



MGMT 590 - TEAM CRYPTOCAST | UNLEASHING NEXT GEN TRADING

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Introduction



INTRODUCTION

Is investing in crypto everyone's game?

75% of bitcoin investors have lost money (CNBC)

**70% of DIY investors lose
money** (Financial times)

Research: Success is
limited until DIY investors
break bad habits

**90% of investors have lost
money in stocks** (Everything equity)

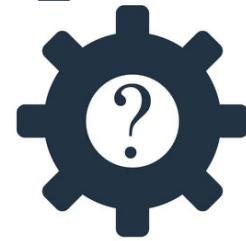
38% sold their crypto
for less than it was worth
when they bought it (lending tree)



INTRODUCTION

What can investors do to potentially make money on their investments?

Problem



Investors face significant challenges in accurately predicting returns and optimizing portfolios for maximum profitability

Gap



Absence of robust techniques tailored specifically to the dynamic nature of the cryptocurrency market

Solution

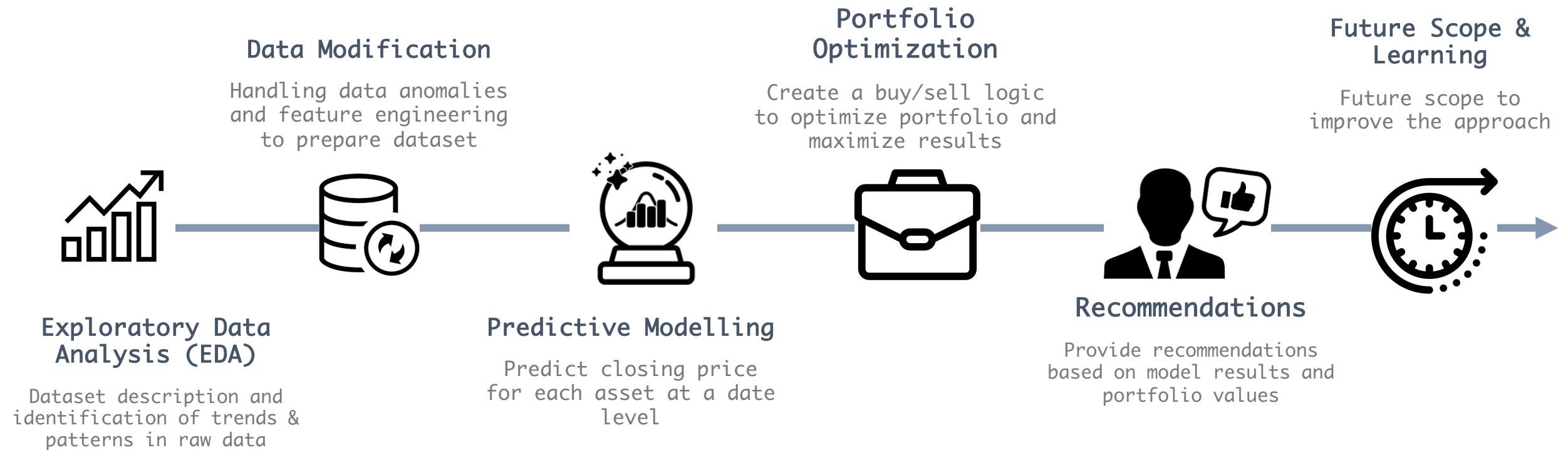


Develop AI-driven solutions that offer precise predictions and optimized trading strategies, empowering investors to make informed decisions



SOLUTION APPROACH

The road to making more money!





Data Analysis



EXPLORATORY DATA ANALYSIS

Let's look at the information we have to predict (guess) the returns!



