monetary system like no other on earth. Their culture thrives on exchanging the world’s heaviest and physically largest form of currency, the “rai” or “fei”, which is essentially chunks of limestone quarried in Palau some 400 kilometres away and rafted over to Yap. The difficulty of importing these stones as well as the currency’s inherent scarcity contribute to its capacity to maintain value within the island’s economy. Perhaps the most remarkable feat of Fei is that the stone doesn’t even have to be moved in order for someone to spend it. Rather, the ownership of each stone is logged in Yap’s collective accounting ledger: the memory of its residents. The extraordinary nature of Yap’s financial system has intrigued economists such as Milton Friedman for decades, comparing it to the gold standard, citing that as long as people have faith in the value of something, anything can be the trusted and transacted monetary device. Philosophically, community consensus of who owns the Fei is the true ‘money’, rather than the physical stone itself.

The global financial crisis in 2008 was an inflection point in regard to whether governments and central banks should really be trusted to regulate our economy. Amidst financial catastrophe, the pseudonymous individual(s) known as Satoshi Nakamoto distributed their whitepaper called “Bitcoin: A Peer-to-Peer Electronic Cash System”. A prominent theme in the paper is as follows: “The root problem with conventional currency is all the trust that’s required to make it work. The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust”. In a way, Bitcoin is a duplicate of Yap’s stone technology. When Bitcoin is sent from one address to another, there is no physical exchange of ownership over the digital tokens. Equally, when a 4-ton Fei stone is used to pay for a wedding, the stone does not move – just its ownership. In the island, trust on this level works because the community is tightly-knit, however, who’s to say the same singular Bitcoin can’t be sent to multiple people in a copy-and-paste fashion? That comes down to Satoshi’s innovative ‘blockchain’.

The Bitcoin blockchain is the pioneer of blockchains. The blockchain is an immutable database of ‘blocks’ linked together, where each block houses a collection of transactions from a recorded period. Once a block is full, a new one is added to the chain, hence, ‘blockchain’. Blocks cannot be amended, only appended, meaning that every confirmed transaction is final and recent transactions are simply added on once verified by nodes on the network. Bitcoin is an opensource public ledger where people can transfer value among Bitcoin wallets. These transfers are proven mathematically by ‘miners’ which are computers optimised to confirm pending transactions within the distributed consensus system. Miners are rewarded with either newly minted coins accompanying new validated blocks or transaction fees from transactions in the block for their computational hashing power (verifying transactions), but only if they’re the first to discover the solution to the complex, cryptographic hashing puzzle.

With all considered, it is commonly understood that blockchains are ‘trustless’ ‘confidence machines’ that do not require the presence of a financial intermediary (banks, PayPal) to certify the flow of transactions. Rather, nodes perform complex calculations in a competitive race to verify transactions and get compensated for it, followed by a consensus mechanism that ensures validators’ calculations are accurate and honest before the block is substantiated and added to the blockchain.

Nevertheless, despite blockchains being relentless trust machines, there is significant resistance to their adoption due to various political, social, technological and regulatory factors. First, a price analysis of five cryptocurrencies is conducted in an exploratory manner. No prior expectations were set before setting forth in this analysis, instead, it is employed to uncover trends and insights into the primary factors influencing adoption and use of these five cryptocurrencies, represented by price movement over time.

# Descriptive Statistical Analysis of Five Cryptocurrencies

## Crypto price charts over the last 4 years

Graphical user interface, application

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What we see here are the price charts of five cryptocurrencies (cryptos) over the last 4 years. Bitcoin (BTC), Ethereum (ETH), Ripple Labs (XRP), DogeCoin (DOGE), and Zilliqa (ZIL) were chosen for analysis for various reasons. BTC, ETH, XRP & DOGE have all been among the top cryptocurrencies with the highest market capitalisation at one point or another over the past few years, making them some of the most important names in this relatively new asset class. Whilst ‘Stablecoins’ have also circulated among the top most valued cryptos in terms of market capitalisation, they will not be heavily focused on in this report as their unit prices cannot be influenced. The “crypto bubble” burst in 2017 after all-time-highs (ATH) were reached for various cryptos, however, this period will not be studied in depth as the crypto environment has shifted significantly since that historical time frame.

