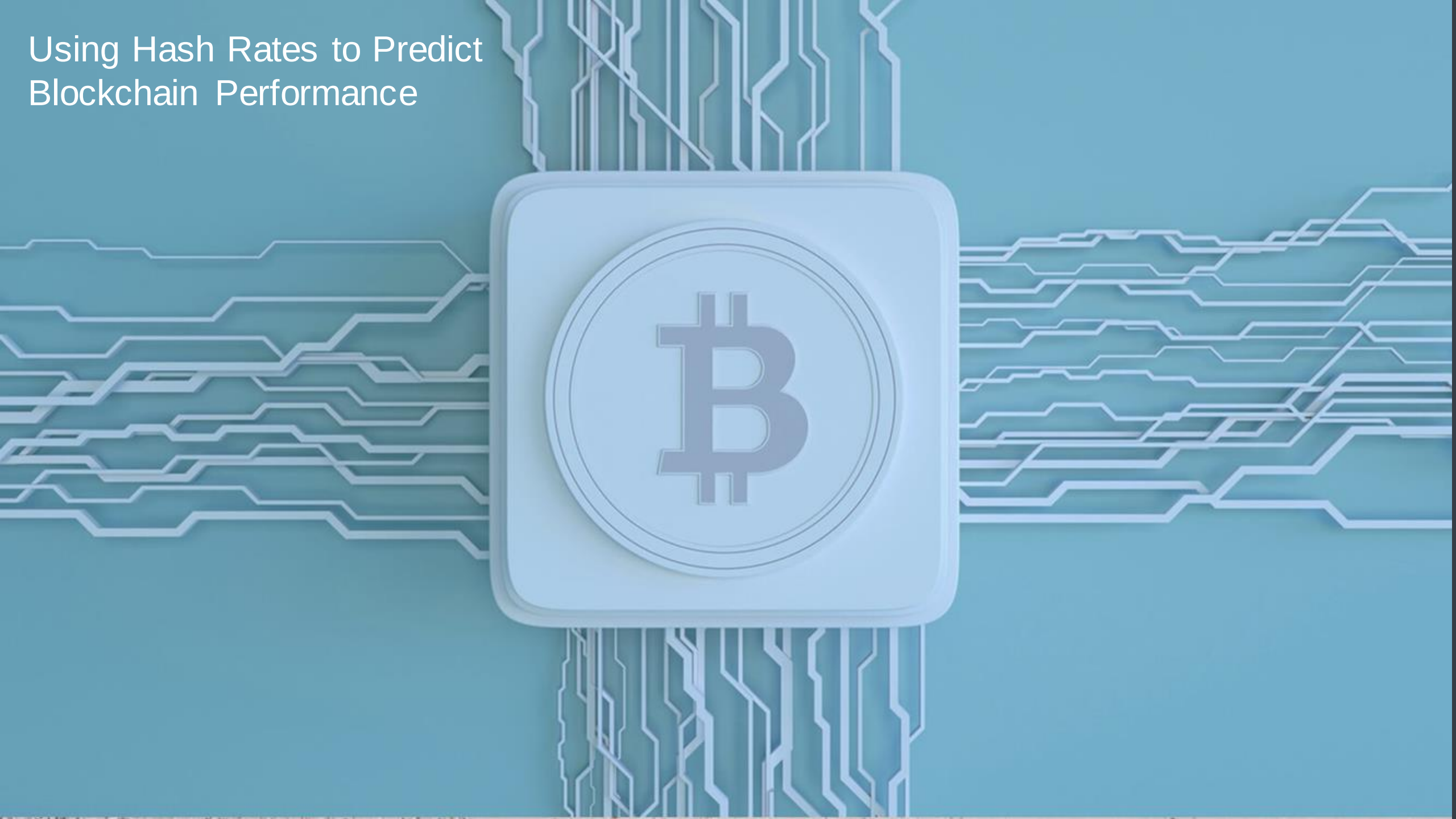
Using Hash Rates to Predict Blockchain Performance

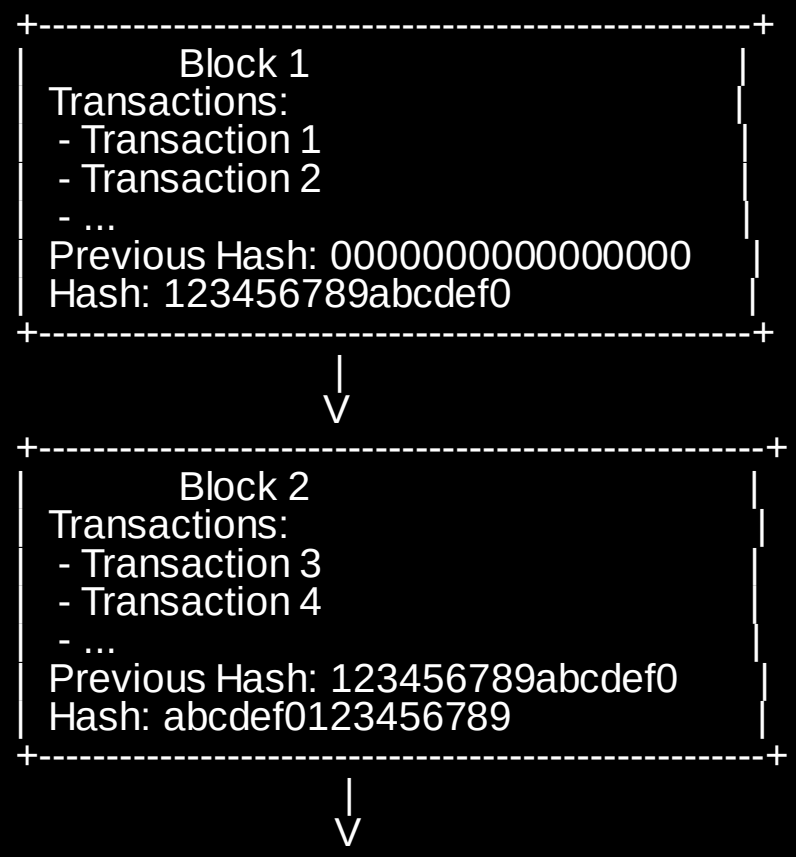


Agenda

- Introduction to Blockchain technology
- Data Prep
- Methodology
- Results
- Summary and Future Work

Blockchain Technology

Blockchain technology is a decentralized distributed ledger system that records transactions across multiple computers in a way that is secure, transparent, and immutable



Who Uses Blockchain Technology?

- Cryptocurrency
- Smart Contracts
- Supply Chain Management
- Identity Management
- Healthcare
- Real Estate
- Digital Voting
- Gaming

What is Blockchain Hash and Hash Rate?