No. of Rows & Columns
24M Rows & 10 Columns



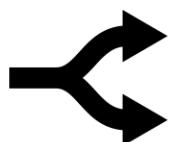
Level of data
Asset ID, Minute



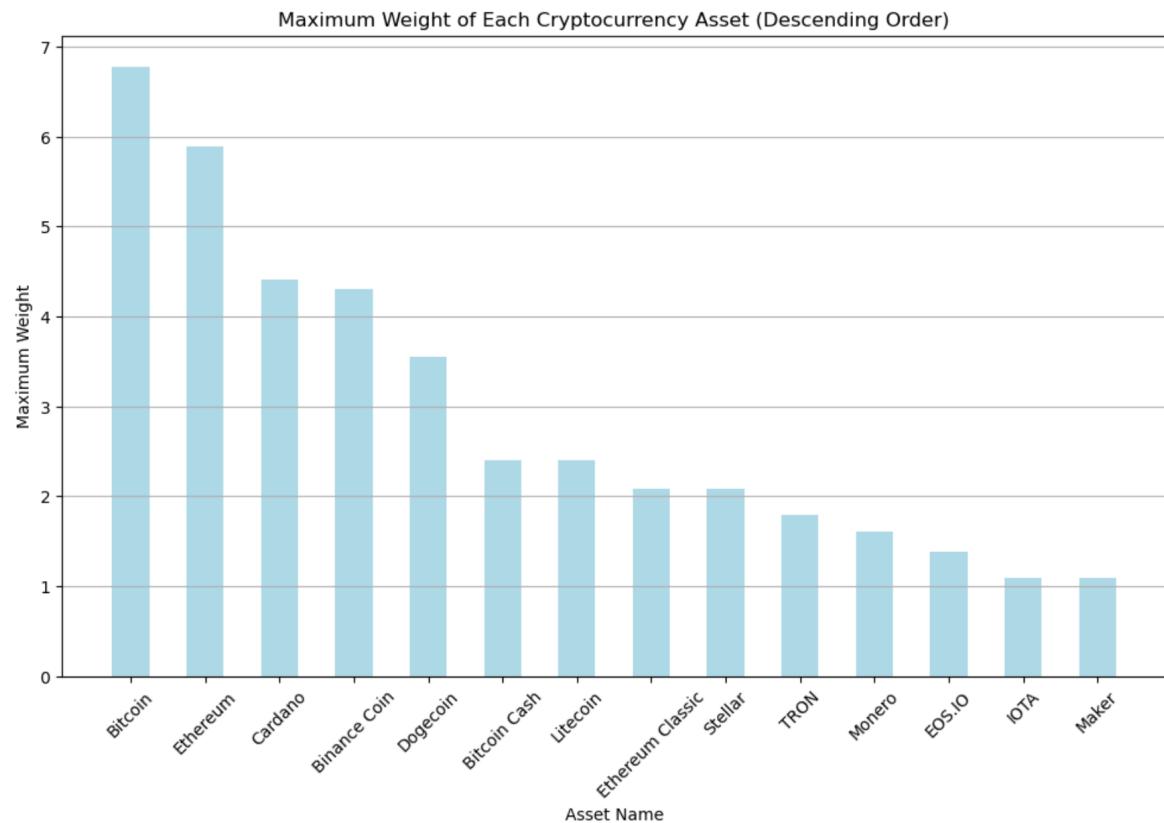
Unique Assets
14 Unique assets



Training Period
2018-01-01 to 2020-12-31



Testing Period
2021-01-01 to 2021-09-21





EXPLORATORY DATA ANALYSIS

Validating Elon Musk's dominance over others

Descriptive Statistics

Asset_Name	Close								
	mean	median	std	min	max	skew	kurtosis	q1	q3
Binance_Coin	90.579456	21.806875	151.102118	4.516000	676.129000	1.976313	2.746414	1.000000	1.000000
Bitcoin	15707.623785	9162.623333	15305.924663	3208.693333	63570.902857	1.628090	1.257114	1.000000	1.000000
Bitcoin_Cash	459.386228	339.381667	313.234976	76.303333	1754.627500	1.550466	2.135488	1.000000	1.000000
Cardano	0.357896	0.084734	0.611065	0.023140	2.966680	2.215746	4.267162	1.000000	1.000000
Dogecoin	0.062397	0.002966	0.121124	0.001495	0.688991	2.152936	4.195294	1.000000	1.000000
EOS.IO	4.754744	3.834725	2.785977	1.738267	21.452000	2.215899	6.260458	1.000000	1.000000
Ethereum	700.957541	274.260000	886.982135	83.606333	4175.517143	1.923295	2.735524	1.000000	1.000000
Ethereum_Classic	15.034982	7.267925	18.206177	3.471000	135.056233	2.679477	7.935805	1.000000	1.000000
IOTA	0.536194	0.308450	0.465965	0.109950	2.509000	1.870254	3.035258	1.000000	1.000000
Litecoin	95.604057	72.218750	61.772818	23.045250	388.114571	1.380191	1.883279	1.000000	1.000000
Maker	1294.016259	637.630000	1195.685252	200.000000	5990.328040	1.431797	1.060195	1.000000	1.000000
Monero	129.068824	94.790000	85.817806	32.117250	484.092500	1.309198	1.196925	1.000000	1.000000
Stellar	0.179690	0.115438	0.135318	0.032404	0.734752	1.257721	1.155631	1.000000	1.000000
TRON	0.035462	0.025472	0.027150	0.008507	0.164172	2.021343	4.027778	1.000000	1.000000