At first glance, we notice that these five cryptos were in a serious recession period, in general, from the beginning of 2019 until price traction again began to build at the beginning of 2020. Also notable, we see that each crypto’s price scale is independent of one another. For example, BTC’s Y-axis grows upwards of US$60,000, whereas ETH’s Y-axis price scale only ascends until just below US$5,000. For this reason, a cumulative price standardisation process is required to make the cryptos’ price movement more comparable.

## Graphical user interface Description automatically generated with low confidenceCumulative returns of 5 Cryptos

The daily relative price changes, or percent changes, illustrate the rate of cumulative growth over time for the different cryptocurrencies. Interestingly, the relative cumulative growth of DOGE far exceeds that of the other four cryptos. Below is a chart without DOGE to make better visual comparisons.

Graphical user interface

Description automatically generated with medium confidenceCumulative returns (Adjusted for comparability)

Now it is possible to recognise the price trends relative to one another more accurately. As shown, BTC out-performed the other three cryptos and acted as the asset class ‘market-maker’ in the sense that the smaller market cap cryptos only began to appreciate once Bitcoin led the way. ETH’s macro price trend seems to mirror that of BTC’s, though, initially lagging before catching up toward the end of 2021. In summary, we need cumulative returns to make different assets comparable.

## Comparison of Daily Volatilities

Table

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As shown above, we see the volatilities of cryptocurrencies on daily fluctuations. The most notable fluctuation is around mid-May 2020, where we observe a stark 35-40% decrease in value across all five assets. Somewhat surprisingly, DOGE was the least affected, ‘only’ losing around 30% of it’s value. XRP and DOGE demonstrate the highest volatility from the beginning of 2021 onwards. In general, the volatility seems to be least in BTC’s case and most in ZIL’s case.

## Comparison of Return Distributions

Chart

Description automatically generated

As evident, on the x-axis, we see the returns; positive on the right-hand side, negative on the left. On the y-axis, we see the frequency, or number of occurrences, of various daily returns over the last 4 years. It’s very interesting to compare the percentage values of daily returns in this way. In Bitcoin and DogeCoin’s case, it is evident that the most frequent daily percent change is actually a positive one since the highest point on the distribution curve sits slightly to the right of zero. In ZIL’s case, we observe a much flatter shape compared to the other four cryptos, where the tails on either side (particularly on the left) are larger than that of the other cryptos.

## Comparison of boxplots with and without outliers

In the first boxplot, we see the distribution of daily returns with outliers, the largest and most significant outlier being attributed to DOGE, where in one occasion there was a return of approximately 270%. The number of outliers is so high that the boxes are compressed, and we can’t actually gain any insights from the first visual representation. For this reason, a boxplot graph without outliers was also necessary in order to meaningfully visualise the data and gain valuable insights such as the interquartile range (blue box) and median value (green line) of each crypto.

Table

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At first glance, it appears as though the medians (midpoint of frequency distribution) are equal to zero, however, upon closed inspection it’s clear that BTC, ETH and ZIL have median values of slightly above zero, while XRP and DOGE sit just below zero. Here, the interquartile range appears to be the highest for Zilliqa, followed by Ethereum, Ripple, DogeCoin, and then Bitcoin.

A picture containing table

Description automatically generated

## Correlation Between Cryptocurrencies

Let’s have a look at how the cryptos are correlated against each other. On top, there’s the correlation of the five cryptocurrencies and at the bottom there’s the visualisation of the correlation matrix.

