

Cryptocurrency

Past Behaviors and Prediction

Time Series Forecasting
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Introduction to
Cryptocurrency



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What is Cryptocurrency?



- Digital currency that can be used to buy goods and services, or sell for profit
- Decentralized system built through blockchain
- P2P network confirmed by miners
- Secure

Company Profiles



Bitcoin

First decentralized
cryptocurrency



Dogecoin

Fun and friendly internet
currency



Ethereum

Most actively used
blockchain and
second-largest
cryptocurrency by market
capitalization

Research Questions

- Can we predict the price of Cryptocurrency based on historical data?
- How far into the future can we predict?



Data at first glance

	A	B	C	D	E	F	G
1	Date	Price	Open	High	Low	Vol.	Change %
2	8-May-21	59,266.90	57,330.30	59,350.50	56,972.20	104.59K	3.37%
3	7-May-21	57,337.20	56,411.40	58,639.30	55,300.10	110.01K	1.65%
4	6-May-21	56,405.40	57,441.00	58,364.90	55,294.50	109.02K	-1.80%
5	5-May-21	57,441.30	53,872.50	57,936.40	53,872.50	119.82K	6.88%
6	4-May-21	53,741.50	57,170.60	57,201.30	53,741.50	132.33K	-6.00%
7	3-May-21	57,169.80	56,605.80	58,925.10	56,562.40	89.24K	1.00%
8	2-May-21	56,603.80	57,807.20	57,868.40	56,110.50	53.61K	-2.08%
9	1-May-21	57,807.10	57,719.10	58,449.40	57,029.50	63.41K	0.15%
10	30-Apr-21	57,720.30	53,562.30	57,925.60	53,088.70	103.74K	7.77%
11	29-Apr-21	53,560.80	54,838.60	55,173.70	52,400.00	83.90K	-2.34%
12	28-Apr-21	54,841.40	55,036.00	56,419.90	53,876.40	86.96K	-0.35%
13	27-Apr-21	55,036.50	54,011.10	55,427.80	53,345.00	84.08K	1.88%
14	26-Apr-21	54,020.50	48,963.50	54,320.90	48,815.90	129.76K	10.33%
15	25-Apr-21	48,963.60	50,088.20	50,532.40	47,098.50	59.20K	-2.25%
16	24-Apr-21	50,088.90	51,140.80	51,183.00	48,775.20	82.25K	-2.06%
17	23-Apr-21	51,143.60	51,707.10	52,099.90	47,659.40	214.46K	-1.13%
18	22-Apr-21	51,729.50	53,821.30	55,408.40	50,590.90	168.13K	-3.88%
19	21-Apr-21	53,820.20	56,479.50	56,764.40	53,657.60	100.26K	-4.71%
20	20-Apr-21	56,483.20	55,645.10	57,054.90	53,422.50	115.49K	1.50%
21	19-Apr-21	55,646.10	56,208.10	57,517.00	54,272.30	117.51K	-1.00%
22	18-Apr-21	56,207.10	60,043.20	60,362.10	51,817.60	216.81K	-6.39%
23	17-Apr-21	60,041.90	61,358.30	62,509.10	59,672.10	84.08K	-2.18%
24	16-Apr-21	61,379.70	63,211.60	63,518.50	60,027.30	136.85K	-2.90%
25	15-Apr-21	63,216.00	62,978.60	63,729.10	62,067.50	76.97K	0.37%
26	14-Apr-21	62,980.40	63,544.20	64,778.00	61,366.30	130.43K	-0.88%
27	13-Apr-21	63,540.90	59,863.60	63,659.00	59,839.40	126.56K	6.14%