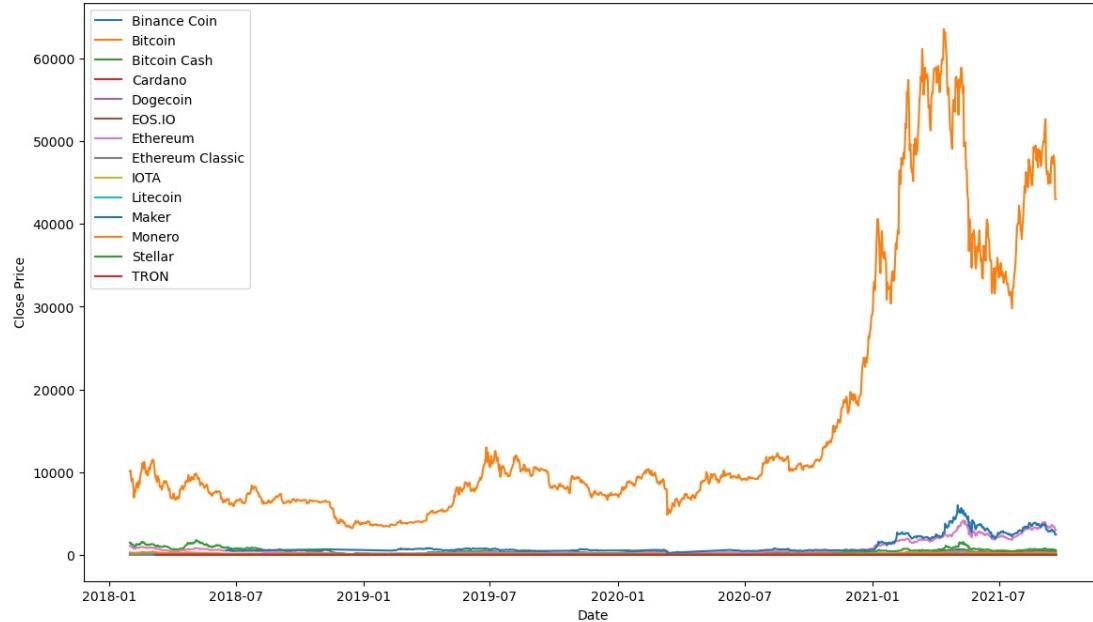
- Bitcoin is the most volatile asset, with a high standard deviation in closing prices, suggesting greater risk compared to others like Cardano
- The range between the minimum and maximum closing prices is exceptionally wide for Bitcoin, highlighting its dramatic price changes over time, compared to other assets such as TRON



