Capstone: Forecasting Bitcoin Price

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Agenda

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PART 2 Key Findings

PART 3 Forecasting

PART 4 Conclusion

PART 5 Recommendations

Background

- Internet was founded in 1983 with the 400 errors we all know and love. The lesser known of the bunch is the 402 error: payment error.

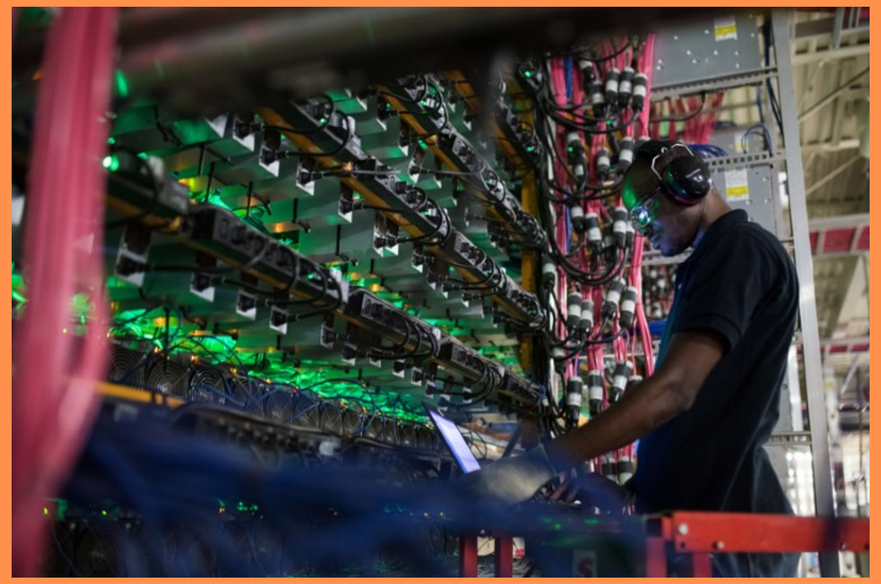
