

Final Project Paper

To start off, this project challenged the two of us. Researching and learning new ways to visualize data accompanied with failing many times, but nonetheless, it was a lot of fun experimenting and seeing our work come alive in our analysis.

We each decided to take either Cryptocurrency or Stocks and analyze that information by itself to see what conclusions and analysis we can come up with; and then we took our analysis and traded off one stock and one cryptocurrency to compare and did different correlations to see what different conclusions we can come to.

We used the ARIMA and Naïve Methods for forecasting to attempt forecasting future stock and crypto prices. According to research, the ARIMA method is more accurate than the Naïve method; and in our analysis we did come to that conclusion.

For crypto, Bitcoin (BTC), Cardano (ADA), and Ethereum (ETH) were chosen for analysis, and although their prices are dramatically different from each other, all three are considered very popular; Bitcoin being the lead in the crypto world. The dates chosen, the beginning of the pandemic to the first of January this year. At first glance, an initial time series graph, we see that they all have similar dips and similar upward trends.

We then dive in a little deeper and look into the chartSeries method in R for one specific reason: to look at trading volume. Ethereum and Cardano are up and coming and have potential in a number of years to surpass Bitcoin, so trading volume is important. Trading volume was relatively stable for Bitcoin, Ethereum and Cardano's traffic had a steep increase after the initial scare of the pandemic was over.

The next thing we looked at was Daily Return on Investment. This is important from a purely investment point of view. Surprisingly, Cardano had the highest return on investment, and the reasons for that being the case could be many. Most important to note is that the time period analyzed is only the past two years, so there could be a lot of room for error. The pandemic years were used to see how big of a difference the pandemic has had on the crypto and stock markets.

We now come to forecasting, using two different models, for comparison and accuracy. We used a forecast of the next hundred days to see if the market in these past three months even remotely resembles what we predict. There are many variables we looked at within these models to reach the forecast. We look at the Autocorrelation (ACF) to get the p-value within the ARIMA(p,q,d) model. This shows us the correlation between the observation at the current time spot and the observations at previous time spots. We then look at the Partial Autocorrelation (PACF) to give us the q-value of the ARIMA model. The correlation between observations at two time spots given that we consider both observations are correlated to observations at other time spots.

After getting all of the data we need for the model, we input all this information into the ARIMA model from R. For Ethereum and Bitcoin, the forecasts look rather similar in a positive trend with dips along the way. When I looked at the past three months the prices look rather similar to the forecast I had for the same amount of time. This was the goal of forecasting these past three months; to make sure that our forecast models were somewhat accurate.

After the models were completed, we needed to look at the numerical accuracy of these models to make sure at the very least our model was statistically accurate as well. We used the MAPE (Mean Absolute Percentage Error) and subtracted that from a hundred to see the

percentage accuracy that we had. All the models were above 95% accurate which is satisfying. The difference in accuracy between the Naive and ARIMA models was about 0.1% so the two models were rather accurate according to the MAPE value. To double down on how accurate our models were we took a look at the RMSE (Root Mean Squared Error) and the p-value. For accuracy, we are looking for a p-value greater than 0.05 and a lesser RMSE. In all categories, the ARIMA model was more accurate numerically. This gave incentive to take the forecasts made seriously.

When looking at the analysis of the stock market, we originally had forecasted that there would be a downward trend in both stock price and trading volume. Due to the COVID-19 pandemic the hypothesis was that there would be a significant downward trend in the price for the stocks we chose. When deciding the stocks to include in our analysis we ended up choosing the top five stocks in the NASDAQ 500. The top five stocks are Apple (AAPL), Microsoft (MSFT), Amazon (AMZN), Alphabet (GOOGL), and Tesla (TSLA). These five stocks hold the most weight in the NASDAQ 500. We were able to find the data for all five of the stock companies using an API to pull the data into xts objects.

We pulled the data from the quantmod package for all five of the stocks named above. After pulling the data we did some initial exploratory data analysis by plotting the closing price and the adjusted price vs the time. From this we noticed that contrary to our initial hypothesis, the price did not fall dramatically but actually increased during the pandemic. Once noticing this we decided to plot all five time series into the same plot. The plot depicted that all five stocks had a significant upward trend during the pandemic. After plotting the time series we decided to explore the volume of stock that each of the five companies sold during that time. All five had significant upward trends implying that these stocks actually flourished during the pandemic and

were traded more during the pandemic. Because of this, we decided to run a return analysis on the five stocks during the pandemic. From this analysis, note that four of the five stocks had a relatively small daily return. However, Tesla's daily return skyrocketed and actually was the best performer in daily returns with the stock reaching new heights in price. From this initial exploratory analysis we noticed that our hypothesis was far from correct and that the stocks actually had a positive trend during the pandemic with some of the stocks reaching new highs in their price.

From here we started to apply the Naive Forecast and ARIMA model to the five stocks to forecast the prices of these five stocks. When using the Naive Forecast model on the five stocks by creating a test data set for that stock and then applying a forecast on that set. From the AAPL forecast we see that the RMSE was 2.368 with a MAE of 1.75, MSFT forecast the RMSE is 3.633 with a MAE of 2.76, AMZN forecast the RMSE of 60.613 and a MAE of 44.603, GOOGL forecast the RMSE of 31.360 and a MAE of 22.777 and TSLA forecast RMSE of 21.070 and MAE of 14.832. We see that for AAPL and MSFT the residuals are quite close to the line of best fit implying that the data is quite close and packed together. In contrast for AMZN, GOOGL and TSLA the residuals are further apart and more sporadic implying that the data has more dramatic dips and spikes. When plotting the forecasts we see that for four of the five stocks the forecasts follow a similar price to that in real life. Of the five forecasts, TSLA has the most dramatic of the forecasts. The naive walk forecasts that TSLA's price would rise to almost \$1,250 and then dip and stabilize at around \$1,100. Even though this did not happen, the forecast realized that the stock would rise past the \$1,000 mark which it did in real life. When looking at the Arima models we see a similar story for all the stocks. For AAPL the RMSE was 2.352 and the MAE was 1.73, MSFT the RMSE was 2.352 and the MAE was 1.738, AMZN the RMSE was 20.885

and the MAE was 14.627, GOOGL the RMSE was 31.360 and the MAE was 22.777, and TSLA the RMSE was 20.885 and the MAE was 14.627. So we see that for the Arima model the five stocks depict a similar story in that MSFT and AAPL had a more tight data set while the rest of the stocks had a more distanced data set. When we note the plots all of the plots stay within the 80% interval except for TSLA, where the Arima model forecasts that TSLA's price will jump outside of the interval.

For the combined portion of our analysis, we took a look at the Pearson Correlation to compare the Stocks and Cryptos. We have to note that when doing these correlations, we chose stocks and cryptocurrencies that were similar in price. We chose AMZN and BTC to be compared and found that the correlation value is 0.7801827 with a p-value of $2.2e-16$; both of which tell us that the two have a strong relationship and strong correlation. This indicated that in the future, any rise and fall in AMZN will likely cause a rise or fall in BTC as well. We also chose to use the Pearson Correlation on TSLA and ETH because of their similarity in price and growth. From this correlation we see that the correlation value of 0.7639482 with a p-value of less than $2.2e-16$. This implies that both TSLA and ETH have a strong relationship and correlation and a spike or dip in TSLA or ETH will cause a spike or dip in the other.

Appendix:

Bitcoin_Analysis

S.ElBakry

Acquiring Crypto Prices from Yahoo Finance API:

```
BTC.Close <- getSymbols('BTC-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')[,4]
```

```
## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```
ADA.Close <- getSymbols('ADA-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')[,4]
ETH.Close <- getSymbols('ETH-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')[,4]
AMZN.close <- getSymbols(Symbols = "AMZN",src = "yahoo",from ="2019-08-28",to="2022-04-01",auto.assign = FALSE)

BTC <- getSymbols('BTC-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')
ETH <- getSymbols('ETH-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')
ADA <- getSymbols('ADA-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')
```

Plotting Basic TimeSeries for Crypto:

```
par(mfrow = c(1,1))
chartSeries(BTC)
```



chartSeries(ETH)



chartSeries(ADA)



Closing Prices by month:

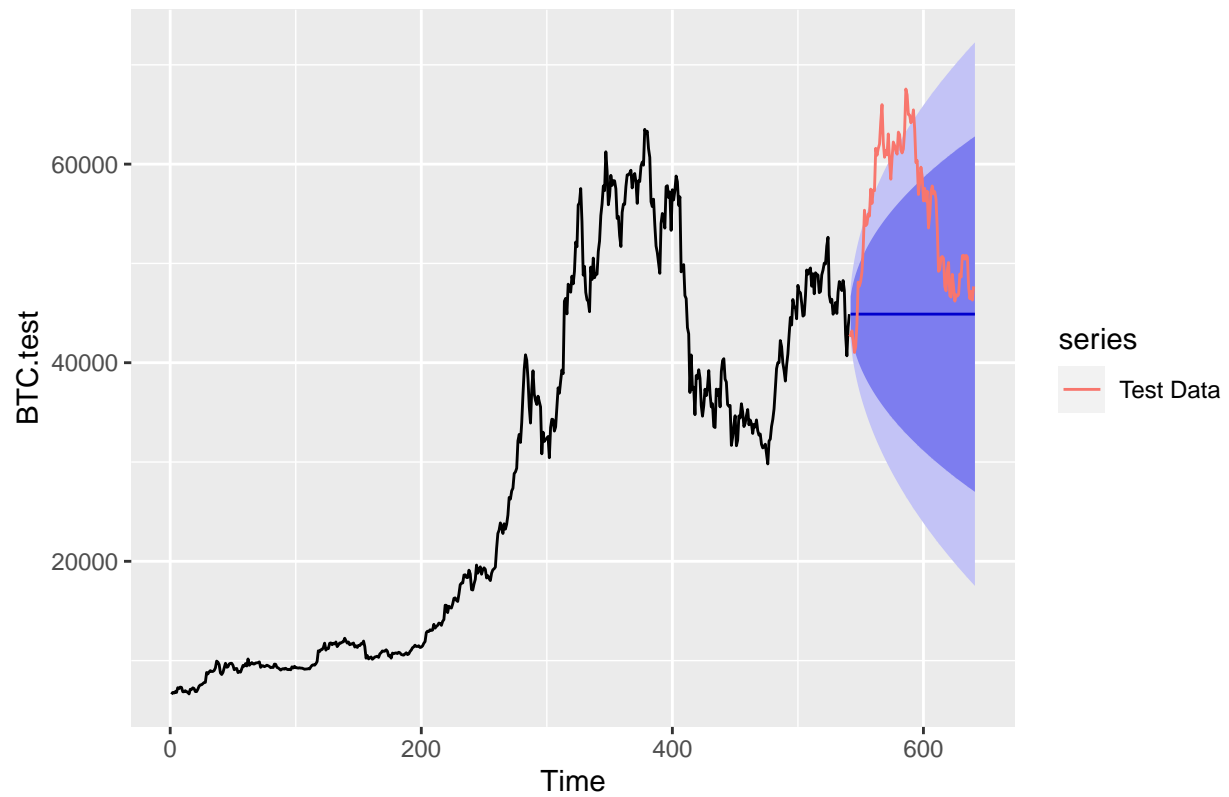
```
closing.BTC.month <- Cl(to.monthly(BTC))
closing.ETH.month <- Cl(to.monthly(ETH))
closing.ADA.month <- Cl(to.monthly(ADA))
```

Forecast Model For BTC Using the Naive Model:

```
n <- 100
BTC.test <- head(Cl(BTC), length(Cl(BTC))-n)
test.BTC <- tail(Cl(BTC), n)
fc.BTC <- naive(BTC.test, h=n)

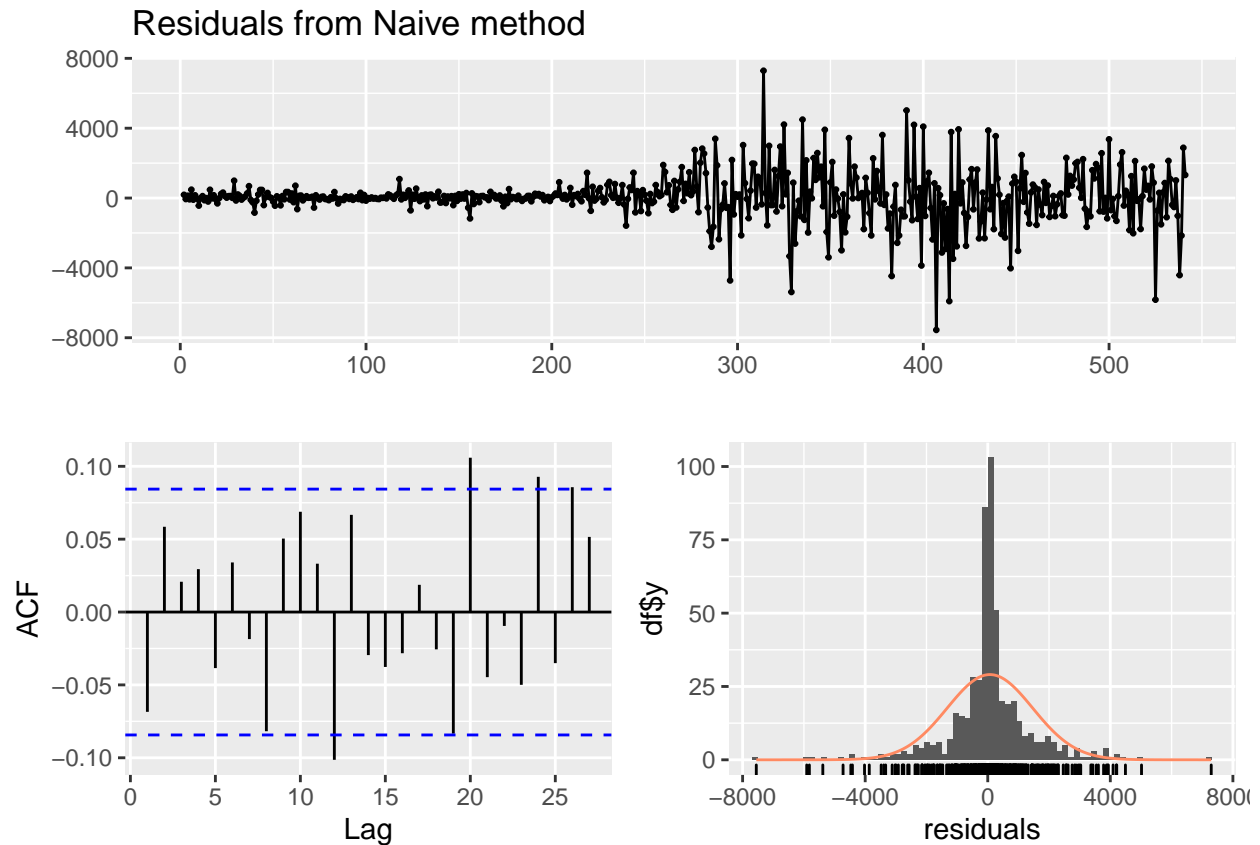
# Plot the result
autoplot(fc.BTC) +
  autolayer(ts(test.BTC, start=length(BTC.test)), series = "Test Data")
```

Forecasts from Naive method



Check the BTC Naive Forecast:

```
checkresiduals(fc.BTC)
```



```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 14.449, df = 10, p-value = 0.1535
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc.BTC)
```

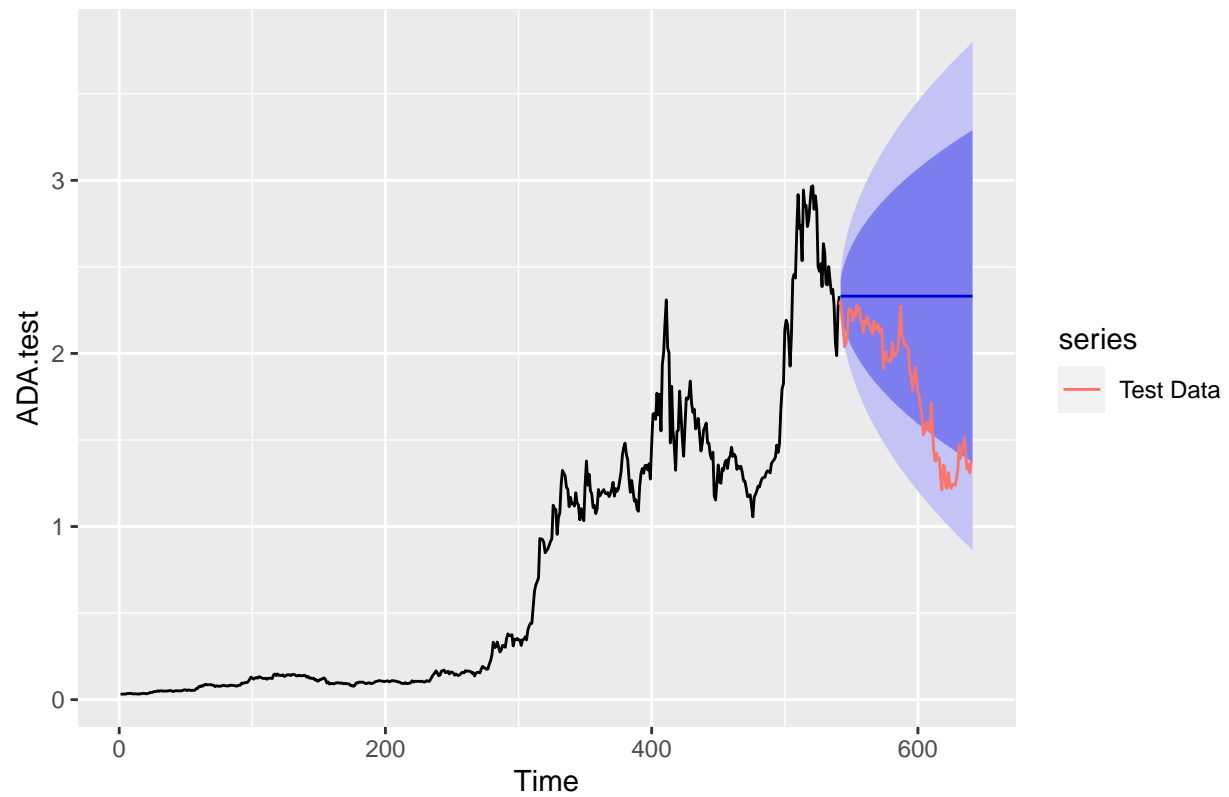
```
##               ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 70.9043 1396.545 843.5451 0.2833237 2.67291    1 -0.06847716
```

Forecast Model For ADA Using the Naive Model:

```
n <- 100
ADA.test <- head(Cl(ADA), length(Cl(ADA))-n)
test.ADA <- tail(Cl(ADA), n)
fc.ADA <- naive(ADA.test, h=n)

# Plot the result
autoplot(fc.ADA, main='ADA Naive Forecast') +
  autolayer(ts(test.ADA, start=length(ADA.test)), series = "Test Data")
```

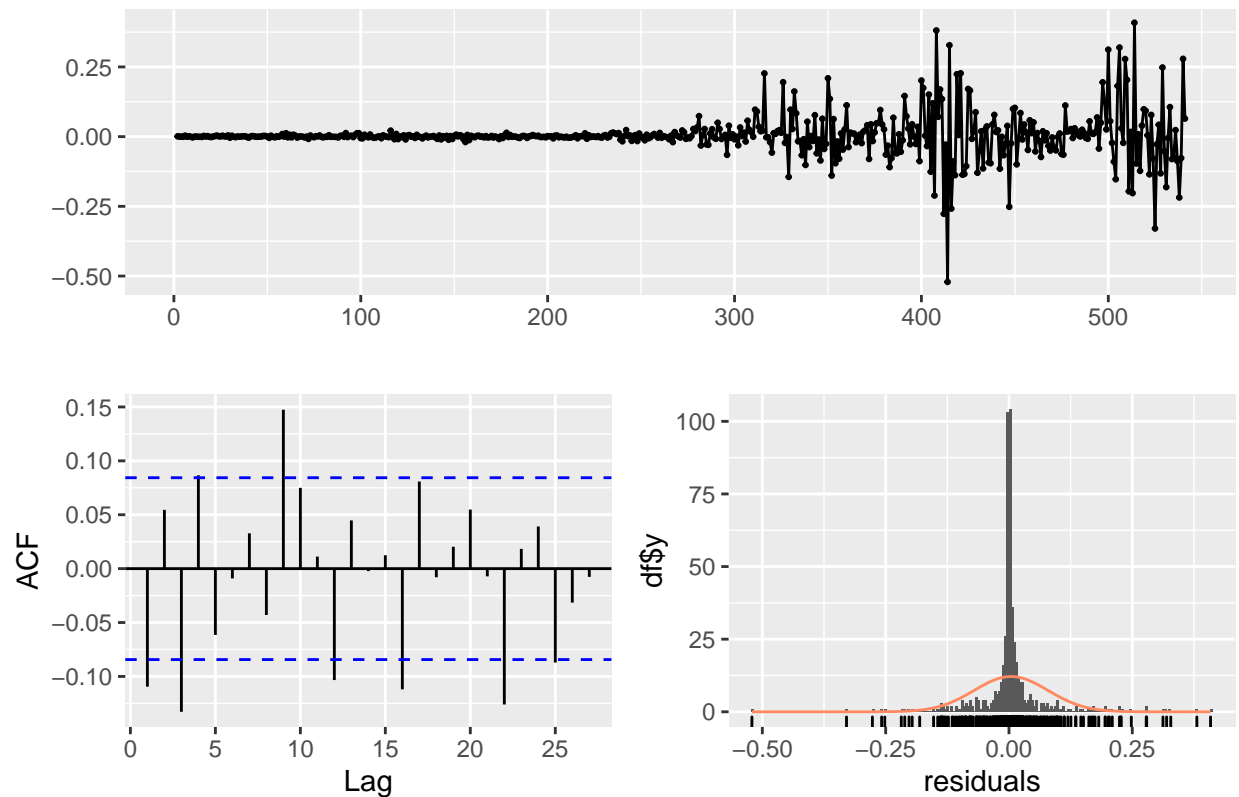
ADA Naive Forecast



Check ADA Naive Forecast:

```
checkresiduals(fc.ADA)
```

Residuals from Naive method



```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 40.632, df = 10, p-value = 1.311e-05
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc.ADA)
```

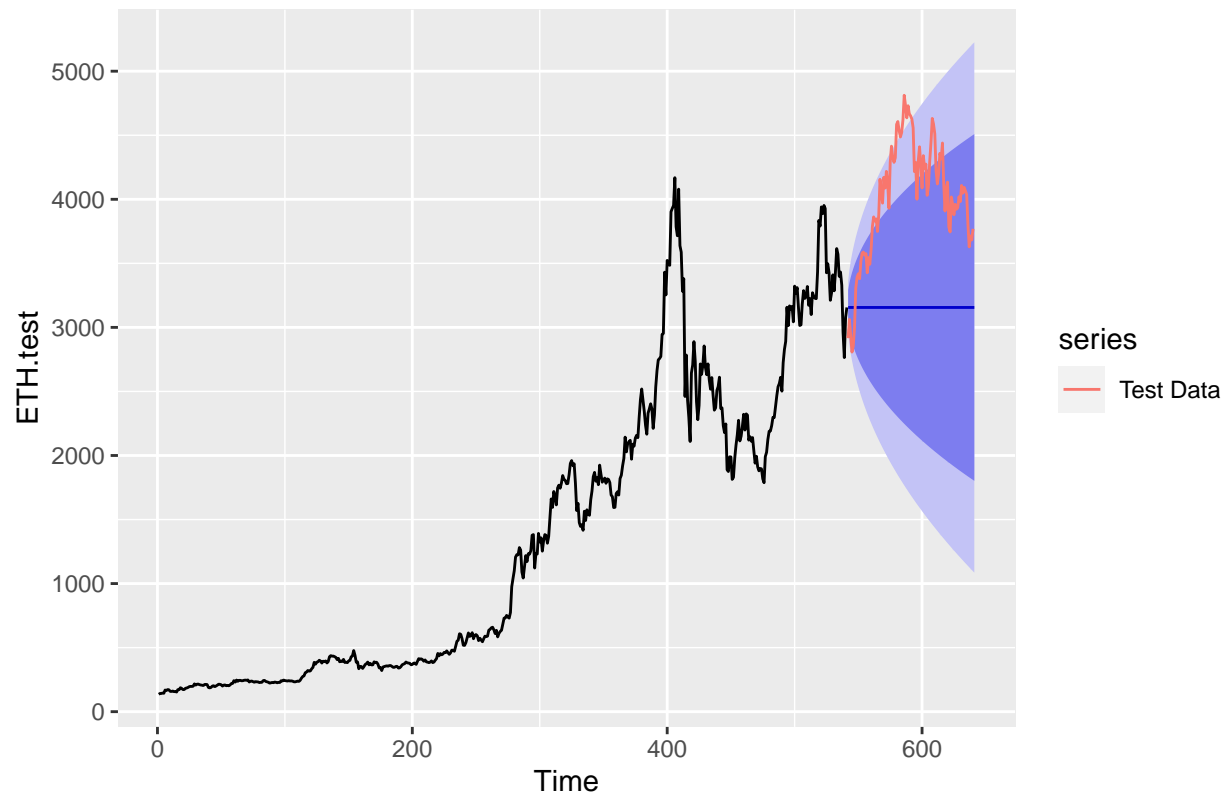
```
##               ME      RMSE      MAE      MPE      MAPE  MASE
## Training set 0.004259419 0.0748107 0.03659268 0.5970514 4.505943    1
##               ACF1
## Training set -0.1094786
```

