Cryptocurrencies vs. The Stock Market

Question: Are Cryptocurrency Prices related to Stock Market Prices?

Sub-Questions: What trends can we see in Stocks and Crypto and what do possible trends look like in the future?

Analysis By: Sana El-Bakry and Jonathan Yun

Link for Youtube Presentation

https://www.youtube.com/watch?v=_-IdITT--mQ

Dependencies

- 'dplyr'
- 'tidyverse'
- 'quantmod'
- ggplot2
- highcharter
- forecast
- coinmarketcapr
- tseries
- timeSeries
- xts
- "ggpubr"

Hypothesis

Overall Hypothesis:

As the prices for the Stock Market rise and fall, we anticipate similar trends in the cryptocurrency market.
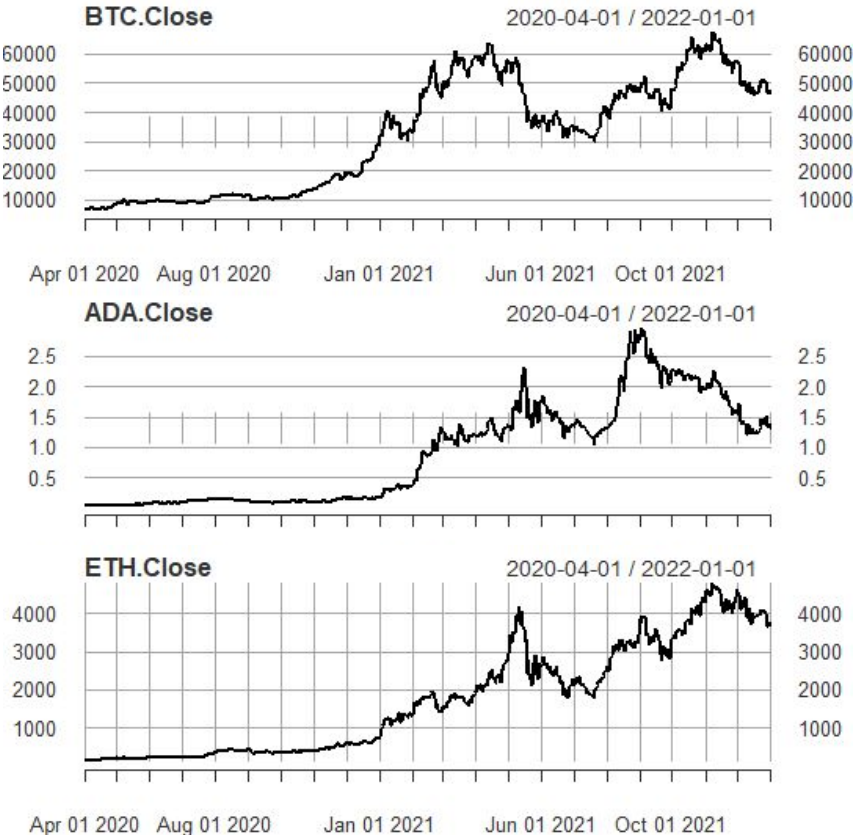
Crypto Hypothesis:

There will be an upward trend in the crypto market once the Ukraine/Russia war dies down (if it does).

Stock Hypothesis:

There will be an downward trend in the stock market once the pandemic starts.

Crypto vs Stock Market

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Key Takeaways:
➔ At the beginning of the pandemic, crypto took a real plunge as expected.
➔ As 2021 came around, some promise started to show for all three and you see a positive upward trend.
➔ When the first of the COVID strains came out and again shutdowns were threatened, crypto again took a plunge(MID 2021).
➔ Now as COVID restrictions die down and there is more control over the situation, there seems to be some promise in the 2022 outlook for crypto.

Crypto Chosen:

1. BTC-USD (Bitcoin)
2. ETH-USD (Ethereum)
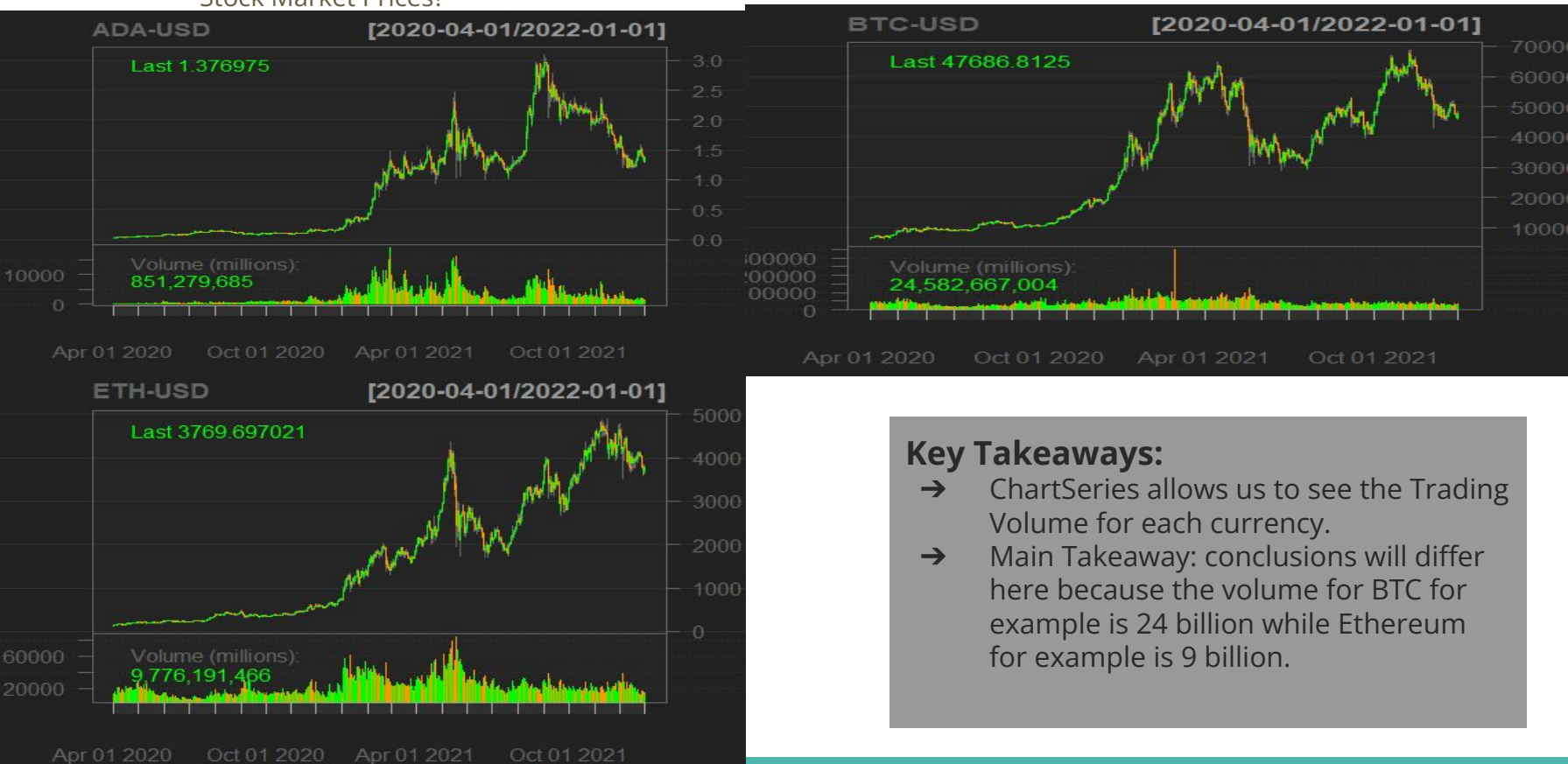3. ADA-USD (Cardano)
- **Why?**
  - These are the most popular crypto in a lot of crypto ranking websites.
  - Bitcoin is currently the top of crypto food chain.

Crypto vs Stock Market

<u>Question:</u> Are Cryptocurrency Prices related to Stock Market Prices?

BTC vs ETH vs ADA Closing Price

Zoom [1m] [3m] [6m] [YTD] [1y] [All]   Apr 1, 2020 → Jan 1, 2022

Key Takeaways:
➔ This is another look at the time series of the cryptocurrencies, using highcharter in R.
➔ Bitcoin(BTC), looks much more pronounced in the graph because the price is much higher than Cardano(ADA), and Ethereum(ETH).
➔ Bitcoin is the leading cryptocurrency right now, with Ethereum showing promise, maybe in a few years to takeover BTC.

Crypto Chosen:

1. BTC-USD
2. ETH-USD
3. ADA-USD
- **Why?**
    - These are the most popular crypto in a lot of crypto ranking websites.
    - Bitcoin is currently the top of crypto food chain.

Crypto vs Stock Market

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Key Takeaways:
➔ ChartSeries allows us to see the Trading Volume for each currency.
➔ Main Takeaway: conclusions will differ here because the volume for BTC for example is 24 billion while Ethereum for example is 9 billion.

Crypto vs Stock Market

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Daily Return BTC vs ETH vs ADA from Apr2020-Jan2022

Cumulative Return   2020-04-01 / 2022-01-01

- Return BTC
- Return ETH
- Return ADA

80
60
40
20

Daily Return
0.15
0.00
-0.10

Drawdown
-0.1
-0.2
-0.3

Apr 01 2020   Aug 01 2020   Jan 01 2021   Jun 01 2021   Oct 01 2021

Key Takeaways:
➔ This is Return Analysis of all three Cryptocurrencies.
➔ From an investment point of view, it is important to look at return.
➔ Looking at the top of the graph, surprisingly, you can see that Cardano (ADA) has the highest cumulative return.
➔ There is a lot of reasons that could be the case.
➔ Cardano recently has received a lot of traffic in terms trading volume, because there is talk that this is a strong possibility this Crypto could skyrocket in a few years, similar to Bitcoin.

Crypto vs Stock Trends

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Forecasting Naive Model:

➔ **Naive or Random Walk forecasts,** forecasting method that used the last observation as the forecast result of our data. It is used as the base model in forecasting.
➔ Why use this one? As stated before this is the base model, so we will compare it to the ARIMA model results and conclude which model is better to take into account for our forecasts.

Forecasting: ARIMA Model

➔ **ARIMA** stands for Auto-Regressive Integrated Moving Average. Also known as **Box-Jenkins approach**. It is one of the most popular techniques used for time series analysis and forecasting purpose.
➔ This approach has two main components:
   ◆ **Auto-Regressive Component:** implication that there is a relationship between one point in a time series with its previous points.
   ◆ **Moving Average**: implies deviation from the mean; dependent on previous deviation. (Hints towards a distributed relationship)
➔ **Lag**: value of time gap being considered. (eg. A lag 1 is autocorrelation between values that are one time period apart)
➔ **Seasonality** allows you to see the order of differencing in a time-series.(eg. Generally speaking, if the time series is positively correlated, it needs a higher order of differencing)

Key Takeaways:
➔ ARIMA model is one of many forecasting models.
➔ ARIMA is one of the simpler but accurate forecasting models
➔ We will use this model to forecast the estimated trends of Crypto and Stocks.