A hash is

- A unique number that cannot be replicated
- Created when a new block of data is added to the chain

Hash rate is

- The computational power to mine blockchain transactions
- Determined by how many guesses per second
- Determines the mining difficulty of a blockchain network

Hash Rate Influences

+ Mining Rewards – cryptocurrency
+ Blockchain security
- Network Congestion
- Electricity Usage

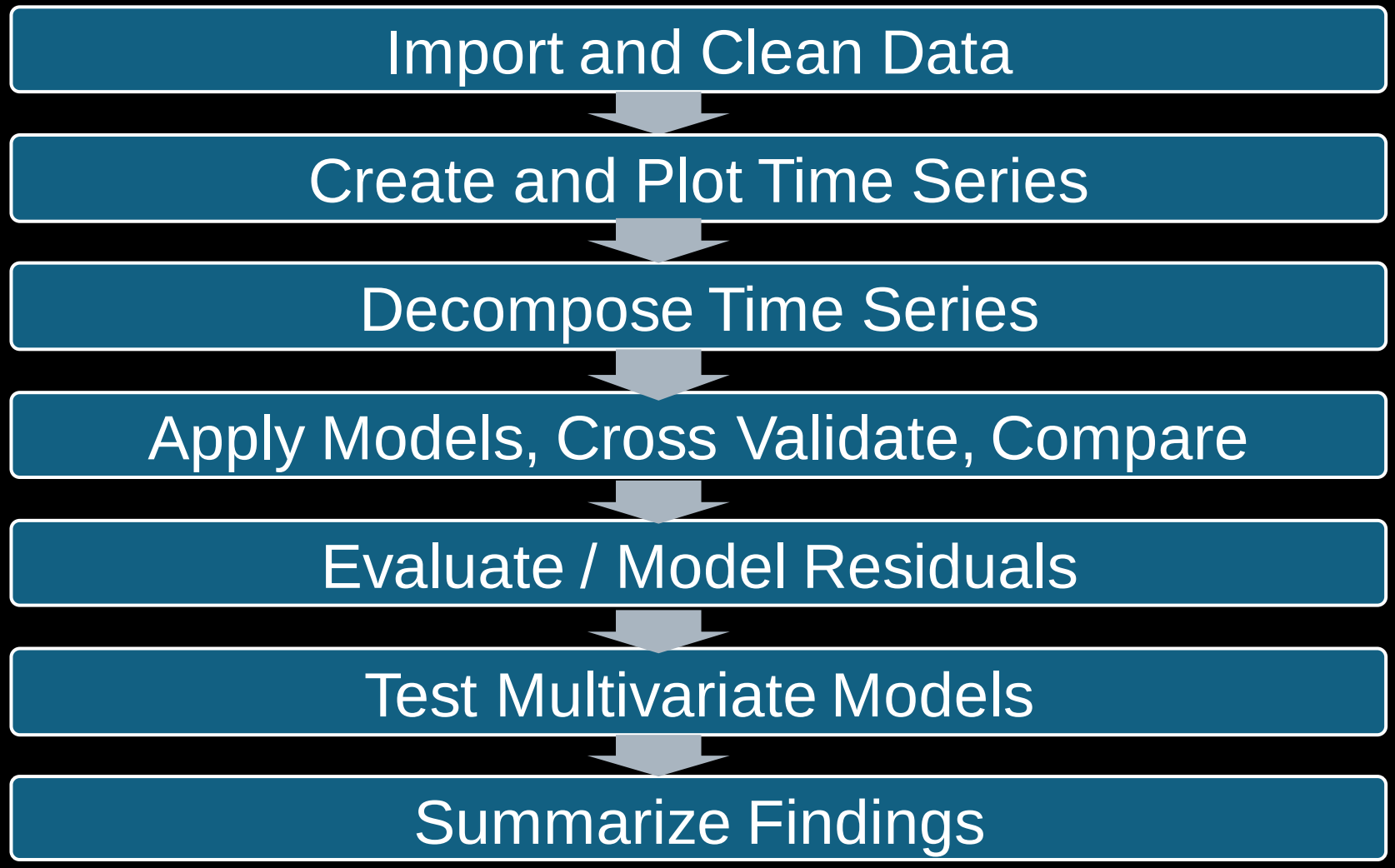
Is there correlation / causation?

Why Model Hash Rate?

Possible Predictor of
+ Mining Rewards
+ Blockchain Security
- Network Congestion
- Energy Consumption

Is there correlation / causation?