Start: 2010-07-18
End: 2021-05-08

Min Price: 0.10
Max Price: 63540.90

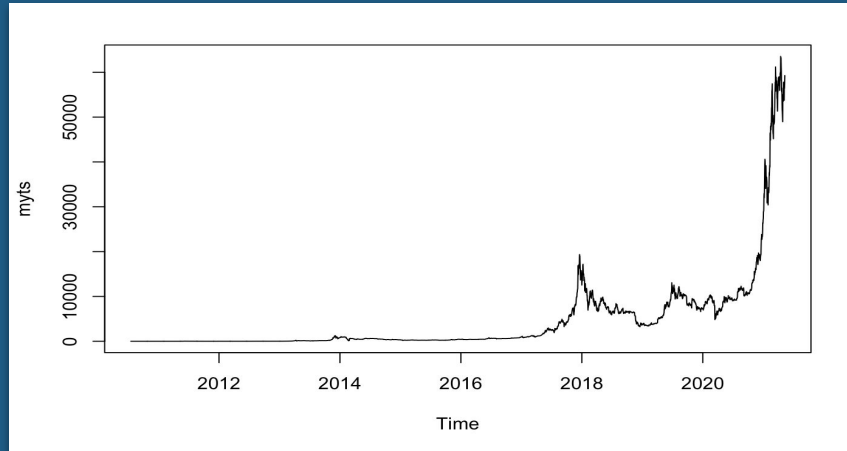
Data at first glance

1. Multiplicative increasing trend

2. Peak:

- 2017

- 2021



Checking for trend and seasonality

Simple Smoothing

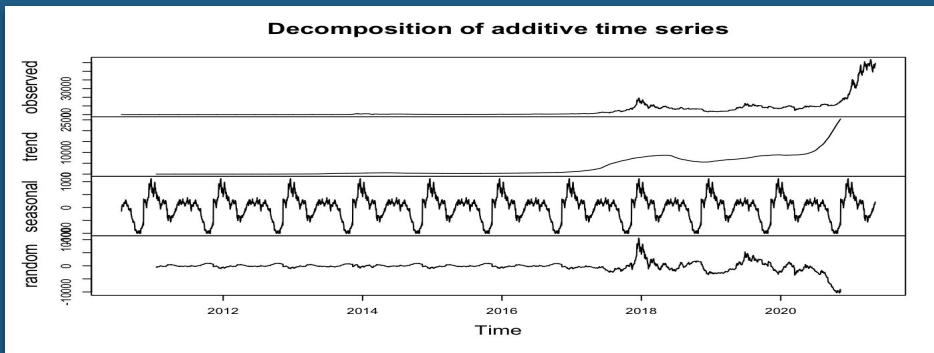
```
Simple_Smoothing<-HoltWinters(myts)
```

Smoothing Parameters:

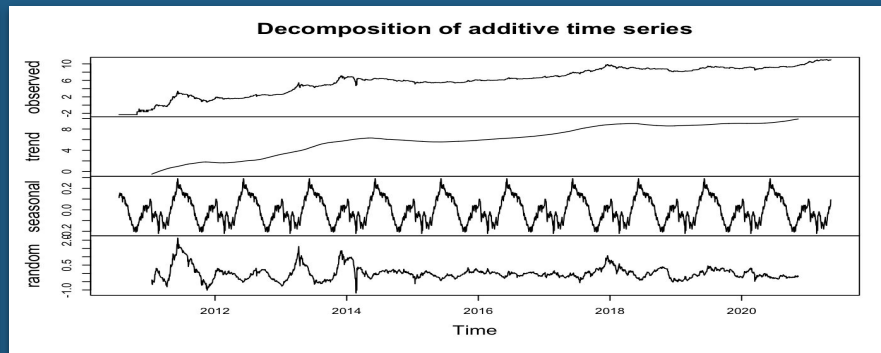
- **Alpha: 0.974881**
- **Beta: 0.00568183**
- **Gamma: 0**

Decomposition for visualization:

```
plot(decompose(myts))
```



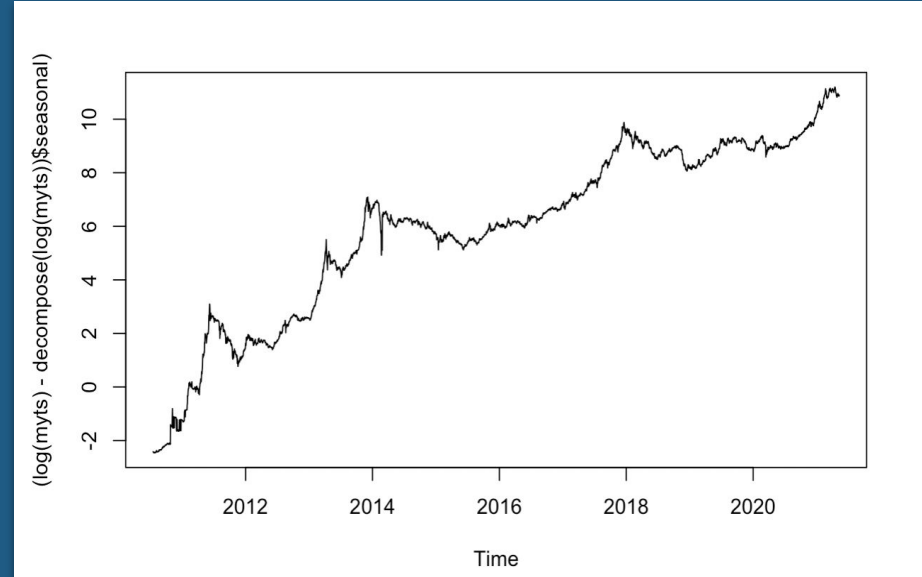
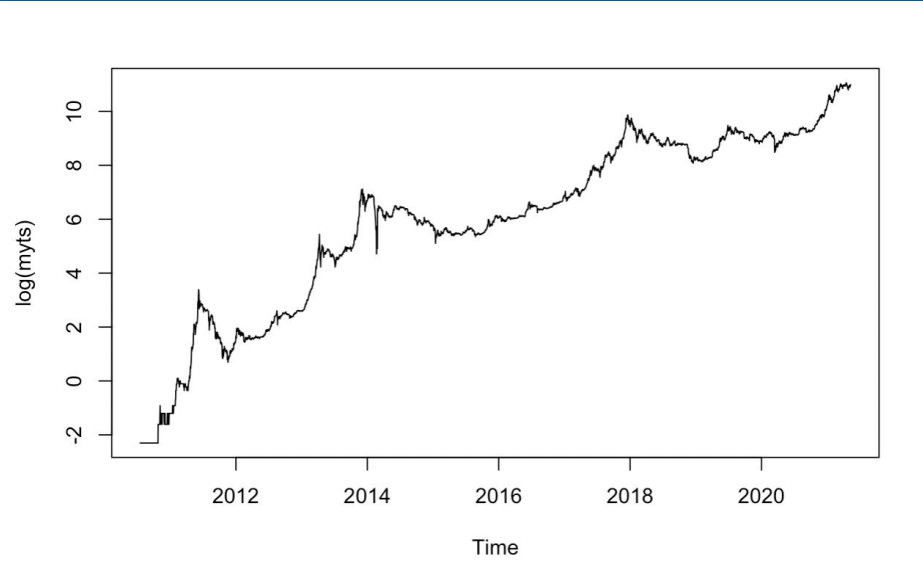
```
plot(decompose(log(myts)))
```