Forecast Model For ETH Using the Naive Model:

```
n <- 100
ETH.test <- head(Cl(ETH), length(Cl(ETH))-n)
test.ETH <- tail(Cl(ETH), n)
fc.ETH <- naive(ETH.test, h=n)

# Plot the result
autoplot(fc.ETH, main='Naive Forecast for ETH') +
  autolayer(ts(test.ETH, start=length(ETH.test)), series = "Test Data")
```

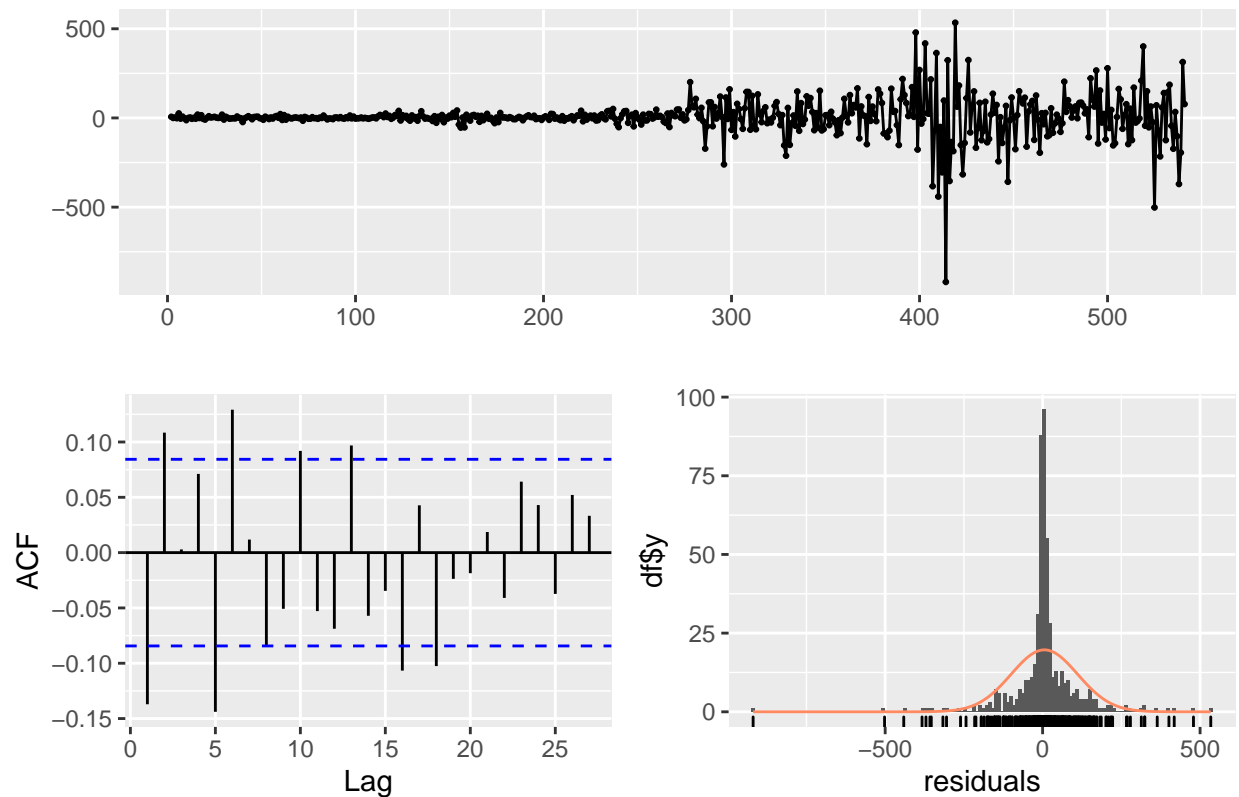
Naive Forecast for ETH



Check ETH Naive Forecast:

```
checkresiduals(fc.ETH)
```

Residuals from Naive method



```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 49.845, df = 10, p-value = 2.851e-07
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc.ETH)
```

```
##                ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 5.592387 105.6073 56.68622 0.4460063 3.748914      1 -0.1370648
```

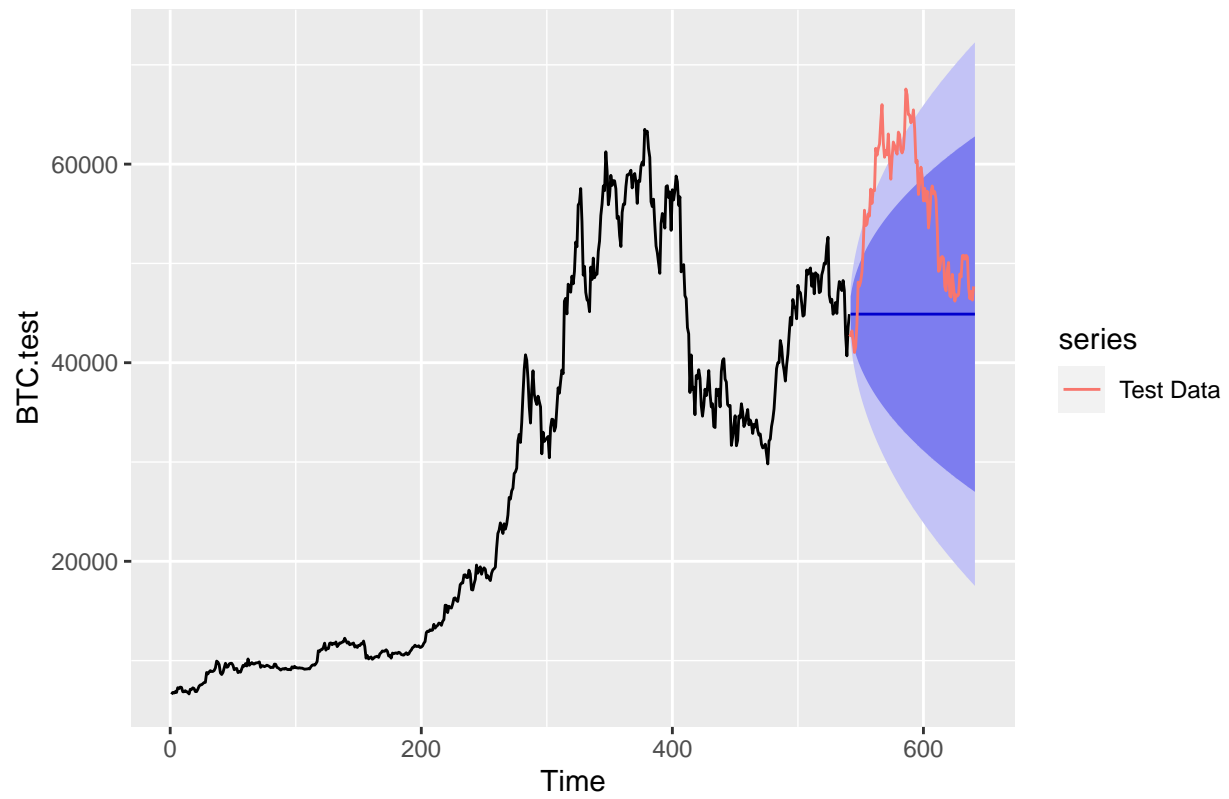
Forecasts for BTC Using ARIMA Model:

```
# Create the Model
arima.BTC <- auto.arima(BTC.test, seasonal=FALSE)

# Forecast n periods of the data
fc_non <- forecast(arima.BTC, h=n)

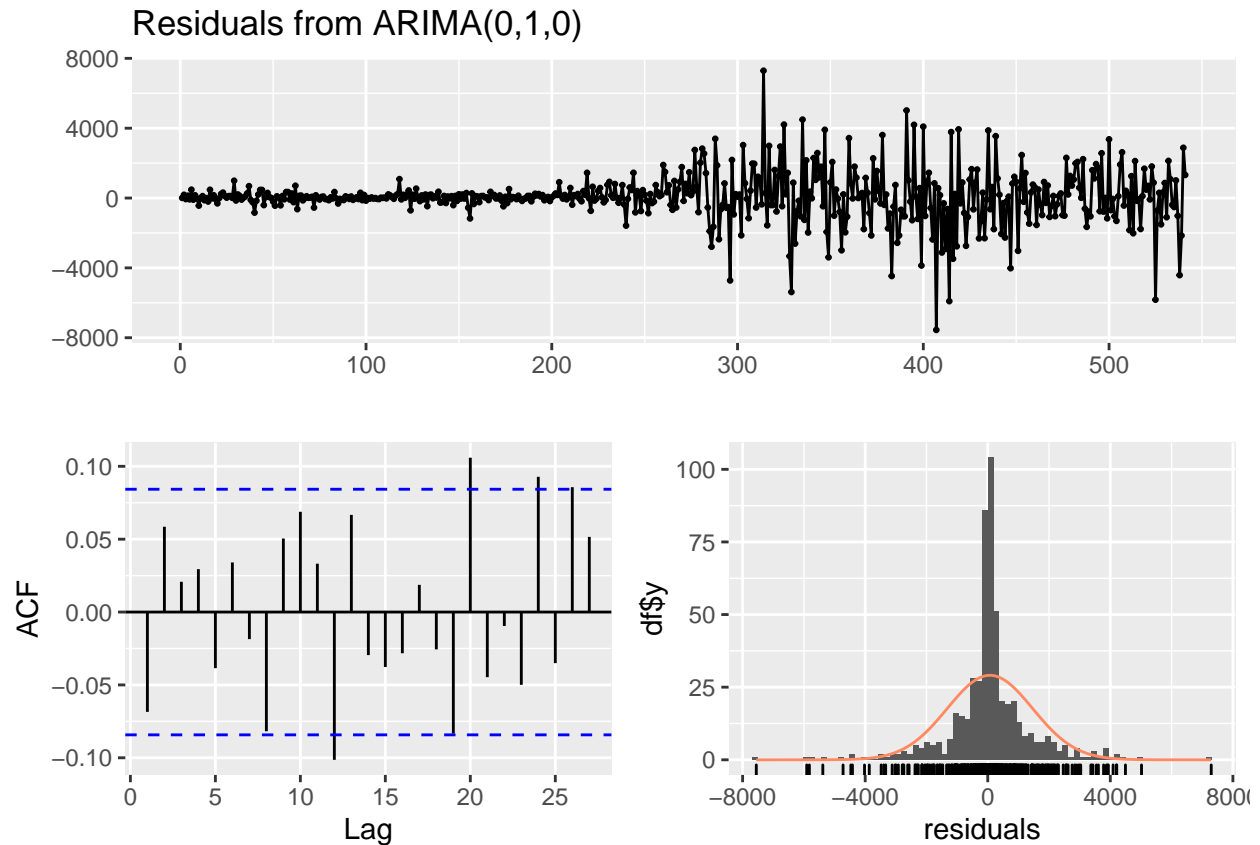
# Plot the result
autoplot(fc_non, main='BTC ARIMA Model Forecast')+
  autolayer(ts(test.BTC, start= length(BTC.test)), series="Test Data")
```


BTC ARIMA Model Forecast



Check BTC Forecast with ARIMA:

```
checkresiduals(fc_non)
```



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,0)
## Q* = 14.48, df = 10, p-value = 0.1522
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc_non)
```

```
##               ME      RMSE      MAE      MPE      MAPE      MASE      ACF1
## Training set 70.78545 1395.254 841.998 0.2829849 2.668154 0.998166 -0.06848412
```

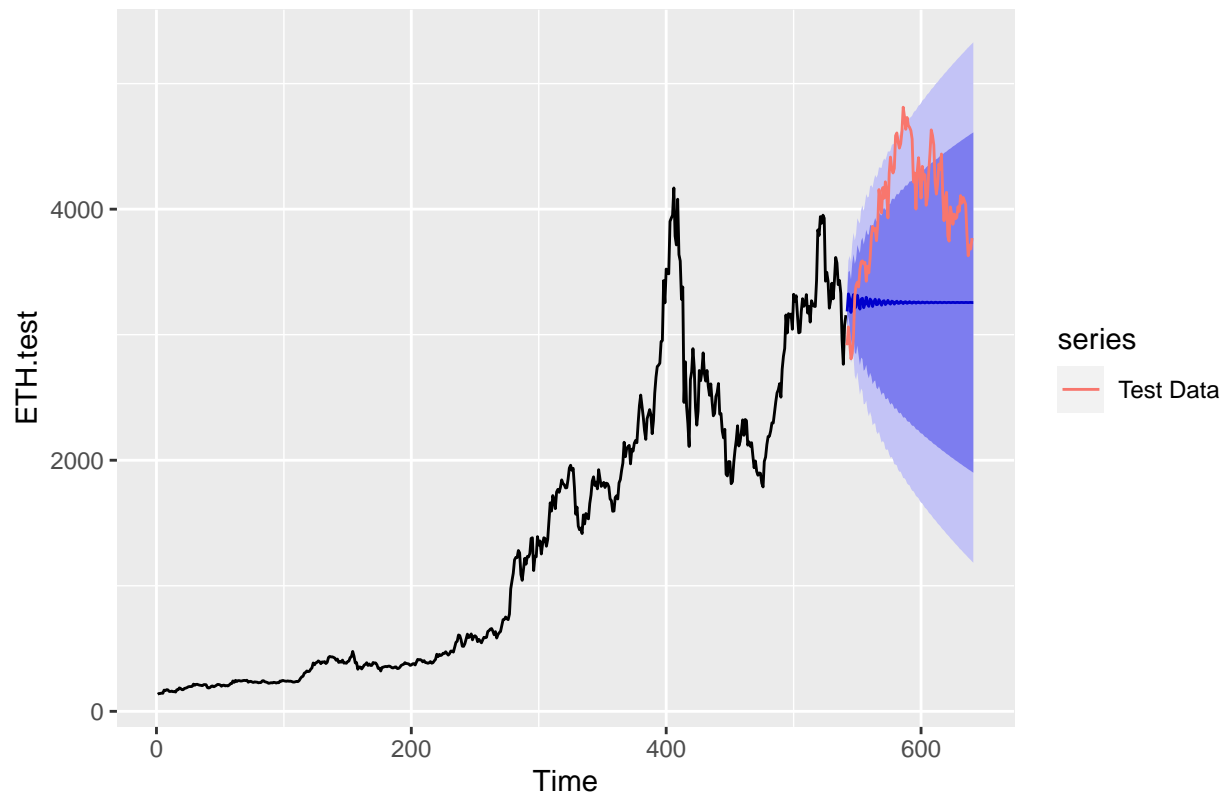
Forecasts for ETH Using ARIMA Model:

```
# Create the Model
arima.ETH <- auto.arima(ETH.test, seasonal=FALSE)

# Forecast n periods of the data
fc_non.ETH <- forecast(arima.ETH, h=n)

# Plot the result
autoplot(fc_non.ETH)+
  autolayer(ts(test.ETH, start= length(ETH.test)), series="Test Data")
```

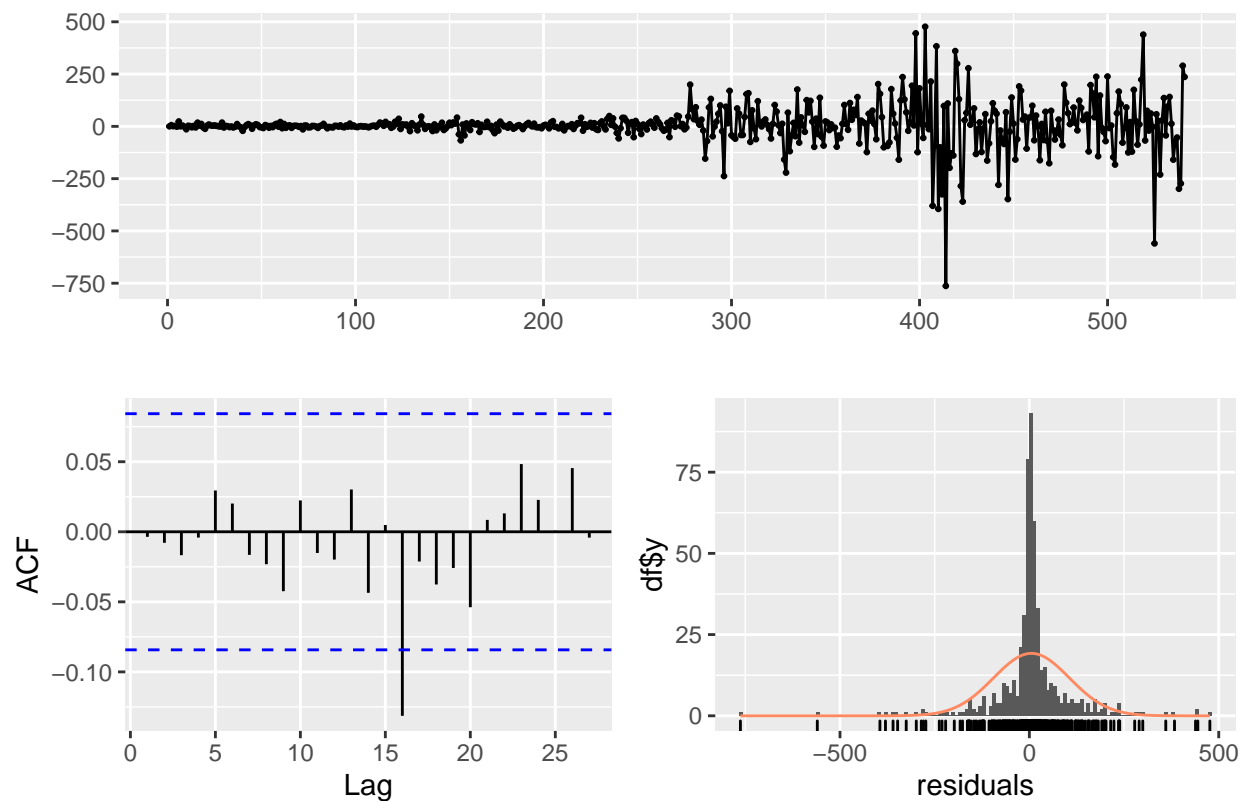
Forecasts from ARIMA(3,1,4)



Check ETH ARIMA Forecast:

```
checkresiduals(fc_non.ETH)
```

Residuals from ARIMA(3,1,4)



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(3,1,4)
## Q* = 2.6171, df = 3, p-value = 0.4545
##
## Model df: 7.   Total lags used: 10
```

```
accuracy(fc_non.ETH)
```

```
##               ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  5.501477 100.2264  53.88911  0.4419025  3.655936  0.9506562
##               ACF1
## Training set -0.003602898
```

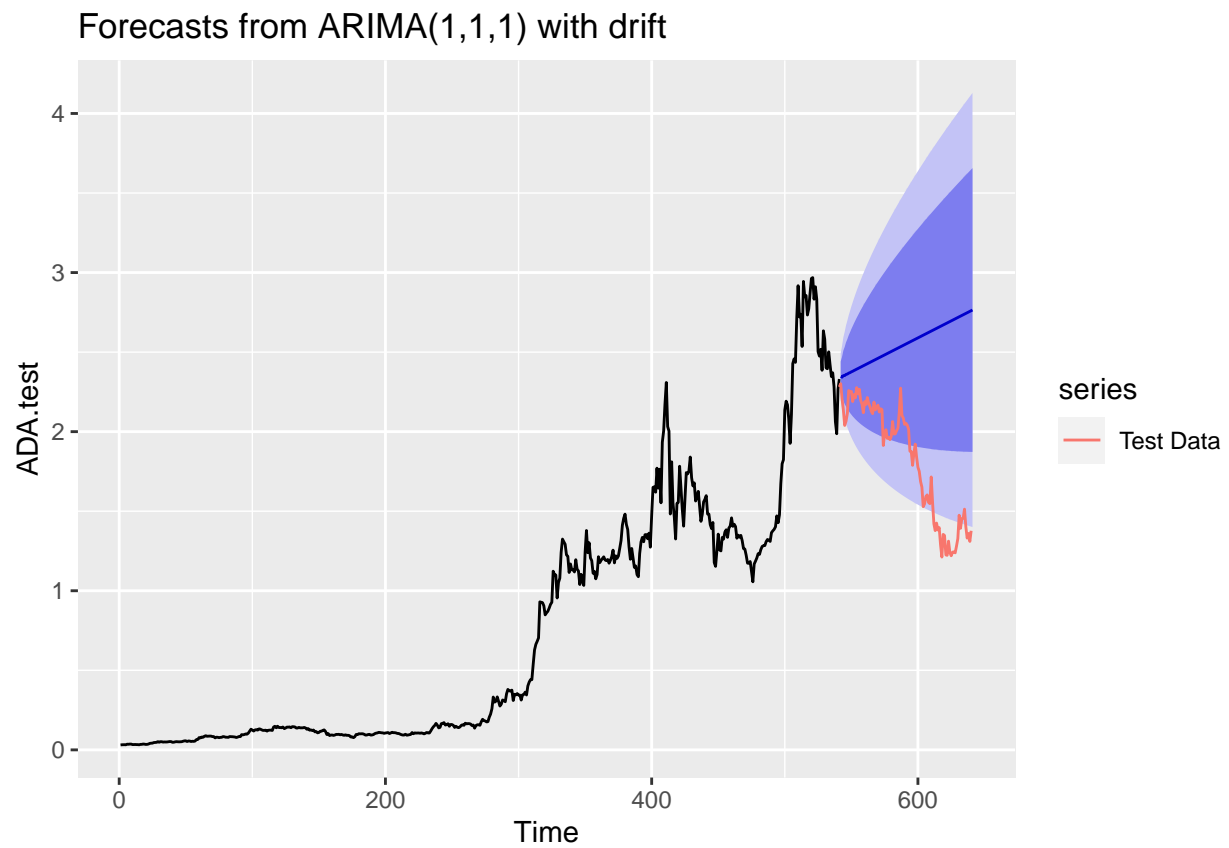
Forecasts for ADA Using ARIMA Model:

```
# Create the Model
arima.ADA <- auto.arima(ADA.test, seasonal=FALSE)

# Forecast n periods of the data
fc_non.ADA <- forecast(arima.ADA, h=n)

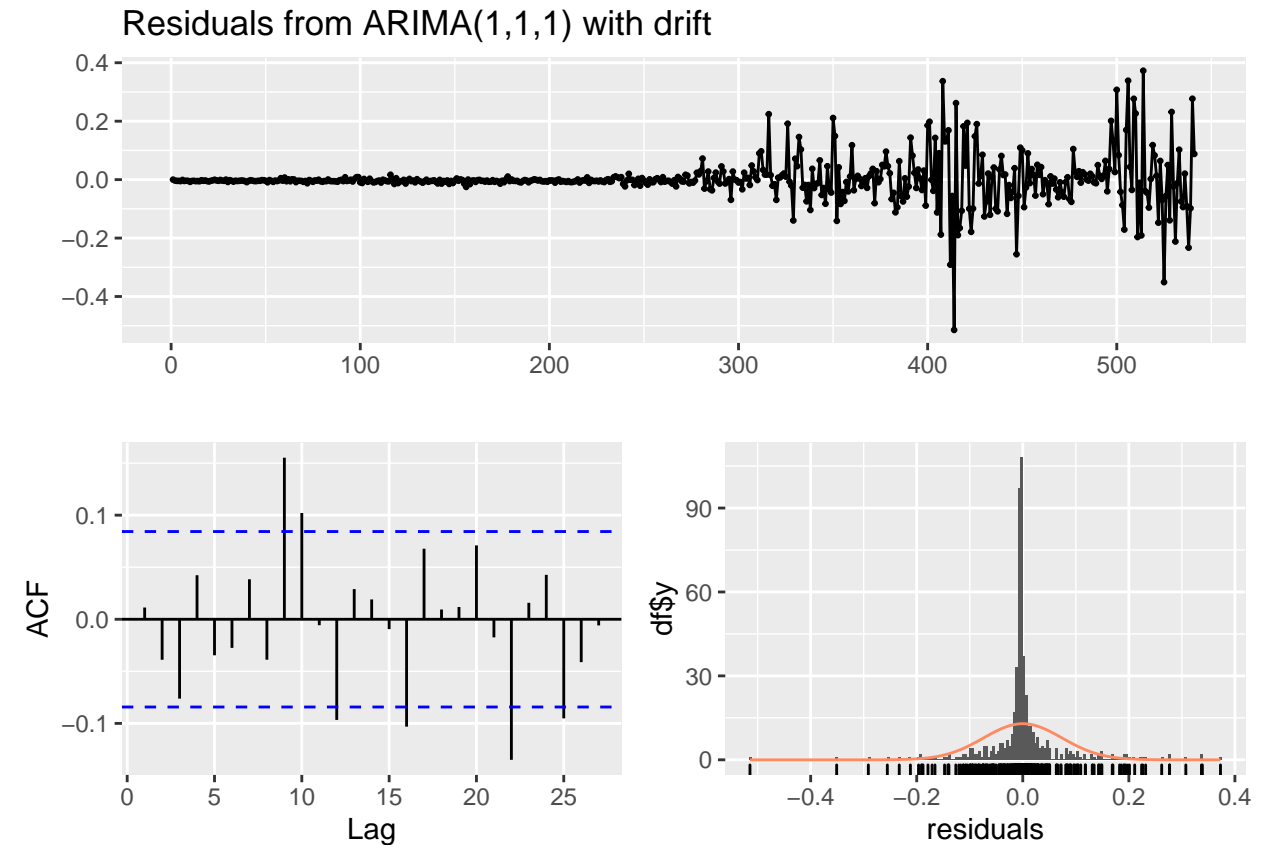
# Plot the result
```

```
autoplot(fc_non.ADA)+  
  autolayer(ts(test.ADA, start= length(ADA.test)), series="Test Data")
```