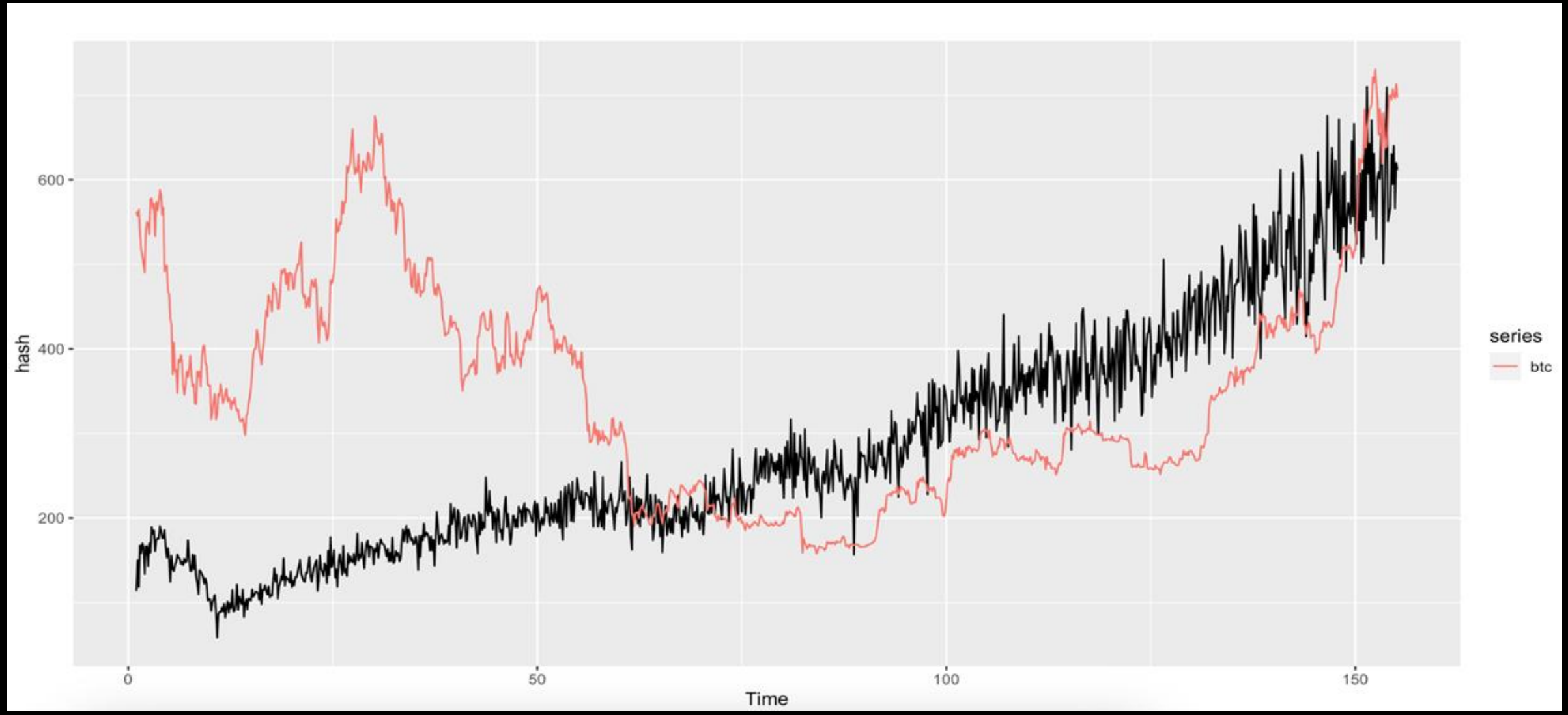
Project Methodology

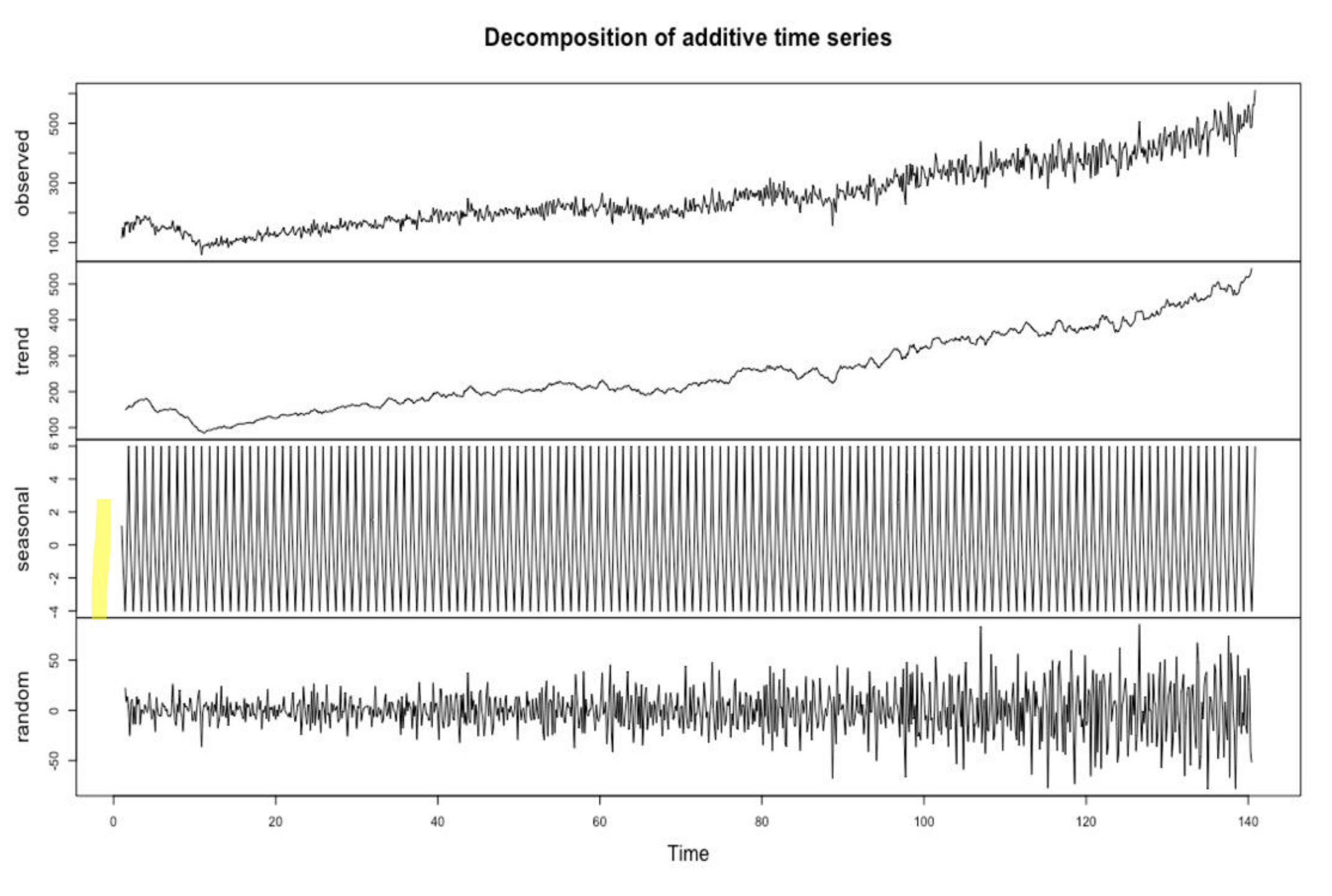


Data Prep

- Converted Hash Rate JSON files into a csv
- Downloaded closing prices for NVDA, Bitcoin, AIQ
- Adjust for Mon-Friday vs. Mon-Sunday frequency
- Create training and test time series