Testing p_values for trend and seasonality

```
##  
## Call:  
## forecast::tslm(formula = myts ~ trend + season)  
##  
## Residuals:  
##      Min       1Q   Median       3Q      Max   
## -9460   -3424   -1171    1779   46699   
##  
## Coefficients:  
##              Estimate Std. Error t value Pr(>|t|)      
## (Intercept) -4993.1814  2312.3357  -2.159   0.0309 *      
## trend         4.9465    0.1069  46.274  <2e-16 ***   
## season2      236.4535   3256.2275   0.073   0.9421        
## season3      217.9889   3256.2275   0.067   0.9466        
## season4      355.7697   3256.2275   0.109   0.9130        
## season5      674.1505   3256.2275   0.207   0.8360        
## season6      764.2222   3256.2275   0.235   0.8145        
## season7      820.7212   3256.2276   0.252   0.8010        
## season8     1051.3656   3256.2276   0.323   0.7468
```

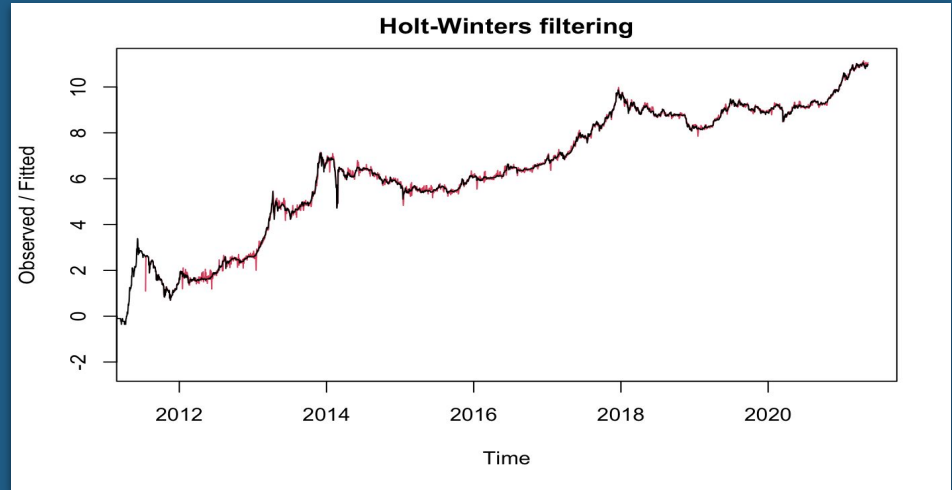
Adjusted Seasonality Method



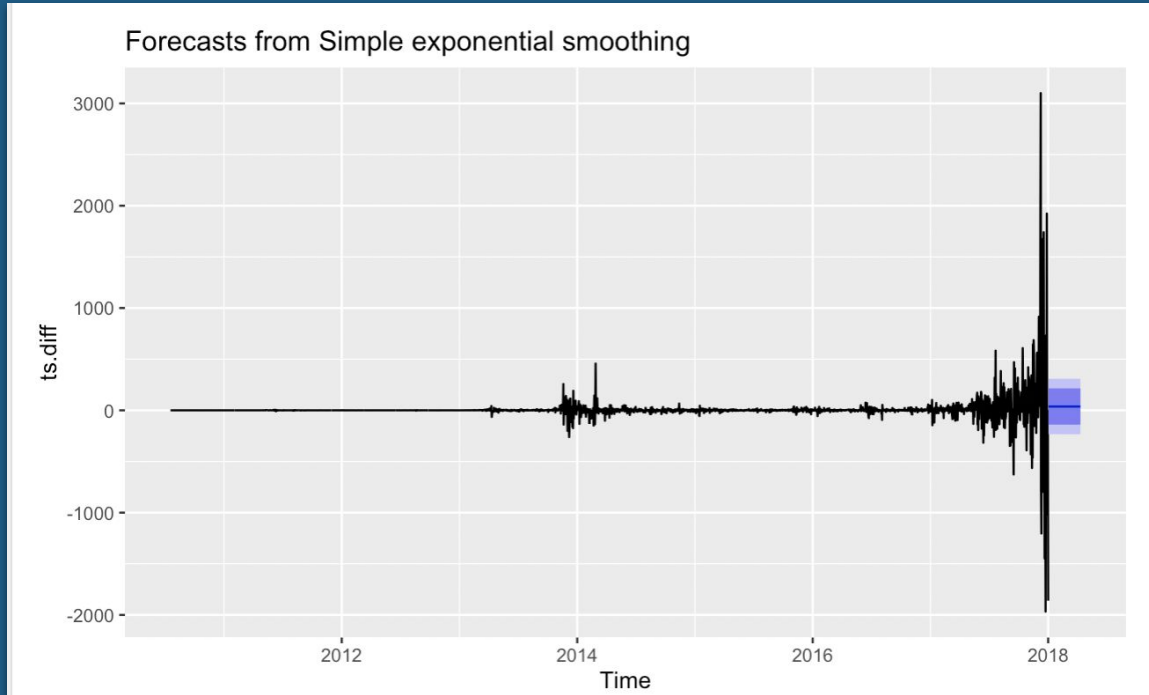
Holt Method

```
forecast=HoltWinters(log(myts),gamma=NULL)  
plot(forecast)
```