- 26 years and a few financial crises later Satoshi Nakamoto (identity unknown) created Bitcoin: the first decentralized, digital asset.

- Not only is Bitcoin decentralized, there is a fixed supply: 21 million.

- Bitcoin is "mined" (like gold): miners set up computers to solve incredibly difficult math equations and their reward for solving the equation is Bitcoin.

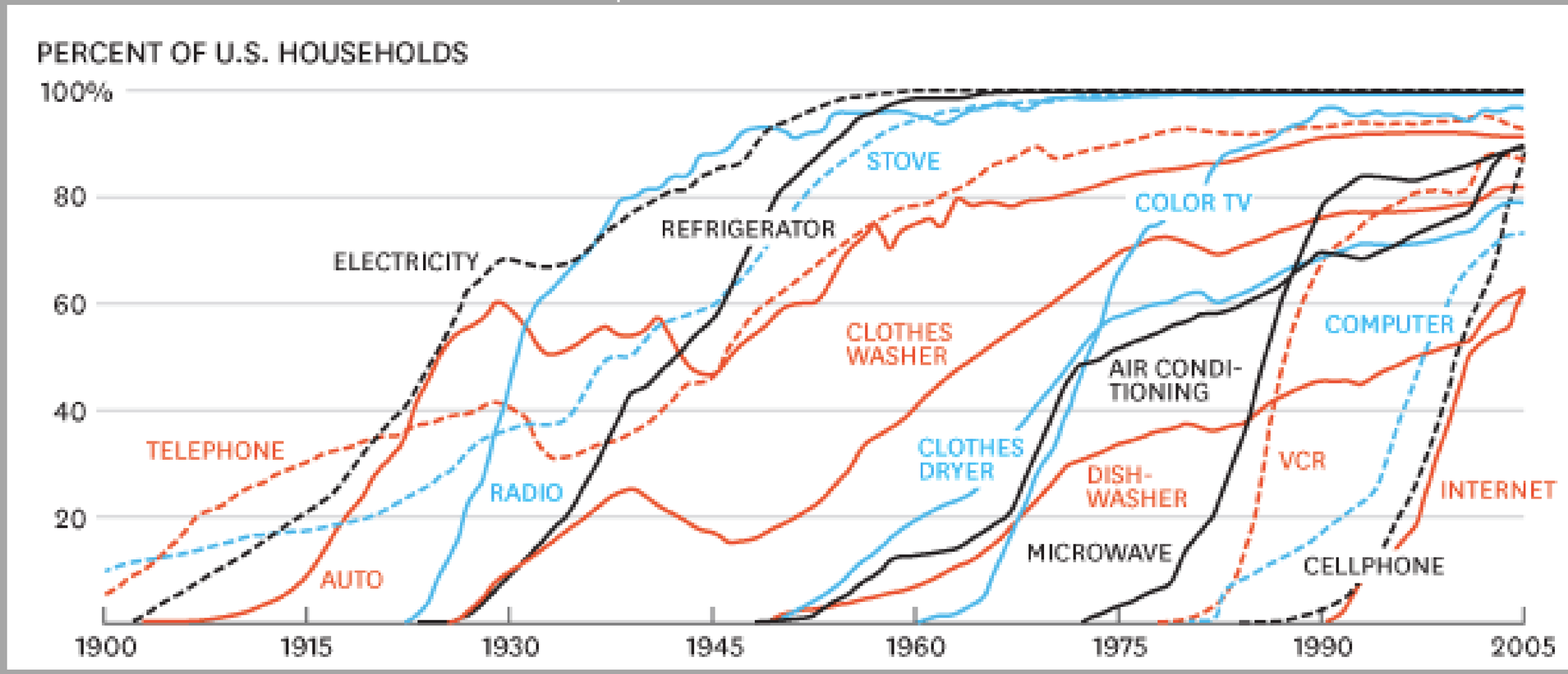
- Miners are simply updating the Bitcoin blockchain.