Check ADA ARIMA Forecast:

```
checkresiduals(fc_non.ADA)
```



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(1,1,1) with drift
## Q* = 26.815, df = 7, p-value = 0.0003598
##
## Model df: 3.   Total lags used: 10
```

```
accuracy(fc_non.ADA)
```

```
##                ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -3.48237e-06 0.07376274 0.03745273 -2.378623 5.731101 1.023503
##                ACF1
## Training set 0.0113059
```

Interactive Timeseries Plot:

```
highchart(type="stock") %>%
  hc_add_series(Cl(BTC), name="BTC") %>%
  hc_add_series(Cl(ETH), name="ETH") %>%
  hc_add_series(Cl(ADA), name="ADA") %>%
  hc_title(text="<b>BTC vs ETH vs ADA Closing Price</b>")
```



Daily Return on ADA, ETH, and BTC:

```
# Calculate the stocks return
return_BTC <- dailyReturn(Cl(BTC))
return_ETH <- dailyReturn(Cl(ETH))
return_ADA <- dailyReturn(Cl(ADA))

# Combine the returns as one data frame
returns <- data.frame(return_BTC,return_ETH,return_ADA)
names(returns) <- c("Return BTC","Return ETH","Return ADA")
returns <- as.xts(returns)

# Plot the returns
library(PerformanceAnalytics)
```

```
## Warning: package 'PerformanceAnalytics' was built under R version 4.1.2
```

```
##
```

```
## Attaching package: 'PerformanceAnalytics'
```

```
## The following objects are masked from 'package:timeDate':
```

```
##
```

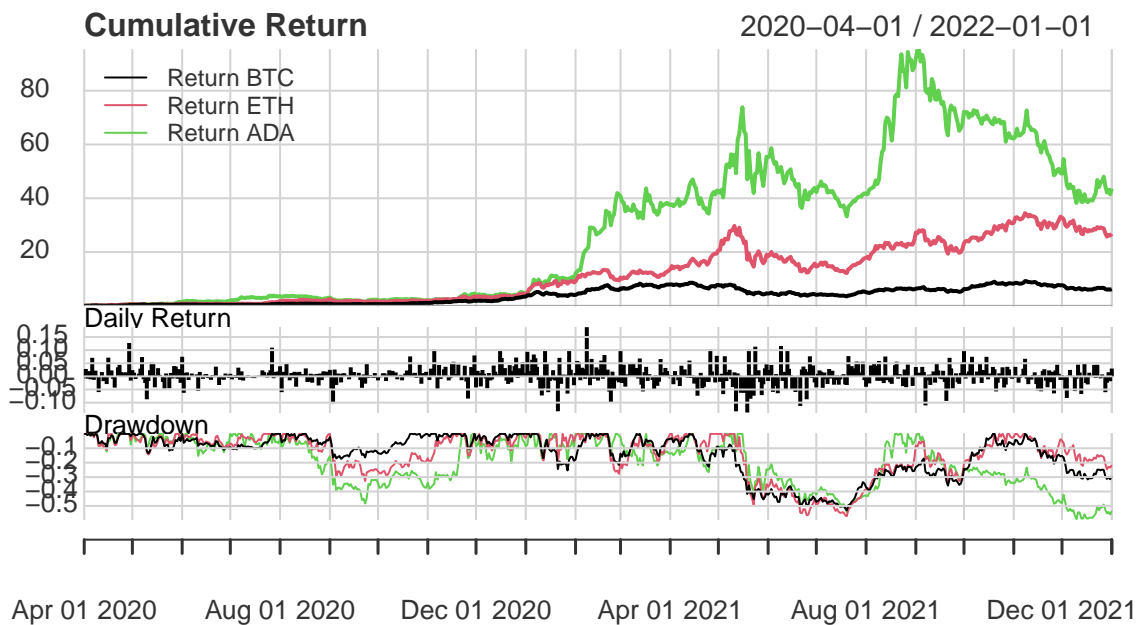
```
##      kurtosis, skewness
```

```
## The following object is masked from 'package:graphics':
```

```
##
##      legend
```

```
charts.PerformanceSummary(returns,main="Daily Return BTC vs ETH vs ADA from Apr2020-Jan2022")
```

Daily Return BTC vs ETH vs ADA from Apr2020–Jan2022



Plotting Normal TimeSeries:

```
#par(mfrow = c(1,1))
#plot(ETH.Close)
#plot(BTC.Close)
#plot(ADA.Close)
```

Correlation between AMZN and Bitcoin Prices:

```
cor.test(AMZN.close, BTC.Close, method = c("pearson","kendall","spearman"))
```

```
## Warning in z + c(-1, 1) * sigma * qnorm((1 + conf.level)/2): Recycling array of length 1 in array-ve
## Use c() or as.vector() instead.
```

```
##
## Pearson's product-moment correlation
##
## data: AMZN.close and BTC.Close
```



```
## t = 31.527, df = 639, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.7479305 0.8087597
## sample estimates:
##      cor
## 0.7801827
```

FinalProject

Jonathan Yun

3/14/2022

```
rm(list = ls())
```

```
library(quantmod)
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

```
##
```

```
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      as.Date, as.Date.numeric
```

```
## Loading required package: TTR
```

```
## Registered S3 method overwritten by 'quantmod':
```

```
##      method      from
```

```
##      as.zoo.data.frame zoo
```

```
library(TTR)
```

```
library(tidyquant)
```

```
## Loading required package: lubridate
```

```
##
```

```
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      date, intersect, setdiff, union
```

```
## Loading required package: PerformanceAnalytics
```

```
##
```

```
## Attaching package: 'PerformanceAnalytics'
```

```
## The following object is masked from 'package:graphics':
```

```
##
```

```
##      legend
```

```
## == Need to Learn tidyquant? =====
```

```
## Business Science offers a 1-hour course - Learning Lab #9: Performance Analysis & Portfolio Optimization
```

```
## </> Learn more at: https://university.business-science.io/p/learning-labs-pro </>
```

```
library(tidyverse)
```

```
## -- Attaching packages ----- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5      v purrr 0.3.4
## v tibble 3.1.6      v dplyr 1.0.7
## v tidyr 1.1.4       v stringr 1.4.0
## v readr 2.1.1      v forcats 0.5.1

## -- Conflicts ----- tidyverse_conflicts() --
## x lubridate::as.difftime() masks base::as.difftime()
## x lubridate::date() masks base::date()
## x dplyr::filter() masks stats::filter()
## x dplyr::first() masks xts::first()
## x lubridate::intersect() masks base::intersect()
## x dplyr::lag() masks stats::lag()
## x dplyr::last() masks xts::last()
## x lubridate::setdiff() masks base::setdiff()
## x lubridate::union() masks base::union()

library(ggplot2)
library(timetk)
library(highcharter)
library(forecast)
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
## combine

library(PerformanceAnalytics)
library(correlation)
```

Stock Prices

```
tickers = c("AAPL", "MSFT", "AMZN", "GOOGL", "TSLA")

getSymbols(tickers,
           from = "2020-04-01",
           to = "2022-01-01")
```

```
## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
## [1] "AAPL" "MSFT" "AMZN" "GOOGL" "TSLA"

stocks <- map(tickers,function(x) Ad(get(x)))
stocks <- reduce(stocks,merge)
colnames(stocks) <- tickers
list = list(AAPL, MSFT, AMZN, GOOGL, TSLA)
```

Highcharting EDA

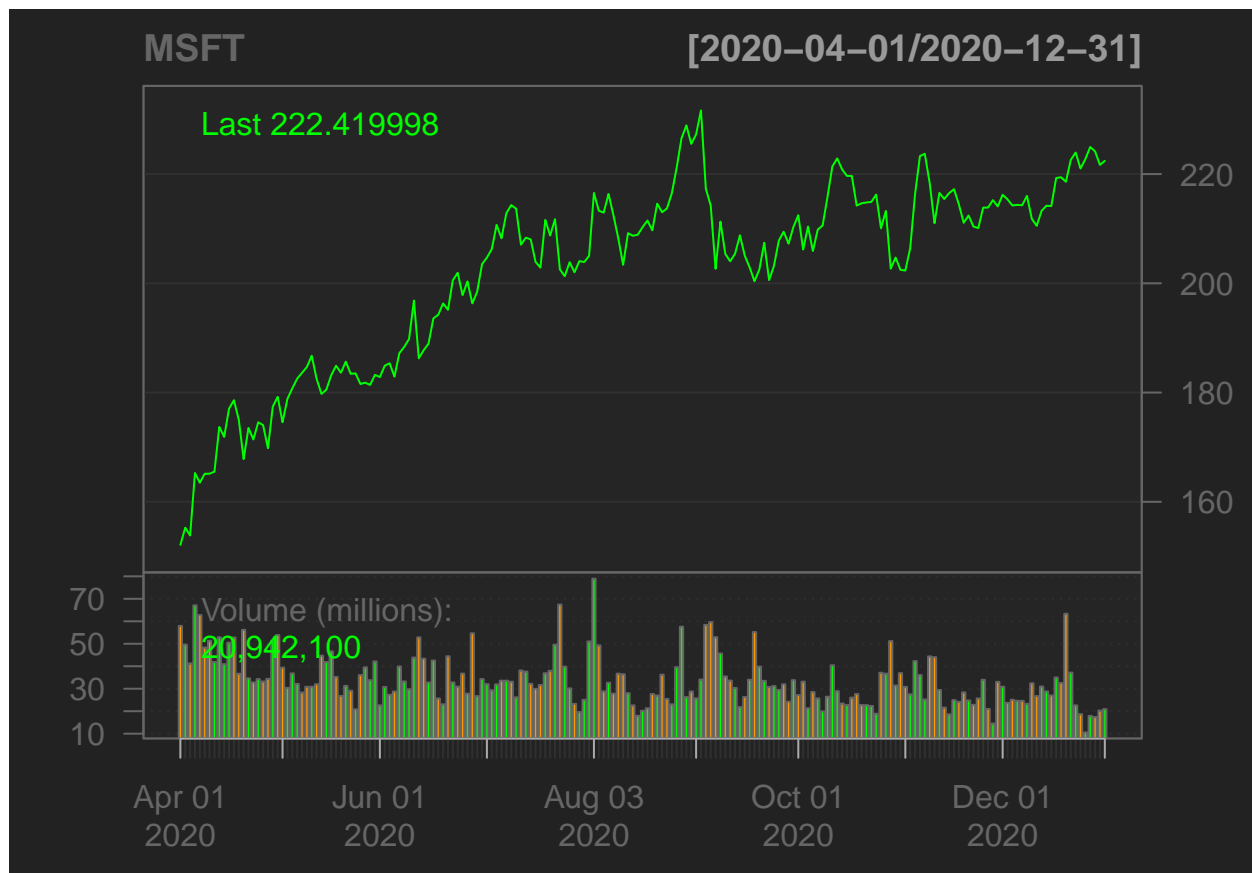
```
# highchart(type = 'stock') %>%
#   hc_add_series(name = "Apple", stocks$AAPL) %>%
#   hc_add_series(name = "Microsoft", stocks$MSFT) %>%
#   hc_add_series(name = "Amazon", stocks$AMZN) %>%
#   hc_add_series(name = "Google", stocks$GOOGL) %>%
#   hc_add_series(name = "Tesla", stocks$TSLA)
```

Charting EDA

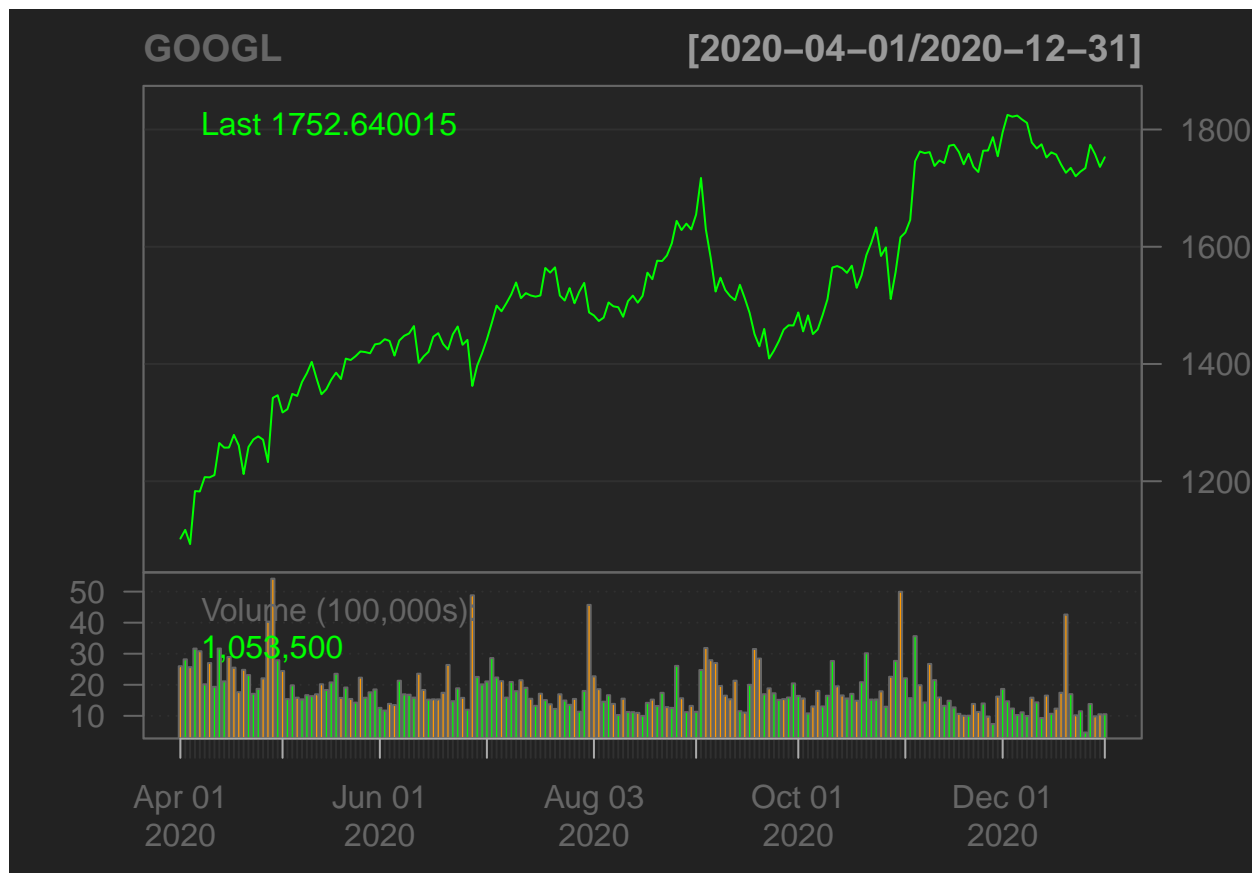
```
chartSeries(AAPL,
            type = "line",
            subset = '2020',
            theme = chartTheme('black'))
```



```
chartSeries(MSFT,
            type = "line",
            subset = '2020',
            theme = chartTheme('black'))
```



```
chartSeries(GOOG,
  type = "line",
  subset = '2020',
  theme = chartTheme('black'))
```



```
chartSeries(TSLA,
  type = "line",
  subset = '2020',
  theme = chartTheme('black'))
```



```
chartSeries(AMZN,
  type = "line",
  subset = '2020',
  theme = chartTheme('black'))
```

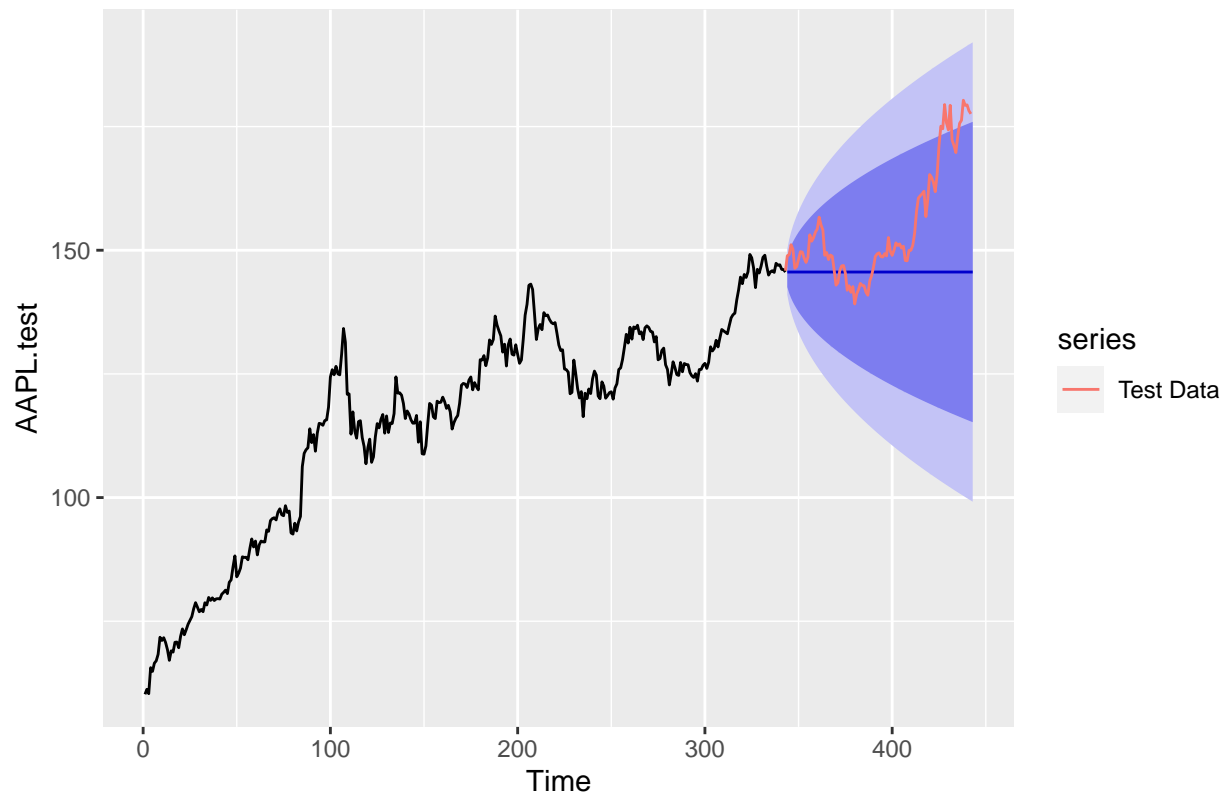


AAPL

```
n <- 100
AAPL.test <- head(Cl(AAPL), length(Cl(AAPL)) - n)
test.AAPL <- tail(Cl(AAPL), n)
fc.AAPL <- naive(AAPL.test, h = n)

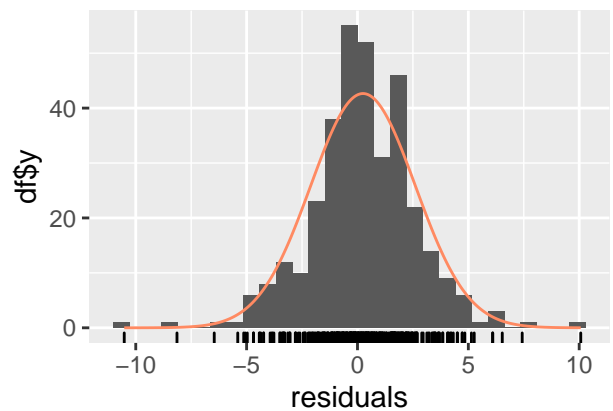
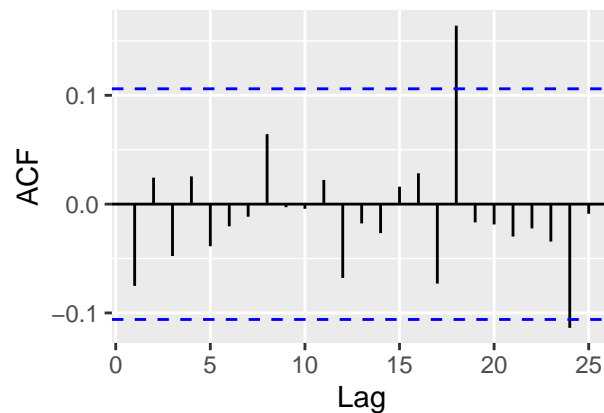
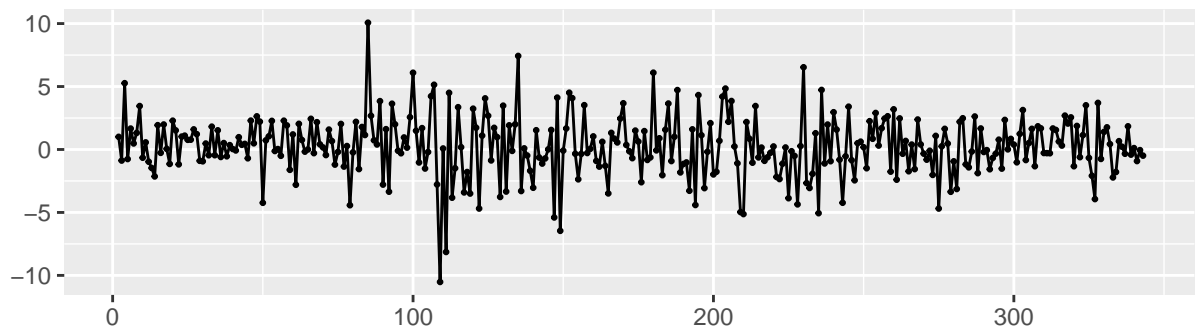
autoplot(fc.AAPL) +
  autolayer(ts(test.AAPL, start = length(AAPL.test)), series = 'Test Data')
```


Forecasts from Naive method



```
checkresiduals(fc.AAPL)
```

Residuals from Naive method

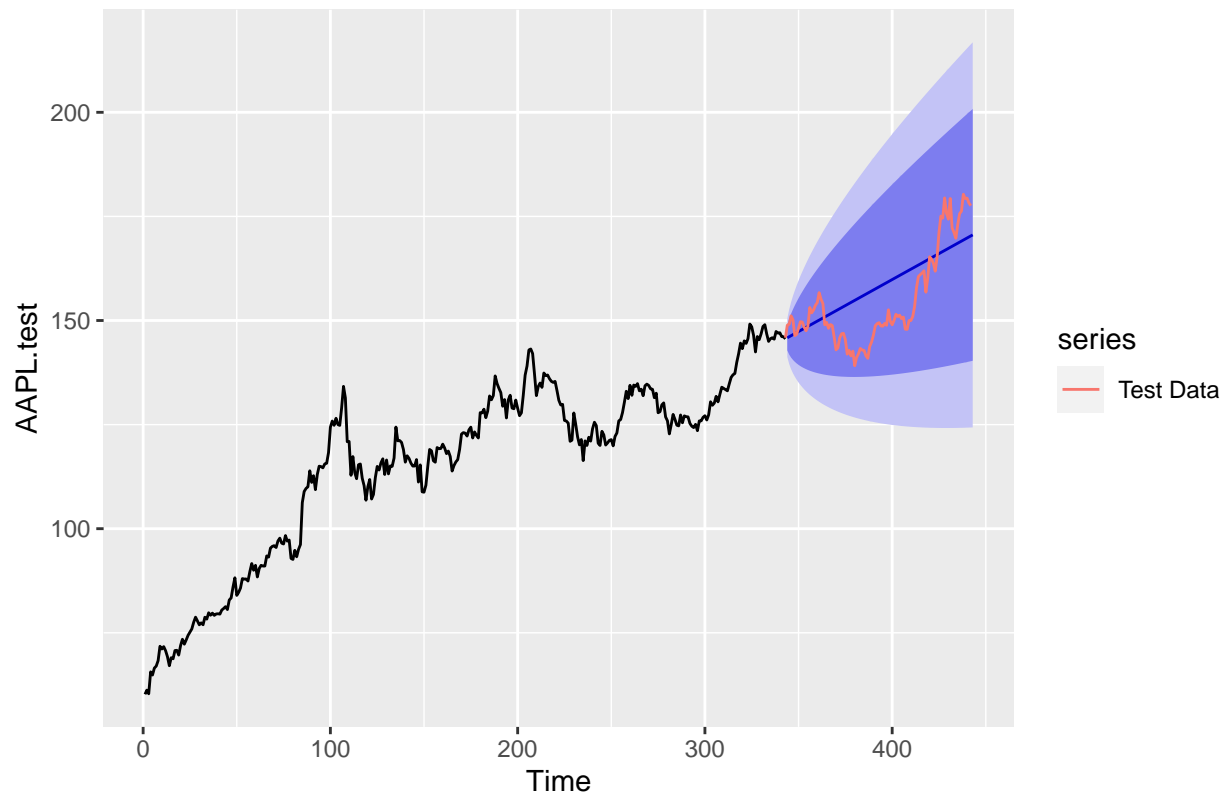


```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 5.3487, df = 10, p-value = 0.8667
##
## Model df: 0.   Total lags used: 10
accuracy(fc.AAPL)
```

```
##           ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 0.2496272 2.369072 1.752112 0.2361826 1.544003    1 -0.07512948

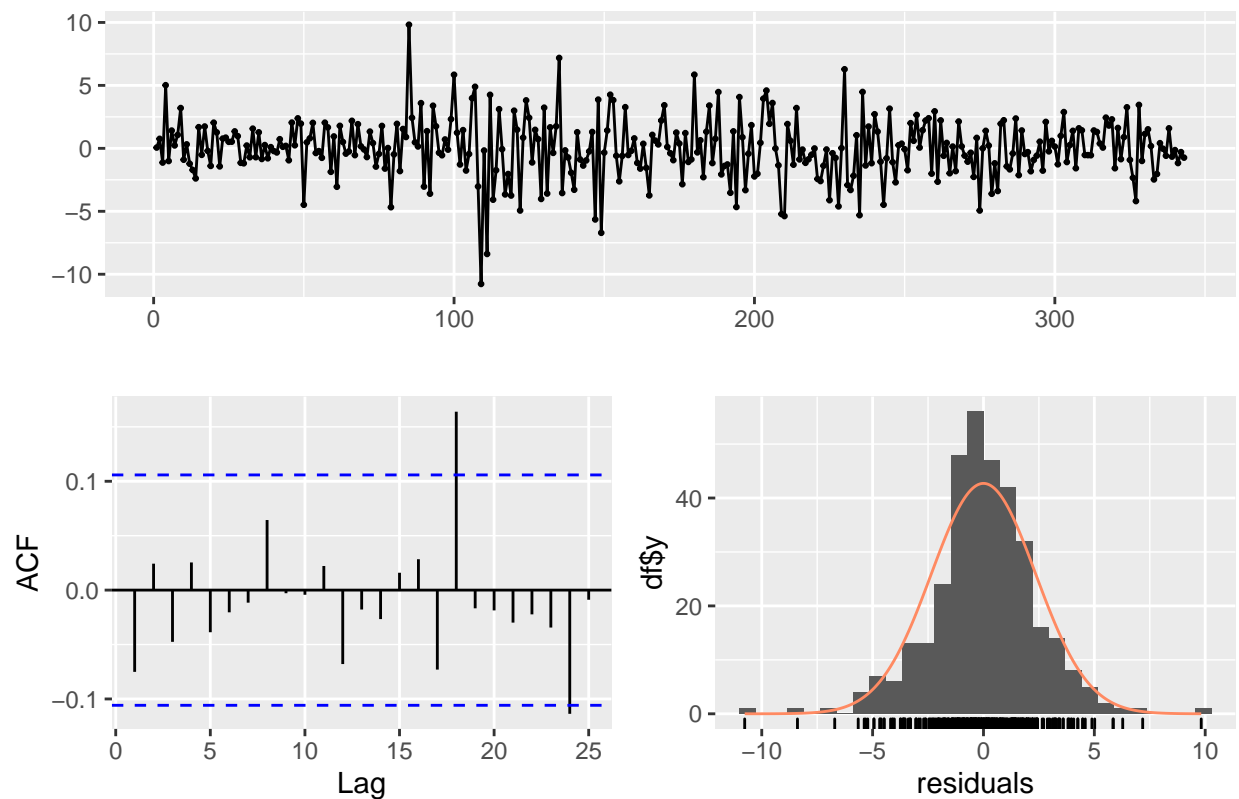
arima.AAPL <- auto.arima(AAPL.test, seasonal = FALSE)
fc_non <- forecast(arima.AAPL, h = n)
autoplot(fc_non, main = 'AAPL Arima Model') +
  autolayer(ts(test.AAPL, start = length(AAPL.test)), series = "Test Data")
```