Crypto vs Stock Trends

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ADA Naive Forecast

Residuals from Naive method


Forecasts from ARIMA(1,1,1) with drift

Residuals from ARIMA(1,1,1) with drift
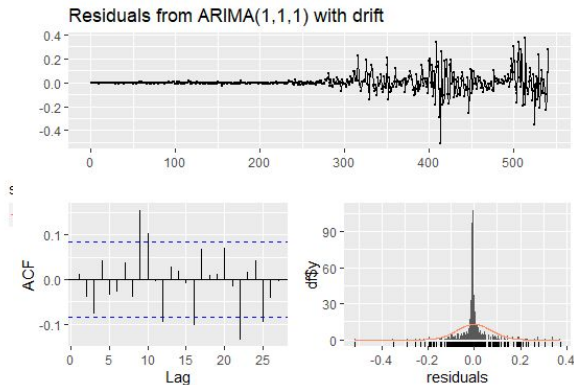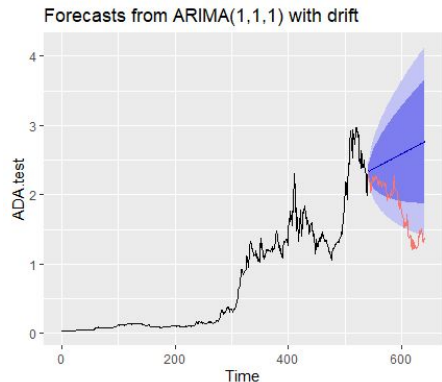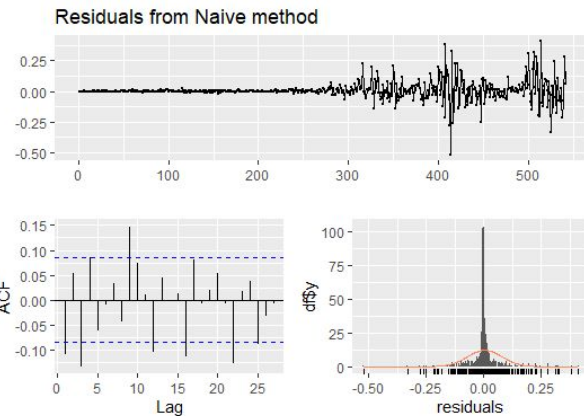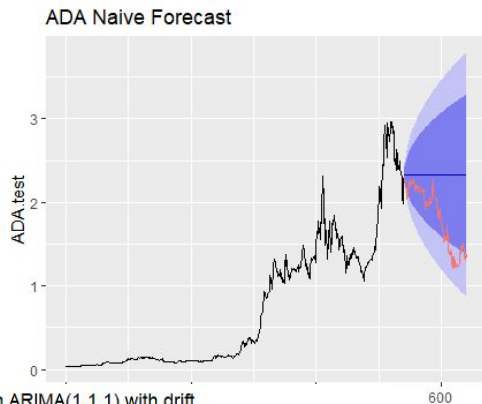
Key Takeaways:
➔ In the next hundred days, ADA will plunge down and at the very end, it will begin to recover.
➔ The ACF residuals show us that there is no autocorrelation which means the models should be good.
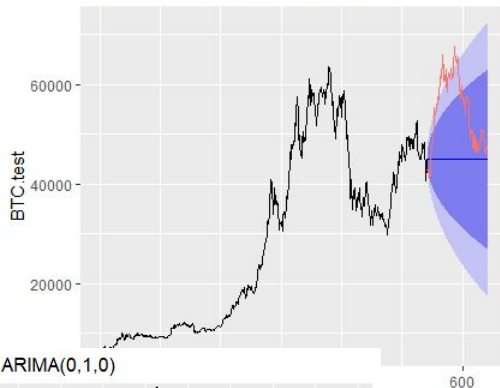➔ Both Models look similar, so the p-value and RMSE(Root Mean Squared Error) will help us determine the better graph.

Cardano Forecasting Results:
➔ The shadows show us that this the darker and lighter dark parts are 80% and 95 % confidence intervals, respectively.

Crypto vs Stock Trends

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Residuals from ARIMA(3,1,4)
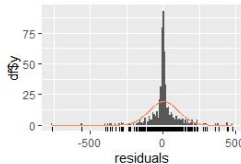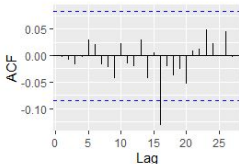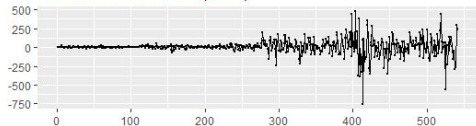
Naive Forecast for ETH
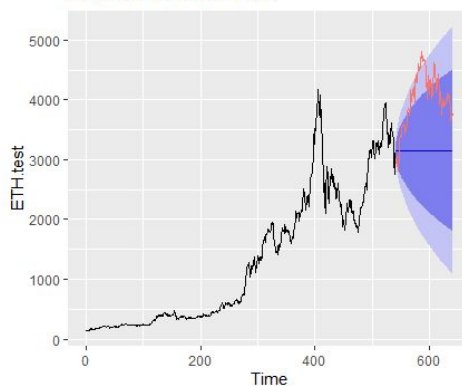
Residuals from Naive method
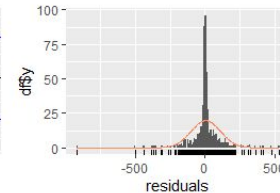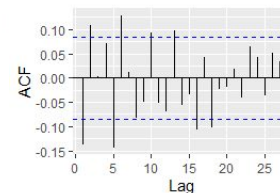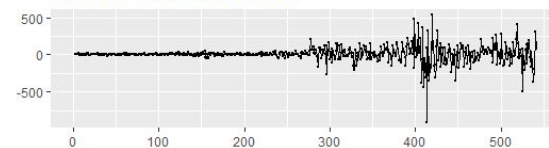
Forecasts from ARIMA(3,1,4)