- Blockchain: system that records all previous transactions and stores them across several computers that are all linked in a peer-to-peer network



Background

- This graph shows the US adoption rate for technologies in the 20th century.
- Bitcoin's value is as simple as supply (fixed) and demand (adoption rate).
- Adoption is increasing: buy Tesla with Bitcoin, Bitcoin ETF's, and numerous companies holding Bitcoin on their balance sheet (to name a few examples).



Problem Statement

As Bitcoin's adoption rate continues to grow, it is important for new and speculative investors to be able to gauge where the current price of Bitcoin is on the adoption curve.

Can a time series model be developed that will forecast the price of Bitcoin within a reasonable error level (error should not be more than 20% of current Bitcoin price)?

As of writing this, the price of Bitcoin is about $63,000: this means error (+/-) should not be more than $6,300 (20% = 12,600).

-NOTE: From this point on, reference to Bitcoin price means Bitcoin’s daily closing price unless specified otherwise.

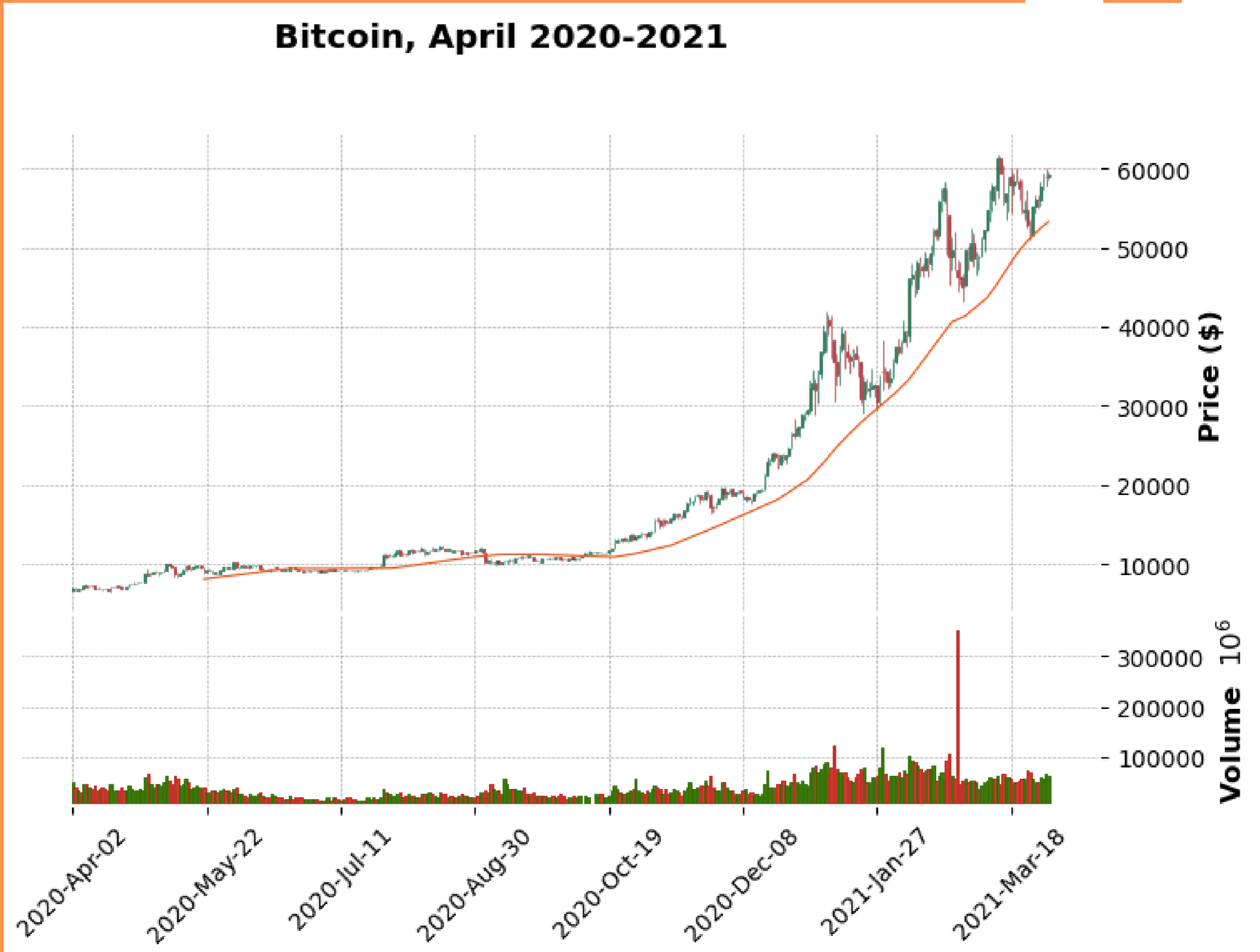
Key Findings

- Bitcoin price growing at an exponential trend: ties back to the adoption rate.

Key Findings

- Bitcoin daily price action is behaving like growth stock: repeatedly testing its 50-day-moving-average while going up.

- Signals there is some sort of pattern to Bitcoin's price growth.