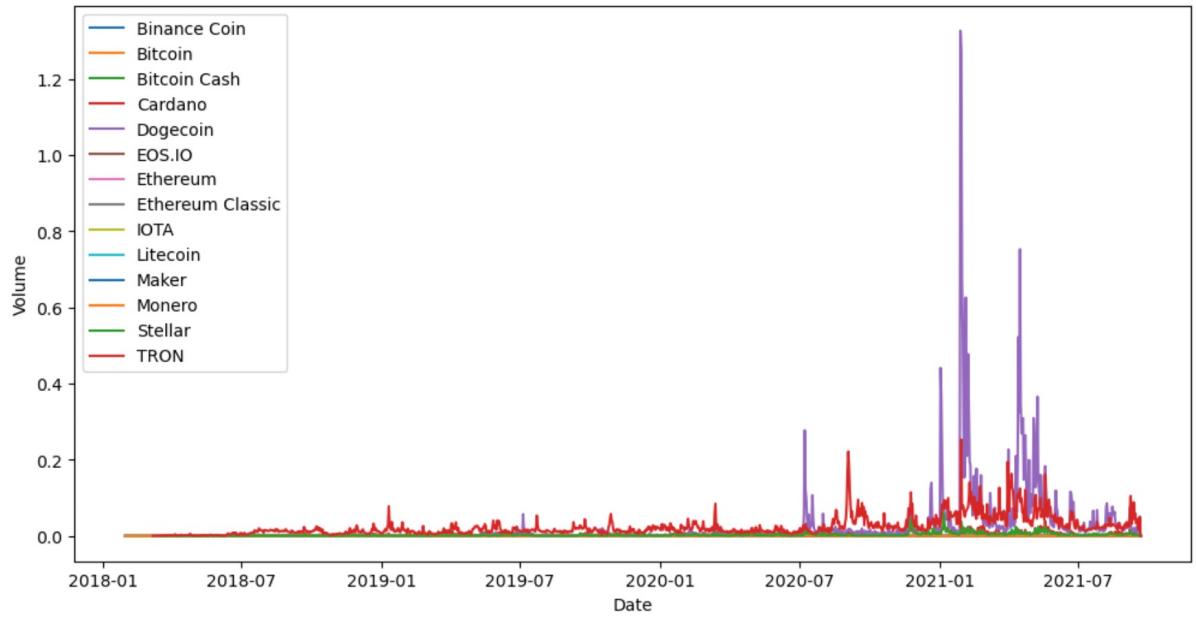
EXPLORATORY DATA ANALYSIS

The dominance continues

Price movement over time



Volume movement over time



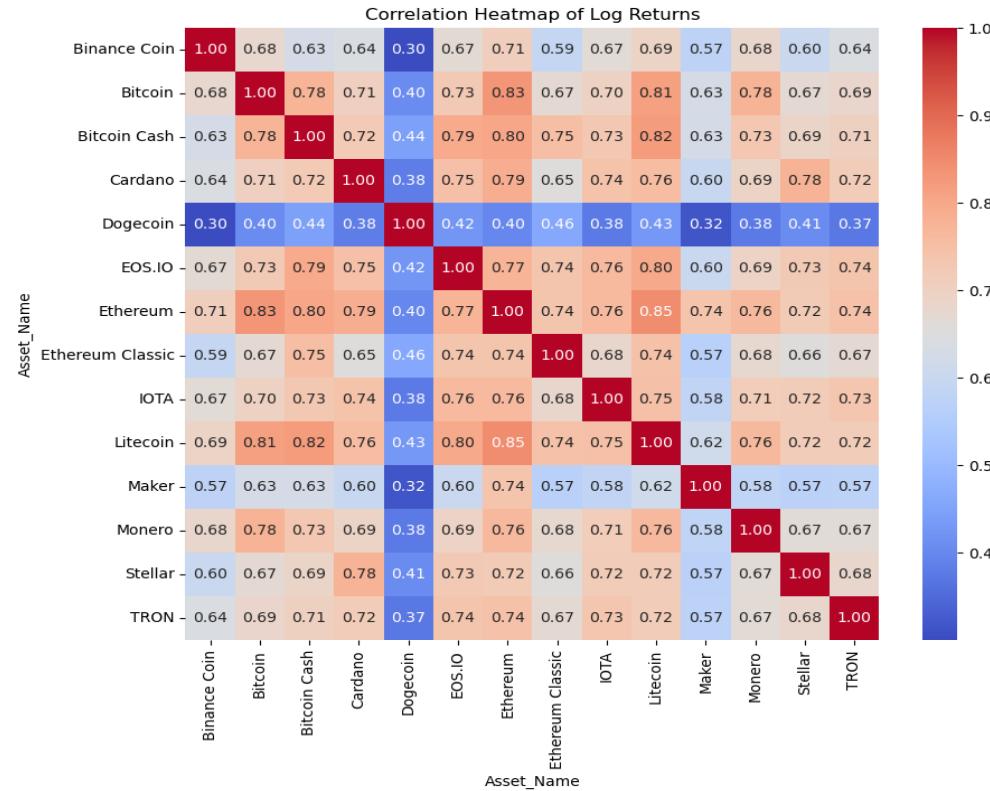
- The first graph indicates that Bitcoin has experienced significantly higher price movements over time compared to other assets, dominating the price scale with its peaks and troughs
- The second graph shows sporadic spikes in trading volume, suggesting periods of heightened market activity or events that prompted substantial trading within a short time frame



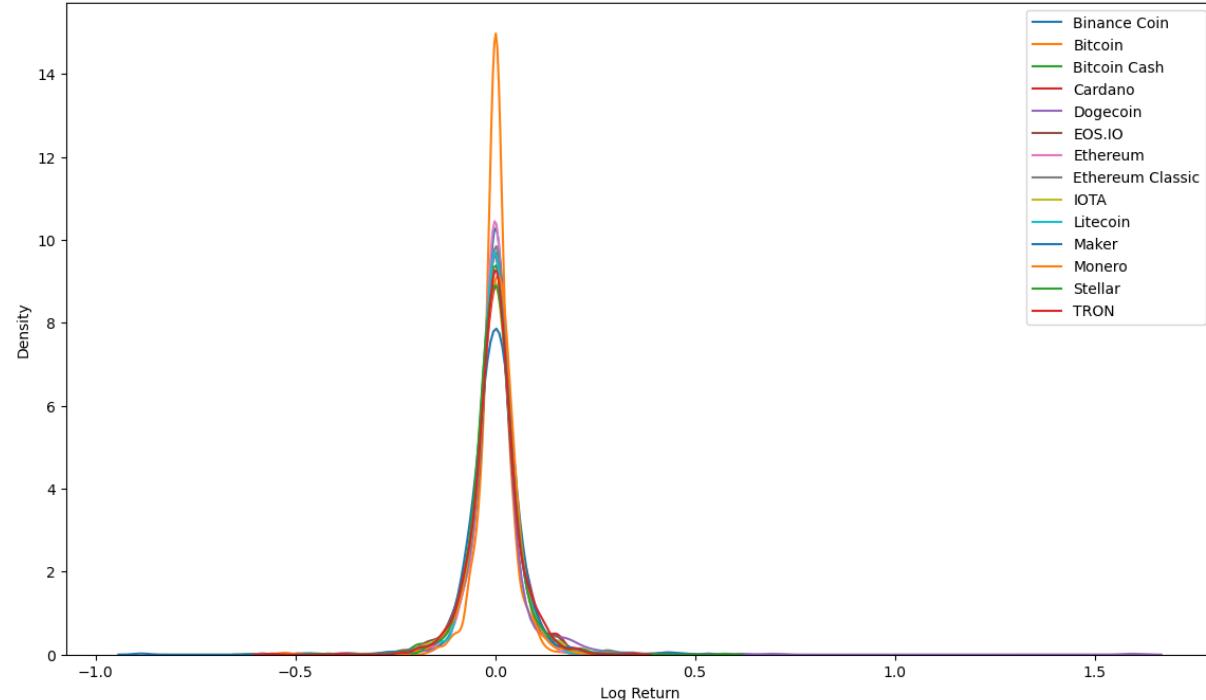
EXPLORATORY DATA ANALYSIS

Would investing in multiple related cryptos increase your chances?

Correlation matrix of log returns



Distribution of daily price changes



- The correlation matrix shows that most cryptocurrencies have positive correlations with each other, indicating that their log returns tend to move in the same direction, with Bitcoin and Ethereum exhibiting particularly strong correlation
- The graph suggests that the log returns are highly peaked around the mean with fatter tails, which implies a higher likelihood of extreme values compared to a normal distribution



Data Preprocessing



DATA PREPROCESSING | FEATURE ENGINEERING

Move from minutes to days: patience is the key to success!