series
— Test Data

Key Takeaways:
➔ In the next hundred days, ETH will spike up and somewhat vary towards the end.
➔ The ACF residuals show us that there is no autocorrelation which means the models should be good.
➔ Both Models look similar, so the p-value and RMSE(Root Mean Squared Error) will help us determine the better graph.
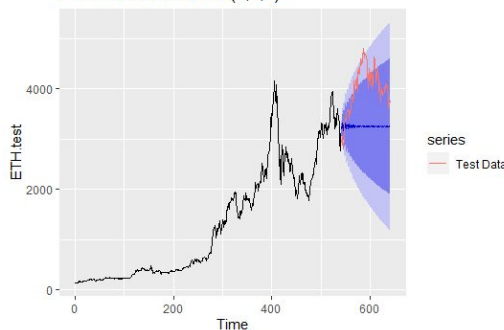
Ethereum Forecasting Results:
➔ The shadows show us that this the darker and lighter dark parts are 80% and 95 % confidence intervals, respectively.

Crypto vs Stock Trends

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BTC ARIMA Model Forecast
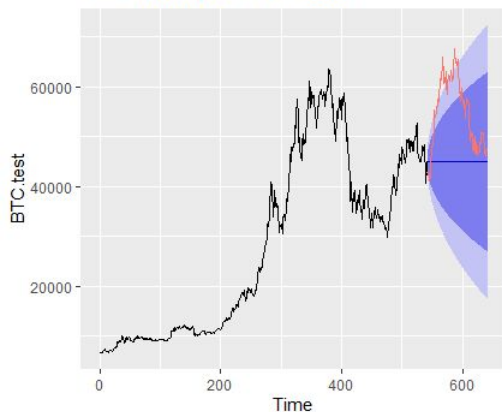
Forecasts from Naive method

Residuals from ARIMA(0,1,0)

Residuals from Naive method

Key Takeaways:
➔ In the next hundred days, BTC will increase and about 80 days in it decreases; and then it will begin to recover.
➔ The ACF residuals show us that there is no autocorrelation which means the models should be good.
➔ Both Models look similar, so the p-value and RMSE(Root Mean Squared Error) will help us determine the better graph.
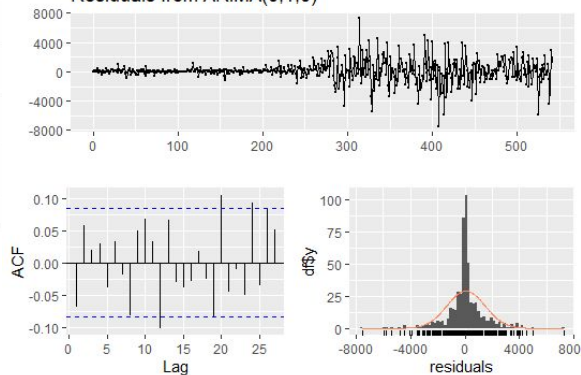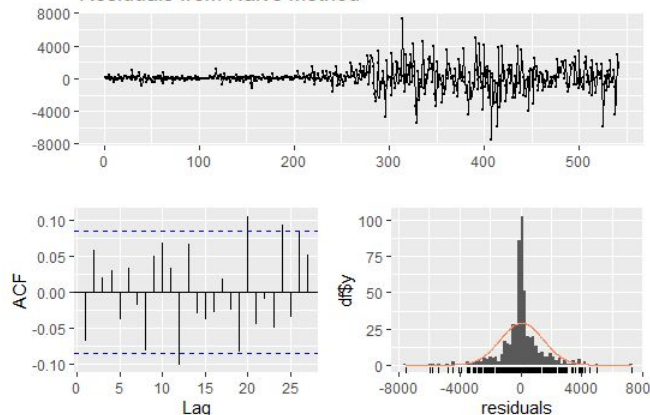
Bitcoin Forecasting Results:
➔ The shadows show us that this the darker and lighter dark parts are 80% and 95 % confidence intervals, respectively.

Crypto vs Stock Trends

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MAPE (Mean Absolute Percentage Error): measures the
difference of forecasts errors and divides by the actual value to give
you a percentage accuracy.
MAPE values: (100-MAPE = % accuracy)
➔   BTC: 97% (NAIVE) |97%(ARIMA)
➔   ETH:96% (NAIVE) | 96%(ARIMA)
➔   ADA:95% (NAIVE) |95% (ARIMA)

P-Values and Root Mean Squared Error(RMSE):(ARIMA)

➔   BTC: 0.1522 | 1395.254
➔   ETH: 0.4545 | 100.2264
➔   ADA: 0.0003598 | 0.07376274

P-Values and Root Mean Squared Error (RMSE):(NAIVE)
➔   BTC: 0.1535 | 1396.545
➔   ADA: 1.311e-05 | 0.0748107
➔   ETH: 2.851e-07 | 105.6073

Key Takeaways:
➔   Smaller RMSE values and a p-value
   greater than 0.05 is what we are
   looking for.
➔   Based on the values here, the ARIMA
   models here for all currencies are
   better than the Naive Models.
➔   In terms of accuracy, both models
   seem very close with small
   differences in the decimals.

Crypto vs Stock Market

We chose AAPL, MSFT, GOOGL, TSLA, and AMZN because they are considered the best stocks to invest into.