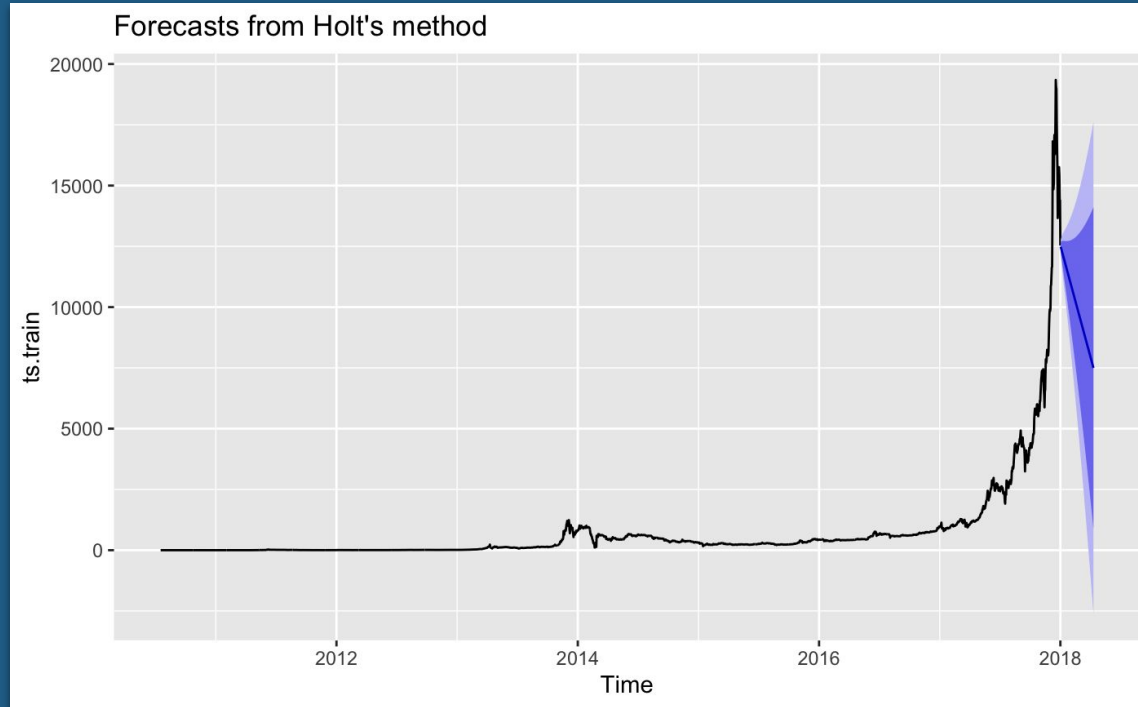
```
Smoothing parameters:  
alpha: 0.7808032  
beta : 8.765215e-05  
gamma: 1
```