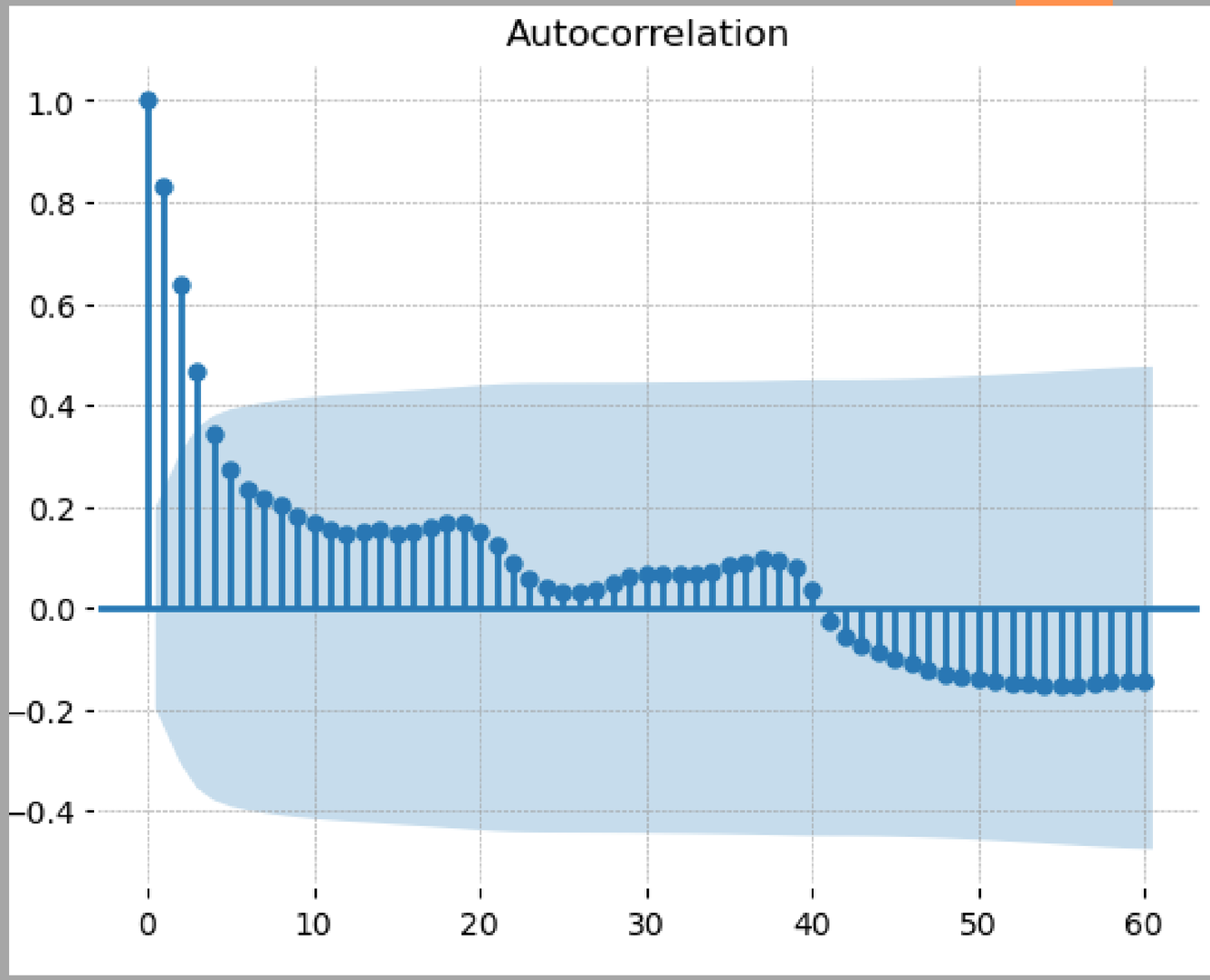


Key Findings

- Seasonality was confirmed at the monthly level: every month there was a repeated pattern found in the chart to the right.

- Bitcoin price is highly correlated (connected) with it's previous price (not surprising since the Bitcoin market never closes).

- Chart shows the monthly Bitcoin price and how the price of Bitcoin 90 days out is still highly correlated with the original price of Bitcoin.



Forecasting

- Based on the findings, exploring ARIMA and Exponential models seemed most appropriate.

- Both have a seasonal extensions.

- ARIMA models address the correlation and the moving average findings.

- Exponential models address the exponential trend.

- Also chose to explore a neural network to allow the computer to train itself on the data.

Forecasting

- Optimized models for AIC & RSS:
    - AIC how much the model liked the data it saw.
    - RSS how well did the model forecast.

