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IW 11
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TECHNICAL ANALYSIS OF CRYPTOCURRENCIES

MOTIVATION AND GOAL

- ▶ Technical analysis methods have been developed and refined historically for only the stock market
- ▶ The goal of my project is to provide basis for the use of traditional technical analysis techniques in the cryptocurrency market

RELATED WORK

- ▶ Panos Fousekis, Dimitra Tzaferi, Returns and volume: Frequency connectedness in cryptocurrency markets, Economic Modelling, Volume 95, 2021, Pages 13-20, ISSN 0264-9993
 - ▶ Mainly deals with volume analysis
- ▶ Mikhaylov, A. (2020). Cryptocurrency market analysis from the open innovation perspective. Journal of Open Innovation : Technology, Market, and Complexity, 6(4), 197
 - ▶ Introduces the idea that standalone stock market techniques may not be fully accurate, and new methods such as the Bitcoin Dominance Index need to be developed
- ▶ Hudson, R., Urquhart, A. Technical trading and cryptocurrencies. Ann Oper Res 297, 191-220 (2021).
 - ▶ Limited in terms of individual methods

APPROACH

- ▶ Studied two cryptocurrencies: Ethereum and Bitcoin, due to their dominance in the cryptocurrency market
- ▶ Applied various technical analysis methods in 4 broad categories: Volume, Volatility, Trend, Momentum
- ▶ Filtered for most accurate and efficient methods, then combined them

IMPLEMENTATION

- ▶ Datasets: CSV files for Ethereum and Bitcoin, containing the Date, Open, High, Low, Close and Volume for each
- ▶ Datasets were filtered to 2020, from June to December (roughly 214 days, some days excluded due to corrupt data)
- ▶ The stock market is open for 220 days of the year, which is where the motivation for using 214 days instead of 365 days came from
- ▶ Especially important to include holidays such as Thanksgiving and Christmas, where news of cryptocurrencies tends to spread between people and trading volume is increased

DATASET PREPROCESSING

```
pd.set_option("display.max_rows", 10, "display.max_columns", 10)
eth
✓ 0.3s
```

	Date	Open	High	Low	Close	Adj Close	Volume
1760	2020-06-01	230.860260	248.236282	230.488052	246.991760	246.991760	1.395173e+10
1761	2020-06-02	246.828186	252.222000	233.225296	237.219055	237.219055	1.378211e+10
1762	2020-06-03	237.395218	244.179321	235.464447	244.179321	244.179321	9.861761e+09
1763	2020-06-04	244.105286	245.928970	236.765305	244.426392	244.426392	1.017041e+10
1764	2020-06-05	244.349594	247.329498	240.682053	241.221985	241.221985	9.293964e+09
...
1969	2020-12-27	635.887146	711.393555	628.334961	682.642334	682.642334	2.609355e+10
1970	2020-12-28	683.205811	745.877747	683.205811	730.397339	730.397339	2.422257e+10
1971	2020-12-29	730.358704	737.952881	692.149414	731.520142	731.520142	1.871068e+10
1972	2020-12-30	731.472839	754.303223	720.988892	751.618958	751.618958	1.729457e+10
1973	2020-12-31	751.626648	754.299438	726.511902	737.803406	737.803406	1.392685e+10

211 rows × 7 columns

ETH

	Date	Close	Volume
2020-06-01	246.991760	1.395173e+10	
2020-06-02	237.219055	1.378211e+10	
2020-06-03	244.179321	9.861761e+09	
2020-06-04	244.426392	1.017041e+10	
2020-06-05	241.221985	9.293964e+09	

```
btc
✓ 0.2s
```

	Date	Open	High	Low	Close	Adj Close	Volume
2084	2020-06-01	9463.605469	10199.565430	9450.899414	10167.268555	10167.268555	35198901068
2085	2020-06-02	10162.973633	10182.340820	9460.571289	9529.803711	9529.803711	39137252109
2086	2020-06-03	9533.760742	9682.859375	9471.846680	9656.717773	9656.717773	25007459262
2087	2020-06-04	9655.854492	9887.610352	9525.247070	9800.636719	9800.636719	25921805072
2088	2020-06-05	9800.215820	9869.237305	9663.216797	9665.533203	9665.533203	23509628646
...
2293	2020-12-27	26439.373047	28288.839844	25922.769531	26272.294922	26272.294922	66479895605
2294	2020-12-28	26280.822266	27389.111328	26207.640625	27084.808594	27084.808594	49056742893
2295	2020-12-29	27081.810547	27370.720703	25987.298828	27362.437500	27362.437500	45265946774
2296	2020-12-30	27360.089844	28937.740234	27360.089844	28840.953125	28840.953125	51287442704
2297	2020-12-31	28841.574219	29244.876953	28201.992188	29001.720703	29001.720703	46754964848

214 rows × 7 columns

Trimmed Datasets

BTC

	Date	Close	Volume
2020-06-01	10167.268555	35198901068	
2020-06-02	9529.803711	39137252109	
2020-06-03	9656.717773	25007459262	
2020-06-04	9800.636719	25921805072	
2020-06-05	9665.533203	23509628646	

IMPLEMENTATION

- ▶ Raw datasets are then expanded to include a variety of technical analysis features through the ta library (<https://github.com/bukosabino/ta>)