AMZN$AMZN.Close — 2020-04-01 / 2021-12-31

TSLA$TSLA.Close — 2020-04-01 / 2021-12-31

MSFT$MSFT.Close — 2020-04-01 / 2021-12-31

AAPL$AAPL.Close — 2020-04-01 / 2021-12-31

GOOGL$GOOGL.Close — 2020-04-01 / 2021-12-31

Crypto vs Stock Market

This plot is a time series of the five stocks mentioned in the previous slide. The plot shows that compared to the crypto, they did not experience a dramatic drop in price.

Crypto vs Stock Market
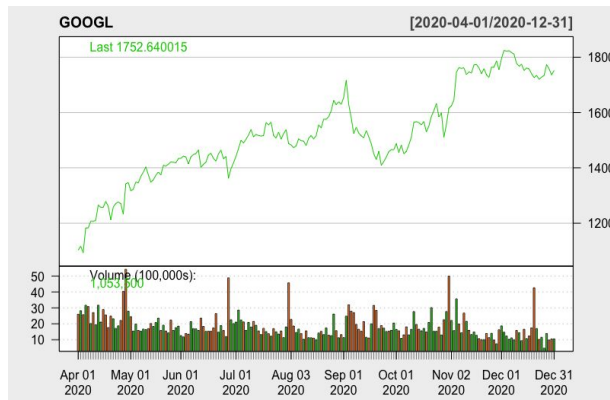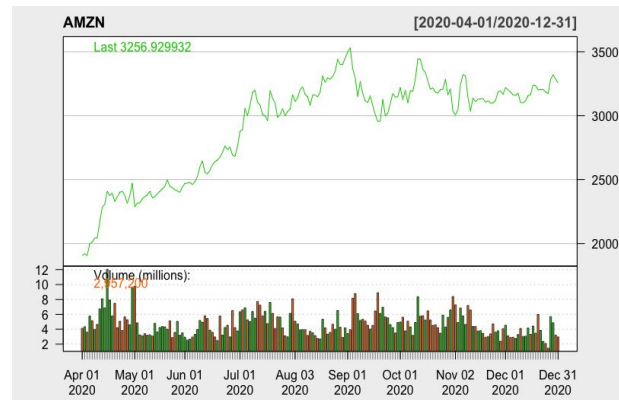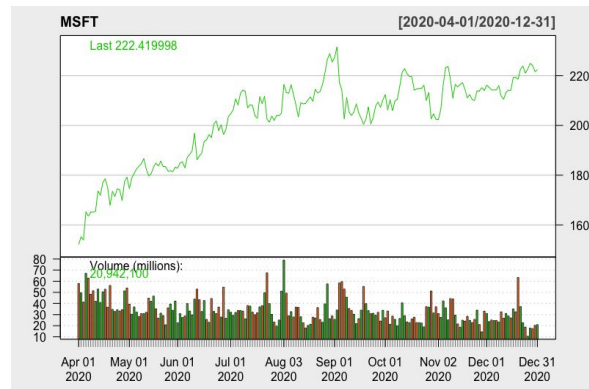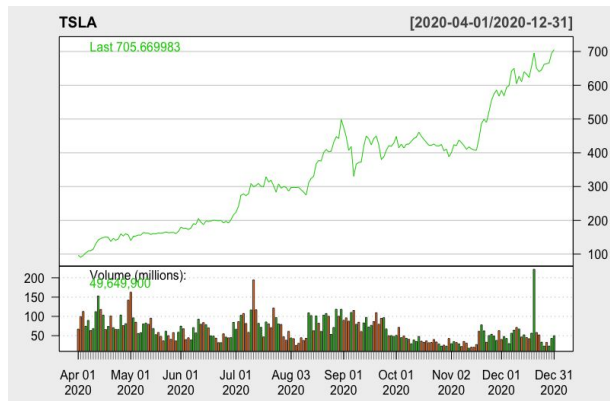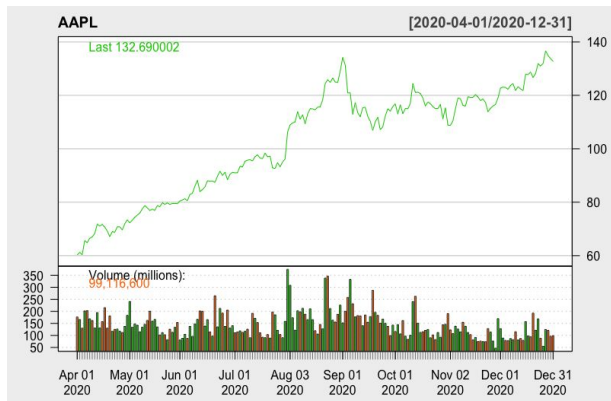
These plots show the trading volume and as one can see the trading volume has an upward trend.