Time Series: Hash Rate vs BTC





Strength of Trend: 0.96

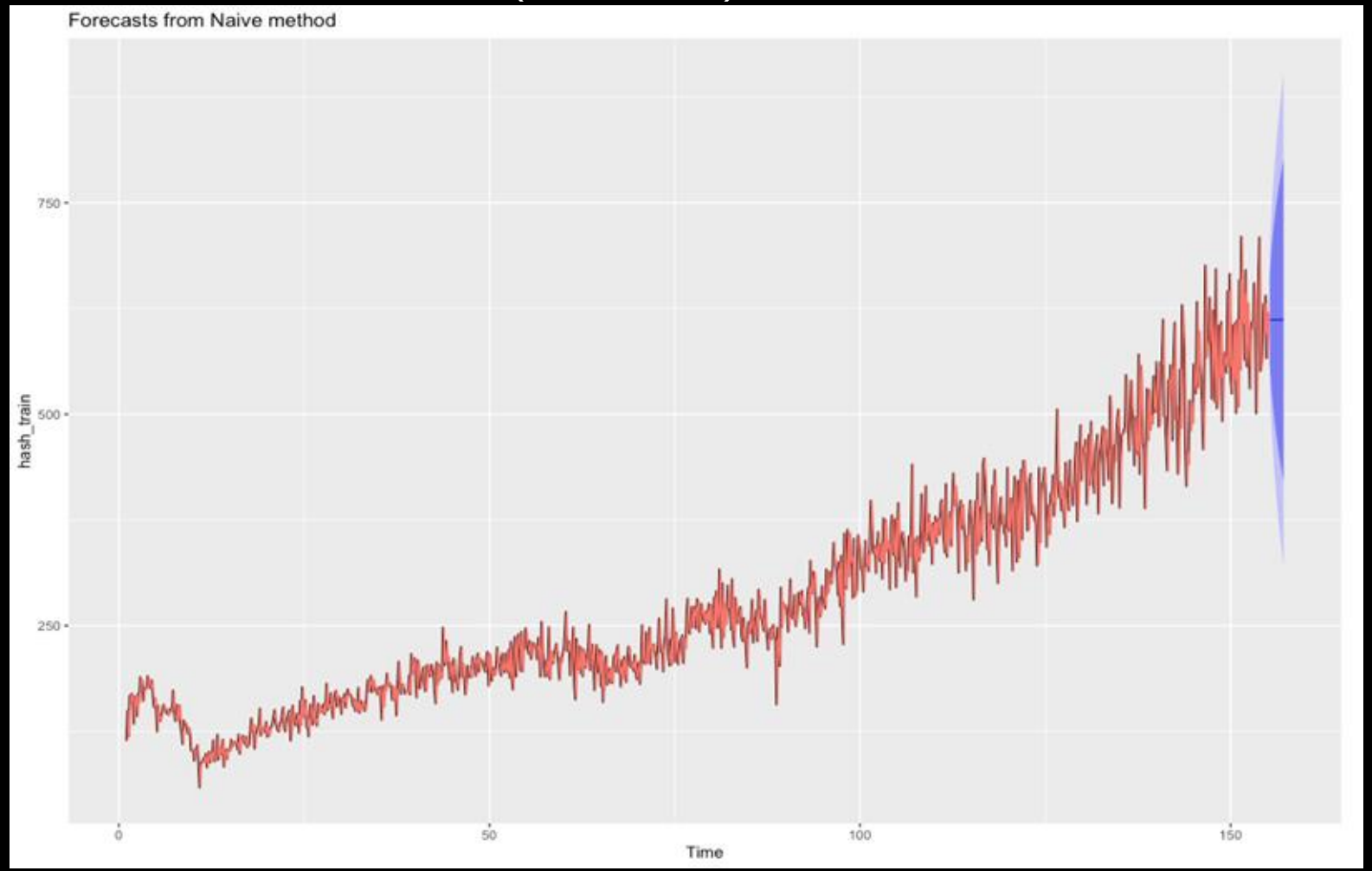
Strength of Seasonality: 0.02

Possibly heteroscedastic

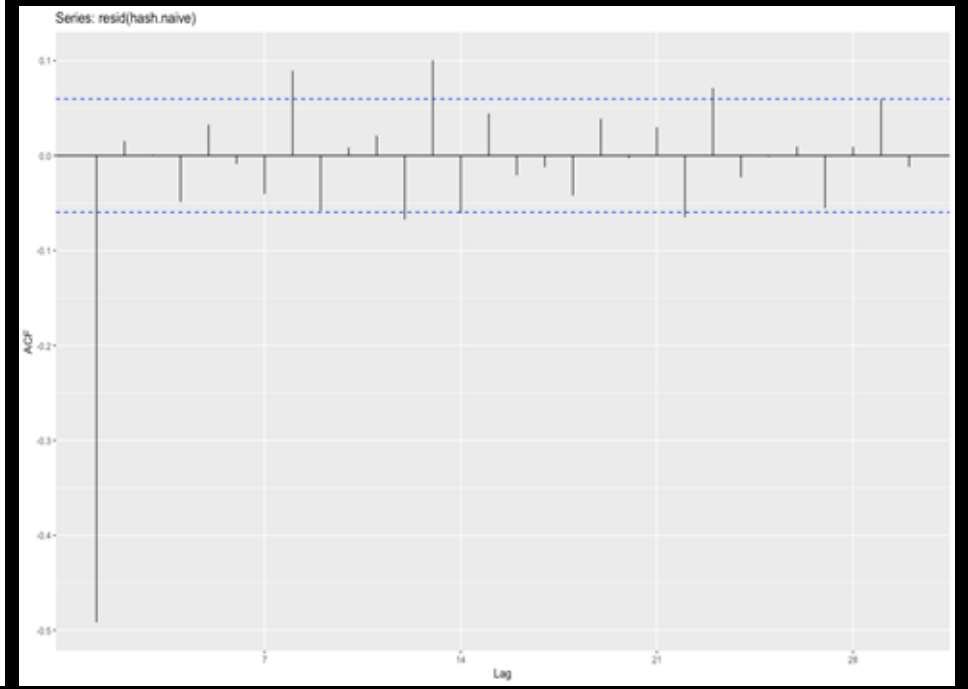
Naive

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
0.4614137	39.63294	28.49668	-0.6106446	9.884198	0.9709984	-0.4917825

Fitted(hash.naive), h=14



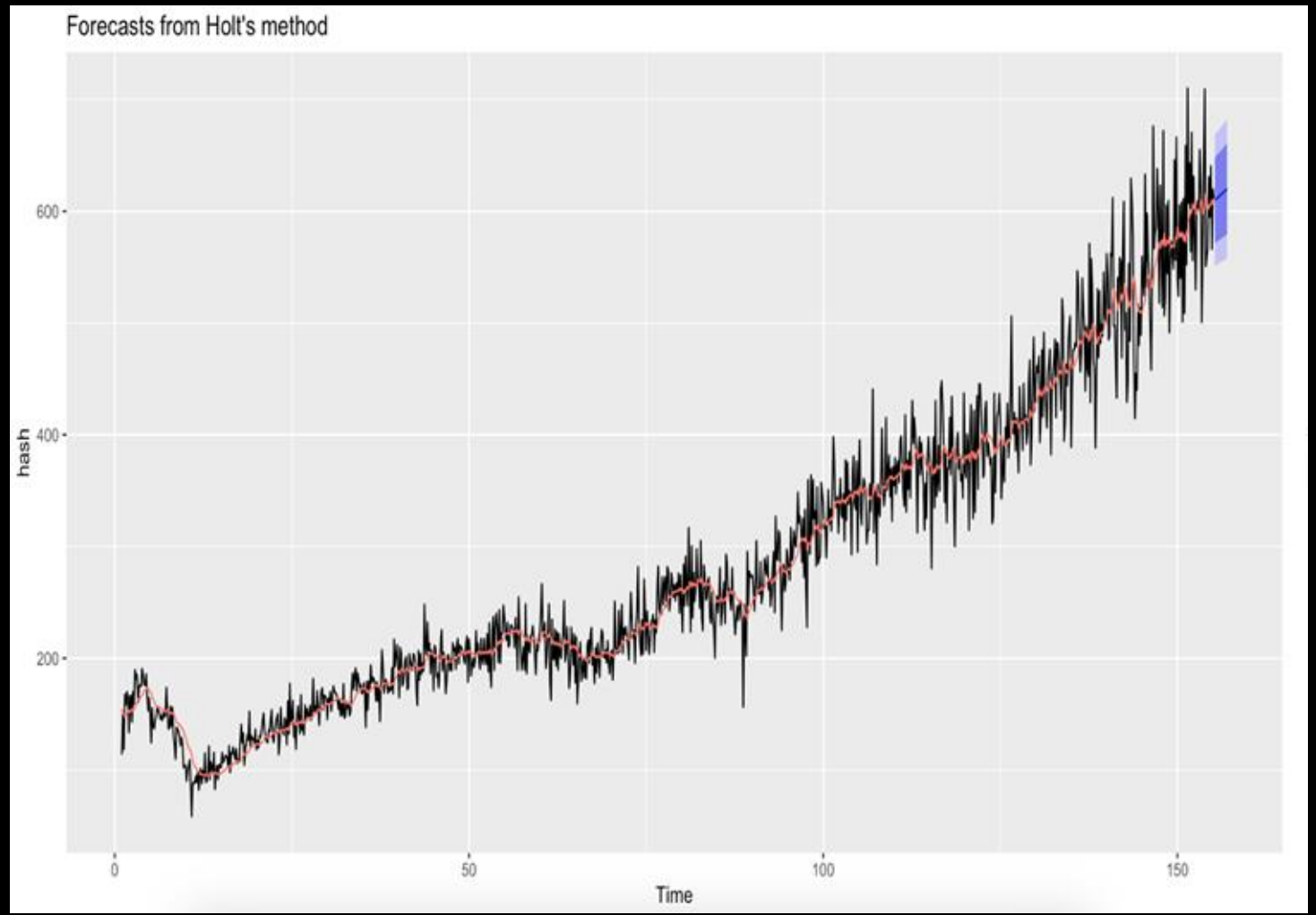
ACF



Holt

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
1.285161	29.88099	21.56406	-0.4213672	7.776944	0.7347759	0.02651261