Simple Exponential Smoothing Forecast



Holt's Prediction

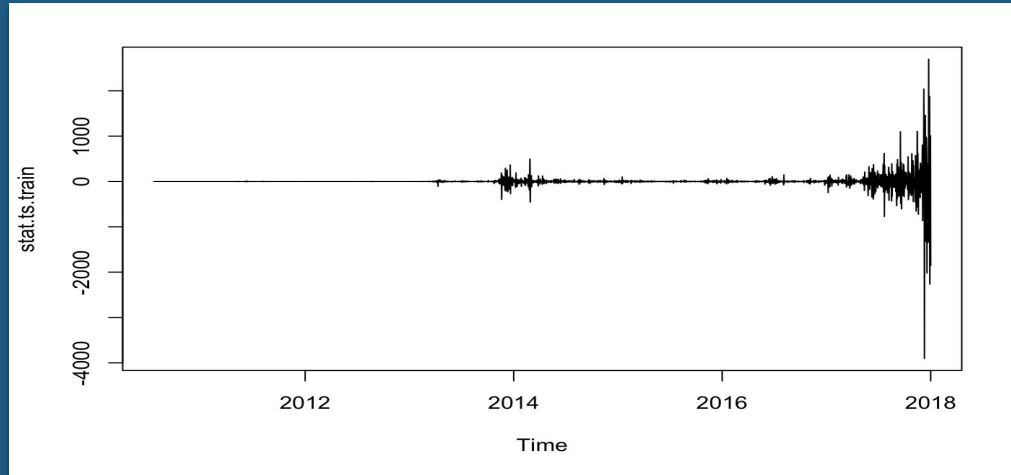


Building the ARIMA model

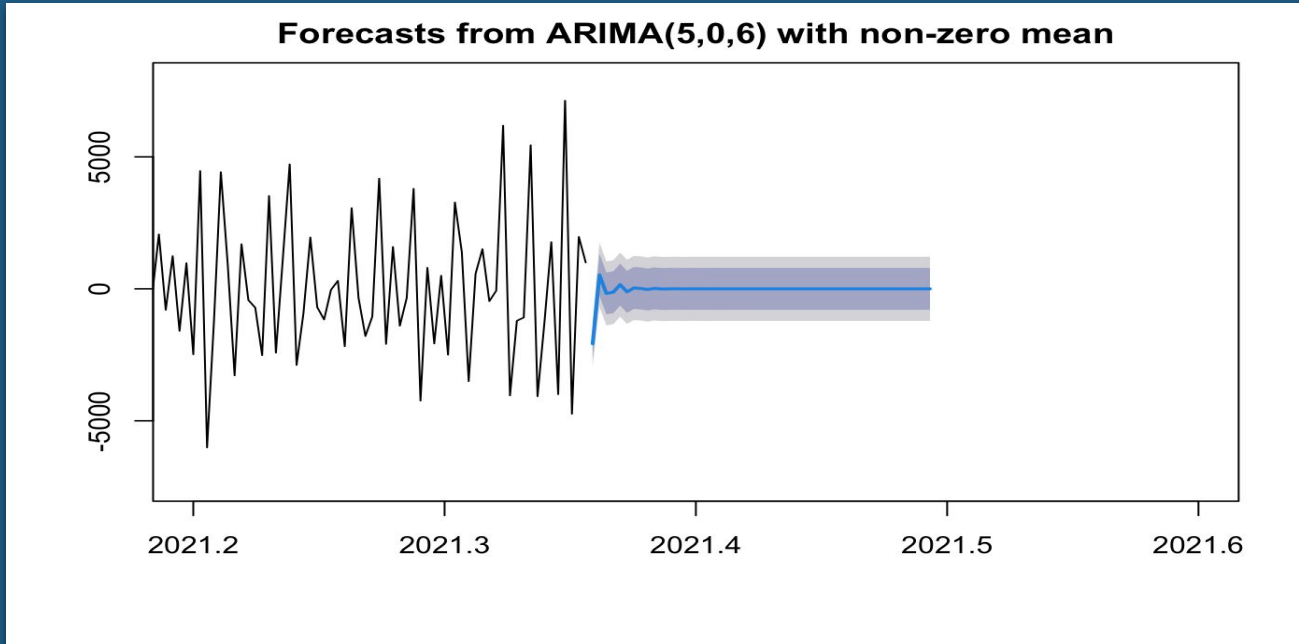
Data is not stationary so apply double differencing in order to get the stationary data

```
stat.ts.train=diff(diff(ts.train))  
plot(stat.ts.train)
```