Crypto vs Stock Market

This plot shows the returns of all the five stocks chosen. Out of the five, Tesla has had the most dramatic daily return of the five companies.
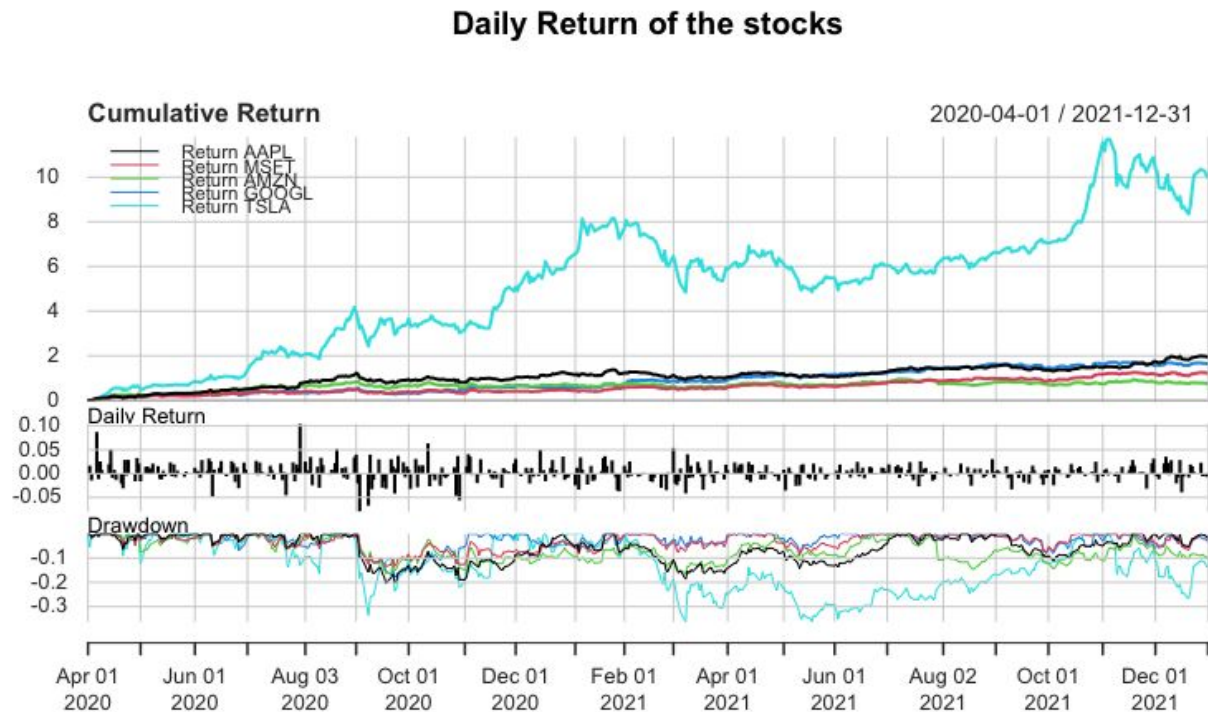
Daily Return of the stocks

Crypto vs Stock Trends

<u>Question:</u> Are Cryptocurrency Prices related to Stock Market Prices?
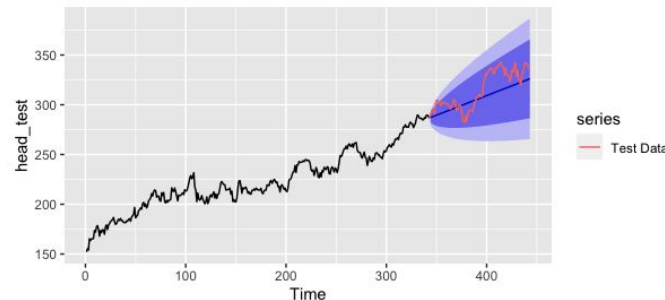
From our Arima and Naive models, we see that overall the price for Apple stock is forecasted to increase. However, there is a slight dip in the beginning before the price begins to climb.
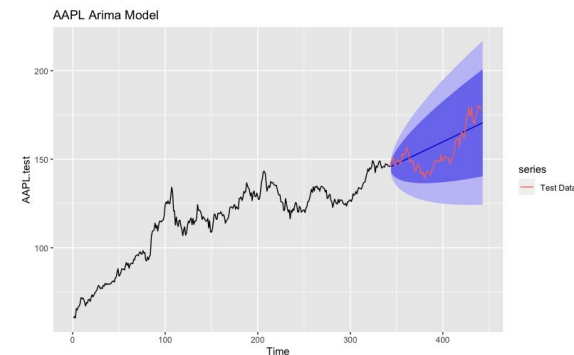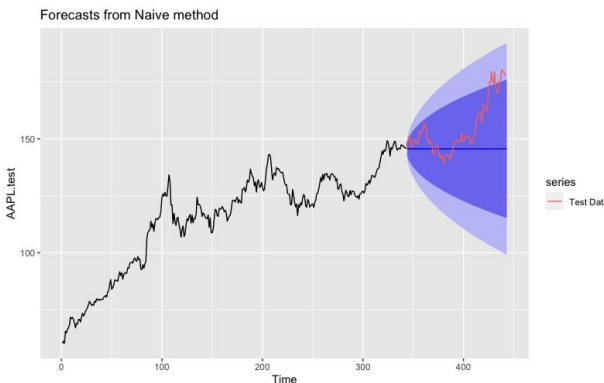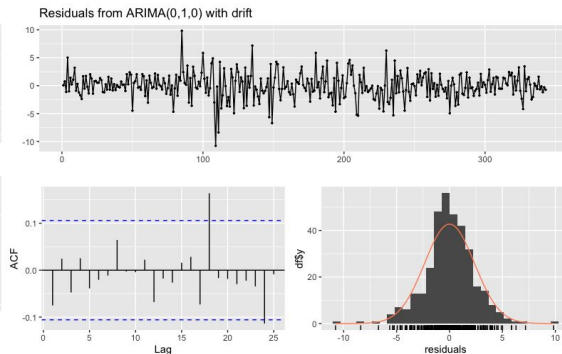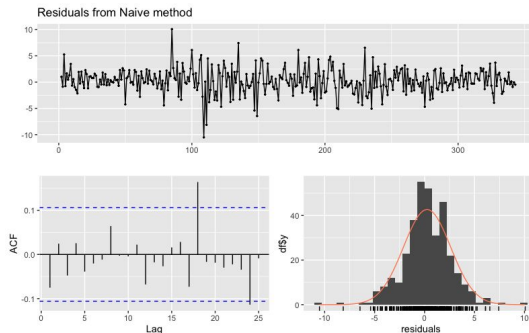
Crypto vs Stock Trends