AAPL Arima Model



```
checkresiduals(fc_non)
```

Residuals from ARIMA(0,1,0) with drift



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,0) with drift
## Q* = 5.3595, df = 9, p-value = 0.8019
##
## Model df: 1.   Total lags used: 10
```

```
accuracy(fc_non)
```

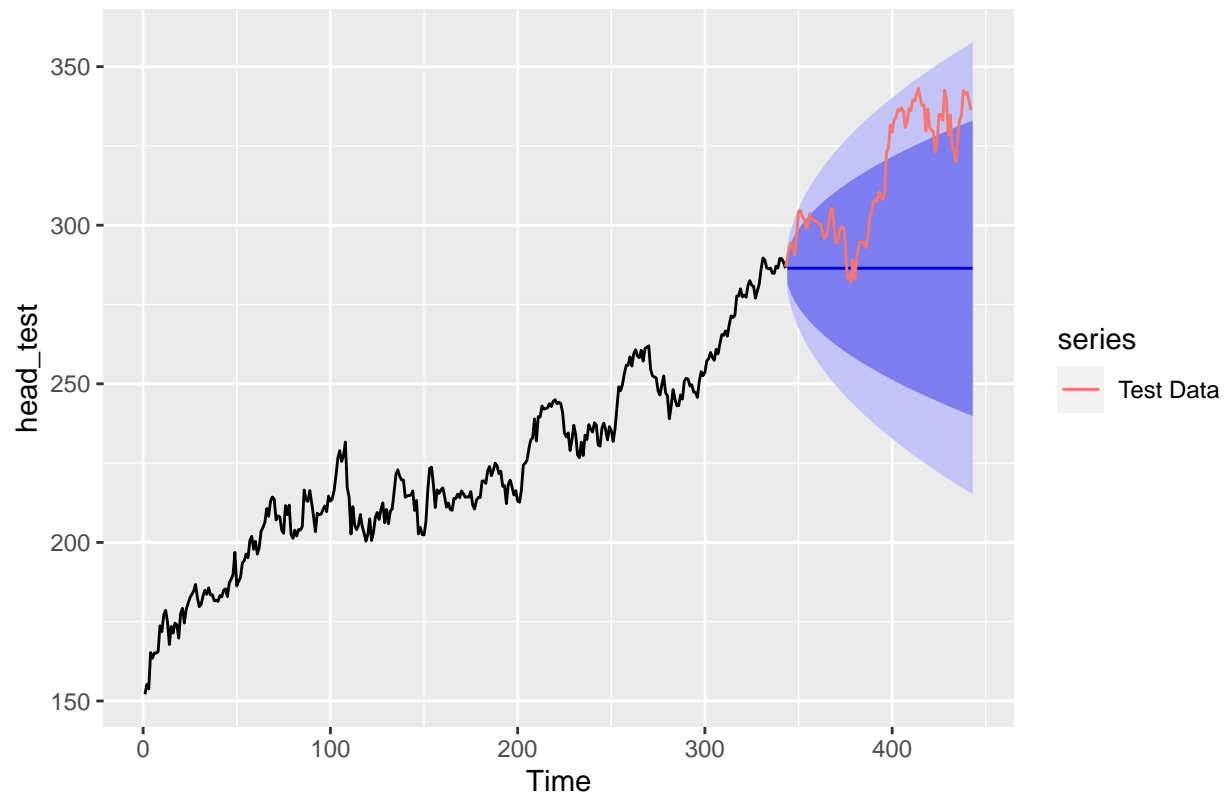
```
##               ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 0.0001748625 2.352449 1.738994 0.01103002 1.529839 0.9925132
##               ACF1
## Training set -0.07510554
```

MSFT

```
head_test <- head(Cl(MSFT), length(Cl(MSFT)) - n)
tail_test <- tail(Cl(MSFT), n)
fc <- naive(head_test, h = n)

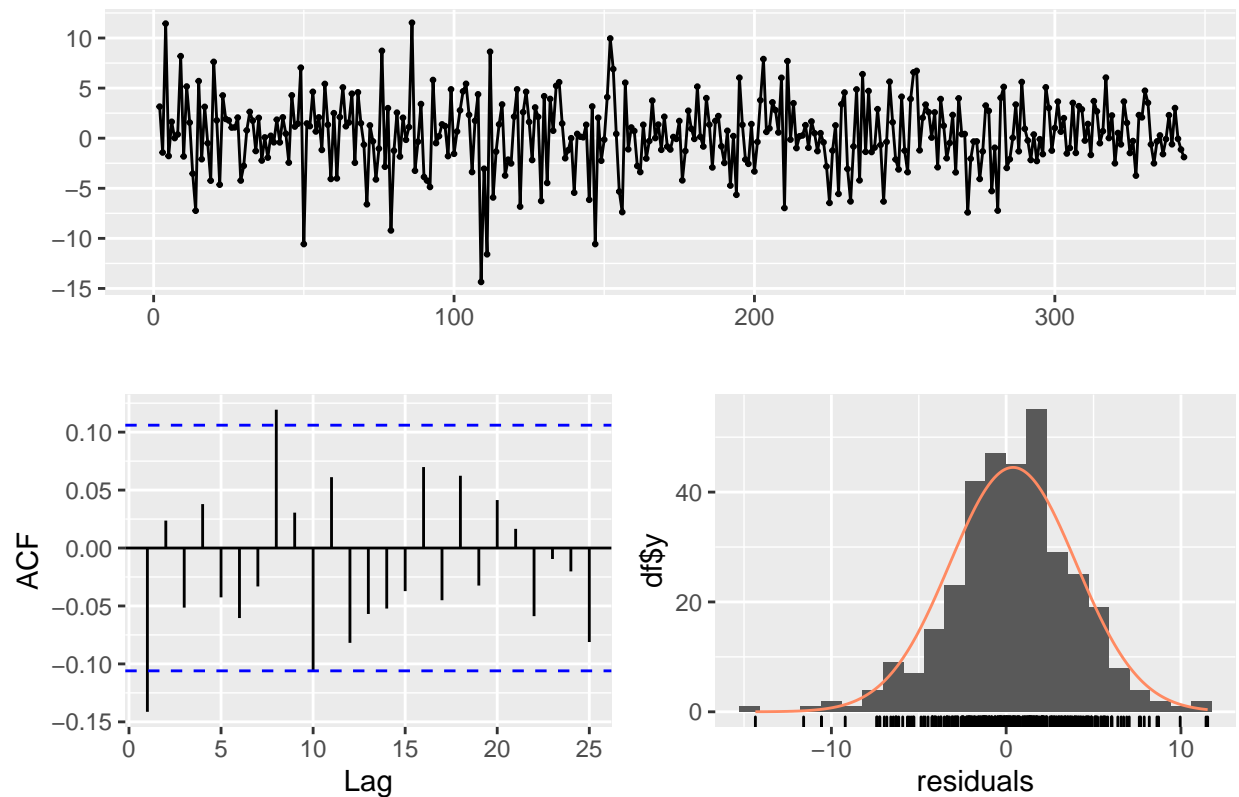
autoplot(fc) +
  autolayer(ts(tail_test, start = length(head_test)), series = 'Test Data')
```

Forecasts from Naive method



```
checkresiduals(fc)
```

Residuals from Naive method



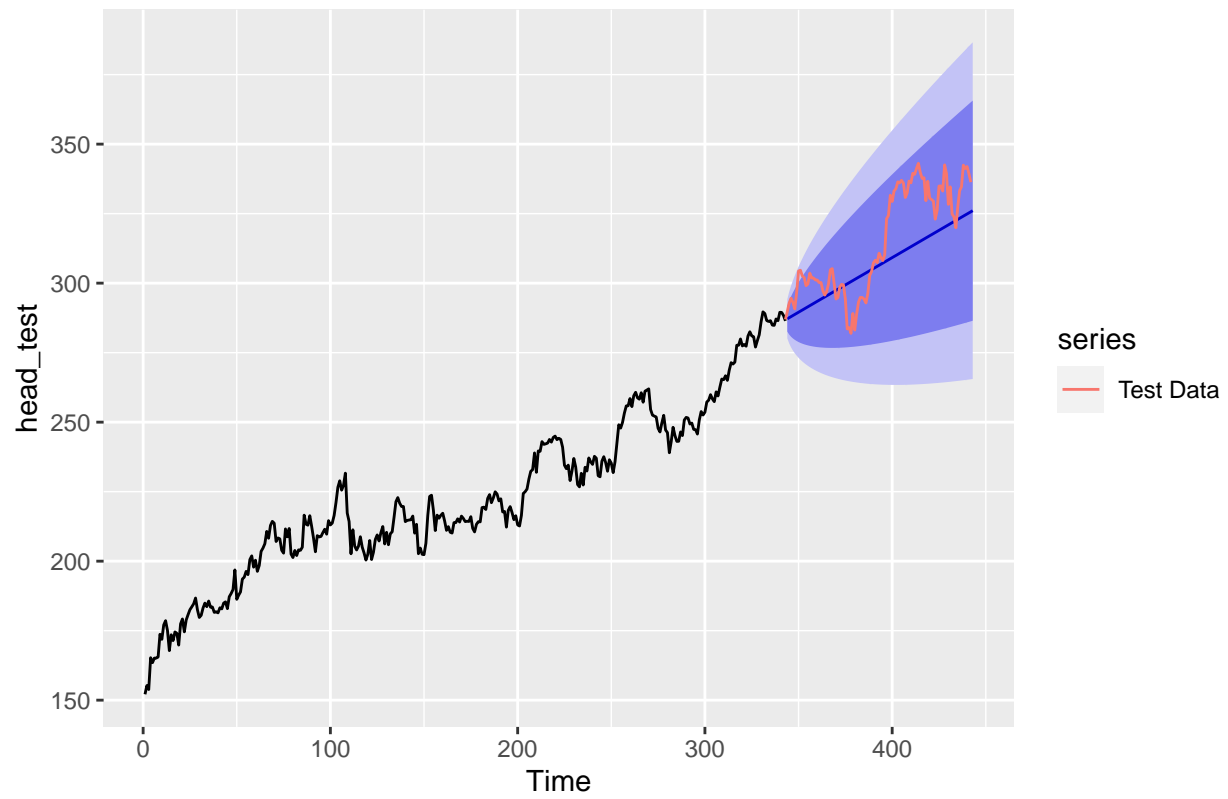
```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 20.159, df = 10, p-value = 0.02779
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc)
```

```
##               ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 0.3927778 3.633663 2.761198 0.1703335 1.27399    1 -0.1413203
```

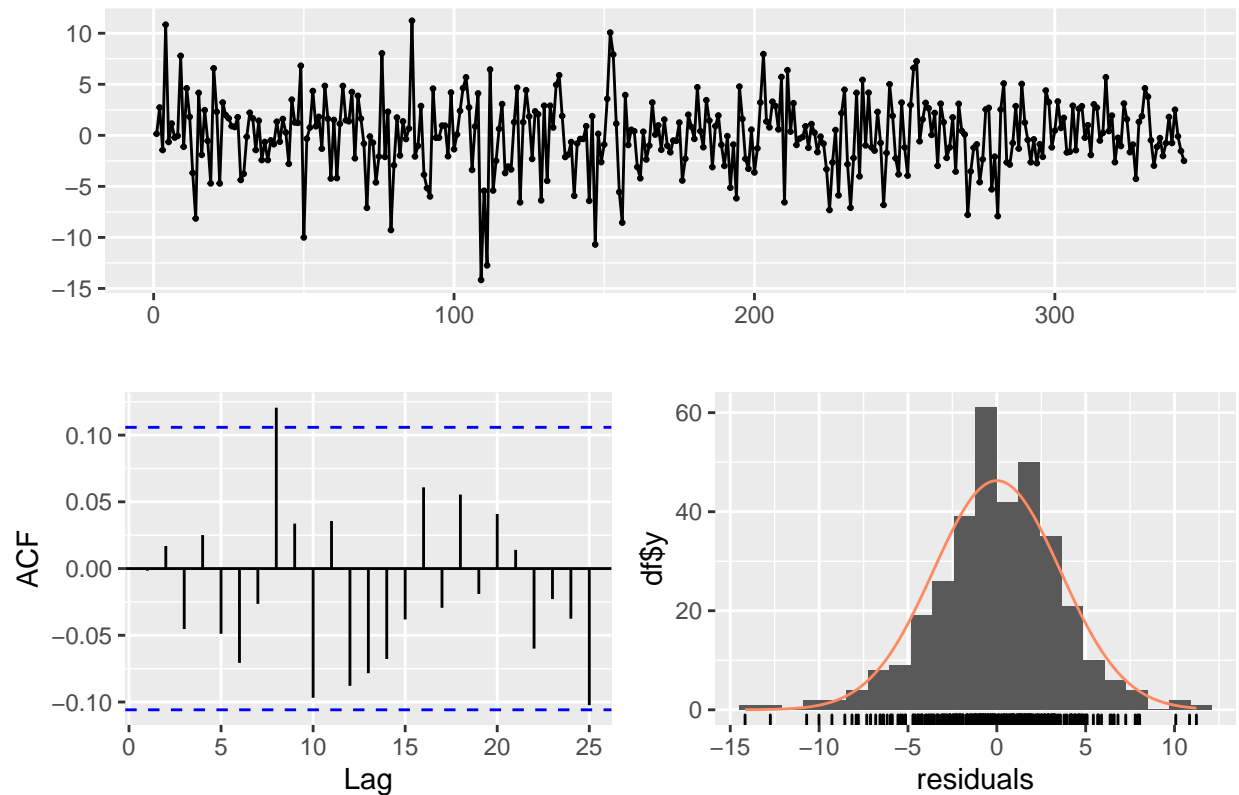
```
arima <- auto.arima(head_test, seasonal = FALSE)
fc_non <- forecast(arima, h = n)
autoplot(fc_non, main = 'MSFT Arima Model') +
  autolayer(ts(tail_test, start = length(head_test)), series = "Test Data")
```

MSFT Arima Model



```
checkresiduals(fc_non)
```

Residuals from ARIMA(0,1,1) with drift



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,1) with drift
## Q* = 12.737, df = 8, p-value = 0.1212
##
## Model df: 2.   Total lags used: 10
```

```
accuracy(fc_non)
```

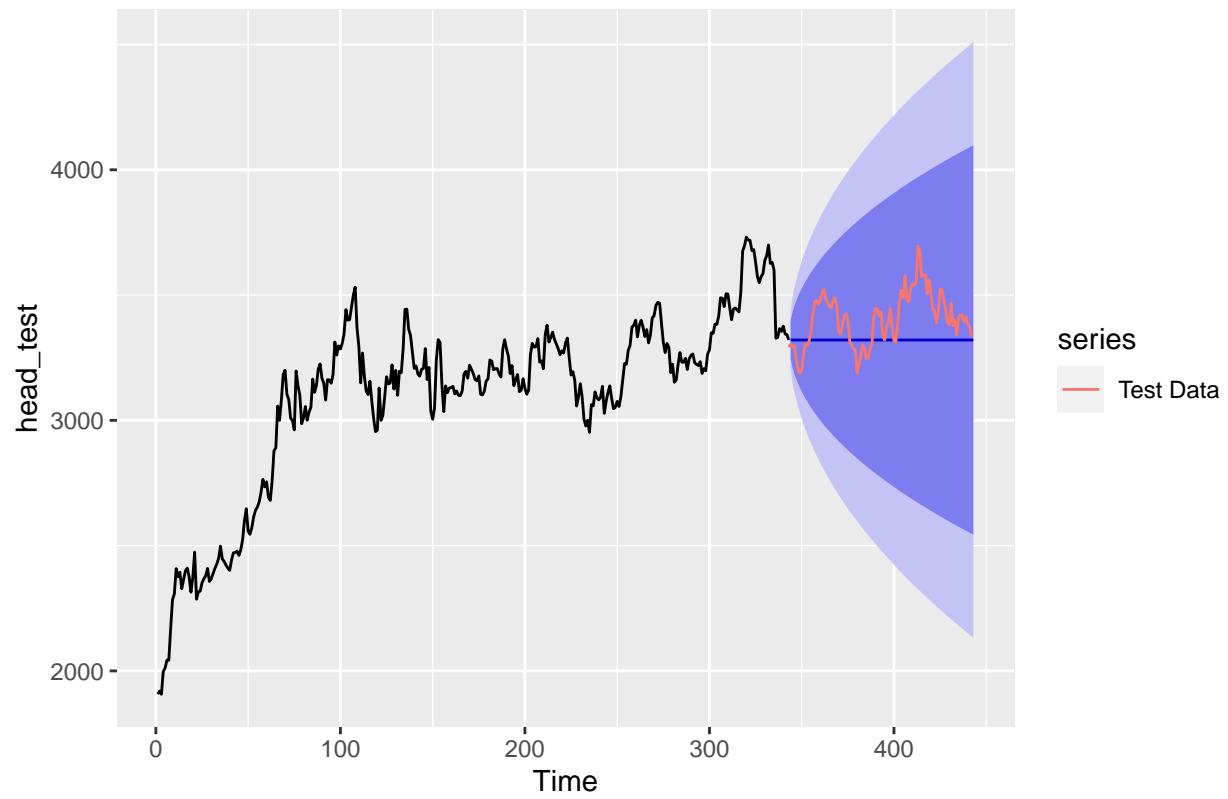
```
##               ME      RMSE      MAE          MPE      MAPE      MASE
## Training set 0.001547301 3.571318 2.711844 -0.008177817 1.247959 0.9821256
##               ACF1
## Training set -0.001620018
```

AMZN

```
head_test <- head(Cl(AMZN), length(Cl(AMZN)) - n)
tail_test  <- tail(Cl(AMZN), n)
fc <- naive(head_test, h = n)

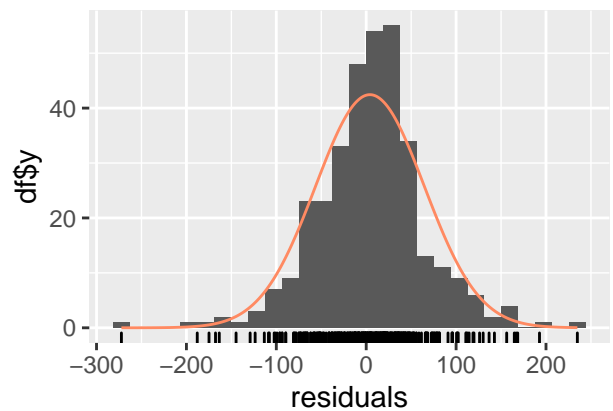
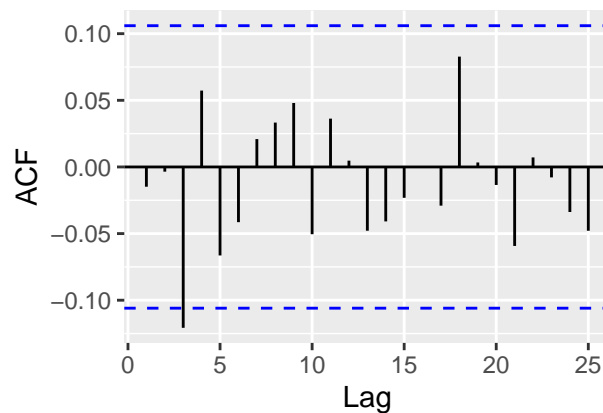
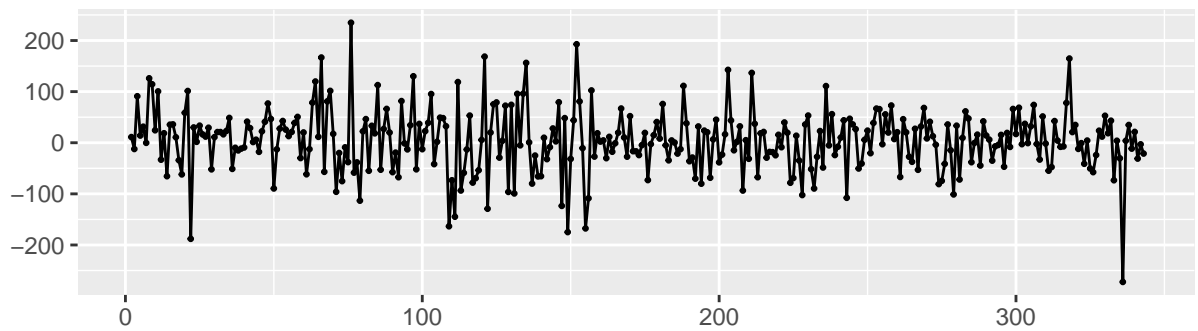
autoplot(fc) +
  autolayer(ts(tail_test, start = length(head_test)), series = 'Test Data')
```