Layer 1 | Daily Level Data-Frame Creation



Kaggle Dataset

- Open Price
- High Price
- Low Price
- Close Price
- Volume Traded
- Volume Weighted Average Price (VWAP)



Daily Level Dataset

- Day Open Price (First)
- Day High Price (Max)
- Day Low Price (Min)
- Day Close Price (Last)
- Daily Sum of Volume Traded (Sum)
- VWAP (Last)

Level: Timestamp (Minute),
Asset ID

Level: Date, Asset ID

All the features have been scaled using Standard Scaler separately for test and train dataset



DATA PREPROCESSING | FEATURE ENGINEERING

Remove that multicollinearity!

Layer 2 | Dropping columns with high VIF

Before

	feature	VIF
0	const	15.917
1	Asset_ID	1.678
2	Open	1525.684
3	High	2703.485
4	Low	896.215
5	Close	1582025.111
6	Volume	1.219
7	Count	2.015
8	VWAP	1565039.545
9	Weight	2.028

After

	feature	VIF
0	const	15.904
1	Asset_ID	1.678
2	Close	1.650
3	Volume	1.197
4	Count	1.815
5	Weight	2.011





DATA PREPROCESSING | FEATURE ENGINEERING

Gotta add more information to make the prediction right!

Layer 3 | Additional Features Creation



Daily Level Dataset

- Daily Volume (number of crypto asset units traded)
- Daily Count of trades
- Weight for each Crypto

Target variable: Daily Close Price



Additional Variables

- **Returns** = Today's closing price/Yesterday's closing price
- **Lagged Features** for 'Close Price' and 'Volume' for the previous day
- **Simple moving average** for 'Close Price' for the last 10 and 50 days
- **RSI indicator** is calculated using a formula that normalizes the ratio of upward and downward price movements into a range between 0 and 100

$$RSI=100-(100/(1+RS))$$

Where RS = Average Gain / Average Loss

RSI Value Over 70: Typically considered overbought

RSI Value Under 30: Generally viewed as oversold

RSI Value Around 50: Often considered neutral, with no strong momentum

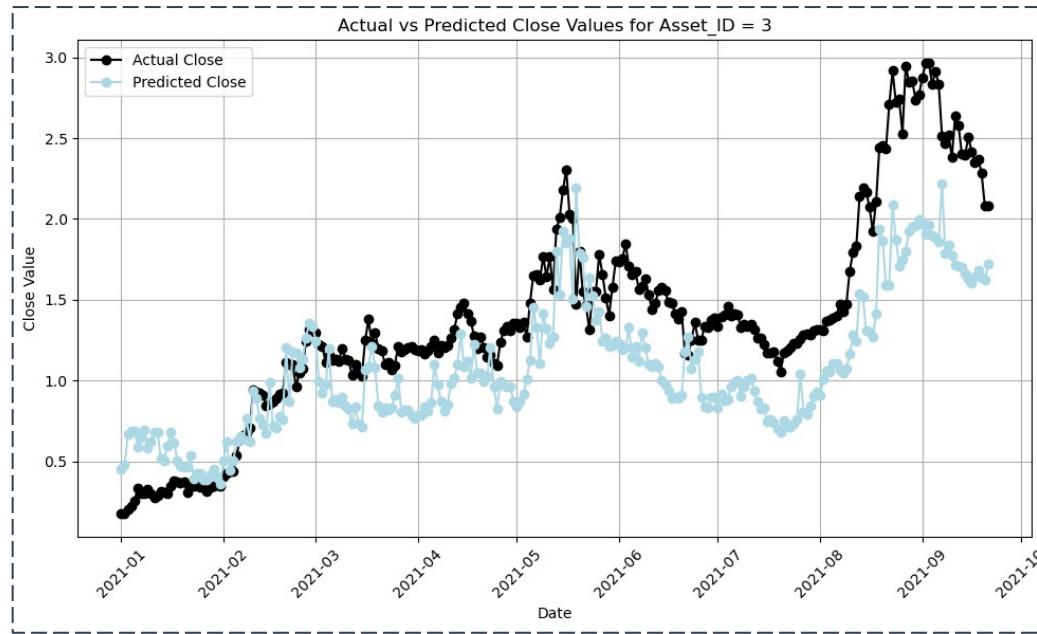


Predictive Modelling



DATA MODELLING | SEQUENTIAL NEURAL NETWORK

Let's start with the basics!