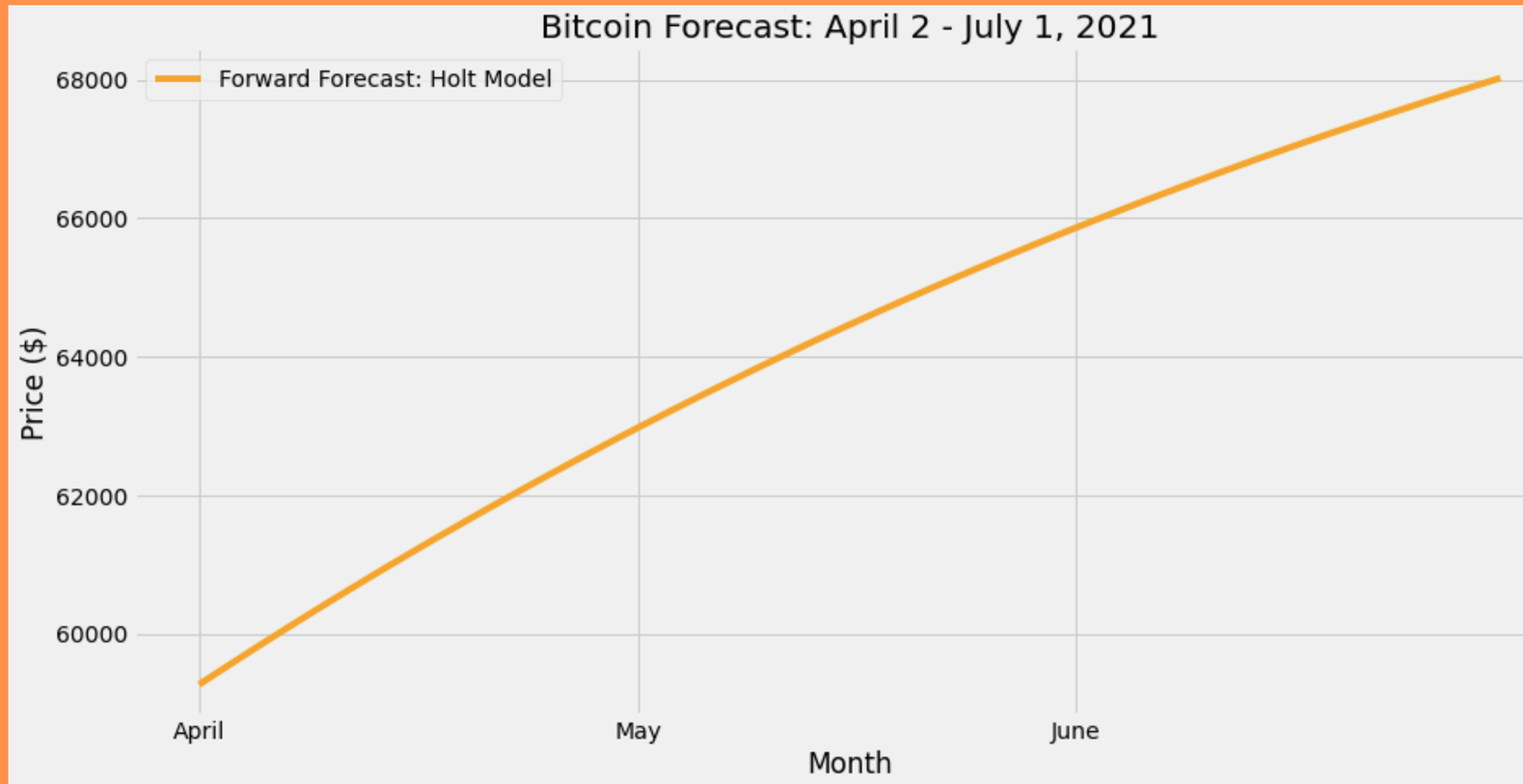
- After running over 8,000 different models, the best performing model was the GRU neural network.

- Both exponential models (Holt/Holt Winter) performed very well: their RMSE came in below the reasonable error level.

Model	Optimized	AIC	RSS
ARIMA	AIC	-9,803.978875555455	195,663,055,382.6728
ARIMA	RSS	-9,763.586525933988	18,940,753,598.031494
SARIMA	AIC	-9,775.04078021729	24,573,606,014.329235
SARIMA	RSS	-8,821.249991627563	7,395,120,381.605706
Holt	AIC	31,511.65372812618	17,592,924,408.176796
Holt	RSS	32,622.519073158164	1,649,003,709.904847
Holt Winter	AIC	31,504.365238411654	20,400,967,764.329018
Holt Winter	RSS	31,594.712991325876	1,777,842,238.3718455
GRU Baseline	RSS	N/A	527,310,145.44964737*
LSTM Baseline	RSS	N/A	9,479,719,403,159.566*
Optimized GRU	RSS	N/A	306,895,354.31196207*

Forecasting: Holt Model

- Holt model had a root mean squared error (RMSE) of $4280.45.
- Assuming the parameters from that model were optimal for all of the data, new model was built to forecast the price of Bitcoin on July 1, 2021: $68,023.95 +/- $4,280.45.
- This shows the trend is already beginning to level off.



Forecasting: GRU RNN

- Neural Network: gives the machine (computer) the opportunity to train itself on the data.

- Gated Recurrent Network (GRU) is a common network architecture used for data where order matters (ex. data tied to a specific date/time).