Forecasts from Naive method



```
checkresiduals(fc)
```

Residuals from Naive method



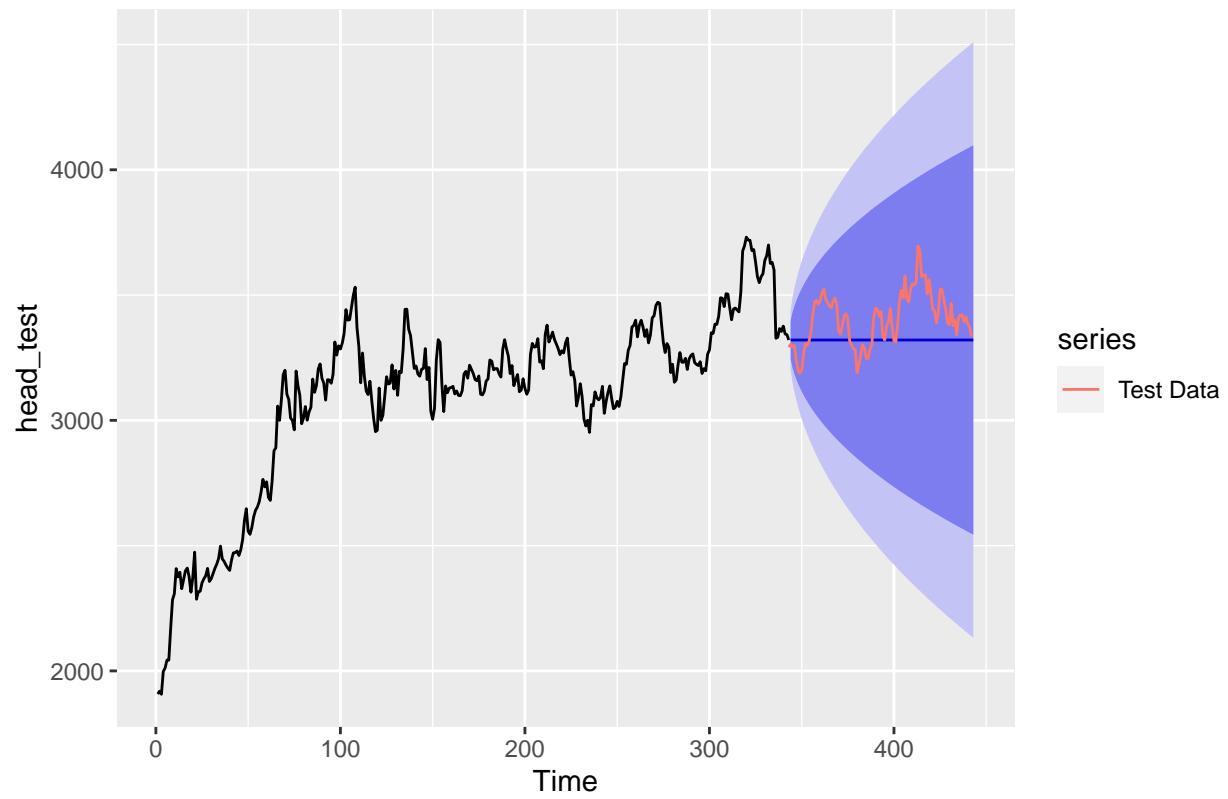
```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 10.68, df = 10, p-value = 0.383
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc)
```

```
##           ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 4.13152 60.61338 44.60316 0.142222 1.458779    1 -0.01483713
```

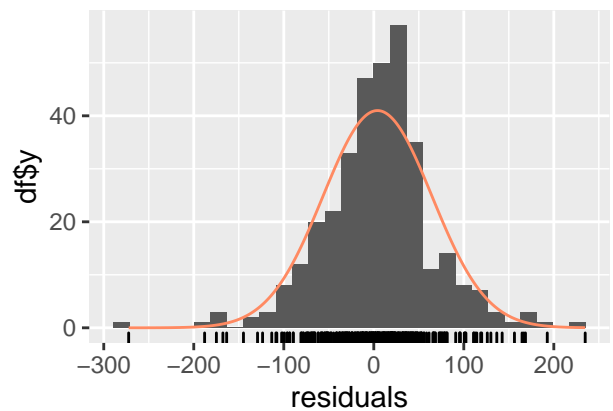
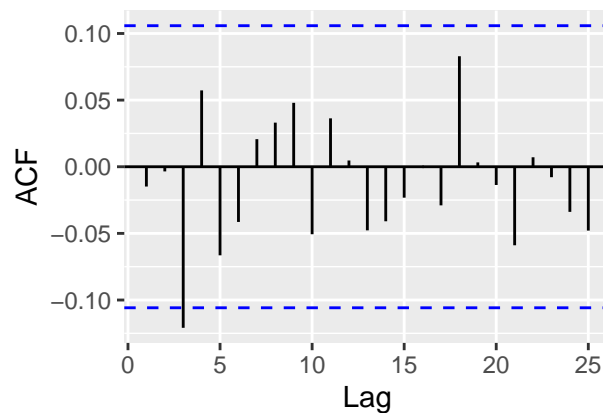
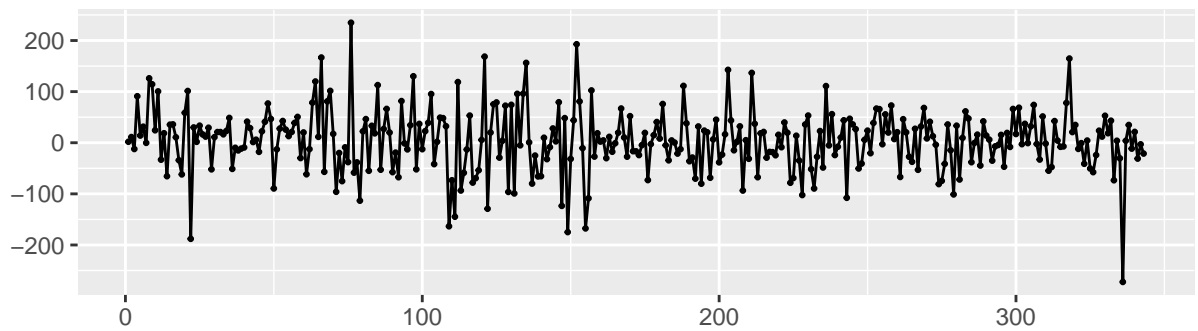
```
arima <- auto.arima(head_test, seasonal = FALSE)
fc_non <- forecast(arima, h = n)
autoplot(fc_non, main = 'AMZN Arima Model') +
  autolayer(ts(tail_test, start = length(head_test)), series = "Test Data")
```

AMZN Arima Model



```
checkresiduals(fc_non)
```

Residuals from ARIMA(0,1,0)



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,0)
## Q* = 10.722, df = 10, p-value = 0.3796
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc_non)
```

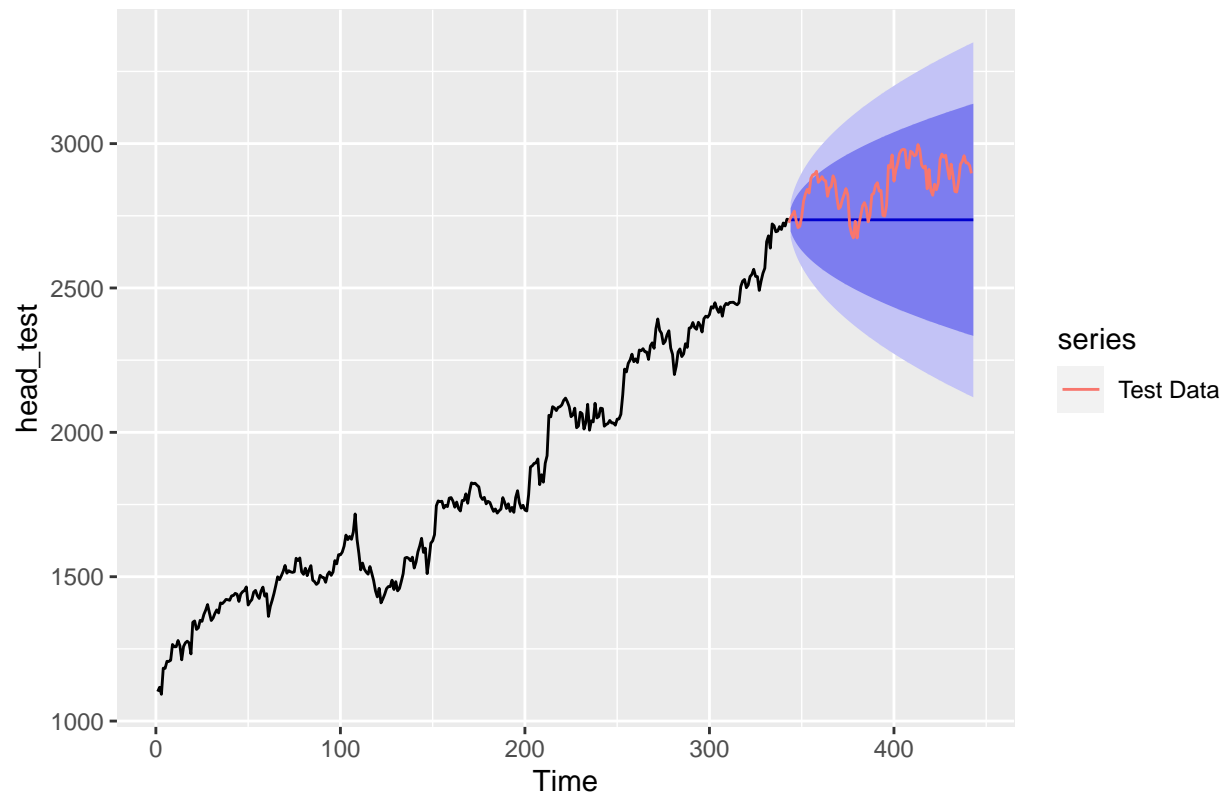
```
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 4.125037 60.52505 44.47868 0.1420989 1.454818 0.9972092
##           ACF1
## Training set -0.01484938
```

GOOGL

```
head_test <- head(Cl(GOOGL), length(Cl(GOOGL)) - n)
tail_test <- tail(Cl(GOOGL), n)
fc <- naive(head_test, h = n)

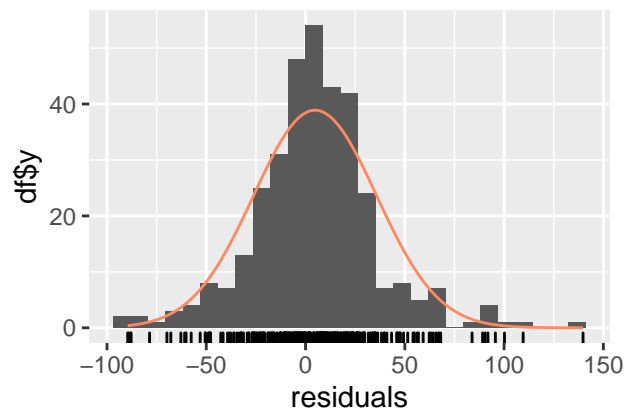
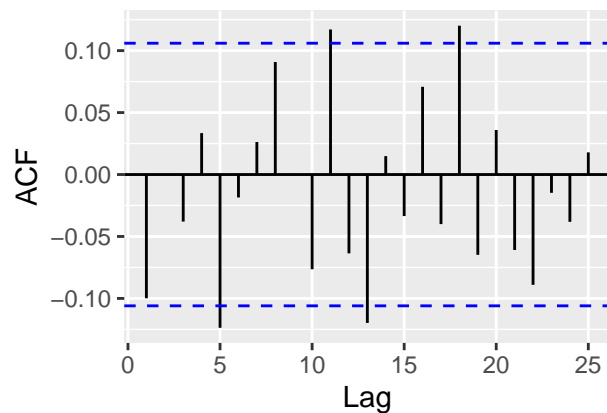
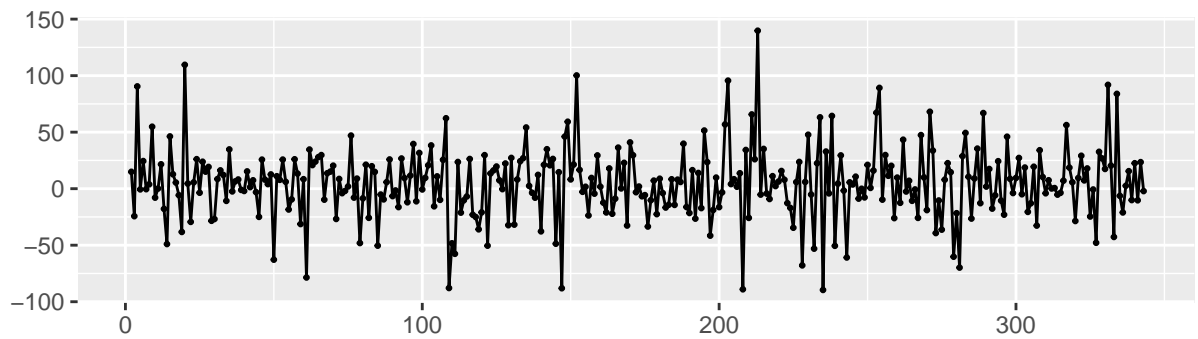
autoplot(fc) +
  autolayer(ts(tail_test, start = length(head_test)), series = 'Test Data')
```

Forecasts from Naive method



```
checkresiduals(fc)
```

Residuals from Naive method



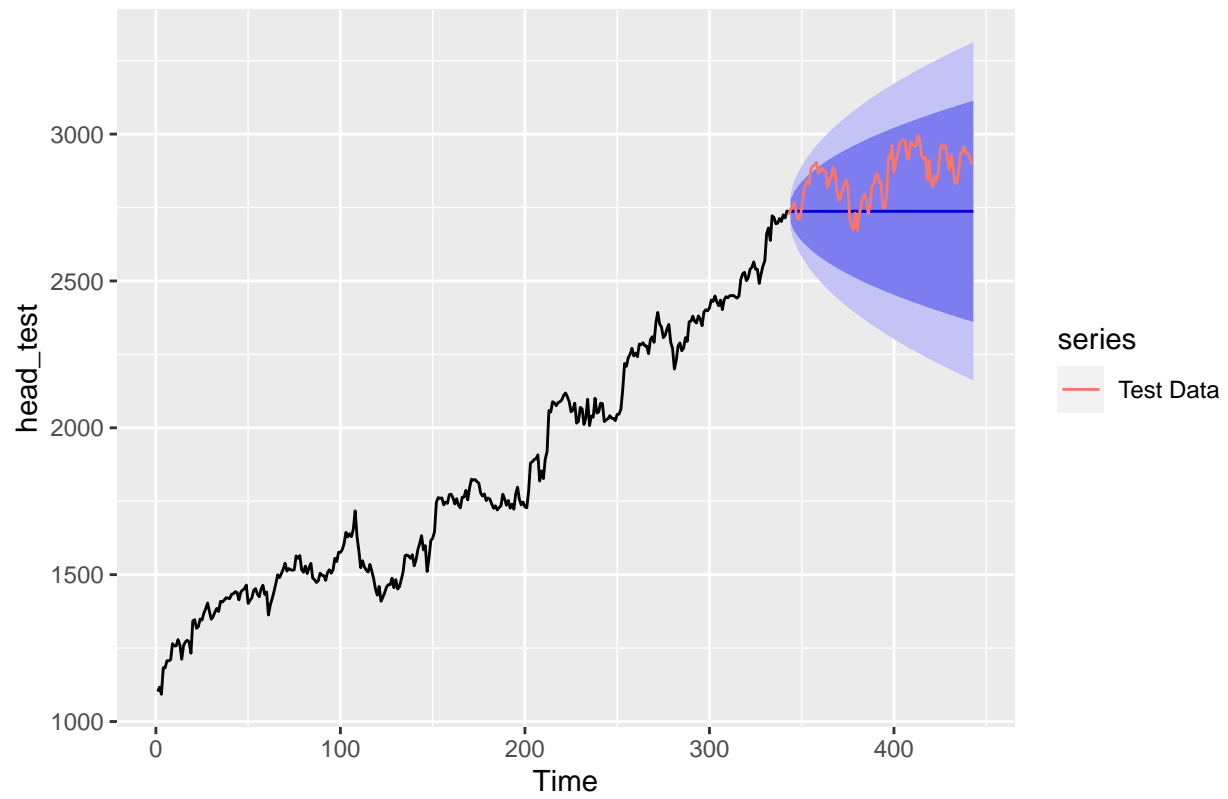
```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 15.014, df = 10, p-value = 0.1316
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc)
```

```
##           ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 4.777894 31.36032 22.77795 0.2494728 1.291387    1 -0.09988434
```

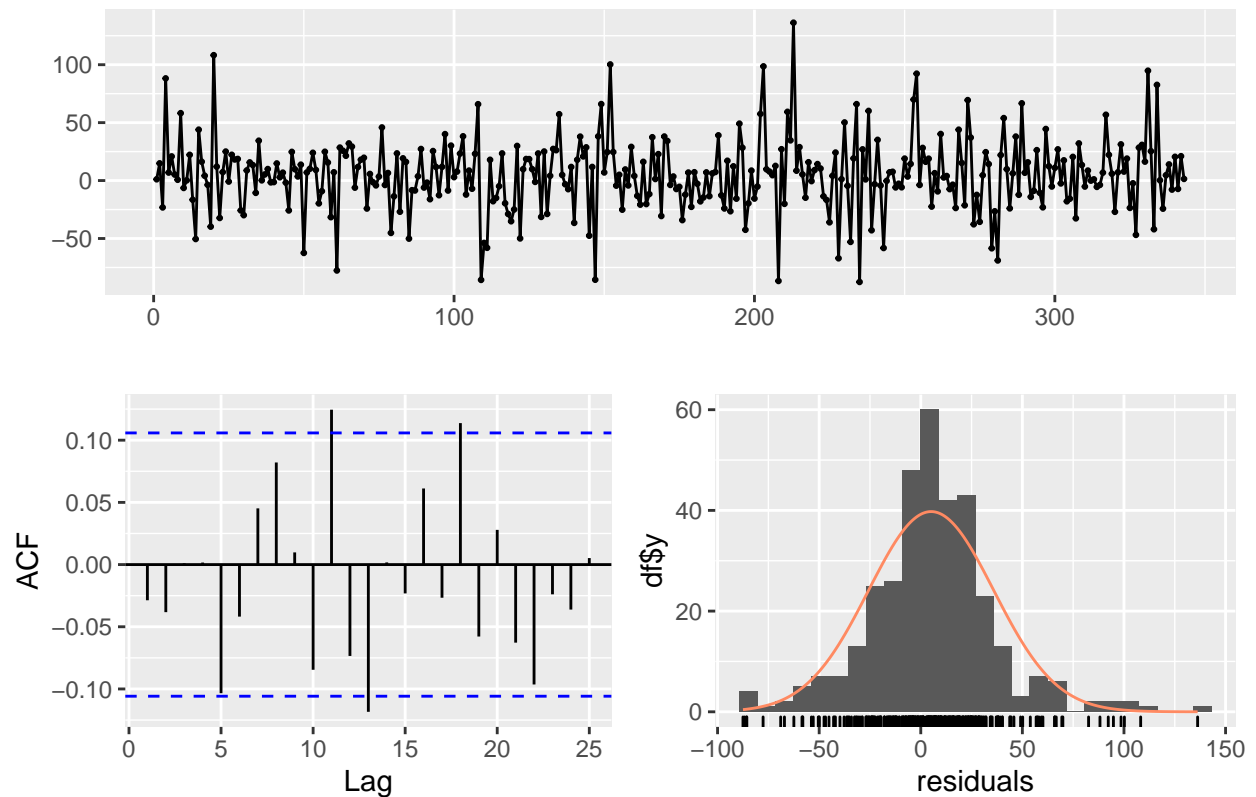
```
arima <- auto.arima(head_test, seasonal = FALSE)
fc_non <- forecast(arima, h = n)
autoplot(fc_non, main = 'GOOGL Arima Model') +
  autolayer(ts(tail_test, start = length(head_test)), series = "Test Data")
```

GOOGL Arima Model



```
checkresiduals(fc_non)
```

Residuals from ARIMA(2,1,2)



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(2,1,2)
## Q* = 10.83, df = 6, p-value = 0.09379
##
## Model df: 4.   Total lags used: 10
```

```
accuracy(fc_non)
```

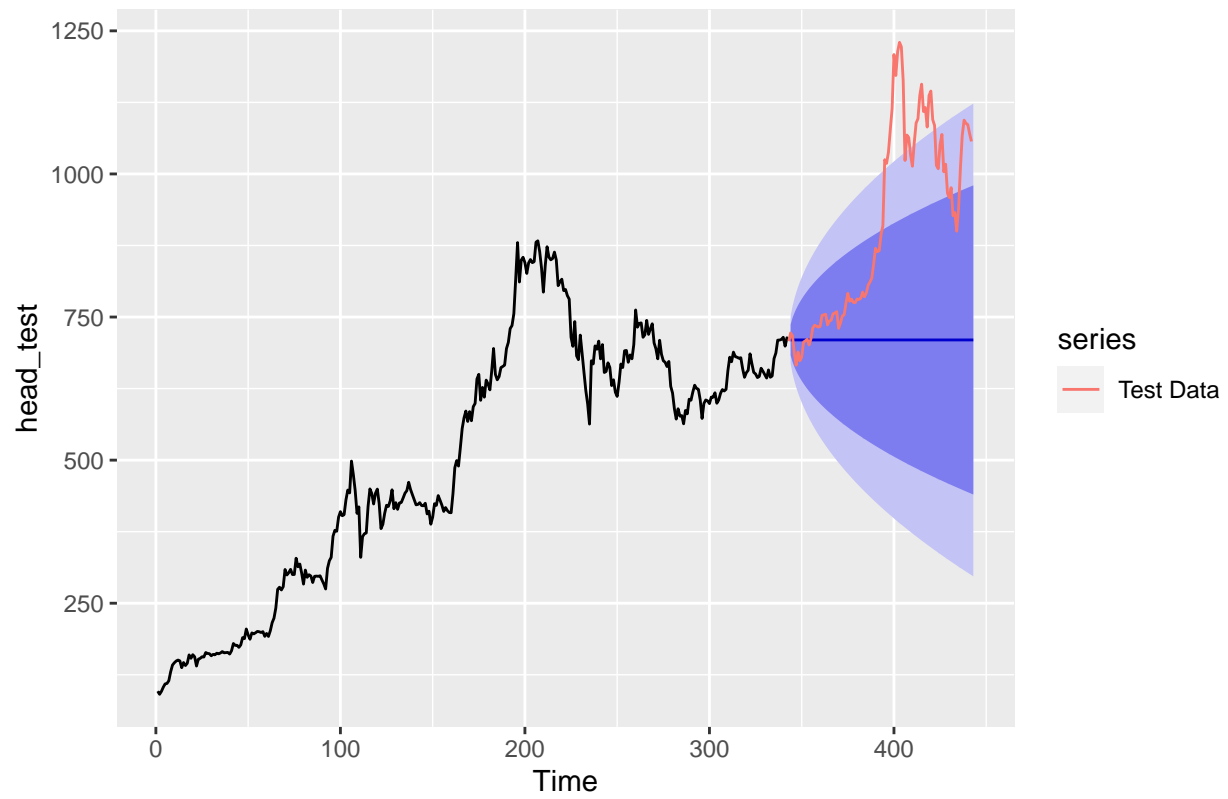
```
##           ME      RMSE      MAE      MPE      MAPE      MASE      ACF1
## Training set 5.106601 31.17296 22.63169 0.266969 1.28383 0.9935787 -0.02868544
```

TSLA

```
head_test <- head(Cl(TSLA), length(Cl(TSLA)) - n)
tail_test  <- tail(Cl(TSLA), n)
fc <- naive(head_test, h = n)

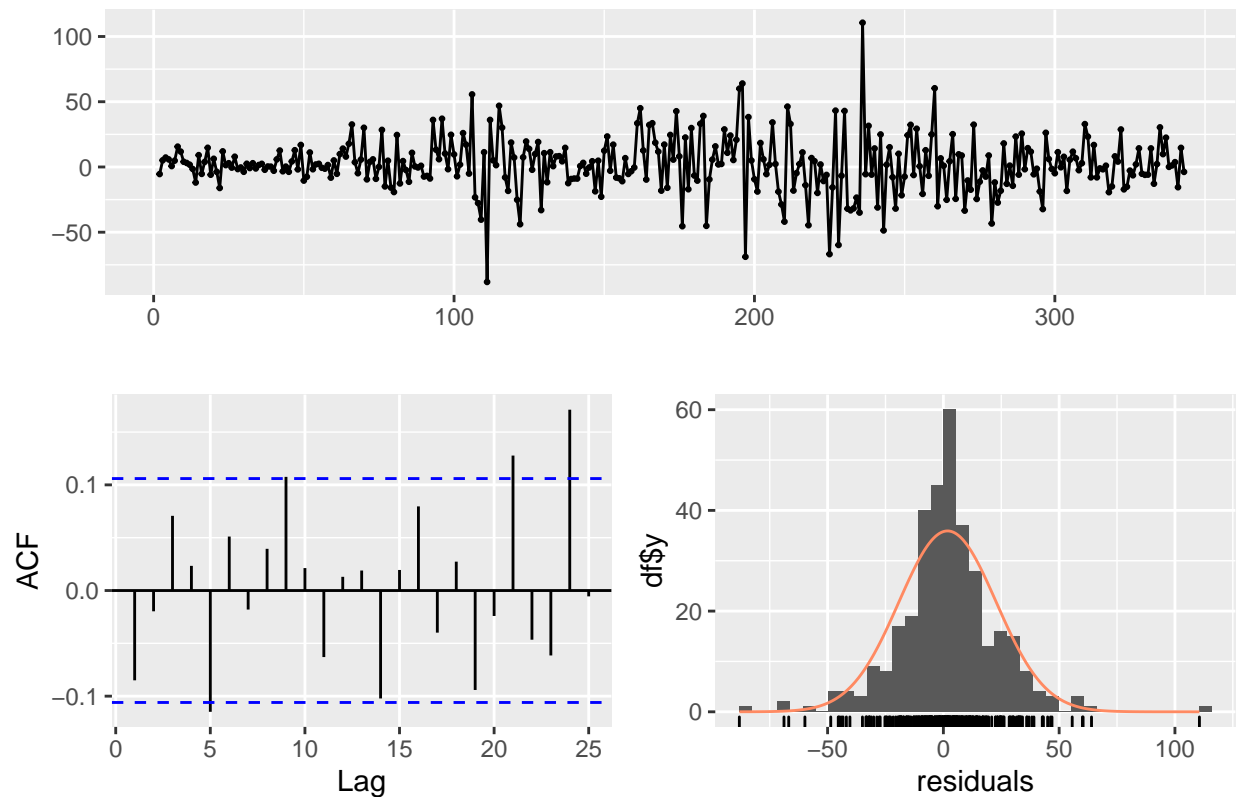
autoplot(fc) +
  autolayer(ts(tail_test, start = length(head_test)), series = 'Test Data')
```