Fitted(hash.holt), h=14



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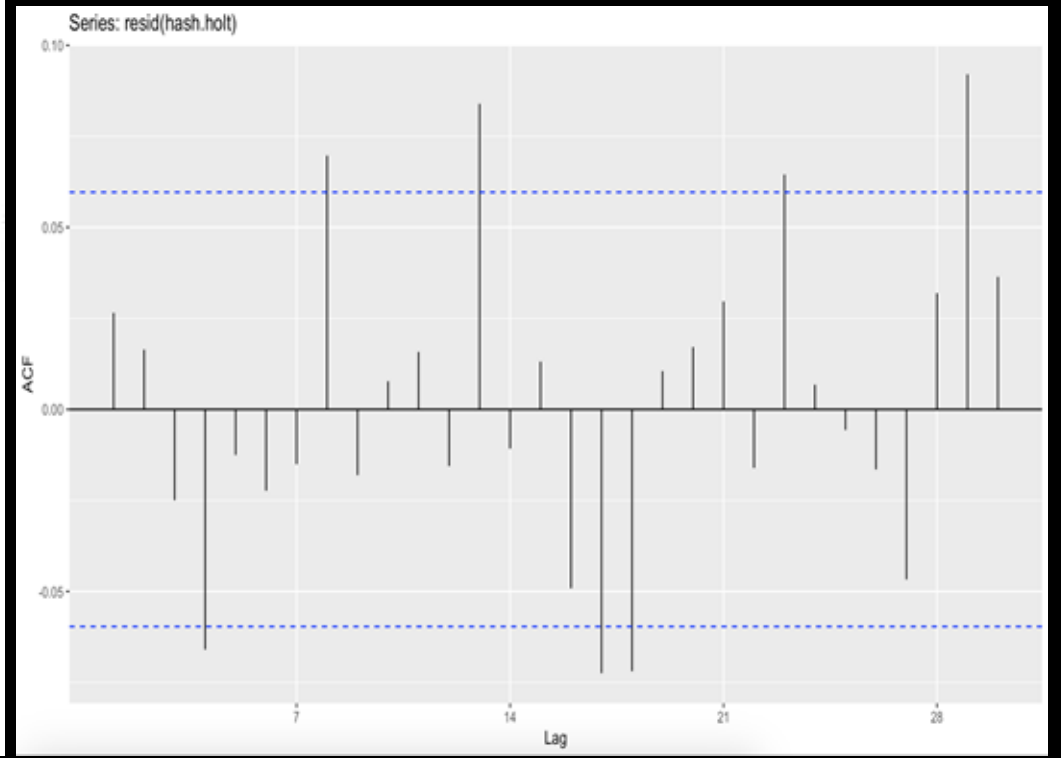
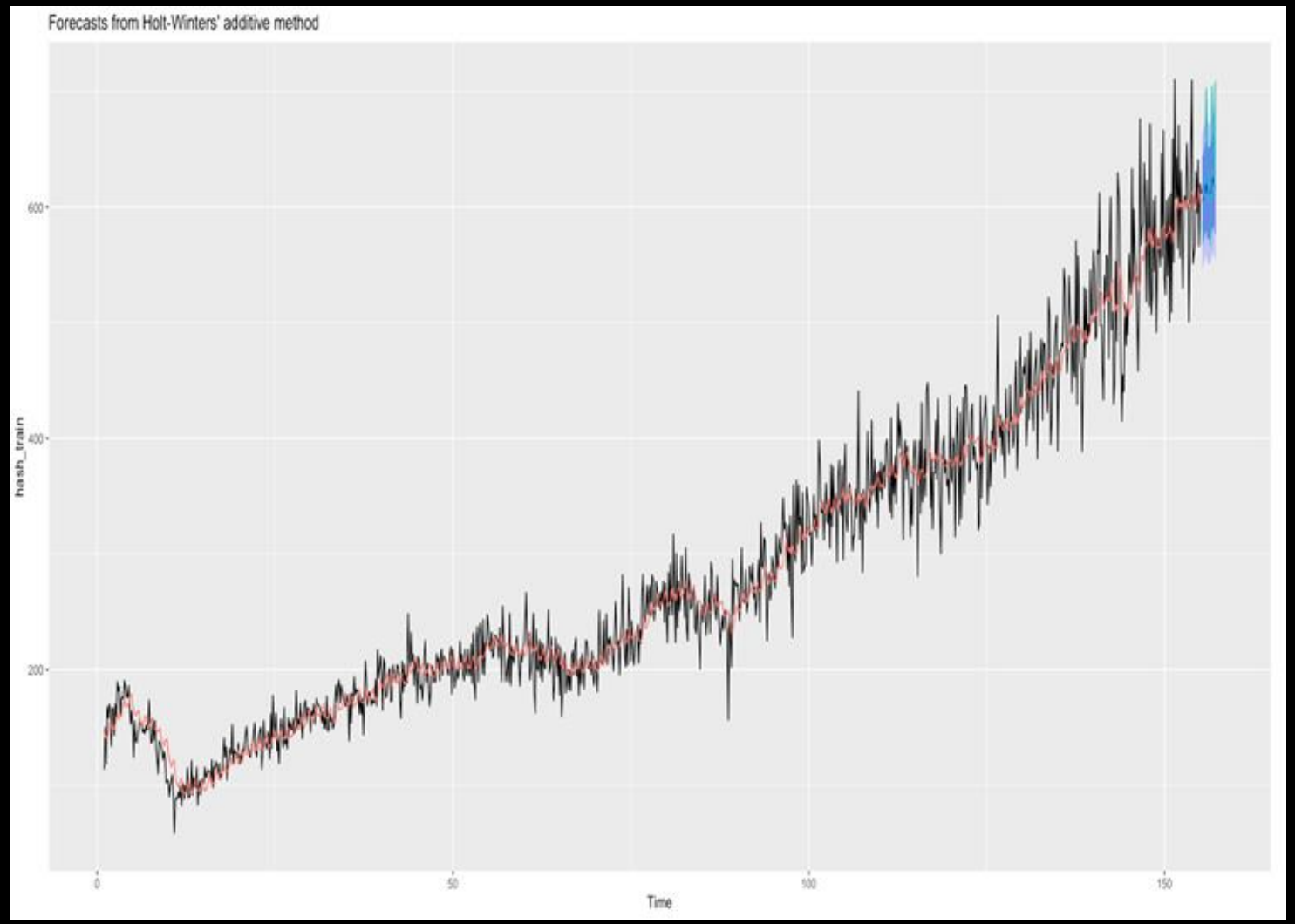


Holt Winters

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
1.21155	29.73498	21.38789	-0.4942107	7.733743	0.7287728	0.01529912