Evaluation Metrics:

Asset_ID	MAPE
0	17.382037
1	50.983971
2	11.402856
3	31.129308
4	2408.154788
5	7.795378
6	11.673695
7	9.053360
8	11.862100
9	14.052920
10	56.493689
11	12.185323
12	31.694732
13	93.495314

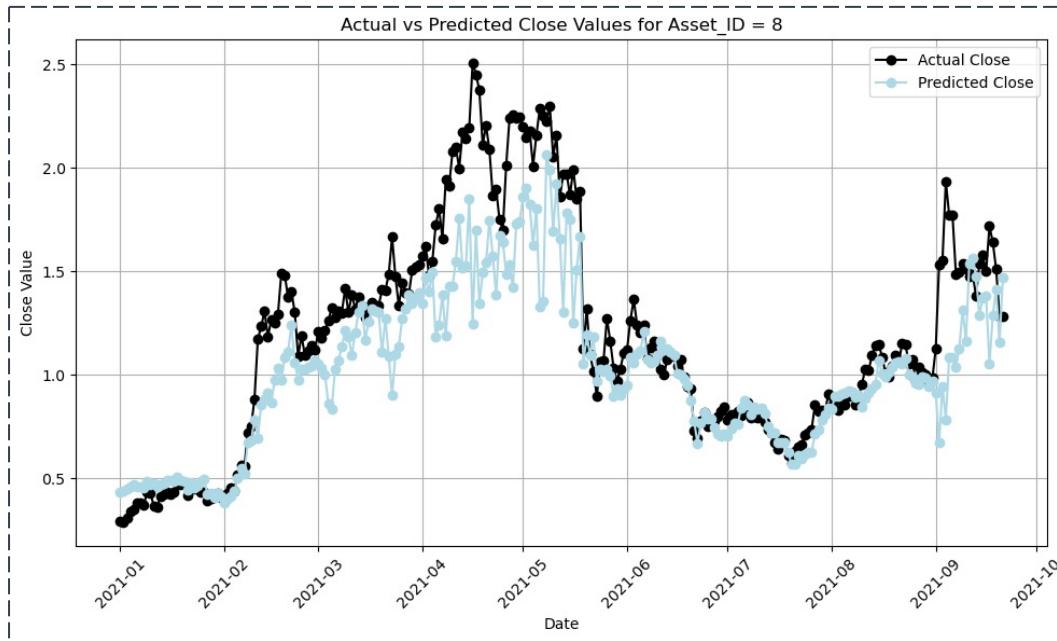


- **Sequential Neural Network:** It's adept at handling the volatility and complexity of crypto markets
- **Activation:** ReLU for hidden layers to introduce non-linearity
- **Optimizer:** Adam for efficient learning
- **Loss Function:** Mean Squared Error (MSE) for accurate error measurement
- **Epochs:** 50, to balance learning and overfitting
- **Batch Size:** 32, for efficient training



DATA MODELLING | BIDIRECTIONAL LSTM

Look into the past and future to improve your present!



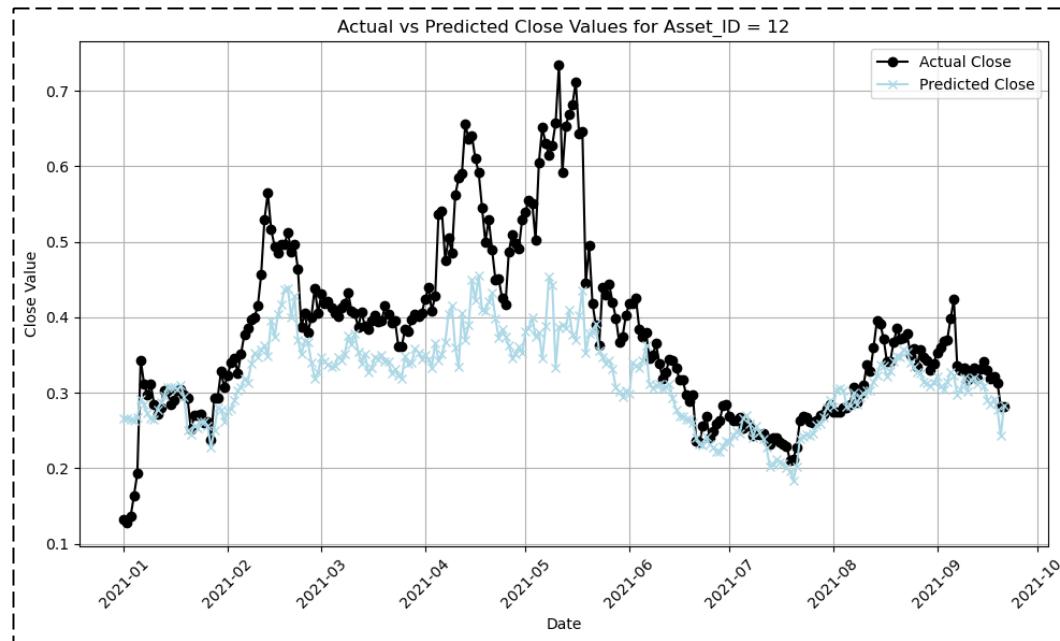
Evaluation Metrics:		
Asset_ID	MAPE	
0	78.820461	
1	99.517151	
2	68.018018	
3	51.724251	
4	84.686134	
5	9.870861	
6	91.310673	
7	24.679760	
8	13.560023	
9	29.231666	
10	95.676482	
11	39.575869	
12	13.346503	
13	16.309883	

- **Bidirectional LSTM:** Captures dependencies in both forward and backward directions of the time series
- **Units:** 64 LSTM units in each layer, providing the capacity to learn complex patterns
- **Dropout:** 0.2, to prevent overfitting by randomly ignoring selected neurons during training
- **Optimizer:** Adam, for efficient gradient descent
- **Loss Function:** Mean Squared Error (MSE), focusing on penalizing larger prediction errors
- Effective in learning from sequences, making them perfect for the time-series data in cryptocurrency markets



DATA MODELLING | STACKED LSTM

Cos stacked is always better..just like pancakes!