Forecasts from Naive method



```
checkresiduals(fc)
```

Residuals from Naive method



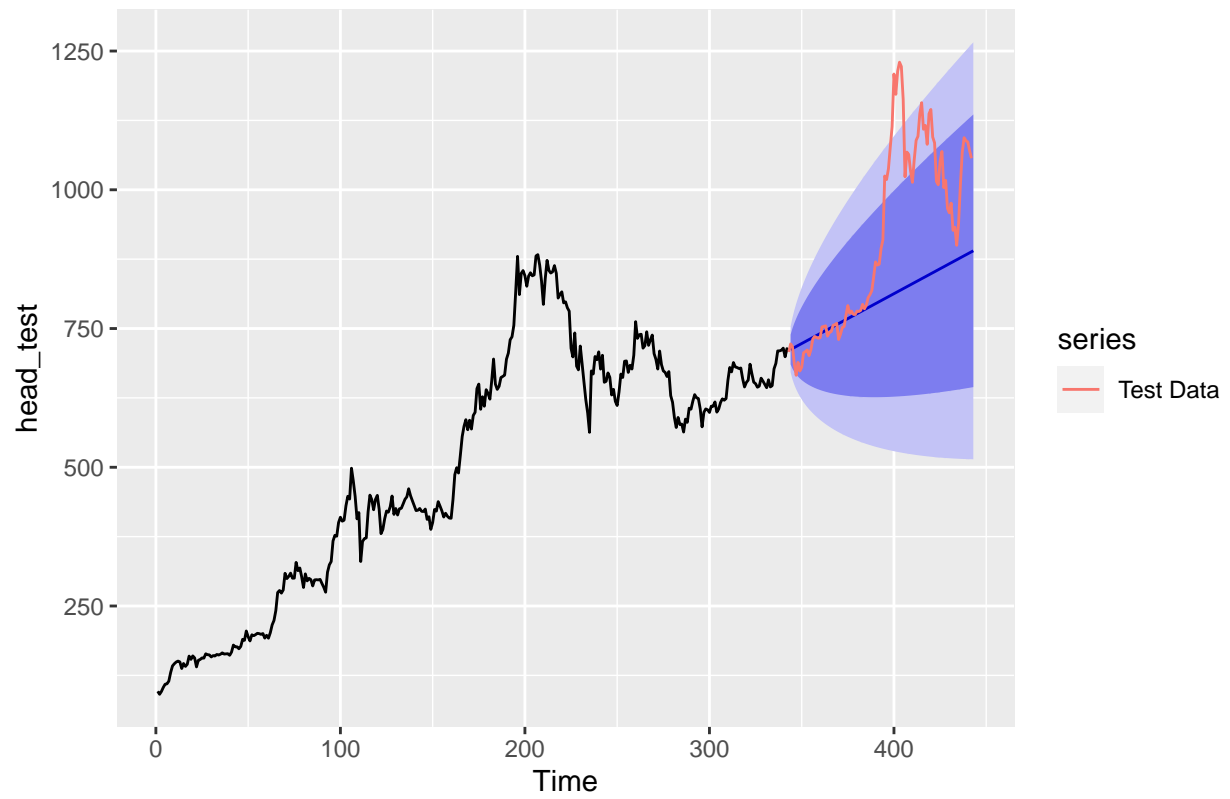
```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 14.977, df = 10, p-value = 0.1329
##
## Model df: 0.   Total lags used: 10
```

```
accuracy(fc)
```

```
##               ME      RMSE      MAE      MPE      MAPE  MASE      ACF1
## Training set 1.79438 21.07068 14.83243 0.4891309 3.154361    1 -0.08500137
```

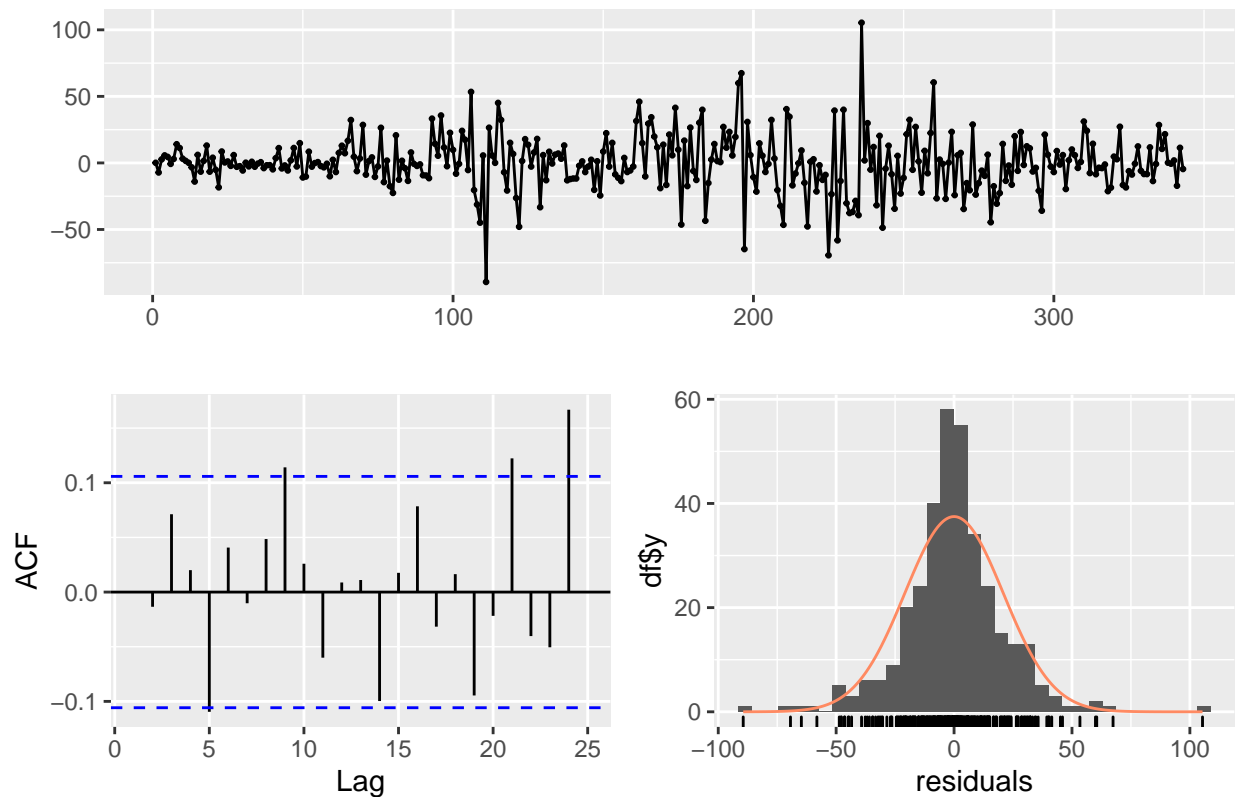
```
arima <- auto.arima(head_test, seasonal = FALSE)
fc_non <- forecast(arima, h = n)
autoplot(fc_non, main = 'TSLA Arima Model') +
  autolayer(ts(tail_test, start = length(head_test)), series = "Test Data")
```

TSLA Arima Model



```
checkresiduals(fc_non)
```

Residuals from ARIMA(0,1,1) with drift



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,1) with drift
## Q* = 12.469, df = 8, p-value = 0.1315
##
## Model df: 2.   Total lags used: 10
accuracy(fc_non)
```

```
##              ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -0.0007121589 20.88491 14.62776 0.001812273 3.092083 0.9862014
##              ACF1
## Training set 0.0003876613
```

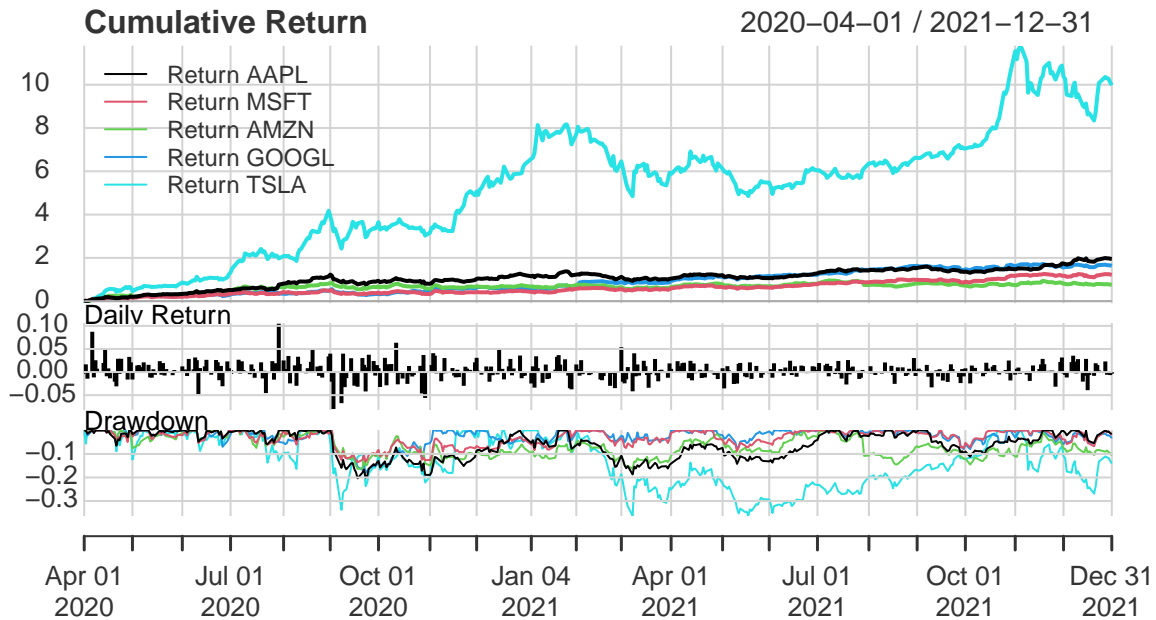
Return Analysis

```
AAPLreturn <- dailyReturn(Cl(AAPL))
MSFTreturn <- dailyReturn(Cl(MSFT))
AMZNreturn <- dailyReturn(Cl(AMZN))
GOOGLreturn <- dailyReturn(Cl(GOOG))
TSLAreturn <- dailyReturn(Cl(TSLA))

totalReturns <- data.frame(AAPLreturn, MSFTreturn, AMZNreturn, GOOGLreturn, TSLAreturn)
names(totalReturns) <- c('Return AAPL', 'Return MSFT', 'Return AMZN', 'Return GOOGL', 'Return TSLA')
totalReturns <- as.xts(totalReturns)

charts.PerformanceSummary(totalReturns, main = 'Daily Return of the stocks')
```

Daily Return of the stocks



Pearson Correlation