The first row details the correlation between Bitcoin and the other cryptos, and what we notice is that there is quite a high correlation for ETH and ZIL against BTC and very low correlation for DOGE. This is very interesting because when we look at DOGE’s correlation against the other cryptos we can see that, in general, DOGE has very low correlation across the board, whereas when we compare ETH to the other cryptos, there is generally quite high correlation.

# Diagnostic Analysis of Cryptocurrencies

The previous section was concerned with a descriptive statistics analysis (technical analysis) approach to price analysis and prediction. This section explores a diagnostic analysis (fundamental analysis) of the five cryptocurrencies which is exemplified by real-world factors influencing the intrinsic value of a crypto’s ecosystem, judging by its use-cases and subsequent adoption or abandonment.

This fundamental analysis attempts to link events to ensuing price movement, where the price movement occurs as a result of new specific use-cases for crypto tokens, news pertaining to potential future adoption or rejection of the token, and various other Political, Economic, Societal, Technological, Legal, or Environmental contributing factors.

## Ripple (XRP)

A screenshot of a computer

Description automatically generated with medium confidence

1. Ripple onboards 10 more companies to its roster (Economic)

Ripple Labs successfully negotiated terms with 10 financial institutions, leading to an immediate spike in network use, and thus, positive price movement thereafter. At the time, Ripple was one of the only blockchain-led institutions offering commercial products and services to its clients.

1. American Express Partnership (Economic)

International payments settlement can take days with a bank, which is why the deployment of FX International Payments (FXIP) was such a ground-breaking, value-added initiative by AMEX and Ripple. B2B payments simply were not being verified quickly enough, prompting AMEX to search for more innovative blockchain-powered solutions with Ripple.

1. XRP listed on 50 exchanges, breaks $1 (Societal)

At the beginning of 2017, XRP was only available to trade on six exchanges. By the end of 2018, XRP was trading on 50 exchanges, partly due to the successful roll out of xRapid. Being listed on so many exchanges made XRP multi-fold more accessible for retail investors to participate in the trade of the digital asset.

1. Ripple vs R3 reach court settlement (Legal)

For an entire year, Ripple and R3 battled in court over Ripple’s failure to respect and follow through with a standing purchase agreement, which would have allowed R3 permission to purchase five billion XRP at $0.00085 even though the trading price per XRP was $0.26. Understandably, investors may have been hesitant to purchase XRP or partner with Ripple amid this period since, had R3 won the case, the rate of each XRP would have plummeted. Investors celebrated that day, as reflected by a 113% price increase mere hours after the settlement.

1. SEC vs XRP begins (Legal)

The Securities Exchange Commission (SEC) prepared to take legal action against Ripple for the ‘sales of unregistered securities’. The case persists to this day and is widely regarded as a huge over-step of authority on the SEC’s behalf. After a slight dip in price, XRP’s price prevails, potentially due to the falsifiable claims made by the SEC. For instance, the SEC claims the Howey test proves Ripple to be in violation of distributing unregulated securities but continuously fails to justify how the Howey test applies to cryptocurrencies. Additionally, it appeared as though Jay Clayton, former SEC Chairman, made a hasty final decision in office when litigating Ripple, the point of contention is, in 2018, Clayton decided Bitcoin did not constitute a security under US law. Granted, Ripple and XRP operate in very different ways to the Bitcoin network.

1. Self-branded “XRP Army” Unites (Societal)

Despite SEC pushing forward with their suit charging two Ripple executives for $1.38bn in ‘unregistered sales of securities’, CoinDesk’s “The Hash” speculate that the 91% price jump over the first week of April, 2021, was the works of the online “XRP Army” community. They even protested at the SEC HQ in Washington, DC.