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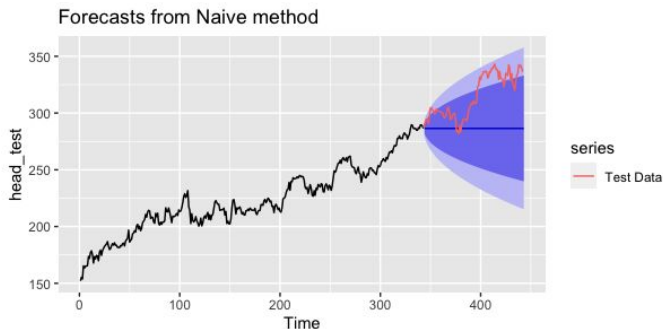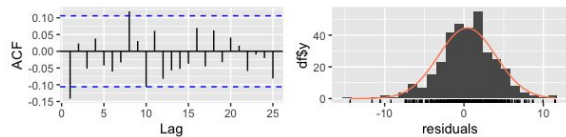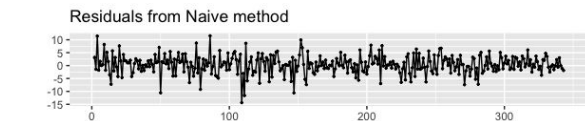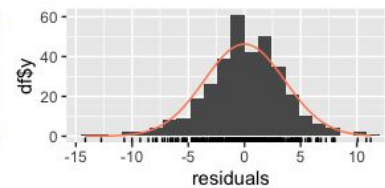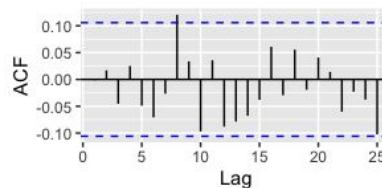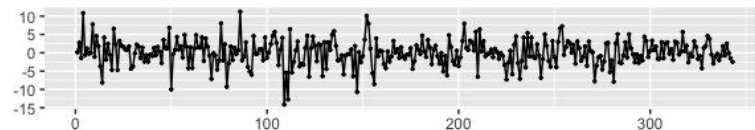
For Microsoft the price also dips but then increases overall.

Crypto vs Stock Trends

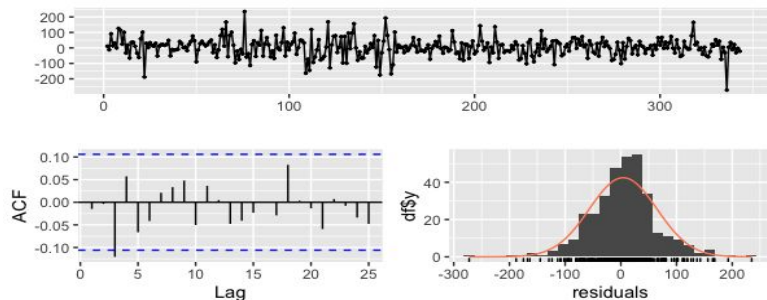Are Cryptocurrency Prices related to Stock Market Prices?

Residuals from ARIMA(0,1,0)
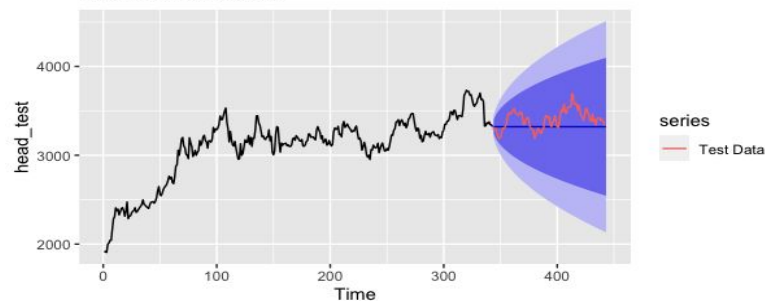

Residuals from Naive method

AMZN Arima Model

For Amazon we see that opposed to the previous two slides, Amazon stays stagnant and does not have a price increase as high as the other two.
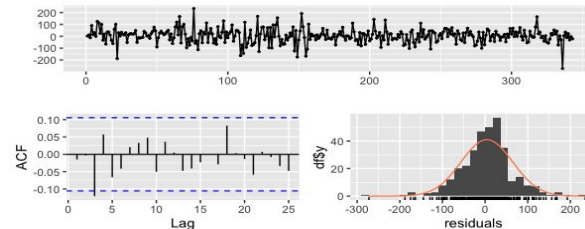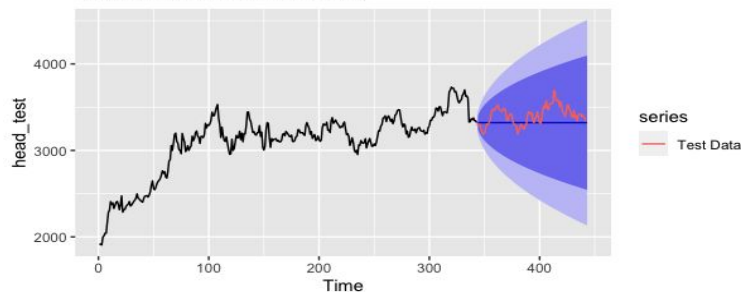
Forecasts from Naive method

Crypto vs Stock Trends

Residuals from ARIMA(2,1,2)

<u>Question:</u> Are Cryptocurrency Prices related to Stock Market Prices?