Evaluation Metrics:		
Asset_ID	MAPE	
0	80.696136	
1	99.755398	
2	82.847707	
3	57.359138	
4	93.986611	
5	10.343444	
6	95.289469	
7	26.801754	
8	16.599642	
9	55.848858	
10	97.761564	
11	64.418782	
12	15.568056	
13	13.491297	

Stacked LSTM: Designed to predict cryptocurrency prices by learning from sequences of data

- Layers:** Sequential model with three LSTM layers, each with 64 units, followed by Dropout layers set at 0.2 to reduce overfitting by ignoring randomly selected neurons during training
- Output:** A Dense layer with a single neuron to predict the closing price
- Optimizer:** Adam, chosen for its effectiveness in handling sparse gradients and adaptive learning rates
- Loss Function:** Mean Squared Error (MSE), targeting the minimization of prediction errors



Portfolio Optimization



PORTFOLIO OPTIMIZATION

The secret sauce to success!



Trading Day 1

Initial Wallet
Balance:
\$ 100,000



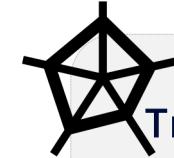
Assets to Purchase

- Top 5 Assets (based on predicted percentage returns)
- Predicted Percentage Returns > 0



Amount Invested

- Amount Invested Per Asset =
 $\text{Wallet Balance} / (\text{Distinct Assets Bought})$



Trading Strategies Employed



Stop-Loss

- Sell assets when they reach 80% of purchase price
- Dynamic stop-loss threshold (80% of purchase price)



Take-Profit



- Sell assets when they reach 120% of purchase price



PORTFOLIO OPTIMIZATION

Look at your investments grow!



Metrics Tracked Per Day

Date | Wallet Balance | Portfolio Current Value | Portfolio {Asset Name: [Quantity, Purchase Price]}

Day 1

```
Date: 2021-01-01 00:00:00, Wallet Balance: 0.0, Portfolio Value: 100000.0, Portfolio: {'Stellar': [151252.3696204574, 0.1322293333333333], 'Cardano': [114254.59351071998, 0.1750476666666666], 'IOTA': [68728.52233676976, 0.291], 'Ethereum Classic': [3506.7007206269977, 5.703366666666668], 'TRON': [744418.7206419867, 0.0268666]}
```

Post 3 Months

```
Date: 2021-04-01 00:00:00, Wallet Balance: 154291.7597633177, Portfolio Value: 155688.9872614803, Portfolio: {'Ethereum Classic': [10875.432027687184, 13.76833333333333]}
```

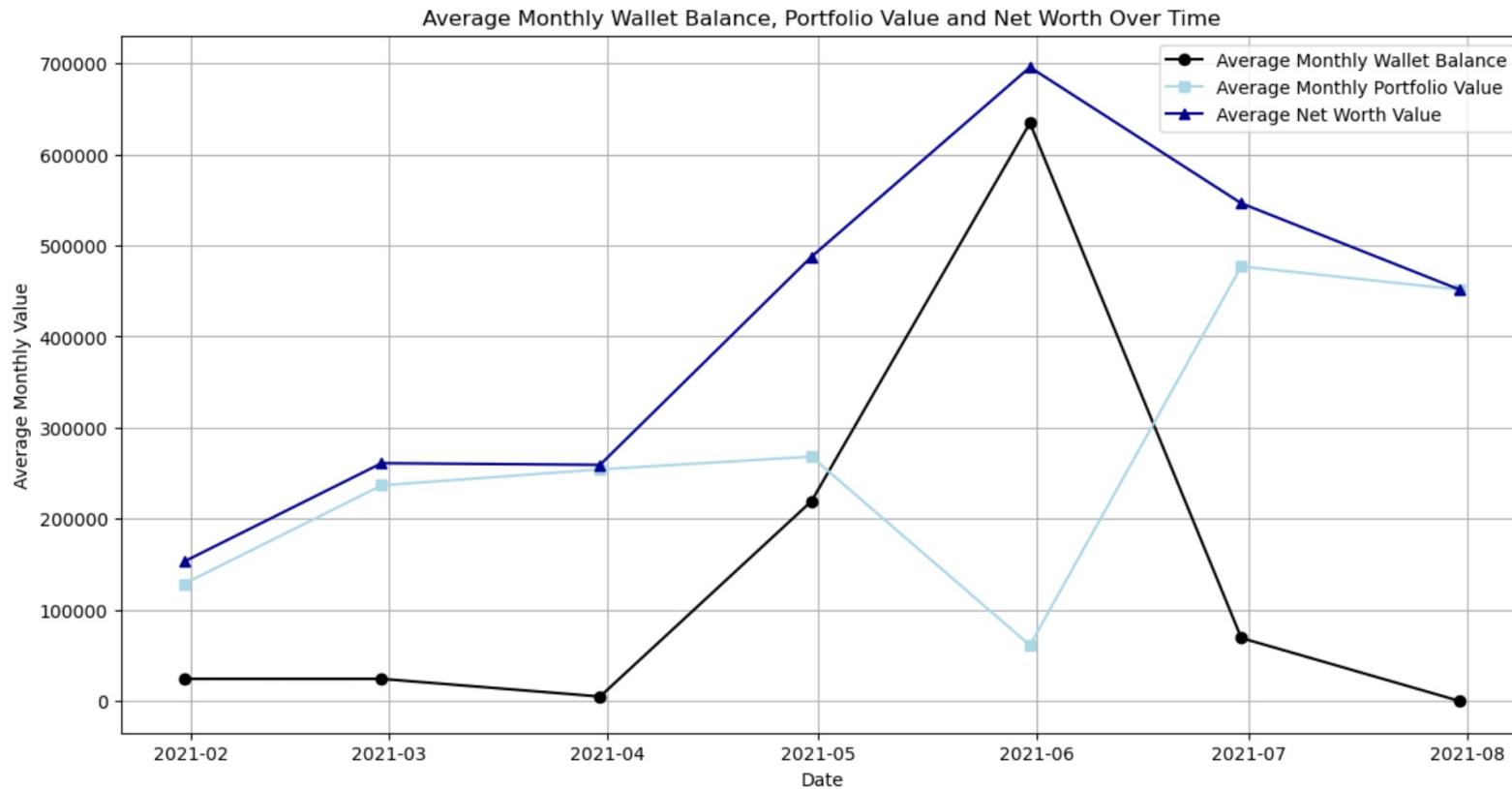
Post 6 Months

```
Date: 2021-07-01 00:00:00, Wallet Balance: 0.0, Portfolio Value: 451422.13768314366, Portfolio: {'EOS.IO': [115035.94489294427, 3.5240666666666662]}
```