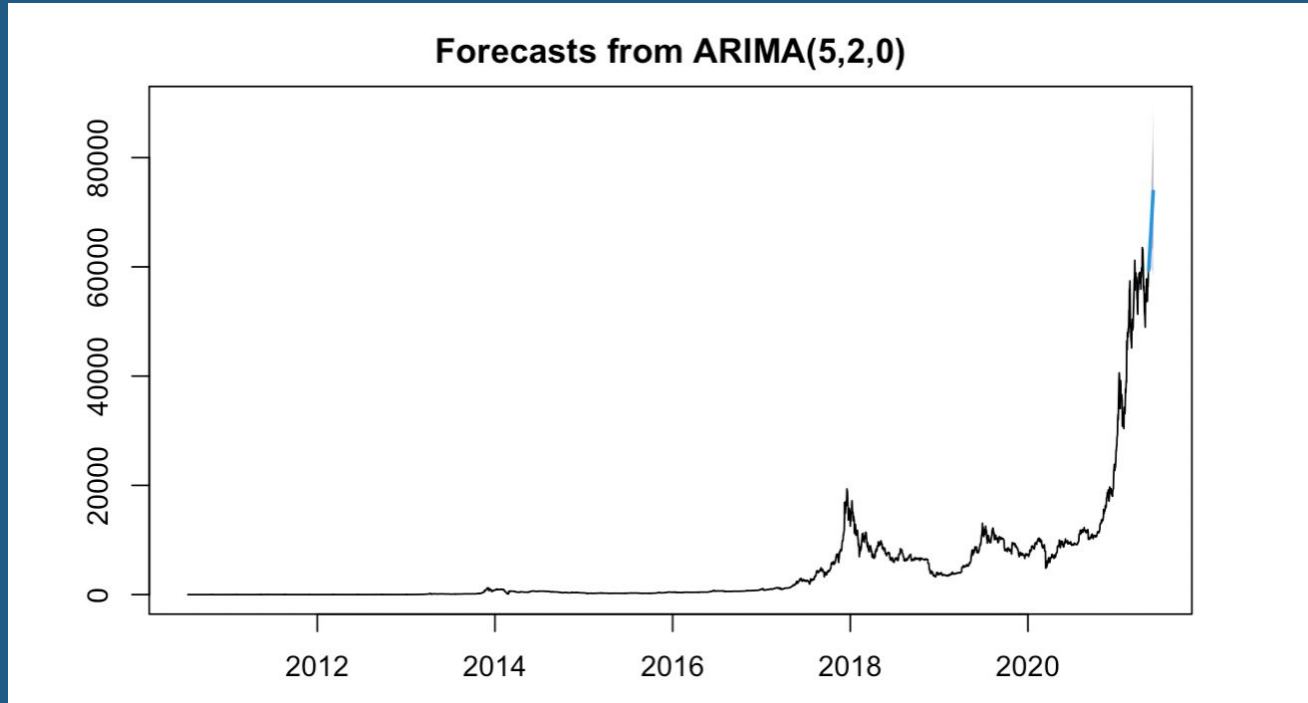
Stationary data

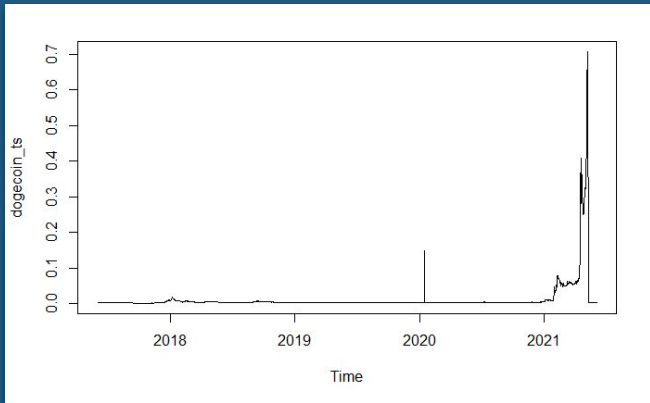


ARIMA Forecasting

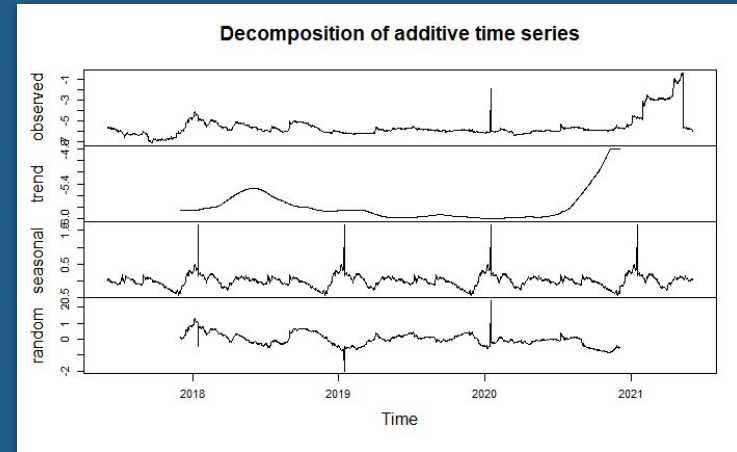
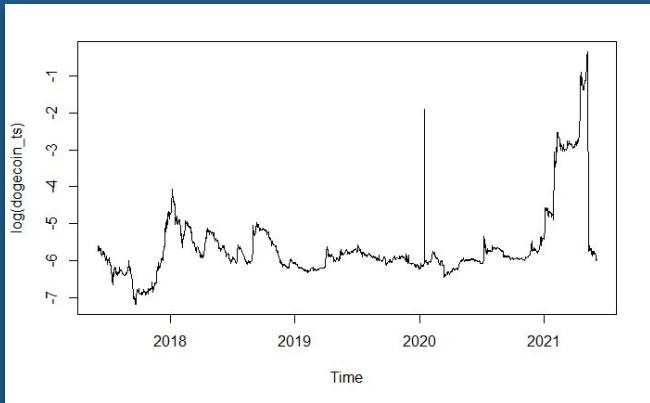


AUTO.ARIMA Forecasting





Dogecoin



```
Call:
forecast::tslm(formula = dogecoin_ts ~ trend + season)
```

Residuals:

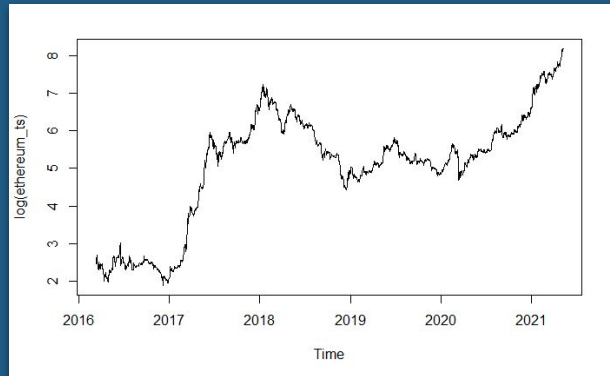
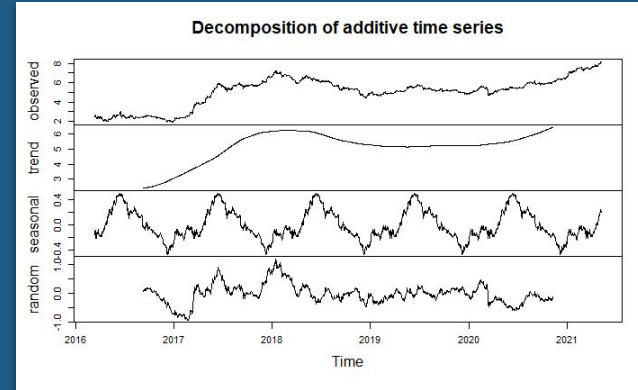
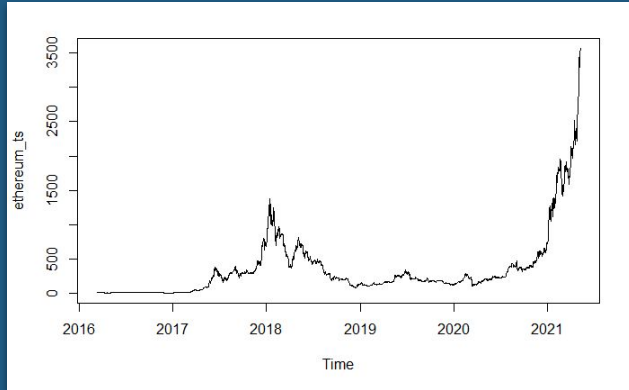
Min	1Q	Median	3Q	Max
-0.18220	-0.01526	-0.00495	0.00968	0.51205

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-1.798e-02	2.591e-02	-0.694	0.487919
trend	2.946e-05	3.303e-06	8.921	< 2e-16 ***
season2	2.903e-04	3.647e-02	0.008	0.993650
season3	1.516e-03	3.647e-02	0.042	0.966855
season4	1.482e-03	3.647e-02	0.041	0.967587
season5	2.114e-03	3.647e-02	0.058	0.953778
season6	2.669e-03	3.647e-02	0.073	0.941657
season7	3.354e-03	3.647e-02	0.092	0.926728
season8	2.737e-03	3.647e-02	0.075	0.940177
season9	2.133e-03	3.647e-02	0.058	0.953365
season10	2.123e-03	3.647e-02	0.058	0.953583

Similar results with other cryptocurrencies

Ethereum

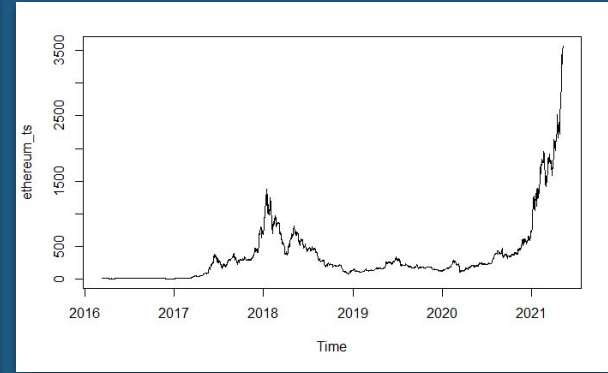
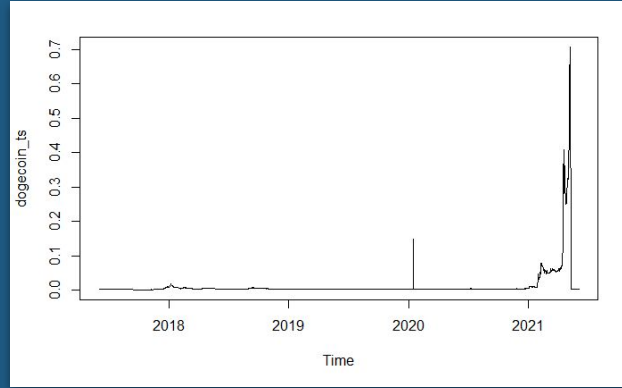
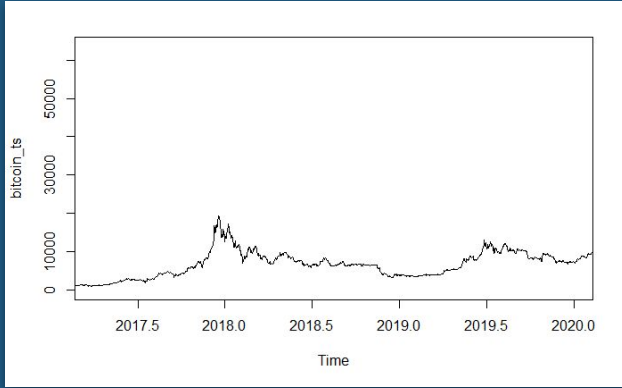


```
Call:
forecast::tslm(formula = ethereum_ts ~ trend + season)

Residuals:
    Min       1Q   Median       3Q      Max
-822.12 -223.83  -22.59   160.39 2390.21

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  -75.07921   197.05074   -0.381  0.7032
trend          0.41540     0.01875   22.160 <2e-16 ***
season2       1.44060     277.33866    0.005  0.9959
season3       22.91520     277.33866    0.083  0.9342
season4       48.70980     277.33866    0.176  0.8606
season5       89.43440     277.33866    0.322  0.7471
season6      107.26700     277.33867    0.387  0.6990
season7      128.55960     277.33868    0.464  0.6430
season8      170.83820     277.33869    0.616  0.5380
season9      175.77080     277.33870    0.634  0.5263
season10     204.00541     277.33871    0.736  0.4621
season11     205.23601     277.33872    0.740  0.4594
season12     177.72461     277.33873    0.641  0.5217
season13     169.22121     277.33875    0.610  0.5418
season14     182.68381     277.33876    0.659  0.5102
season15     188.99441     277.33878    0.718  0.4732
season16     201.32301     277.33880    0.726  0.4680
season17     139.31161     277.33882    0.502  0.6155
season18     151.03021     277.33884    0.545  0.5861
season19     147.22081     277.33886    0.531  0.5956
season20     158.76741     277.33888    0.572  0.5671
season21     202.75801     277.33891    0.731  0.4648
```