```
getSymbols('ETH-USD', auto.assign=FALSE, from='2020-04-01', to='2022-01-01')
```

##	ETH-USD.Open	ETH-USD.High	ETH-USD.Low	ETH-USD.Close	ETH-USD.Volume
## 2020-04-01	133.6123	135.6346	129.7309	135.6346	12456564435
## 2020-04-02	135.7322	146.7871	135.7322	142.0291	15322861686
## 2020-04-03	142.1105	146.8999	139.6194	142.0913	13184603402
## 2020-04-04	142.2152	145.3773	140.1218	145.2194	11946658257
## 2020-04-05	145.2610	146.1285	142.1021	143.5466	11280993591
## 2020-04-06	143.6082	169.2726	143.5446	169.1359	21636382525
## 2020-04-07	169.1474	175.2041	164.2033	165.1019	21659346091
## 2020-04-08	165.2403	173.2103	164.4932	172.6417	17063110836
## 2020-04-09	172.7613	172.8978	167.9871	170.8071	14901696210
## 2020-04-10	170.8293	170.9498	154.9145	158.4124	17980944616
## 2020-04-11	158.5390	161.1676	155.2983	158.2160	13555089447
## 2020-04-12	158.2324	164.5170	156.3205	161.1424	15123721386
## 2020-04-13	160.7207	160.7497	151.6145	156.2796	16465282133
## 2020-04-14	156.3560	160.9443	155.8659	157.5964	14723156630
## 2020-04-15	157.5656	160.7111	152.8028	153.2869	14171753737
## 2020-04-16	153.2004	173.1573	150.3594	172.1574	22910469236
## 2020-04-17	172.2794	174.2759	169.7516	171.6386	16714684266
## 2020-04-18	171.6181	187.9405	171.6181	186.9140	20160323443
## 2020-04-19	186.8620	188.0989	180.1208	181.6150	19146038381
## 2020-04-20	181.4802	186.0835	170.3213	172.2972	21266681335
## 2020-04-21	172.0177	175.1785	170.5528	172.7377	16458767984
## 2020-04-22	172.6704	183.7510	171.8266	182.5996	17994666395

## 2020-04-23	182.6202	189.0889	180.3407	185.0287	21275740032
## 2020-04-24	185.2221	190.2104	185.2221	189.2369	16788555028
## 2020-04-25	189.2074	196.7924	188.4595	195.5153	18260969748
## 2020-04-26	195.4136	199.3450	194.7681	197.3175	18335367012
## 2020-04-27	197.4757	199.5528	193.4542	197.2247	18670194595
## 2020-04-28	197.2735	198.7865	194.8494	198.4154	18217507467
## 2020-04-29	198.4652	218.4546	198.1245	216.9682	26397548759
## 2020-04-30	216.9091	227.5297	206.4369	207.6021	28089191904
## 2020-05-01	207.9017	217.6280	207.7809	214.2191	20816320834
## 2020-05-02	214.2301	215.8475	212.8787	215.3254	18260876092
## 2020-05-03	215.3521	219.2709	208.6924	210.9332	20469034664
## 2020-05-04	210.8909	211.8284	199.0477	208.1740	22602446422
## 2020-05-05	208.0130	211.7786	204.0311	206.7744	19004689099
## 2020-05-06	206.4814	211.5346	204.0409	204.0558	20343543799
## 2020-05-07	203.9129	214.3925	202.0748	212.2894	23594744655
## 2020-05-08	212.1982	216.3277	208.8307	212.9916	20445139356
## 2020-05-09	213.1422	214.7391	209.0715	211.6001	18950547549
## 2020-05-10	211.5522	211.5522	182.7112	188.5996	25211575193
## 2020-05-11	188.6322	191.3623	180.7183	185.9128	20054601647
## 2020-05-12	185.8773	191.6013	185.7018	189.3125	15899726284
## 2020-05-13	189.3741	200.1973	189.1277	199.1933	17054662289
## 2020-05-14	198.8915	204.1176	196.8688	202.9491	20150524861
## 2020-05-15	202.9554	203.5664	193.7557	195.6227	16602342092
## 2020-05-16	195.6134	202.7712	194.5016	200.6771	15379081645
## 2020-05-17	200.6089	209.1609	200.1028	207.1587	15470397303
## 2020-05-18	207.1798	215.9085	207.1091	214.5251	17411566928
## 2020-05-19	214.6049	214.6049	210.1431	213.4511	14346192779
## 2020-05-20	213.4462	214.7168	207.9758	210.0967	12730175511
## 2020-05-21	210.1292	211.6252	193.3464	199.8836	13308321229
## 2020-05-22	199.8371	208.5915	198.0409	207.1692	12041592114
## 2020-05-23	207.1945	210.3865	205.2942	208.6944	10665476768
## 2020-05-24	208.7161	210.5951	202.3703	202.3703	11833299572
## 2020-05-25	201.9827	206.3614	200.6676	205.3197	10415044124
## 2020-05-26	205.2596	205.7525	200.2643	201.9023	10159741290
## 2020-05-27	201.8930	208.8634	201.7851	208.8634	10631034756
## 2020-05-28	208.8854	220.2765	206.2427	219.8404	12212469604
## 2020-05-29	219.9250	224.2169	218.2381	220.6751	12265816557
## 2020-05-30	220.7172	243.9431	218.7445	242.3456	15027397867
## 2020-05-31	242.3514	244.0453	230.0528	230.9757	12234904813
## 2020-06-01	230.8603	248.2363	230.4881	246.9918	13951727936
## 2020-06-02	246.8282	252.2220	233.2253	237.2191	13782107567
## 2020-06-03	237.3952	244.1793	235.4644	244.1793	9861760817
## 2020-06-04	244.1053	245.9290	236.7653	244.4264	10170414304
## 2020-06-05	244.3496	247.3295	240.6821	241.2220	9293963914
## 2020-06-06	241.2014	245.9810	239.7245	241.9313	8114873845
## 2020-06-07	241.9081	245.4353	236.3253	245.1673	9544883157
## 2020-06-08	245.1786	246.6442	241.5422	246.3099	8076783299
## 2020-06-09	246.1750	248.3424	242.3385	244.9115	8446545788
## 2020-06-10	244.8221	248.6512	242.8197	247.4449	8792990206
## 2020-06-11	247.5485	249.8883	229.9430	231.7027	12356528860
## 2020-06-12	231.6255	239.3547	229.6451	237.4932	8868955009
## 2020-06-13	237.5446	239.1931	235.8897	238.9088	7141624980
## 2020-06-14	238.9682	239.1015	232.9582	234.1147	7439385176
## 2020-06-15	234.0583	234.2378	221.2418	229.9289	10536099884

## 2020-06-16	229.7623	236.3943	228.4261	234.4162	7965648016
## 2020-06-17	234.4924	235.9541	229.3416	233.0283	7701391592
## 2020-06-18	232.8987	234.5706	228.9514	232.1012	6713800872
## 2020-06-19	231.9550	232.1541	226.7952	227.1383	6946372590
## 2020-06-20	226.9764	231.4490	226.6406	229.2743	6252830566
## 2020-06-21	229.2161	232.3589	228.4930	228.9898	5600408178
## 2020-06-22	229.0034	243.7760	228.9347	242.5332	9079586552
## 2020-06-23	242.5370	244.8644	239.7597	244.1422	6624530348
## 2020-06-24	244.1859	248.5080	232.8077	235.7725	8815030025
## 2020-06-25	235.7029	236.0534	230.2966	232.9445	7010426122
## 2020-06-26	232.8775	233.9019	229.2595	229.6680	7187490226
## 2020-06-27	229.6315	232.4934	220.5646	222.9598	6918380955
## 2020-06-28	222.9145	228.5983	219.4727	225.3472	6205925718
## 2020-06-29	225.3614	229.9032	222.2550	228.1949	6726164653
## 2020-06-30	227.9684	229.4768	224.8152	226.3150	6094093001
## 2020-07-01	226.1346	232.7561	224.8357	231.1134	6463737443
## 2020-07-02	231.2889	232.3969	225.4620	229.3922	6212210566
## 2020-07-03	229.3190	229.6293	224.9140	225.3871	5109032700
## 2020-07-04	225.2885	230.0541	225.1333	229.0741	5228310135
## 2020-07-05	228.9762	229.8567	224.5445	227.6646	5292172429
## 2020-07-06	227.6850	242.1327	227.0295	241.5102	8782917553
## 2020-07-07	240.9726	242.6819	234.2187	239.0755	6441497597
## 2020-07-08	239.1600	248.3089	238.3984	246.6700	9892586411
## 2020-07-09	246.7483	247.2917	239.8987	243.0160	8429099199
## 2020-07-10	242.8680	242.8838	236.7305	240.9850	7281370522
## 2020-07-11	241.0448	241.5275	238.3312	239.4582	5643067316
## 2020-07-12	239.4596	243.3111	237.7702	242.1317	6596394718
## 2020-07-13	242.1819	244.3105	238.2324	239.6046	7787751468
## 2020-07-14	239.9756	242.0038	237.7962	240.2115	7357458555
## 2020-07-15	240.1436	241.4027	237.0962	238.4235	6189328448
## 2020-07-16	238.4509	239.0063	231.6212	233.6409	5832057567
## 2020-07-17	233.6914	234.4151	232.1100	232.7731	5859850529
## 2020-07-18	232.8557	236.5440	232.3249	235.4838	5397402117
## 2020-07-19	235.4583	239.1607	233.2797	238.4875	6251377305
## 2020-07-20	238.4949	239.5762	234.8526	236.1532	5600686192
## 2020-07-21	236.3025	246.1863	235.6810	245.0167	6806696015
## 2020-07-22	245.0373	262.9850	242.4843	262.1906	7702077383
## 2020-07-23	262.3886	277.5835	261.0471	274.6891	10281309262
## 2020-07-24	274.7227	286.1928	269.2398	279.2154	9466060358
## 2020-07-25	279.0264	306.7410	279.0264	304.0568	10785021813
## 2020-07-26	303.6924	316.3863	300.2678	309.6436	12003973026
## 2020-07-27	309.6579	330.7012	309.6579	321.5141	15644257058
## 2020-07-28	321.8297	325.9060	307.7213	316.6573	12357108065
## 2020-07-29	316.5554	324.3808	313.1096	318.1909	10878845706
## 2020-07-30	318.1450	338.6312	315.7511	334.5866	11827689045
## 2020-07-31	334.6337	348.6114	329.3409	345.5547	12030600492
## 2020-08-01	345.7986	388.8480	343.5874	385.1997	14045259477
## 2020-08-02	385.5499	411.2283	357.1436	370.6717	18909744275
## 2020-08-03	371.1338	396.5070	369.3363	386.2952	12834648062
## 2020-08-04	386.1565	400.7006	382.9851	389.8755	14086704221
## 2020-08-05	389.7108	406.3040	386.2185	401.5906	12875466638
## 2020-08-06	401.5839	403.4887	392.6002	394.9619	11304626458
## 2020-08-07	395.2269	398.2490	367.9355	379.5128	12751687084
## 2020-08-08	379.5516	393.9874	377.3497	393.9874	9342060531

## 2020-08-09	395.3052	399.7371	385.8307	391.1205	9451065592
## 2020-08-10	391.0415	399.3759	391.0415	395.8876	11685827893
## 2020-08-11	395.8947	398.4789	370.8606	380.3841	12792218737
## 2020-08-12	380.0638	391.3123	367.9236	391.0242	12408772745
## 2020-08-13	390.8381	432.9046	379.7109	428.7418	18480303526
## 2020-08-14	428.6773	444.5778	423.3459	437.3978	15064589987
## 2020-08-15	437.5630	441.7546	429.8746	433.3549	12416067894
## 2020-08-16	433.3506	436.2658	415.0862	433.7866	12168816874
## 2020-08-17	433.9738	442.7350	422.6473	429.5312	13227089410
## 2020-08-18	429.6696	432.5803	419.6741	423.6693	11978984079
## 2020-08-19	423.7386	427.0247	396.6783	406.4638	13137391167
## 2020-08-20	406.7589	418.7344	404.0261	416.4398	10043032427
## 2020-08-21	416.1488	418.6380	387.4411	389.1263	11781796374
## 2020-08-22	389.0311	396.4666	382.8146	395.8351	10131847985
## 2020-08-23	395.5628	396.4904	385.0398	391.3845	8137303970
## 2020-08-24	391.6790	409.3886	389.3146	408.1442	10328860398
## 2020-08-25	408.0717	408.5279	374.3554	384.0010	12428442042
## 2020-08-26	383.9774	391.8733	378.7058	386.4661	9967343483
## 2020-08-27	386.6099	395.3492	374.8665	382.6326	10457777652
## 2020-08-28	382.6296	397.7576	381.2738	395.8747	9120674421
## 2020-08-29	395.6876	405.6164	393.0374	399.9215	8777703481
## 2020-08-30	399.6167	428.6640	399.6084	428.3957	11211948040
## 2020-08-31	428.5090	438.5603	419.7702	435.0797	12774741797
## 2020-09-01	434.8745	487.2119	432.0792	477.0519	18862763756
## 2020-09-02	477.0079	480.3310	424.4600	440.0405	19691854014
## 2020-09-03	440.2400	449.5325	381.1297	385.6719	19622845896
## 2020-09-04	384.6716	402.4117	371.6367	388.2412	16747106257
## 2020-09-05	388.0384	394.1723	316.7744	335.2601	29880047640
## 2020-09-06	335.3346	359.7640	319.0419	353.3623	27643678917
## 2020-09-07	353.4503	358.2119	326.2544	352.6735	21763614732
## 2020-09-08	353.2023	355.5629	328.8168	337.6021	17991403432
## 2020-09-09	337.8249	359.1645	332.1650	351.1100	14547933520
## 2020-09-10	351.4293	377.3936	351.1118	368.1019	31421134556
## 2020-09-11	368.1185	376.6304	355.5826	374.6956	27296269329
## 2020-09-12	374.5954	387.5385	367.8422	387.1831	13295405814
## 2020-09-13	387.5193	388.9598	354.3402	365.5700	15005899191
## 2020-09-14	365.6996	384.4852	357.5698	377.2689	17536695361
## 2020-09-15	377.1540	381.5083	363.6068	364.8392	16140584321
## 2020-09-16	364.7440	372.7674	356.6827	365.8123	16107612177
## 2020-09-17	365.8658	393.9016	364.7951	389.0192	19899531080
## 2020-09-18	389.3375	391.9041	376.9650	384.3645	14108357740
## 2020-09-19	384.0417	387.0764	378.7241	385.5444	11049507684
## 2020-09-20	385.5980	385.5980	367.0944	371.0528	12292195784
## 2020-09-21	371.4001	375.7370	336.0690	341.7861	17398267133
## 2020-09-22	341.7238	346.6008	336.8550	344.5032	12732578043
## 2020-09-23	344.5899	344.6714	318.9692	321.1163	12899346599
## 2020-09-24	320.9850	351.4615	318.5451	349.3556	15714304470
## 2020-09-25	349.4114	357.7727	339.0159	352.1833	14381086966
## 2020-09-26	352.3509	355.8548	348.1071	355.4881	13049148579
## 2020-09-27	354.9599	361.9844	349.8341	357.4385	13598126926
## 2020-09-28	357.9259	366.4322	354.5476	355.1594	14258455166
## 2020-09-29	354.3630	360.3534	352.1469	359.7574	11600013236
## 2020-09-30	360.0385	361.1788	353.3279	359.9379	11818610610
## 2020-10-01	360.3091	369.2644	346.4771	353.2059	14679481911

## 2020-10-02	352.9497	354.1154	336.4672	346.2389	14215390463
## 2020-10-03	346.2186	351.3077	344.6666	346.5221	10060167889
## 2020-10-04	346.6022	354.0457	345.1310	352.5790	10696959020
## 2020-10-05	352.7368	355.2141	349.6799	353.9568	11809507622
## 2020-10-06	353.9565	354.9890	338.0033	340.8159	12830796112
## 2020-10-07	340.9431	342.4508	334.5456	341.8087	11929918060
## 2020-10-08	342.0446	352.2115	335.6475	350.7661	13461017711
## 2020-10-09	351.1129	368.3103	348.2058	365.5905	13043501763
## 2020-10-10	365.4025	378.2672	365.3540	370.9676	13618484324
## 2020-10-11	370.9284	377.2468	369.8280	375.1421	12584512533
## 2020-10-12	374.7987	395.1222	366.6423	387.7313	15867455424
## 2020-10-13	387.1429	387.3757	375.5825	381.1908	14226744838
## 2020-10-14	381.9715	387.2962	374.1750	379.4840	13918846567
## 2020-10-15	379.1922	381.2088	371.3541	377.4418	14964182545
## 2020-10-16	377.8685	380.0215	362.5974	366.2290	14670784817
## 2020-10-17	366.0157	369.7681	364.4890	368.8559	10951115359
## 2020-10-18	368.7275	378.5977	368.1291	378.2137	11047103109
## 2020-10-19	378.4696	383.3177	373.7023	379.9356	12811242092
## 2020-10-20	379.7197	380.7610	367.6011	369.1369	13741586582
## 2020-10-21	369.0594	400.6273	368.7280	392.1900	20241324322
## 2020-10-22	391.4886	420.1417	391.2763	413.7730	15772846485
## 2020-10-23	414.0513	418.9599	403.0820	409.7667	14256222052
## 2020-10-24	409.7672	416.5997	407.8517	412.4576	12201739194
## 2020-10-25	412.4576	417.1592	405.3506	406.2178	10890207469
## 2020-10-26	406.2180	411.2799	383.7829	393.8883	15155684229
## 2020-10-27	393.8882	409.7729	390.6085	403.9970	13940434102
## 2020-10-28	403.9971	408.9648	381.1463	388.6508	15276441134
## 2020-10-29	388.6511	393.2277	381.2888	386.7301	12920477749
## 2020-10-30	386.7303	391.4647	375.0924	382.8200	13688056970
## 2020-10-31	382.8200	393.0101	381.2953	386.5903	11276963426
## 2020-11-01	386.5903	397.1161	385.1655	396.3582	10475146018
## 2020-11-02	396.3560	403.2408	381.0176	383.1567	13997574252
## 2020-11-03	383.1560	389.5154	371.3127	387.6022	12588494762
## 2020-11-04	387.6032	407.6656	377.8276	402.1420	15126077675
## 2020-11-05	402.1429	417.5259	397.2458	414.0674	15440711038
## 2020-11-06	414.0667	456.2006	412.9823	454.7193	16738305610
## 2020-11-07	454.7226	465.6755	428.4564	435.7131	18873289788
## 2020-11-08	435.7188	457.7805	433.1538	453.5548	11292383601
## 2020-11-09	453.5742	457.3496	435.1639	444.1631	13704320630
## 2020-11-10	444.1664	453.7584	439.6001	449.6796	12090381666
## 2020-11-11	449.6797	473.5789	449.5249	462.9605	14075403511
## 2020-11-12	462.9595	467.6778	452.0724	461.0053	12877327234
## 2020-11-13	461.0055	475.2173	457.2982	474.6264	13191505725
## 2020-11-14	474.6264	475.1614	452.9861	460.1498	10312037942
## 2020-11-15	460.1499	460.9941	440.2543	447.5591	10308617165
## 2020-11-16	447.5590	463.8310	445.5016	459.9403	11441239444
## 2020-11-17	464.4066	482.2322	460.7766	480.3601	14593057877
## 2020-11-18	480.3468	491.9999	465.8310	479.4841	17880199224
## 2020-11-19	479.4810	480.1217	465.7043	471.6304	12473929218
## 2020-11-20	471.6315	513.6104	471.6315	509.7446	18629943296
## 2020-11-21	509.7446	550.2274	504.2378	549.4866	20757099184
## 2020-11-22	549.4866	579.3725	514.5172	558.0681	21967049601
## 2020-11-23	558.0595	609.9876	551.2653	608.4540	27272302872
## 2020-11-24	608.5228	621.1734	593.8351	603.8978	23281758100

## 2020-11-25	603.9020	605.0942	559.6714	570.6866	20088492893
## 2020-11-26	570.5149	575.6415	485.4973	518.8011	31104004592
## 2020-11-27	519.1081	530.7772	497.2426	517.4937	16831105703
## 2020-11-28	517.5974	548.0449	508.1254	538.2298	14770243833
## 2020-11-29	538.2646	576.6024	531.9875	575.7581	15017517758
## 2020-11-30	575.7571	615.2405	571.5378	614.8425	20276867833
## 2020-12-01	615.0703	635.1606	571.7540	587.3242	27178964465
## 2020-12-02	587.2616	604.0225	578.7410	598.3524	16883292129
## 2020-12-03	598.4592	622.4527	588.3464	616.7087	16146190946
## 2020-12-04	616.7228	618.9832	569.2835	569.3542	16337589997
## 2020-12-05	569.3477	596.5955	563.1066	596.5955	13498010566
## 2020-12-06	596.5687	606.7919	584.4117	601.9090	11290893016
## 2020-12-07	601.7971	602.9179	585.4286	591.8434	10720480962
## 2020-12-08	591.9008	594.7516	552.4692	554.8278	14398919320
## 2020-12-09	554.7929	577.2884	532.9984	573.4791	15855915840
## 2020-12-10	573.5040	574.6002	549.7841	559.6785	11672582040
## 2020-12-11	559.6792	560.3767	537.8116	545.7974	11098819124
## 2020-12-12	545.5786	573.3394	545.2456	568.5673	8534557897
## 2020-12-13	568.6099	593.7812	564.5660	589.6632	9070377862
## 2020-12-14	589.7825	590.4930	577.1184	586.0112	8125837102
## 2020-12-15	586.0218	596.2477	580.6288	589.3556	9326645840
## 2020-12-16	589.3787	636.6403	582.0391	636.1818	15817248373
## 2020-12-17	636.1542	673.8342	628.7494	642.8690	25479532147
## 2020-12-18	642.9170	662.6991	632.3561	654.8120	15756303983
## 2020-12-19	654.6242	668.7696	646.6162	659.2979	12830893778
## 2020-12-20	659.1851	659.9237	625.0145	638.2908	13375855442
## 2020-12-21	638.3152	646.8466	600.8361	609.8179	14419493621
## 2020-12-22	609.4205	635.0766	589.5520	634.8542	14745890080
## 2020-12-23	634.8246	637.1228	560.3643	583.7146	15261413038
## 2020-12-24	584.1356	613.8152	568.5964	611.6072	14317413703
## 2020-12-25	611.5546	633.0614	605.4244	626.4107	13520927700
## 2020-12-26	626.4980	650.7214	617.4021	635.8358	14761125202
## 2020-12-27	635.8871	711.3936	628.3350	682.6423	26093552821
## 2020-12-28	683.2058	745.8777	683.2058	730.3973	24222565862
## 2020-12-29	730.3587	737.9529	692.1494	731.5201	18710683199
## 2020-12-30	731.4728	754.3032	720.9889	751.6190	17294574210
## 2020-12-31	751.6266	754.2994	726.5119	737.8034	13926846861
## 2021-01-01	737.7084	749.2018	719.7922	730.3676	13652004358
## 2021-01-02	730.4026	786.7985	718.1095	774.5350	19740771179
## 2021-01-03	774.5118	1006.5650	771.5616	975.5077	45200463368
## 2021-01-04	977.0588	1153.1892	912.3054	1040.2330	56945985763
## 2021-01-05	1041.4988	1129.3715	986.8113	1100.0061	41535932781
## 2021-01-06	1101.0050	1209.4286	1064.2334	1207.1122	44699914188
## 2021-01-07	1208.0784	1282.5796	1167.4431	1225.6781	40468027280
## 2021-01-08	1225.9679	1273.8275	1076.0815	1224.1971	44334826666
## 2021-01-09	1223.7405	1303.8718	1182.2704	1281.0773	33233105361
## 2021-01-10	1280.8711	1347.9261	1194.7156	1262.2467	40616938053
## 2021-01-11	1261.6229	1261.6229	924.9226	1090.1454	60733630300
## 2021-01-12	1088.5267	1149.2402	1012.7642	1043.4346	37494601692
## 2021-01-13	1043.7410	1134.3385	994.5491	1130.7394	30109792795
## 2021-01-14	1130.2312	1244.1631	1093.0608	1218.4530	33410915929
## 2021-01-15	1221.8772	1250.5059	1090.7211	1171.8346	35972039310
## 2021-01-16	1171.4431	1290.0536	1157.6238	1233.5376	32319240157
## 2021-01-17	1233.4534	1265.6447	1174.3885	1230.1722	29258032819

## 2021-01-18	1230.3132	1259.4501	1187.3110	1257.2795	25817455560
## 2021-01-19	1257.4346	1432.3000	1254.5229	1377.2959	47195935190
## 2021-01-20	1375.2484	1405.7441	1243.2999	1382.2740	46784030909
## 2021-01-21	1382.6844	1382.6844	1098.4762	1121.5709	45932464754
## 2021-01-22	1118.8890	1271.6876	1046.5966	1236.5122	43918338506
## 2021-01-23	1235.2679	1272.1511	1200.8933	1230.9906	27253895441
## 2021-01-24	1231.2106	1395.1113	1225.2740	1391.6094	36418163554
## 2021-01-25	1390.6399	1467.7849	1304.9740	1324.4148	43565777745
## 2021-01-26	1323.7417	1376.0851	1253.3403	1357.0581	41572917750
## 2021-01-27	1358.3334	1368.0741	1215.3113	1253.1871	39394416990
## 2021-01-28	1251.2798	1356.2887	1226.1740	1332.4922	34637234789
## 2021-01-29	1369.0868	1428.9812	1292.2401	1382.5228	53611955259
## 2021-01-30	1382.2319	1402.3998	1328.5291	1376.1155	30616574234
## 2021-01-31	1376.8236	1378.9160	1288.5016	1314.9862	25198853581
## 2021-02-01	1314.8552	1373.8458	1274.3578	1369.0405	29210670920
## 2021-02-02	1369.5051	1542.9910	1362.7712	1515.1937	45437142801
## 2021-02-03	1514.7697	1660.9095	1510.0103	1660.9095	41874566399
## 2021-02-04	1661.1702	1689.1866	1561.8535	1594.7627	44396871836
## 2021-02-05	1594.7933	1756.5110	1594.7933	1718.6509	40108628454
## 2021-02-06	1717.7975	1738.3145	1649.0687	1677.8468	39873420648
## 2021-02-07	1677.6057	1690.0366	1501.7502	1614.2278	39889440151
## 2021-02-08	1613.6422	1770.5908	1571.5800	1746.6168	48012285956
## 2021-02-09	1746.9261	1815.9636	1711.6206	1768.0350	44180727529
## 2021-02-10	1768.0398	1826.6968	1686.5424	1744.2434	41916084617
## 2021-02-11	1743.7142	1806.5391	1708.6792	1783.7980	36021495262
## 2021-02-12	1783.4891	1861.3569	1744.1689	1843.5326	37905036865
## 2021-02-13	1843.9868	1871.6035	1770.6121	1814.1099	35359490535
## 2021-02-14	1814.3723	1848.1541	1789.9142	1805.0841	31439114900
## 2021-02-15	1804.6768	1833.8306	1683.9066	1779.7910	38955610883
## 2021-02-16	1778.9456	1824.5187	1729.6420	1781.0675	34269369268
## 2021-02-17	1781.3501	1853.6676	1736.7058	1848.4583	35955412703
## 2021-02-18	1848.2063	1949.9034	1848.2063	1937.4492	28255902969
## 2021-02-19	1938.8599	1969.5470	1896.6844	1960.1648	26268814253
## 2021-02-20	1959.9030	2036.2865	1830.5315	1919.5341	34696091102
## 2021-02-21	1918.6731	1974.2596	1890.3682	1935.6011	23626547717
## 2021-02-22	1935.5579	1936.4537	1580.6266	1781.9929	42409646036
## 2021-02-23	1781.4091	1781.4091	1378.8409	1570.2040	52029864713
## 2021-02-24	1571.4764	1710.9838	1511.0189	1626.5757	31329000537
## 2021-02-25	1625.3939	1670.2241	1465.0590	1475.7037	24481681873
## 2021-02-26	1478.6533	1559.0289	1407.9792	1446.0337	31435997881
## 2021-02-27	1446.9294	1524.9324	1433.7870	1459.9731	20742103233
## 2021-02-28	1459.8605	1468.3915	1300.4722	1416.0490	27637026080
## 2021-03-01	1417.1511	1567.6946	1416.4161	1564.7076	24032838645
## 2021-03-02	1564.0635	1597.6101	1461.3254	1492.6088	22523669722
## 2021-03-03	1491.4512	1650.3606	1481.9058	1575.8531	22674780680
## 2021-03-04	1574.6238	1622.9539	1511.1034	1541.9143	22906118718
## 2021-03-05	1541.5417	1547.8782	1450.8914	1533.2750	21067146937
## 2021-03-06	1532.3728	1669.1066	1519.1411	1654.7416	22746262366
## 2021-03-07	1655.3925	1730.9242	1636.5645	1723.1538	23809935410
## 2021-03-08	1724.2292	1835.1921	1670.9420	1834.7279	27630991158
## 2021-03-09	1835.1481	1868.0488	1804.2664	1868.0488	23461244507
## 2021-03-10	1868.4890	1873.8032	1766.4905	1799.1663	25154173185
## 2021-03-11	1798.0339	1843.8188	1734.6171	1826.1949	24013132909
## 2021-03-12	1826.5468	1839.4973	1728.9810	1772.1024	22435821312

## 2021-03-13	1772.1664	1937.6455	1733.6399	1924.6854	25014689475
## 2021-03-14	1923.8638	1930.7798	1845.1200	1854.5643	19344589211
## 2021-03-15	1854.0867	1889.1967	1749.6063	1791.7023	26244738810
## 2021-03-16	1792.4138	1817.0602	1720.0532	1806.9718	23828509590
## 2021-03-17	1807.0562	1839.8190	1749.1799	1823.4493	24512917348
## 2021-03-18	1823.1584	1848.6461	1705.7161	1782.8551	23263845504
## 2021-03-19	1782.5687	1841.1960	1746.4734	1817.6241	21249297710
## 2021-03-20	1817.5227	1874.7090	1811.7286	1812.6346	22677674970
## 2021-03-21	1812.6066	1823.3530	1764.1393	1788.2170	22977404620
## 2021-03-22	1788.3622	1811.9683	1674.2998	1691.3340	23599296129
## 2021-03-23	1690.8718	1725.1088	1662.5399	1678.6501	21998237965
## 2021-03-24	1678.0026	1740.4282	1570.7880	1593.4135	31228051473
## 2021-03-25	1593.1233	1625.9115	1560.3705	1595.3593	29650328701
## 2021-03-26	1595.2101	1702.9229	1594.7367	1702.8420	22548516548
## 2021-03-27	1703.0361	1732.8243	1674.3193	1716.4946	18102277710
## 2021-03-28	1716.4056	1728.5841	1672.6604	1691.3560	16599472938
## 2021-03-29	1691.2632	1837.1880	1683.7166	1819.6849	22796570548
## 2021-03-30	1819.4663	1860.9747	1793.9224	1846.0337	22512781703
## 2021-03-31	1846.0983	1947.8378	1793.0022	1918.3621	30226902621
## 2021-04-01	1919.1572	1989.0551	1912.1785	1977.2769	30914259795
## 2021-04-02	1976.9327	2152.4519	1960.6787	2143.2256	34862511022
## 2021-04-03	2142.8960	2144.9624	2028.4225	2028.4225	32011518871
## 2021-04-04	2027.6713	2110.3535	2007.1118	2093.1228	26006501902
## 2021-04-05	2093.2607	2140.9854	2032.3877	2107.8872	28889391170
## 2021-04-06	2109.4932	2151.2234	2057.6091	2118.3789	29222865881
## 2021-04-07	2117.7285	2133.1875	1945.4421	1971.0773	36116271935
## 2021-04-08	1969.1332	2091.5164	1959.0795	2088.5737	25312956529
## 2021-04-09	2088.7722	2102.8738	2055.1633	2072.1089	19812472092
## 2021-04-10	2071.1116	2196.9963	2062.7876	2135.9421	24986243611
## 2021-04-11	2136.1570	2165.1914	2119.8657	2157.6570	19692836132
## 2021-04-12	2157.3618	2199.7188	2110.3689	2139.3533	21727936609
## 2021-04-13	2139.3643	2318.4233	2138.5596	2299.1877	29456642939
## 2021-04-14	2299.3479	2449.6875	2284.5637	2435.1050	35592822986
## 2021-04-15	2436.0347	2544.2673	2409.9241	2519.1162	32325606817
## 2021-04-16	2516.6018	2547.5557	2318.6750	2431.9465	36196928256
## 2021-04-17	2429.9810	2497.3853	2333.6829	2344.8950	32349808978
## 2021-04-18	2346.4524	2365.4604	2011.7668	2237.1370	50696368718
## 2021-04-19	2238.0327	2276.7769	2086.6887	2166.1887	34060654971
## 2021-04-20	2161.9395	2345.8350	2060.1438	2330.2109	39433483315
## 2021-04-21	2331.1602	2467.2007	2238.3669	2364.7517	38899067643
## 2021-04-22	2357.8711	2641.0950	2315.9602	2403.5352	53575904724
## 2021-04-23	2401.2563	2439.5371	2117.0396	2363.5862	55413933925
## 2021-04-24	2367.1992	2367.7410	2163.6931	2211.6257	31854226936
## 2021-04-25	2214.4138	2354.0867	2172.5151	2316.0596	31814355546
## 2021-04-26	2319.4780	2536.3374	2308.3152	2534.4817	35208325408
## 2021-04-27	2534.0312	2676.3928	2485.3750	2662.8652	32275969215
## 2021-04-28	2664.6855	2757.4773	2564.0815	2746.3801	34269031076
## 2021-04-29	2748.6497	2797.9724	2672.1067	2756.8770	32578127990
## 2021-04-30	2757.7341	2796.0549	2728.1699	2773.2070	29777179889
## 2021-05-01	2772.8384	2951.4409	2755.9084	2945.8928	28726205272
## 2021-05-02	2945.5601	2984.8918	2860.5261	2952.0562	28032013047
## 2021-05-03	2951.1758	3450.0378	2951.1758	3431.0862	49174290212
## 2021-05-04	3431.1316	3523.5859	3180.7427	3253.6294	62402045158
## 2021-05-05	3240.5547	3541.4626	3213.1016	3522.7832	48334198383

## 2021-05-06	3524.9309	3598.8960	3386.2400	3490.8804	44300394788
## 2021-05-07	3490.1052	3573.2900	3370.2620	3484.7290	39607240515
## 2021-05-08	3481.9880	3950.1650	3453.7686	3902.6477	50208491286
## 2021-05-09	3911.4631	3981.2590	3743.9890	3928.8447	50568290278
## 2021-05-10	3924.4133	4197.4731	3684.4517	3952.2939	62691789007
## 2021-05-11	3948.2720	4178.2090	3783.8894	4168.7012	52679737865
## 2021-05-12	4174.6357	4362.3506	3785.8486	3785.8486	69023382175
## 2021-05-13	3828.9185	4032.5635	3549.4072	3715.1484	78398214539
## 2021-05-14	3720.1223	4171.0171	3703.3999	4079.0574	48174271215
## 2021-05-15	4075.9517	4129.1855	3638.1221	3638.1221	42422321751
## 2021-05-16	3641.8308	3878.8960	3350.9517	3587.5061	47359478734
## 2021-05-17	3581.3430	3587.7656	3129.0088	3282.3977	54061732774
## 2021-05-18	3276.8723	3562.4651	3246.4041	3380.0701	40416525218
## 2021-05-19	3382.6572	3437.9358	1952.4602	2460.6792	84482912776
## 2021-05-20	2439.6387	2993.1453	2170.2290	2784.2942	67610826680
## 2021-05-21	2772.3413	2938.2051	2113.3472	2430.6213	53774070802
## 2021-05-22	2436.0146	2483.9832	2168.1243	2295.7056	42089937660
## 2021-05-23	2298.3672	2384.4116	1737.4688	2109.5798	56005721977
## 2021-05-24	2099.9360	2672.5957	2090.6396	2643.5911	53697121740
## 2021-05-25	2649.0332	2750.5349	2394.3555	2706.6289	49558333256
## 2021-05-26	2707.0527	2911.7356	2652.0945	2888.6987	42499766020
## 2021-05-27	2888.7524	2888.7524	2642.6079	2736.4885	33373635283
## 2021-05-28	2742.4690	2761.3633	2336.3613	2419.9062	39999114805
## 2021-05-29	2414.0671	2566.9385	2208.4910	2279.5142	33773720220
## 2021-05-30	2278.2888	2472.1877	2188.8345	2390.3054	25876619428
## 2021-05-31	2387.1985	2715.8550	2279.5051	2714.9453	31007383150
## 2021-06-01	2707.5605	2739.7375	2531.1606	2633.5183	27363223090
## 2021-06-02	2634.4561	2801.3923	2555.4014	2706.1250	27723267359
## 2021-06-03	2708.3762	2891.2549	2667.6843	2855.1265	30038207402
## 2021-06-04	2857.1655	2857.1655	2562.6375	2688.1951	34173841611
## 2021-06-05	2691.6194	2817.4849	2558.2336	2630.5769	30496672724
## 2021-06-06	2629.7488	2743.4412	2616.1624	2715.0928	25311639414
## 2021-06-07	2713.0474	2845.1851	2583.9951	2590.2632	30600111277
## 2021-06-08	2594.6023	2620.8462	2315.5466	2517.4387	41909736778
## 2021-06-09	2510.1992	2625.0706	2412.1978	2608.2671	36075832186
## 2021-06-10	2611.1426	2619.9578	2435.4016	2471.5186	28753626390
## 2021-06-11	2472.8589	2495.4148	2326.8696	2353.7688	24832564195
## 2021-06-12	2354.7522	2447.2278	2265.7581	2372.4844	25724364410
## 2021-06-13	2372.6902	2547.3679	2312.6401	2508.3916	27092945370
## 2021-06-14	2508.7705	2606.4329	2469.3882	2537.8911	26964576331
## 2021-06-15	2587.7627	2639.2292	2515.1531	2610.9368	29005279219
## 2021-06-16	2544.8647	2554.6289	2354.3506	2367.6636	24101926180
## 2021-06-17	2367.3064	2457.1755	2312.3015	2372.0020	21871633186
## 2021-06-18	2374.5869	2377.1951	2147.3083	2231.7332	22752818388
## 2021-06-19	2235.1592	2278.4150	2168.8850	2178.4990	18765854896
## 2021-06-20	2171.3379	2275.3828	2049.9626	2246.3645	22535930423
## 2021-06-21	2245.3179	2259.4641	1867.1854	1888.4475	33745173825
## 2021-06-22	1886.6676	1993.1598	1707.6006	1874.9501	35547251725
## 2021-06-23	1878.6250	2043.5304	1827.5715	1989.7363	28408659206
## 2021-06-24	1968.9574	2032.3394	1887.4320	1988.4563	20272845769
## 2021-06-25	1989.2158	2017.7595	1794.4004	1813.2173	22774334998
## 2021-06-26	1810.8843	1850.1798	1719.5594	1829.2393	20637542361
## 2021-06-27	1830.9969	1979.9581	1811.2459	1978.8947	19885474742
## 2021-06-28	1981.3865	2139.8054	1963.6155	2079.6575	25514602841

## 2021-06-29	2083.4487	2242.2388	2076.2402	2160.7683	24815124419
## 2021-06-30	2164.2163	2282.9890	2090.7607	2274.5476	25828056268
## 2021-07-01	2274.3975	2274.3975	2081.0811	2113.6055	29061701793
## 2021-07-02	2109.8926	2155.5964	2021.8248	2150.0403	31796212554
## 2021-07-03	2150.8350	2237.5671	2117.5901	2226.1143	17433361641
## 2021-07-04	2226.5503	2384.2869	2190.8376	2321.7241	18787107473
## 2021-07-05	2321.9229	2321.9229	2163.0415	2198.5825	20103794829
## 2021-07-06	2197.9194	2346.2949	2197.9194	2324.6794	20891861314
## 2021-07-07	2323.2085	2403.7734	2298.0269	2315.1619	22398345285
## 2021-07-08	2317.9492	2324.0068	2089.4143	2120.0264	23188123689
## 2021-07-09	2115.5740	2185.3762	2051.0667	2146.6924	23029574602
## 2021-07-10	2146.9998	2190.1240	2081.9236	2111.4036	17581542471
## 2021-07-11	2110.8757	2172.6533	2083.8037	2139.6648	14705386138
## 2021-07-12	2140.5068	2167.7102	2011.0189	2036.7211	17768129077
## 2021-07-13	2034.0984	2040.6936	1922.5779	1940.0840	16621628658
## 2021-07-14	1941.1678	2015.1074	1869.2231	1994.3313	17342819679
## 2021-07-15	1994.7120	2037.7426	1883.2722	1911.1757	15688092552
## 2021-07-16	1916.5984	1959.6963	1853.5903	1880.3829	14884569147
## 2021-07-17	1876.8813	1917.5979	1855.5908	1898.8252	13364282076
## 2021-07-18	1900.1943	1988.3364	1883.0126	1895.5521	13791868728
## 2021-07-19	1893.0536	1916.1180	1807.9099	1817.2966	14157735481
## 2021-07-20	1819.0820	1836.9980	1722.0508	1787.5107	17368597636
## 2021-07-21	1786.2762	2025.6804	1759.0233	1990.9708	21253359756
## 2021-07-22	1994.8229	2044.1165	1954.2979	2025.2028	17495480331
## 2021-07-23	2025.1057	2129.4412	2000.4363	2124.7766	16200392492
## 2021-07-24	2123.9612	2197.6494	2107.3235	2189.2188	16057446601
## 2021-07-25	2187.1455	2194.4382	2108.8298	2191.3738	14566483636
## 2021-07-26	2191.3098	2428.8171	2177.3296	2233.3667	29614324233
## 2021-07-27	2230.1970	2316.9502	2154.7312	2298.3335	23067480378
## 2021-07-28	2302.0813	2341.7778	2250.9141	2296.5454	18991302378
## 2021-07-29	2299.0120	2396.4519	2273.4048	2380.9568	16313373113
## 2021-07-30	2382.5452	2469.7048	2322.3372	2466.9614	20212848934
## 2021-07-31	2461.5757	2551.1611	2423.8162	2536.2100	18001710283
## 2021-08-01	2530.4629	2695.4294	2520.9319	2561.8521	22697987055
## 2021-08-02	2557.7747	2665.7310	2511.3752	2610.1533	22162754104
## 2021-08-03	2609.4131	2630.3142	2449.3535	2502.3496	22696753413
## 2021-08-04	2508.5449	2764.4436	2463.4695	2724.6199	25038698173
## 2021-08-05	2725.6697	2840.4307	2540.6841	2827.3289	31057928075
## 2021-08-06	2827.5034	2944.9033	2727.7927	2890.9417	26528577879
## 2021-08-07	2891.7075	3170.2297	2868.5356	3157.2388	33081467129
## 2021-08-08	3161.2327	3184.6040	2951.7473	3013.7327	28433638008
## 2021-08-09	3012.8857	3185.7012	2900.9260	3167.8562	31983260936
## 2021-08-10	3163.0500	3228.9407	3059.2290	3141.6912	27605221710
## 2021-08-11	3142.8303	3269.2095	3122.9165	3164.2451	26729035052
## 2021-08-12	3164.1758	3236.3147	2984.1670	3043.4143	25403699845
## 2021-08-13	3049.0012	3324.6716	3037.6760	3322.2117	23868866254
## 2021-08-14	3322.7627	3329.2810	3214.5198	3265.4434	19860862133
## 2021-08-15	3266.2761	3320.0842	3117.7917	3310.5042	22166205051
## 2021-08-16	3309.4221	3333.9949	3139.7786	3156.5095	23080039949
## 2021-08-17	3149.3804	3288.8127	2996.4683	3014.8459	25509056745
## 2021-08-18	3011.9636	3124.9761	2959.0283	3020.0898	21539248425
## 2021-08-19	3019.1270	3184.4355	2963.1501	3182.7021	19546290360
## 2021-08-20	3182.1626	3298.2466	3178.1038	3286.9353	20885619828
## 2021-08-21	3286.9316	3307.3516	3209.8662	3226.0840	18113977628

## 2021-08-22	3226.2273	3272.7332	3142.0071	3242.1155	15983278460
## 2021-08-23	3241.3574	3373.3843	3235.8513	3319.2573	20511110509
## 2021-08-24	3324.8555	3358.6882	3154.1213	3172.4563	20131028906
## 2021-08-25	3174.2698	3248.7273	3086.1150	3224.9153	18902728235
## 2021-08-26	3228.7473	3249.6553	3060.2288	3100.3254	17405668117
## 2021-08-27	3096.4060	3281.8406	3064.4851	3270.6008	18489602004
## 2021-08-28	3275.1045	3284.8459	3217.4036	3244.4033	13709633698
## 2021-08-29	3246.7710	3283.2356	3158.8403	3227.0027	13296586731
## 2021-08-30	3227.1926	3346.5811	3151.4446	3224.3743	19306924485
## 2021-08-31	3227.7581	3466.9922	3195.2166	3433.7327	27280502987
## 2021-09-01	3430.7625	3836.8674	3387.4084	3834.8281	30070890104
## 2021-09-02	3825.0278	3830.7114	3726.7505	3790.9900	24387397330
## 2021-09-03	3787.4866	4022.4692	3712.6782	3940.6147	26207765094
## 2021-09-04	3937.9102	3969.4487	3837.9312	3887.8284	20806963328
## 2021-09-05	3886.3311	3979.1865	3838.4873	3952.1335	18371468576
## 2021-09-06	3951.5208	3968.4265	3868.9944	3928.3794	18674691198
## 2021-09-07	3926.5276	3945.3142	3062.2224	3426.3943	39131346397
## 2021-09-08	3428.3782	3559.1213	3224.7649	3497.3152	31738430771
## 2021-09-09	3452.5483	3562.9927	3400.5171	3427.3401	24118055831
## 2021-09-10	3425.5649	3512.5713	3157.0591	3211.5059	22355974097
## 2021-09-11	3209.0305	3346.5264	3208.9619	3270.2781	18627122934
## 2021-09-12	3270.2917	3462.4683	3235.1094	3410.1345	16810411424
## 2021-09-13	3407.4719	3426.5022	3121.5142	3285.5117	22721552948
## 2021-09-14	3286.3164	3429.1697	3273.6309	3429.1697	19125420848
## 2021-09-15	3431.2173	3615.2827	3365.9131	3615.2827	17548551804
## 2021-09-16	3613.0737	3673.3108	3489.8057	3571.2949	20093903064
## 2021-09-17	3569.5681	3589.3052	3356.4500	3398.5388	17722363229
## 2021-09-18	3397.4229	3540.8076	3371.8923	3432.0183	15995220233
## 2021-09-19	3433.2878	3448.3220	3286.1724	3329.4480	14257609743
## 2021-09-20	3329.6707	3343.3254	2940.8391	2958.9934	27371684581
## 2021-09-21	2977.3105	3101.6975	2676.4075	2764.4312	30405062665
## 2021-09-22	2763.2092	3089.0830	2741.4407	3077.8679	23742102645
## 2021-09-23	3077.9744	3173.5447	3038.0979	3155.5237	18516291047
## 2021-09-24	3154.5620	3159.6440	2747.3376	2931.6692	25595422789
## 2021-09-25	2930.8848	2968.9946	2818.9705	2925.5657	18932786754
## 2021-09-26	2926.3430	3114.8574	2744.5830	3062.2654	21172766310
## 2021-09-27	3065.8379	3163.6650	2932.6929	2934.1389	19164053681
## 2021-09-28	2928.9634	2970.7705	2793.3606	2807.2966	16895079070
## 2021-09-29	2809.2976	2946.8813	2786.9883	2853.1433	15763456158
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## 2021-10-04	3418.7764	3434.7754	3283.4487	3380.0891	17747154101
## 2021-10-05	3381.7844	3541.4517	3365.8176	3518.5186	16632591670
## 2021-10-06	3516.5703	3622.5513	3354.4697	3580.5620	21855226591
## 2021-10-07	3576.8145	3650.0132	3479.9092	3587.9749	19090322927
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## 2021-10-11	3419.7268	3622.2896	3385.7617	3545.3540	18579189588
## 2021-10-12	3546.4778	3546.4778	3407.3381	3492.5732	18109578443
## 2021-10-13	3492.7537	3607.7417	3417.6021	3606.2017	16211275589
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## 2021-10-25	4084.4258	4236.6670	4072.0347	4217.8770	15995727040
## 2021-10-26	4217.3379	4289.1313	4106.8237	4131.1021	17157714562
## 2021-10-27	4132.1733	4299.1528	3930.2573	3930.2573	26219530404
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## 2021-11-01	4288.2173	4377.3223	4160.9668	4324.6270	17985288261
## 2021-11-02	4322.5010	4599.9482	4288.6865	4584.7988	20794448222
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## 2021-11-06	4482.6479	4530.9971	4334.9736	4521.5811	14429076700
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## 2021-11-08	4619.6494	4822.3633	4619.6494	4812.0874	19290896267
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## 2021-11-10	4733.3628	4859.5029	4485.0933	4636.1743	22748160545
## 2021-11-11	4635.4536	4778.0591	4580.9902	4730.3843	17933201129
## 2021-11-12	4724.3066	4808.7388	4510.9204	4667.1152	18316060208
## 2021-11-13	4666.7192	4702.1152	4582.1807	4651.4604	14457436261
## 2021-11-14	4648.6328	4689.8428	4516.9355	4626.3589	12172962219
## 2021-11-15	4627.0908	4764.6362	4546.5991	4557.5039	16275851299
## 2021-11-16	4570.4780	4891.7046	4144.3350	4216.3652	27417502801
## 2021-11-17	4213.9106	4300.3066	4107.1260	4287.5938	22183461850
## 2021-11-18	4287.8022	4343.5571	3959.2278	4000.6509	21383250893
## 2021-11-19	3995.7295	4311.7139	3982.9175	4298.3066	20626269711
## 2021-11-20	4298.3506	4434.3882	4209.2427	4409.9312	15448261277
## 2021-11-21	4412.1953	4422.4917	4255.4551	4269.7329	14094831413
## 2021-11-22	4266.5093	4302.0229	4033.5723	4088.4578	19752218877
## 2021-11-23	4089.6804	4385.4834	4069.7666	4340.7637	22133497059
## 2021-11-24	4340.0361	4376.8760	4176.1836	4239.9814	21838037128
## 2021-11-25	4271.3945	4550.5181	4249.7744	4274.7432	18705358318
## 2021-11-26	4522.2090	4550.8423	3933.5066	4030.9089	26281795488
## 2021-11-27	4042.9990	4187.6841	4033.5139	4096.9121	16515693874
## 2021-11-28	4101.6489	4297.9165	3989.9700	4294.4536	15953126340
## 2021-11-29	4296.9468	4460.8486	4284.5049	4445.1050	19086475837
## 2021-11-30	4447.7681	4753.2661	4358.0742	4631.4790	28626354111
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##	2021-12-12	4084.8113	4173.6089	3993.0559	4134.4531	14057603914
##	2021-12-13	4136.3599	4145.9551	3680.6091	3784.2268	23999841386
##	2021-12-14	3782.8228	3866.6338	3700.1047	3745.4404	23836759957
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##	2021-12-23	3981.9617	4149.0269	3897.2344	4108.0156	18007273742
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##	2021-12-26	4094.1516	4105.0239	4013.0264	4067.3281	11197244172
##	2021-12-27	4064.7463	4126.0015	4033.4924	4037.5476	11424360002
##	2021-12-28	4037.5381	4037.5381	3769.2800	3800.8931	17299472803
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## 2021-01-11	1090.1454
## 2021-01-12	1043.4346
## 2021-01-13	1130.7394
## 2021-01-14	1218.4530
## 2021-01-15	1171.8346
## 2021-01-16	1233.5376
## 2021-01-17	1230.1722
## 2021-01-18	1257.2795
## 2021-01-19	1377.2959
## 2021-01-20	1382.2740
## 2021-01-21	1121.5709
## 2021-01-22	1236.5122
## 2021-01-23	1230.9906

## 2021-01-24	1391.6094
## 2021-01-25	1324.4148
## 2021-01-26	1357.0581
## 2021-01-27	1253.1871
## 2021-01-28	1332.4922
## 2021-01-29	1382.5228
## 2021-01-30	1376.1155
## 2021-01-31	1314.9862
## 2021-02-01	1369.0405
## 2021-02-02	1515.1937
## 2021-02-03	1660.9095
## 2021-02-04	1594.7627
## 2021-02-05	1718.6509
## 2021-02-06	1677.8468
## 2021-02-07	1614.2278
## 2021-02-08	1746.6168
## 2021-02-09	1768.0350
## 2021-02-10	1744.2434
## 2021-02-11	1783.7980
## 2021-02-12	1843.5326
## 2021-02-13	1814.1099
## 2021-02-14	1805.0841
## 2021-02-15	1779.7910
## 2021-02-16	1781.0675
## 2021-02-17	1848.4583
## 2021-02-18	1937.4492
## 2021-02-19	1960.1648
## 2021-02-20	1919.5341
## 2021-02-21	1935.6011
## 2021-02-22	1781.9929
## 2021-02-23	1570.2040
## 2021-02-24	1626.5757
## 2021-02-25	1475.7037
## 2021-02-26	1446.0337
## 2021-02-27	1459.9731
## 2021-02-28	1416.0490
## 2021-03-01	1564.7076
## 2021-03-02	1492.6088
## 2021-03-03	1575.8531
## 2021-03-04	1541.9143
## 2021-03-05	1533.2750
## 2021-03-06	1654.7416
## 2021-03-07	1723.1538
## 2021-03-08	1834.7279
## 2021-03-09	1868.0488
## 2021-03-10	1799.1663
## 2021-03-11	1826.1949
## 2021-03-12	1772.1024
## 2021-03-13	1924.6854
## 2021-03-14	1854.5643
## 2021-03-15	1791.7023
## 2021-03-16	1806.9718
## 2021-03-17	1823.4493
## 2021-03-18	1782.8551

## 2021-03-19	1817.6241
## 2021-03-20	1812.6346
## 2021-03-21	1788.2170
## 2021-03-22	1691.3340
## 2021-03-23	1678.6501
## 2021-03-24	1593.4135
## 2021-03-25	1595.3593
## 2021-03-26	1702.8420
## 2021-03-27	1716.4946
## 2021-03-28	1691.3560
## 2021-03-29	1819.6849
## 2021-03-30	1846.0337
## 2021-03-31	1918.3621
## 2021-04-01	1977.2769
## 2021-04-02	2143.2256
## 2021-04-03	2028.4225
## 2021-04-04	2093.1228
## 2021-04-05	2107.8872
## 2021-04-06	2118.3789
## 2021-04-07	1971.0773
## 2021-04-08	2088.5737
## 2021-04-09	2072.1089
## 2021-04-10	2135.9421
## 2021-04-11	2157.6570
## 2021-04-12	2139.3533
## 2021-04-13	2299.1877
## 2021-04-14	2435.1050
## 2021-04-15	2519.1162
## 2021-04-16	2431.9465
## 2021-04-17	2344.8950
## 2021-04-18	2237.1370
## 2021-04-19	2166.1887
## 2021-04-20	2330.2109
## 2021-04-21	2364.7517
## 2021-04-22	2403.5352
## 2021-04-23	2363.5862
## 2021-04-24	2211.6257
## 2021-04-25	2316.0596
## 2021-04-26	2534.4817
## 2021-04-27	2662.8652
## 2021-04-28	2746.3801
## 2021-04-29	2756.8770
## 2021-04-30	2773.2070
## 2021-05-01	2945.8928
## 2021-05-02	2952.0562
## 2021-05-03	3431.0862
## 2021-05-04	3253.6294
## 2021-05-05	3522.7832
## 2021-05-06	3490.8804
## 2021-05-07	3484.7290
## 2021-05-08	3902.6477
## 2021-05-09	3928.8447
## 2021-05-10	3952.2939
## 2021-05-11	4168.7012

## 2021-05-12	3785.8486
## 2021-05-13	3715.1484
## 2021-05-14	4079.0574
## 2021-05-15	3638.1221
## 2021-05-16	3587.5061
## 2021-05-17	3282.3977
## 2021-05-18	3380.0701
## 2021-05-19	2460.6792
## 2021-05-20	2784.2942
## 2021-05-21	2430.6213
## 2021-05-22	2295.7056
## 2021-05-23	2109.5798
## 2021-05-24	2643.5911
## 2021-05-25	2706.6289
## 2021-05-26	2888.6987
## 2021-05-27	2736.4885
## 2021-05-28	2419.9062
## 2021-05-29	2279.5142
## 2021-05-30	2390.3054
## 2021-05-31	2714.9453
## 2021-06-01	2633.5183
## 2021-06-02	2706.1250
## 2021-06-03	2855.1265
## 2021-06-04	2688.1951
## 2021-06-05	2630.5769
## 2021-06-06	2715.0928
## 2021-06-07	2590.2632
## 2021-06-08	2517.4387
## 2021-06-09	2608.2671
## 2021-06-10	2471.5186
## 2021-06-11	2353.7688
## 2021-06-12	2372.4844
## 2021-06-13	2508.3916
## 2021-06-14	2537.8911
## 2021-06-15	2610.9368
## 2021-06-16	2367.6636
## 2021-06-17	2372.0020
## 2021-06-18	2231.7332
## 2021-06-19	2178.4990
## 2021-06-20	2246.3645
## 2021-06-21	1888.4475
## 2021-06-22	1874.9501
## 2021-06-23	1989.7363
## 2021-06-24	1988.4563
## 2021-06-25	1813.2173
## 2021-06-26	1829.2393
## 2021-06-27	1978.8947
## 2021-06-28	2079.6575
## 2021-06-29	2160.7683
## 2021-06-30	2274.5476
## 2021-07-01	2113.6055
## 2021-07-02	2150.0403
## 2021-07-03	2226.1143
## 2021-07-04	2321.7241

## 2021-07-05	2198.5825
## 2021-07-06	2324.6794
## 2021-07-07	2315.1619
## 2021-07-08	2120.0264
## 2021-07-09	2146.6924
## 2021-07-10	2111.4036
## 2021-07-11	2139.6648
## 2021-07-12	2036.7211
## 2021-07-13	1940.0840
## 2021-07-14	1994.3313
## 2021-07-15	1911.1757
## 2021-07-16	1880.3829
## 2021-07-17	1898.8252
## 2021-07-18	1895.5521
## 2021-07-19	1817.2966
## 2021-07-20	1787.5107
## 2021-07-21	1990.9708
## 2021-07-22	2025.2028
## 2021-07-23	2124.7766
## 2021-07-24	2189.2188
## 2021-07-25	2191.3738
## 2021-07-26	2233.3667
## 2021-07-27	2298.3335
## 2021-07-28	2296.5454
## 2021-07-29	2380.9568
## 2021-07-30	2466.9614
## 2021-07-31	2536.2100
## 2021-08-01	2561.8521
## 2021-08-02	2610.1533
## 2021-08-03	2502.3496
## 2021-08-04	2724.6199
## 2021-08-05	2827.3289
## 2021-08-06	2890.9417
## 2021-08-07	3157.2388
## 2021-08-08	3013.7327
## 2021-08-09	3167.8562
## 2021-08-10	3141.6912
## 2021-08-11	3164.2451
## 2021-08-12	3043.4143
## 2021-08-13	3322.2117
## 2021-08-14	3265.4434
## 2021-08-15	3310.5042
## 2021-08-16	3156.5095
## 2021-08-17	3014.8459
## 2021-08-18	3020.0898
## 2021-08-19	3182.7021
## 2021-08-20	3286.9353
## 2021-08-21	3226.0840
## 2021-08-22	3242.1155
## 2021-08-23	3319.2573
## 2021-08-24	3172.4563
## 2021-08-25	3224.9153
## 2021-08-26	3100.3254
## 2021-08-27	3270.6008

## 2021-08-28	3244.4033
## 2021-08-29	3227.0027
## 2021-08-30	3224.3743
## 2021-08-31	3433.7327
## 2021-09-01	3834.8281
## 2021-09-02	3790.9900
## 2021-09-03	3940.6147
## 2021-09-04	3887.8284
## 2021-09-05	3952.1335
## 2021-09-06	3928.3794
## 2021-09-07	3426.3943
## 2021-09-08	3497.3152
## 2021-09-09	3427.3401
## 2021-09-10	3211.5059
## 2021-09-11	3270.2781
## 2021-09-12	3410.1345
## 2021-09-13	3285.5117
## 2021-09-14	3429.1697
## 2021-09-15	3615.2827
## 2021-09-16	3571.2949
## 2021-09-17	3398.5388
## 2021-09-18	3432.0183
## 2021-09-19	3329.4480
## 2021-09-20	2958.9934
## 2021-09-21	2764.4312
## 2021-09-22	3077.8679
## 2021-09-23	3155.5237
## 2021-09-24	2931.6692
## 2021-09-25	2925.5657
## 2021-09-26	3062.2654
## 2021-09-27	2934.1389
## 2021-09-28	2807.2966
## 2021-09-29	2853.1433
## 2021-09-30	3001.6790
## 2021-10-01	3307.5161
## 2021-10-02	3391.6943
## 2021-10-03	3418.3586
## 2021-10-04	3380.0891
## 2021-10-05	3518.5186
## 2021-10-06	3580.5620
## 2021-10-07	3587.9749
## 2021-10-08	3563.7593
## 2021-10-09	3575.7168
## 2021-10-10	3425.8528
## 2021-10-11	3545.3540
## 2021-10-12	3492.5732
## 2021-10-13	3606.2017
## 2021-10-14	3786.0142
## 2021-10-15	3862.6348
## 2021-10-16	3830.3821
## 2021-10-17	3847.1045
## 2021-10-18	3748.7603
## 2021-10-19	3877.6509
## 2021-10-20	4155.9922

## 2021-10-21	4054.3228
## 2021-10-22	3970.1819
## 2021-10-23	4171.6636
## 2021-10-24	4087.9031
## 2021-10-25	4217.8770
## 2021-10-26	4131.1021
## 2021-10-27	3930.2573
## 2021-10-28	4287.3188
## 2021-10-29	4414.7466
## 2021-10-30	4325.6504
## 2021-10-31	4288.0742
## 2021-11-01	4324.6270
## 2021-11-02	4584.7988
## 2021-11-03	4607.1938
## 2021-11-04	4537.3242
## 2021-11-05	4486.2432
## 2021-11-06	4521.5811
## 2021-11-07	4620.5547
## 2021-11-08	4812.0874
## 2021-11-09	4735.0688
## 2021-11-10	4636.1743
## 2021-11-11	4730.3843
## 2021-11-12	4667.1152
## 2021-11-13	4651.4604
## 2021-11-14	4626.3589
## 2021-11-15	4557.5039
## 2021-11-16	4216.3652
## 2021-11-17	4287.5938
## 2021-11-18	4000.6509
## 2021-11-19	4298.3066
## 2021-11-20	4409.9312
## 2021-11-21	4269.7329
## 2021-11-22	4088.4578
## 2021-11-23	4340.7637
## 2021-11-24	4239.9814
## 2021-11-25	4274.7432
## 2021-11-26	4030.9089
## 2021-11-27	4096.9121
## 2021-11-28	4294.4536
## 2021-11-29	4445.1050
## 2021-11-30	4631.4790
## 2021-12-01	4586.9902
## 2021-12-02	4511.3022
## 2021-12-03	4220.7061
## 2021-12-04	4119.5874
## 2021-12-05	4198.3228
## 2021-12-06	4358.7373
## 2021-12-07	4315.0615
## 2021-12-08	4439.3579
## 2021-12-09	4119.8159
## 2021-12-10	3908.4961
## 2021-12-11	4084.4524
## 2021-12-12	4134.4531
## 2021-12-13	3784.2268