GOOGL Arima Model

Residuals from Naive method

Forecasts from Naive method

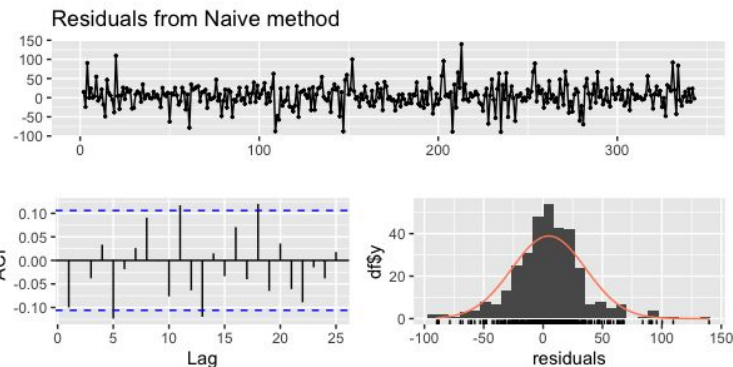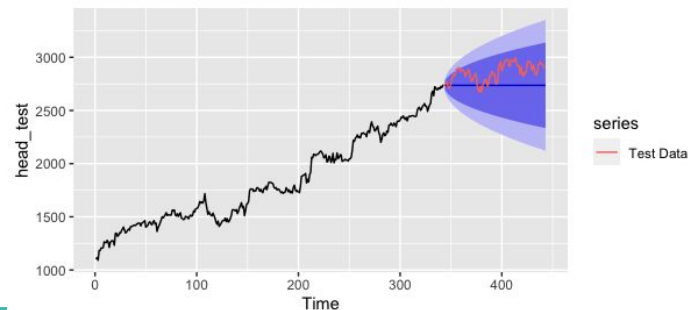Google also follows a similar path to Amazon. There is not a significant increase in price, however the price is still positive.

Crypto vs Stock Trends
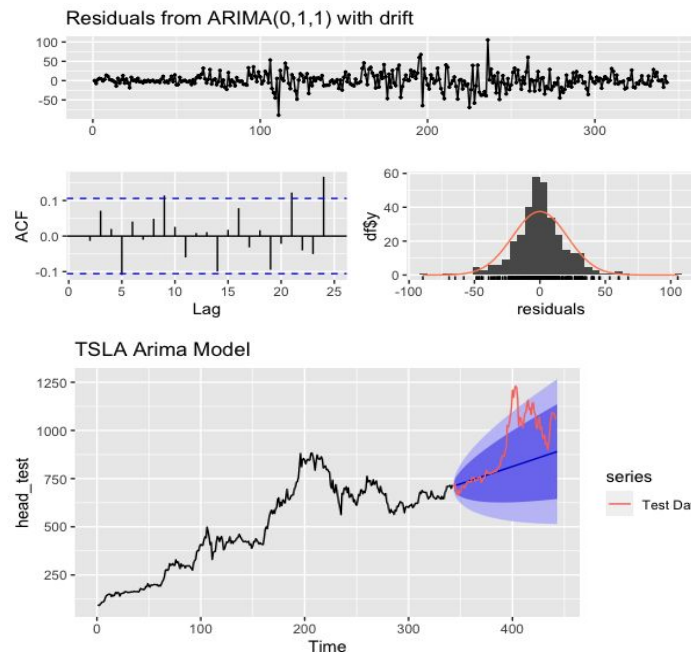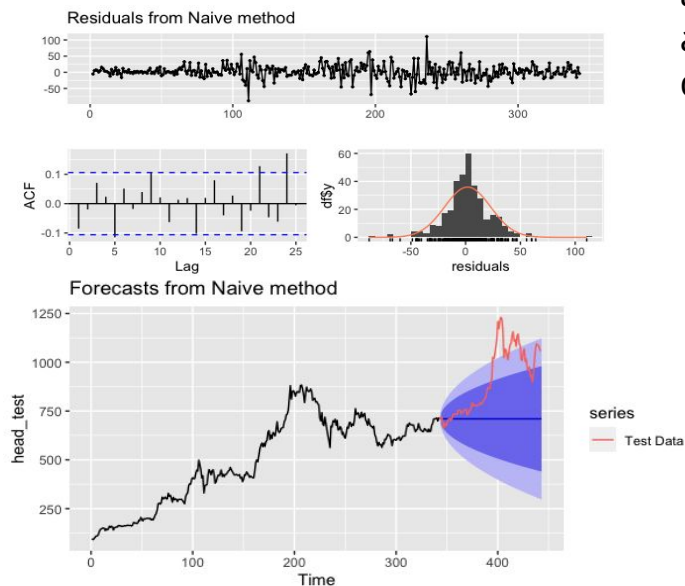
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Tesla has the most dramatic increase of all the five stock prices. The price spikes well above the 80% interval and then falls slightly down.

Combined Analysis

We performed a **Pearson Correlation** analysis between Amazon stock prices and Bitcoin crypto prices.

We received a correlation value of 0.7801827, which tells us that we have a relatively strong positive correlation between Amazon and Bitcoin.

The p-value is 2.2e-16, which also tells us that the relationship between Amazon and Bitcoin is significant.

Combined Analysis

We also performed a Pearson Correlation analysis between Ethereum and Tesla closing prices.

The correlation value is 0.7639482 which implies that there is a strong correlation between Ethereum and Tesla closing prices.

The p-value is also less than 2.2e-16.

Conclusion

- Based on our Pearson Correlations, you see there is a strong correlation between Stocks market prices and Crypto Prices .