PORTFOLIO OPTIMIZATION

And if that was too much info, here's a visualization!



- There is a significant increase in average net worth and portfolio value around early 2021, with a particularly sharp rise and subsequent fall around mid-2021. Overall, the net worth increases by almost 400% in the span of 6 months

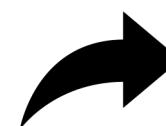


Recommendation



RECOMMENDATION | APP BASED TRACKER

Use the app to keep your money close and worries away!



Benefits to Traders

- Stop-Loss
- Take-Profit
- Goal Setting & Tracking
- Personalized Recommendations
- Higher Average Returns
- Real-Time Feedback
- Enhanced Trading Experience

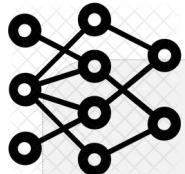


Learnings & Future Scope



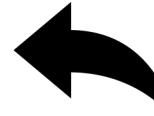
FUTURE STEPS | MODEL ENHANCEMENT

Nothing is perfect and so is our model!



Best fit model approach

Create a best fit approach that fits multiple models for each assets and selects the best according to MAPE



Hyperparameter tuning & experimentation

Experiment with different activation functions (ReLU, Leaky ReLU, ELU), search for the optimal learning rate, batch size, and use early stopping to halt when the model's training performance



Validation Strategies

- Employ Cross-Validation for time series data to ensure the model is tested on various unseen segments of the data
- Test the model against **adversarial examples** to assess its resilience



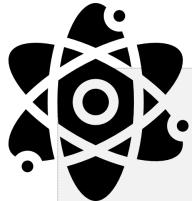
Leverage External Data

Social Media Sentiment Analysis: Integrate sentiment analysis from social media platforms to gauge public sentiment towards specific assets, which can provide leading indicators for market movements



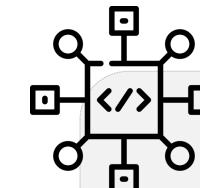
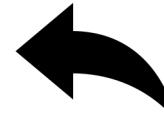
FUTURE STEPS | PORTFOLIO OPTIMIZATION

Nothing is perfect and so is our methodology!



Dynamic Asset Allocation

Employ advanced portfolio optimization techniques, like dynamic rebalancing based on predictive model outputs or adapting to market conditions, to maximize returns or minimize risk



Algorithmic Trading Strategy Development

Develop and test various trading strategies (momentum, mean reversion, machine learning-based predictions) to diversify approaches and potentially enhance returns



Reinforcement Learning

Apply reinforcement learning algorithms to dynamically adjust portfolio allocations based on learned strategies that maximize rewards (e.g., returns) while penalizing excessive risk



Continuous Improvement & Adaption

Establish a process for continuous monitoring and updating of the trading model and strategy, incorporating new data, market insights, and feedback from trading performance to adapt to changing conditions





DISCLAIMER!

You are on your own!



*Investing in cryptocurrencies is subject to market risk, and subject to market fluctuations. Before deciding to invest in cryptocurrencies, you should carefully consider your investment objectives, level of experience, and risk appetite. The possibility exists that you could sustain a loss of some or all your initial investment and therefore you should not invest money that you cannot afford to lose. You should be aware of all the risks associated with cryptocurrency trading and seek advice from an independent financial advisor if you have any doubts



Thank you!