```
## 2021-12-14      3745.4404
## 2021-12-15      4018.3887
## 2021-12-16      3962.4697
## 2021-12-17      3879.4866
## 2021-12-18      3960.8601
## 2021-12-19      3922.5925
## 2021-12-20      3933.8445
## 2021-12-21      4020.2600
## 2021-12-22      3982.0996
## 2021-12-23      4108.0156
## 2021-12-24      4047.9829
## 2021-12-25      4093.2810
## 2021-12-26      4067.3281
## 2021-12-27      4037.5476
## 2021-12-28      3800.8931
## 2021-12-29      3628.5317
## 2021-12-30      3713.8521
## 2021-12-31      3682.6328
## 2022-01-01      3769.6970
```

```
ETH.Close <- getSymbols('ETH-USD',auto.assign=FALSE,from='2020-04-01',to='2022-01-01')[,4]
ETH.Close <- head(ETH.Close, -198)
cor.test(TSLA$TSLA.Close, ETH.Close)
```

```
## Warning in z + c(-1, 1) * sigma * qnorm((1 + conf.level)/2): Recycling array of length 1 in array-ve
## Use c() or as.vector() instead.
```

```
##
## Pearson's product-moment correlation
##
## data: TSLA$TSLA.Close and ETH.Close
## t = 24.862, df = 441, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.7221825 0.8001636
## sample estimates:
## cor
## 0.7639482
```