Fitted(hash.hw), h=14



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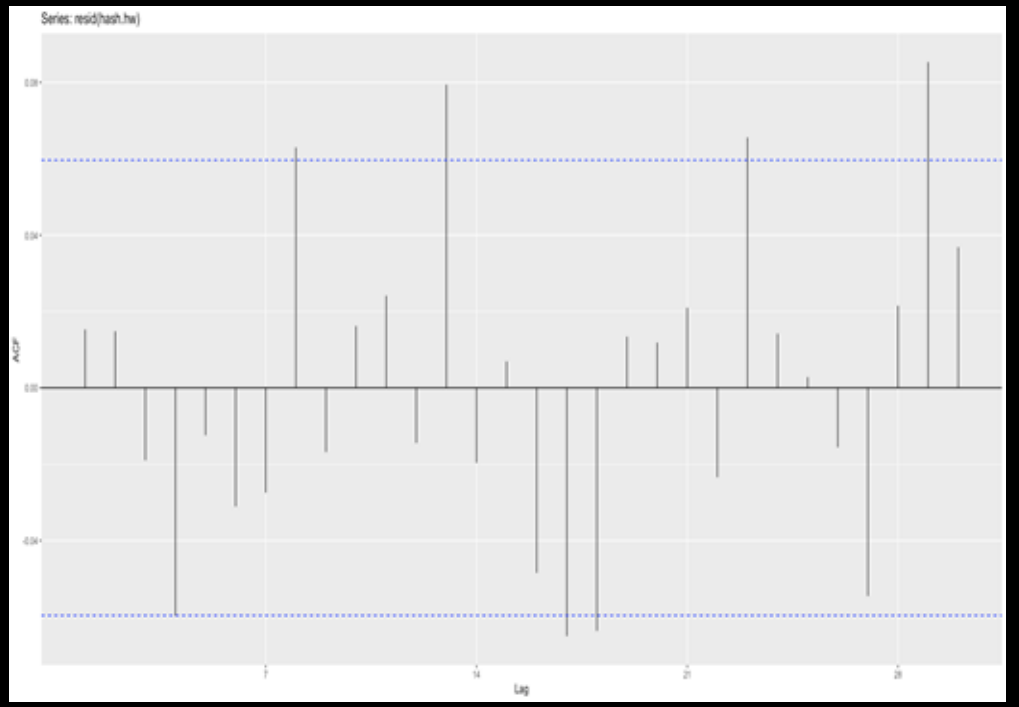
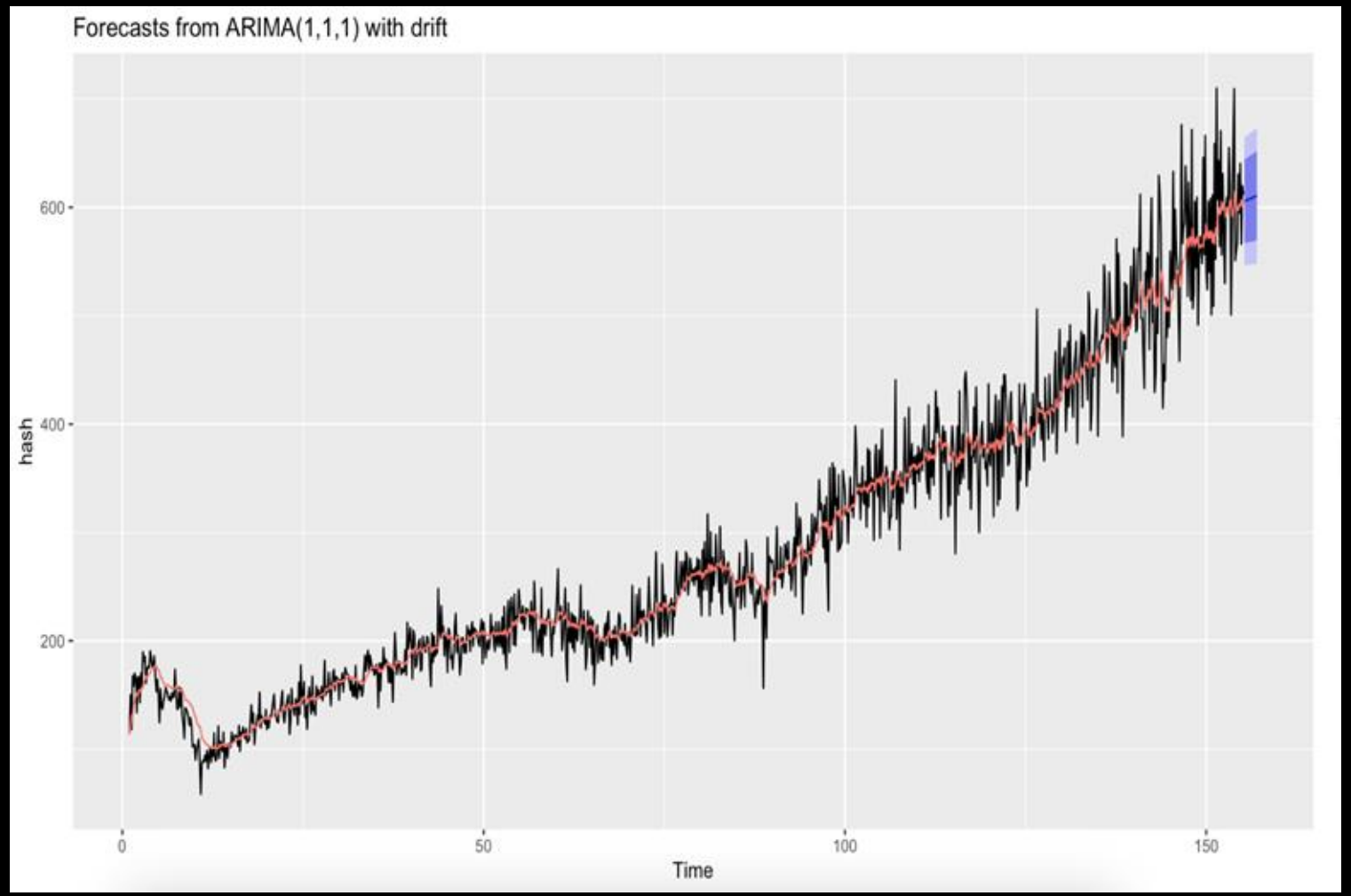


ARIMA

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
0.1016486	29.91551	21.54967	-1.35594	7.794675	0.7342853	0.00029106

Fitted(hash.arima), h=14



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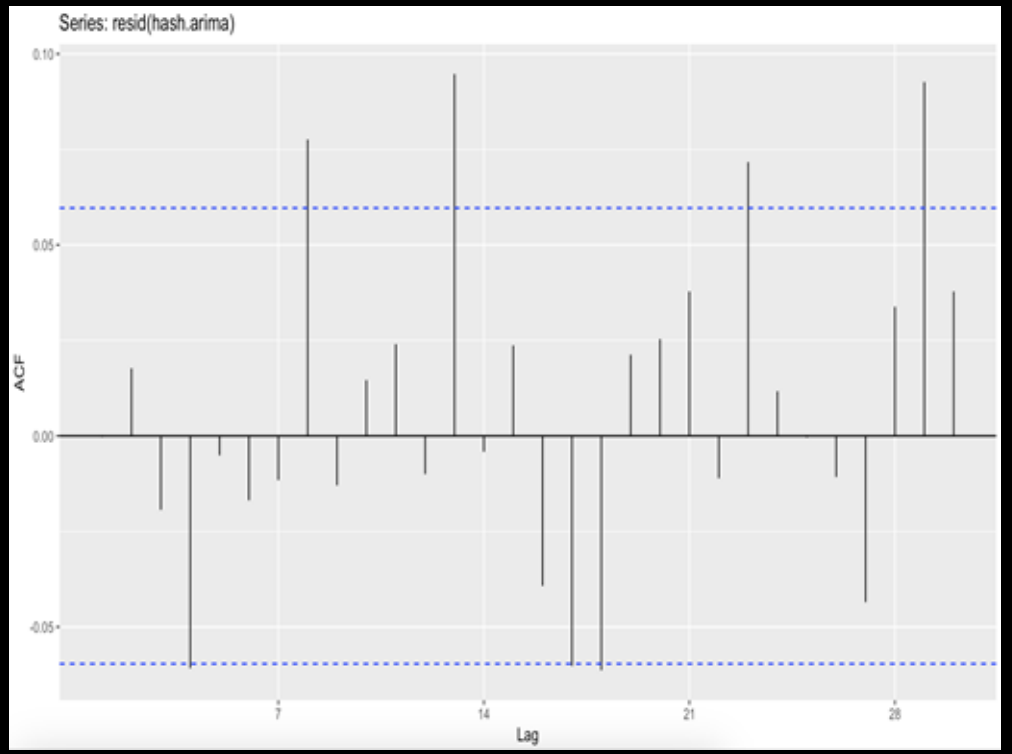
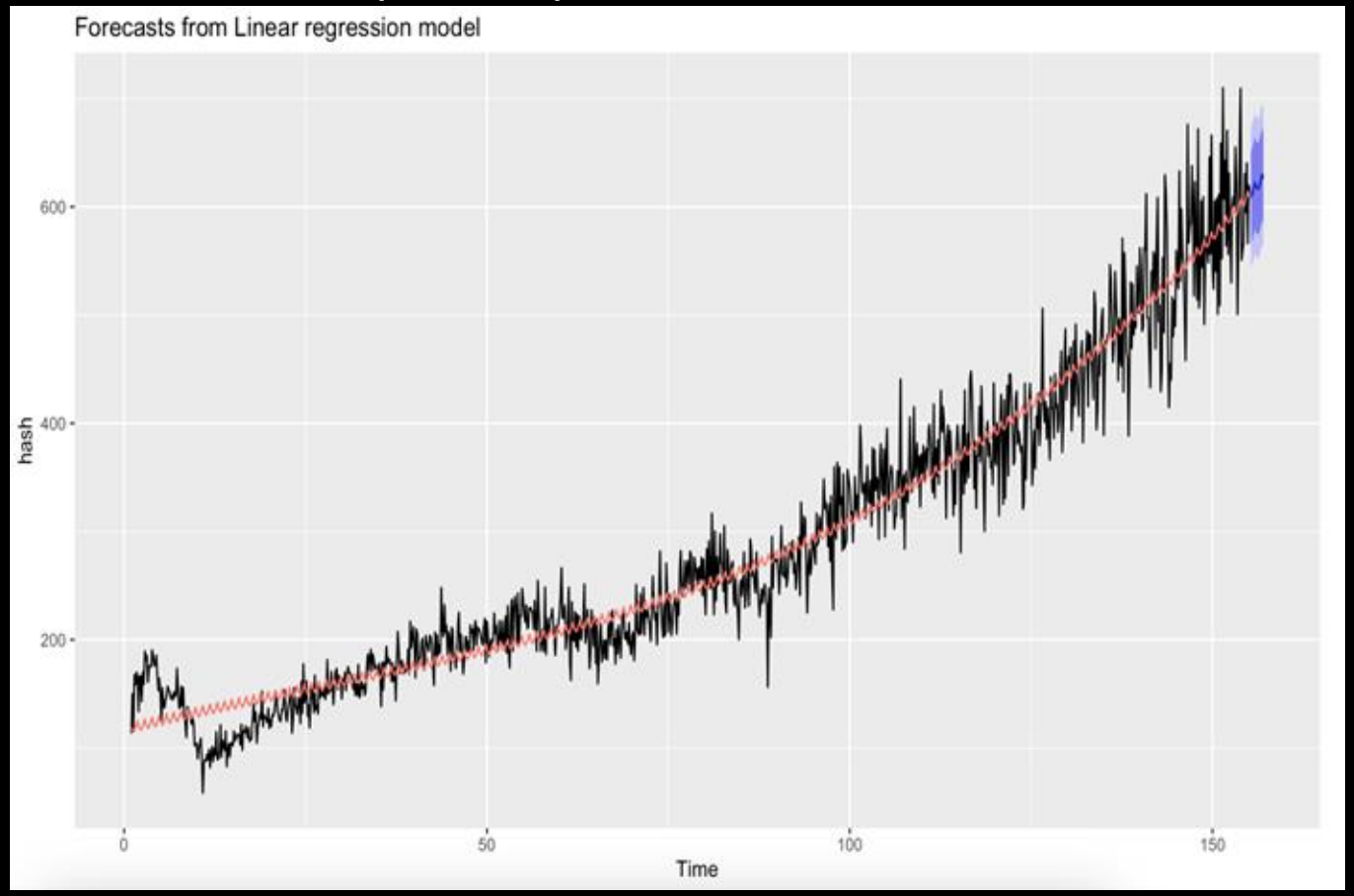