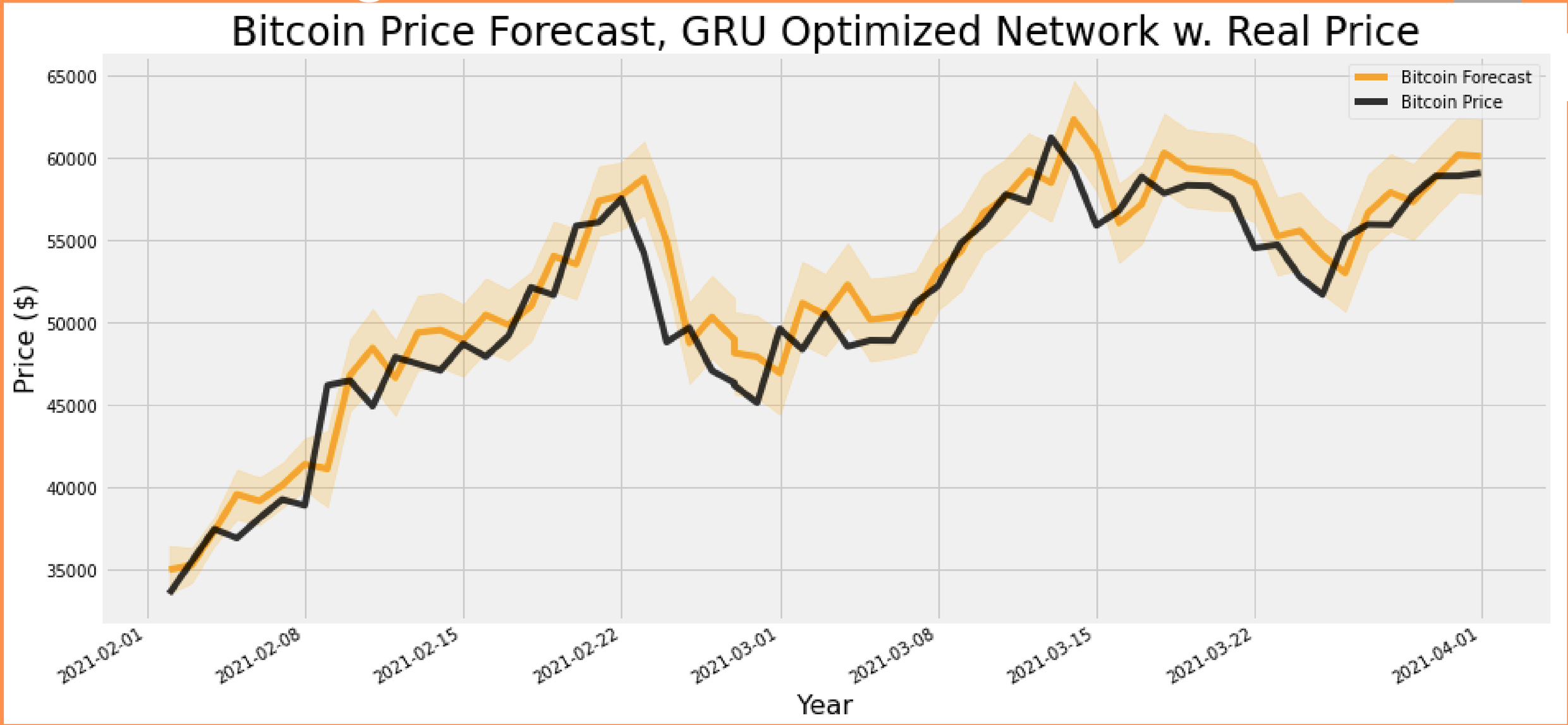
- Next slide will show the forecasted Bitcoin price, an error window, and the real Bitcoin price.

- Network only forecasted 60 days out (skips first 30 days): this is by design.

- Network unable to forecast outside of the range of available data: this is also by design.

- Forecast has a one period delay based on the real data.

Forecasting: GRU RNN



Conclusions

01

A time series model can be developed to forecast the price of Bitcoin within a reasonable error level.

02

A GRU Neural Network provided the strongest forecast.

03

Both a Holt Exponential and Holt Winter Exponential models were able to forecast within the reasonable error level that was defined (+/- 10%)

Recomendations

1

RECREATE GRU NEURAL NETWORK

Design it to be able to forward forecast outside of the data points that are available.

2

CREATE BITCOIN SPECIFIC MODEL

All models were built with existing code and technology, limitations of these codes were tested and new code will need to be created for the future.

3

BUY BITCOIN

Not financial advice

Questions?