Historical Data

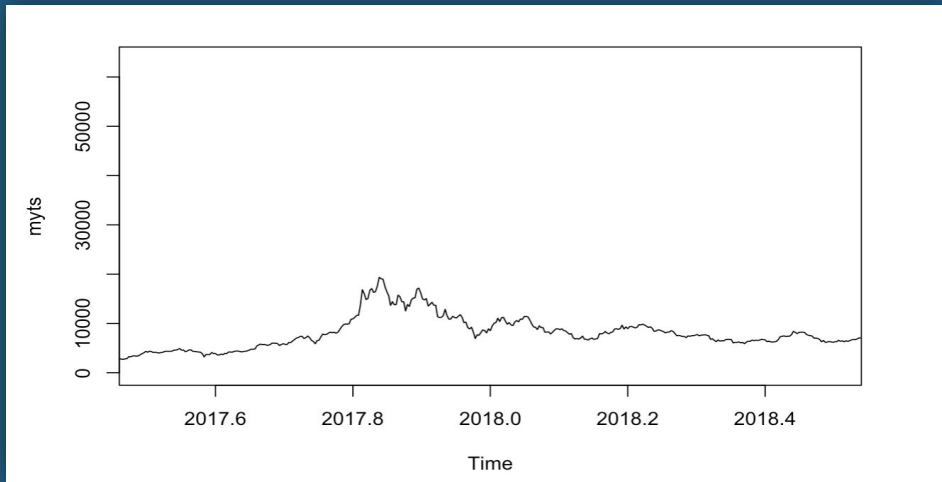
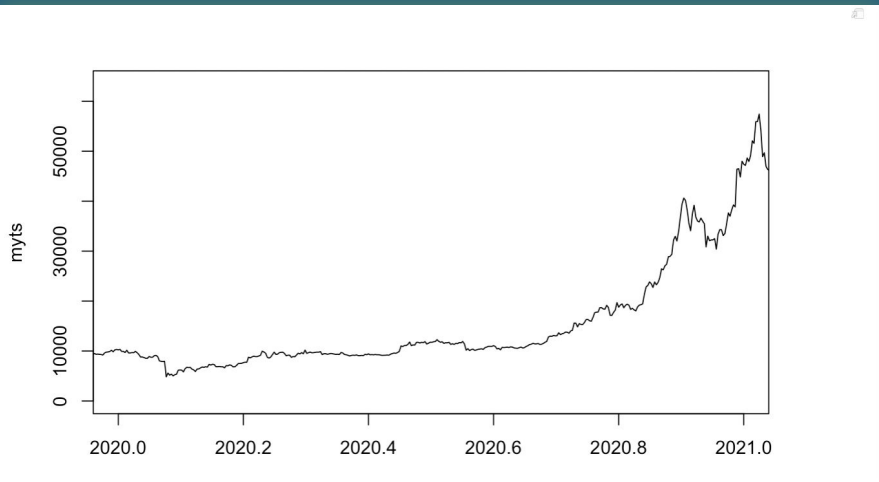


Late 2017

Early 2020

Early 2021

Influences



MicroStrategy Adopts Bitcoin as Primary Treasury Reserve Asset

August 11, 2020 06:00 AM Eastern Daylight Time

TYSONS CORNER, Va.--[\[BUSINESS WIRE\]](#)--[MicroStrategy](#)[®] Incorporated (Nasdaq: MSTR), the largest independent publicly-traded business intelligence company, today announced that it has purchased 21,454 bitcoins at an aggregate purchase price of \$250 million, inclusive of fees and expenses. The purchase of Bitcoin cryptocurrency was made pursuant to the two-pronged capital allocation strategy previously announced by the company when it released its second quarter 2020 financial results on July 28, 2020.

[CME Group](#), the largest derivatives exchange in the world, as well as one of the oldest, will launch bitcoin futures trading on Dec. 18th, while CBOE Global Markets, which owns the Chicago Board Options Exchange (the largest U.S. options exchange) and BATS Global Markets, plans to beat CME to the punch by opening its own trading on Dec. 10th.

August 2020

December 2017

Considerable Factors



Policy changes

Economy:: 2017 & 2021

Trend

Cycle

Questions?



References

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<https://www.investopedia.com/articles/fundamental-analysis/10/indicators-that-move-the-market.asp>