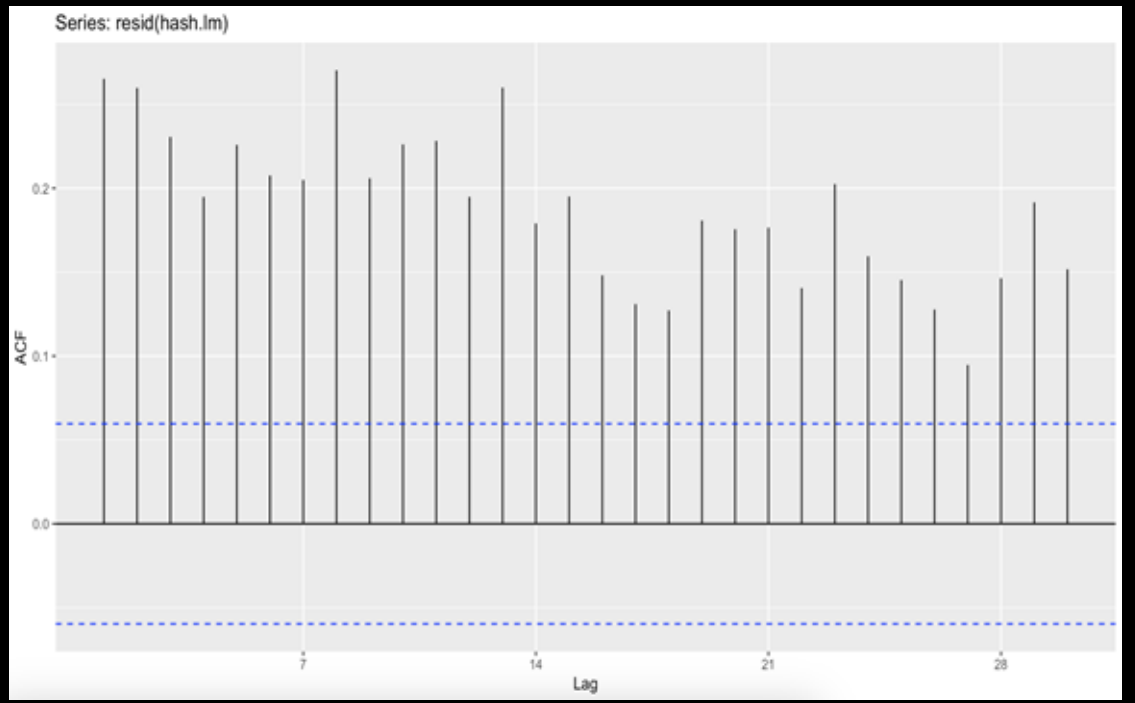
Linear Regression (trend^3 + Seasonal)

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
6.363621e-16	32.58723	25.14914	-1.826275	10.40374	0.856934	0.2652366