Obviously, there are countless more news articles and conversations constantly on-going regarding cryptocurrencies and blockchain-powered companies than is possible to keep track of. When considering crypto price prediction, it appears evident that, as shown above, there is some correlation between headlines posted on the internet and subsequent price movement. A substantial majority of crypto and blockchain discourse takes place on social media platforms which is presents a huge opportunity to gain historical as well as live public sentiment pertaining to the research topic of choice. Mata et al. managed to show a positive correlation between (positive/ negative sentiment) tweets mentioning Bitcoin and Bitcoin price trends. Similarly, Stenqvist and Lönnö studied a dataset of over two million tweets discussing Bitcoin over a one month period to explain Bitcoin price fluctuations, citing that machine learning application and text classification techniques should be explored further to improve the accuracy of such predictive models.

In light of researchers’ success in correlating text sentiment with cryptocurrency price fluctuations and even showing promising steps toward building an accurate price prediction model, this research paper deems it necessary to strive further in this important forecasting field. While it is beyond the scope of this paper to prescribe any technical recommendations as to exactly how a machine learning algorithms using natural language processing (NLP) should be built, it is recommended that further research be conducted to develop distinctive sentiment lexicon datasets for the specific use-case of price prediction.

# Predictive Analysis of Cryptocurrency Prices

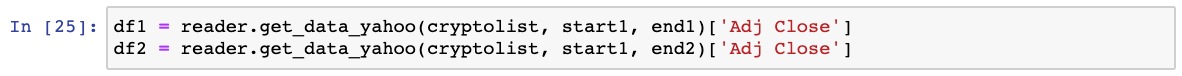
This report uses the timeseries prediction model developed by Facebook’s Data Science Team (fbprophet). Firstly, two backtests of the model are conducted in retrodiction, one from a year back and another from six months prior.

Two time horizons are required, “end1” for the 1 year backtest and “end2” for the 6 month backtest, where “start1” indicates where the backtest begins from.

Graphical user interface, text

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After that, two online requests are required for each time horizon, where “df1” is for the 1 year backtest and “df2” is for the 6 month backtest.



Text

Description automatically generatedOn the left-hand side are two prediction models, where the dataframes above define the parameters of the models. Both models “modelfb1” and “modelfb2” are fit to dataframes “df1” and “df2”, respectively.

Below, the future time horizons are defined. The “make\_future\_dataframe” function of the model is used to define the 365 day backtest (“future”), and 180 days for the 6 month backtest (“future1”).

Graphical user interface, text, application, email

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Chart

Description automatically generatedAs described, we first have to backtest the data to determine whether this price prediction model is accurate in predicting future price discovery. The degree to which this backtest proves to reflect realised crypto price data of the last 6 months and 1 year supports analysts’ confidence in its ability to accurately predict trends leading into the future.

Chart, histogram

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Chart, histogram

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As we can see after plotting the prediction of the 1 year and the 6 month backtest, with the aid of the actual Bitcoin price chart (black box overlaying, adapted from Binance Cryptocurrency Exchange platform), the model would have failed to predict the price accurately both times. “modelfb1.plot” drastically under-predicted BTC’s price movement 1 year into the future, whereas “modelfb2.plot” clearly over-predicted BTC’s price movement 6 months into the future, in retrospect.

Chart

Description automatically generatedFinally, the third model, “BTC 6 months in the future”, is plotted using the original DataFrame and a 6-month time horizon to predict Bitcoin’s price 180 days in the future.

# Conclusion: Going Above & Beyond

This analytical report presents descriptive, diagnostic, and predictive analytics techniques for the purpose of predicting future cryptocurrency prices. However, it is evident that Facebook’s general spatiotemporal prediction algorithm (Prophet) is not optimised for, nor specialised enough to be geared toward predicting Bitcoin’s future price trends – yet. To extend this research, interested parties should consider incorporating varied data types with a multi-dimensional data processing procedure. A supervised machine learning (ML) classification model and unsupervised ML dimensionality reduction model can be fitted to data collected using natural language processing techniques via API’s to retrieve such data from social media platforms.

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# Appendix:

Data used in all descriptive models:

Graphical user interface, text, application, email

Description automatically generated

<https://finance.yahoo.com/quote/BTC-USD?p=BTC-USD&.tsrc=fin-srch>