Fitted(hash.lm), h=14



ACF

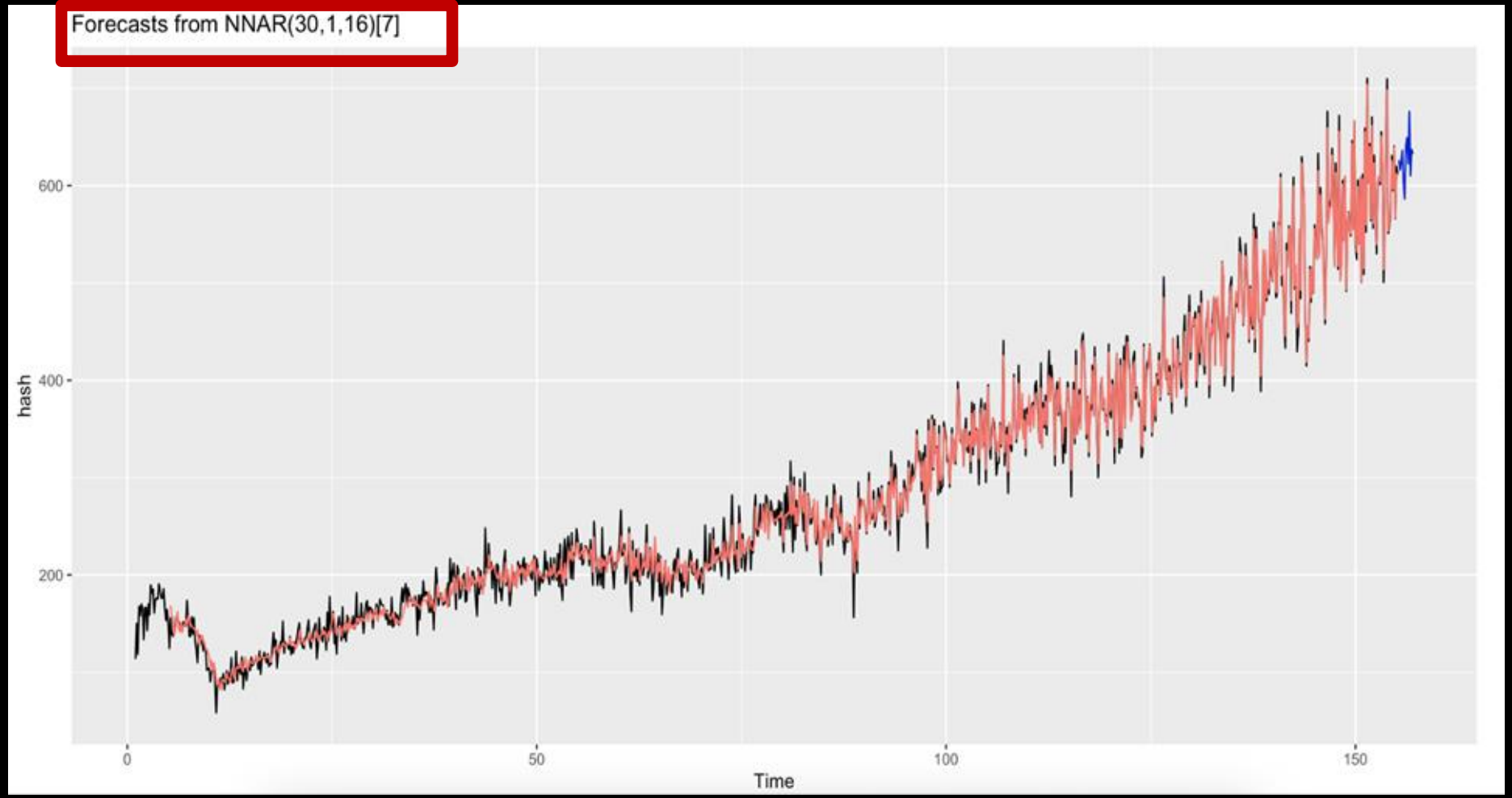


Neural Net

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
-0.0676387	11.27615	8.532282	-0.4880217	3.981926	0.2907297	0.01685735
-	68.89656	-	-	-	-	-

CV shows model was overfit (512 weights)

h=14



Vector Autoregressive Model with Bitcoin

```
hash = btc.l1 + hash.l1 + const

          Estimate Std. Error t value Pr(>|t|)
btc.l1    0.002894   0.009104   0.318  0.75060
hash.l1   0.960278   0.008707 110.291  < 2e-16 ***
const    10.764654   4.128222   2.608  0.00924 **
```

Not significant

```
Estimation results for equation btc:
====================================
btc = btc.l1 + hash.l1 + const

          Estimate Std. Error t value Pr(>|t|)
btc.l1    0.997044   0.002932 340.045   <2e-16 ***
hash.l1   0.006286   0.002804   2.241   0.0252 *
const    -0.627433   1.329634  -0.472   0.6371
```

Significant but very small coefficient

Our choice – Holt Winters

Better accuracy, better residuals

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Naive (Baseline)	*0.4614137*	*39.63294*	*28.49668*	*-0.6106446*	*9.884198*	*0.9709984*	*-0.4917825*
Holt	1.285161	29.88099	21.56406	-0.4213672	7.776944	0.7347759	0.02651261
HW	1.21155	29.73498	21.38789	-0.4942107	7.733743	0.7287728	0.01529912
ARIMA	0.1016486	29.91551	21.54967	-1.35594	7.794675	0.7342853	-0.000291076
Linear	6.363621e-16	32.58723	25.14914	-1.826275	10.40374	0.856934	0.2652366
NN	-0.0676387	11.27615	8.532282	-0.4880217	3.981926	0.2907297	0.01685735
NN CV	-	68.89656	-	-	-	-	-

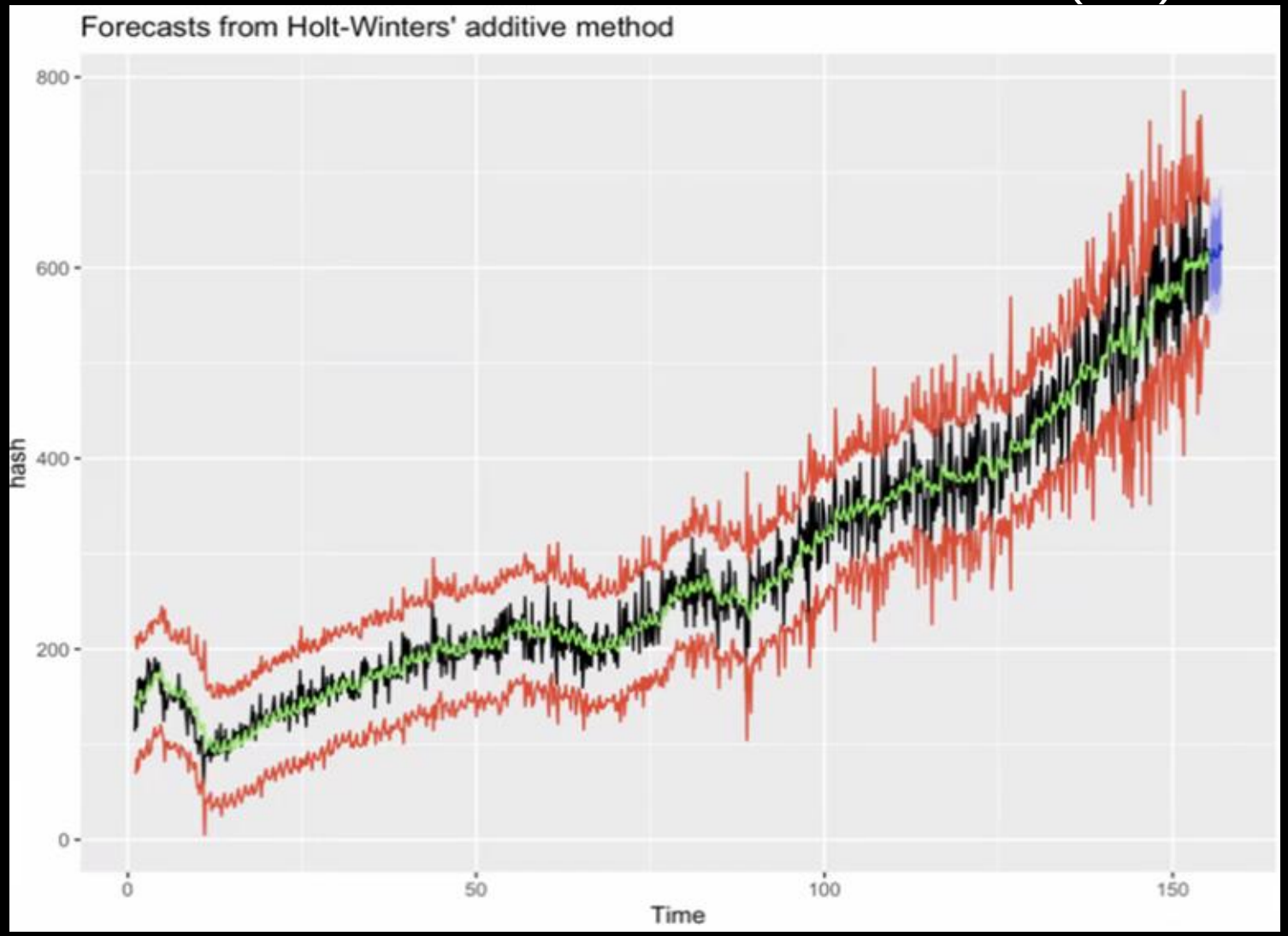
Holt-Winters Model, Non-constant Variance

Garch order=c(1,1)

```
> ArchTest(resid(hash.hw)^2)

        ARCH LM-test; Null hypothesis: no ARCH effects

data:  resid(hash.hw)^2
Chi-squared = 32.815, df = 12, p-value = 0.001034
```



Summary and Future Work

- We were able to model hash-rate with good accuracy
- Neural Network model could be useful with larger dataset
- Attempt to predict impact of miner’s activity’s impact
  - Blockchain functions that are less speculative than cryptocurrency
  - Electricity usage, network congestion