Date	volatility_kcc	volatility_kch	volatility_kcl	volatility_kw	volatility_kcp
2020-06-01	241.905365	259.653595	224.157135	14.673697	0.643293
2020-06-02	241.397074	259.769541	223.024607	15.221781	0.386297
2020-06-03	241.356170	256.509440	226.202901	12.556770	0.593153
2020-06-04	241.610517	255.266385	227.954649	11.304035	0.603101
2020-06-05	241.903982	254.158166	229.649799	10.131444	0.472173

Sample Volatility Metrics

IMPLEMENTATION: TA CATEGORIES

Volume

- Money Flow Index (MFI)
- Accumulation/Distribution Index (ADI)
- On-Balance Volume (OBV)
- Chaikin Money Flow (CMF)
- Force Index (FI)
- Ease of Movement (EoM, EMV)
- Volume-price Trend (VPT)
- Negative Volume Index (NVI)
- Volume Weighted Average Price (VWAP)

Volatility

- Average True Range (ATR)
- Bollinger Bands (BB)
- Keltner Channel (KC)
- Donchian Channel (DC)
- Ulcer Index (UI)

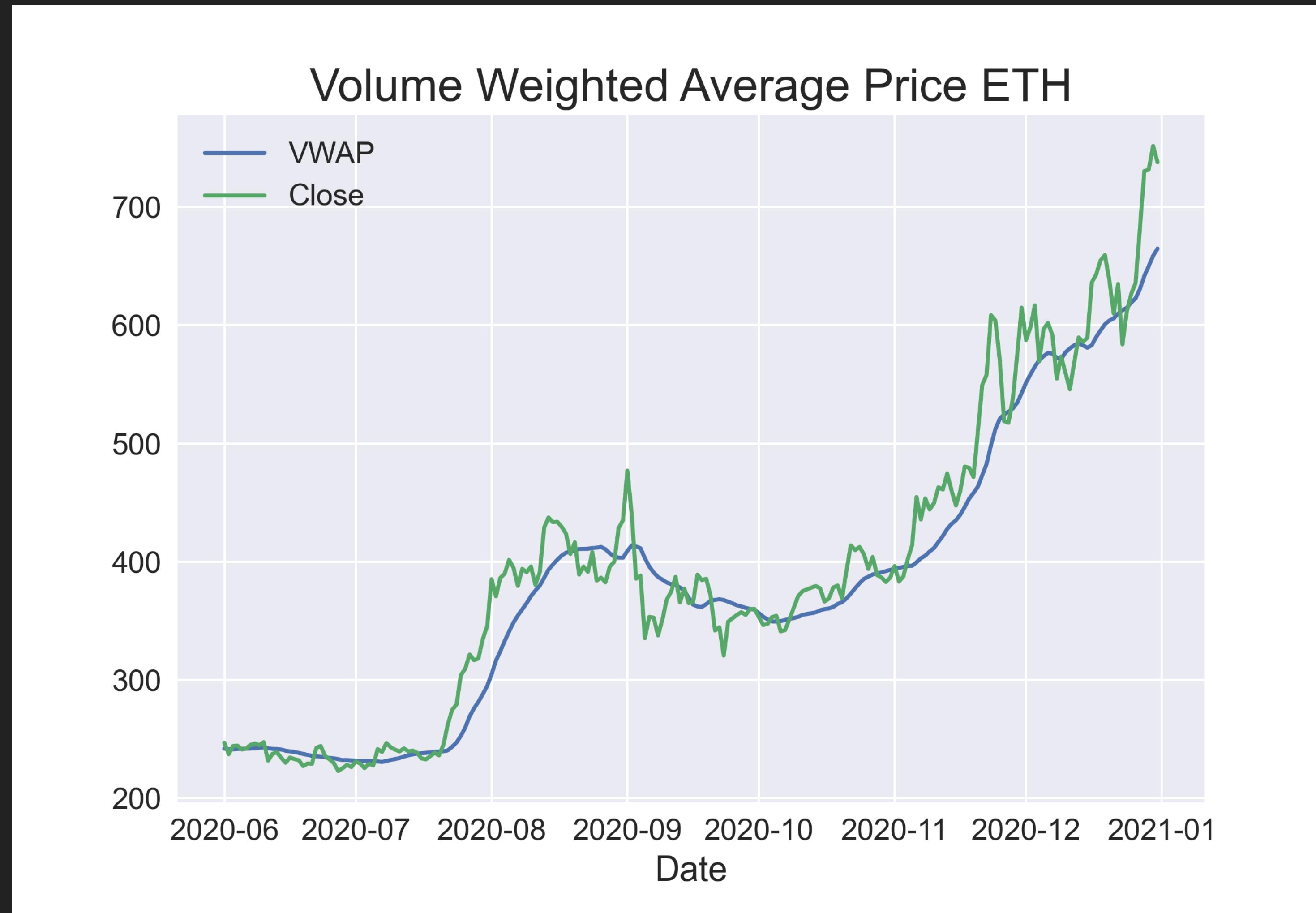
Trend

- Simple Moving Average (SMA)
- Exponential Moving Average (EMA)
- Weighted Moving Average (WMA)
- Moving Average Convergence Divergence (MACD)
- Average Directional Movement Index (ADX)
- Vortex Indicator (VI)
- Trix (TRIX)
- Mass Index (MI)
- Commodity Channel Index (CCI)
- Detrended Price Oscillator (DPO)
- KST Oscillator (KST)
- Ichimoku Kinkō Hyō (Ichimoku)
- Parabolic Stop And Reverse (Parabolic SAR)
- Schaff Trend Cycle (STC)

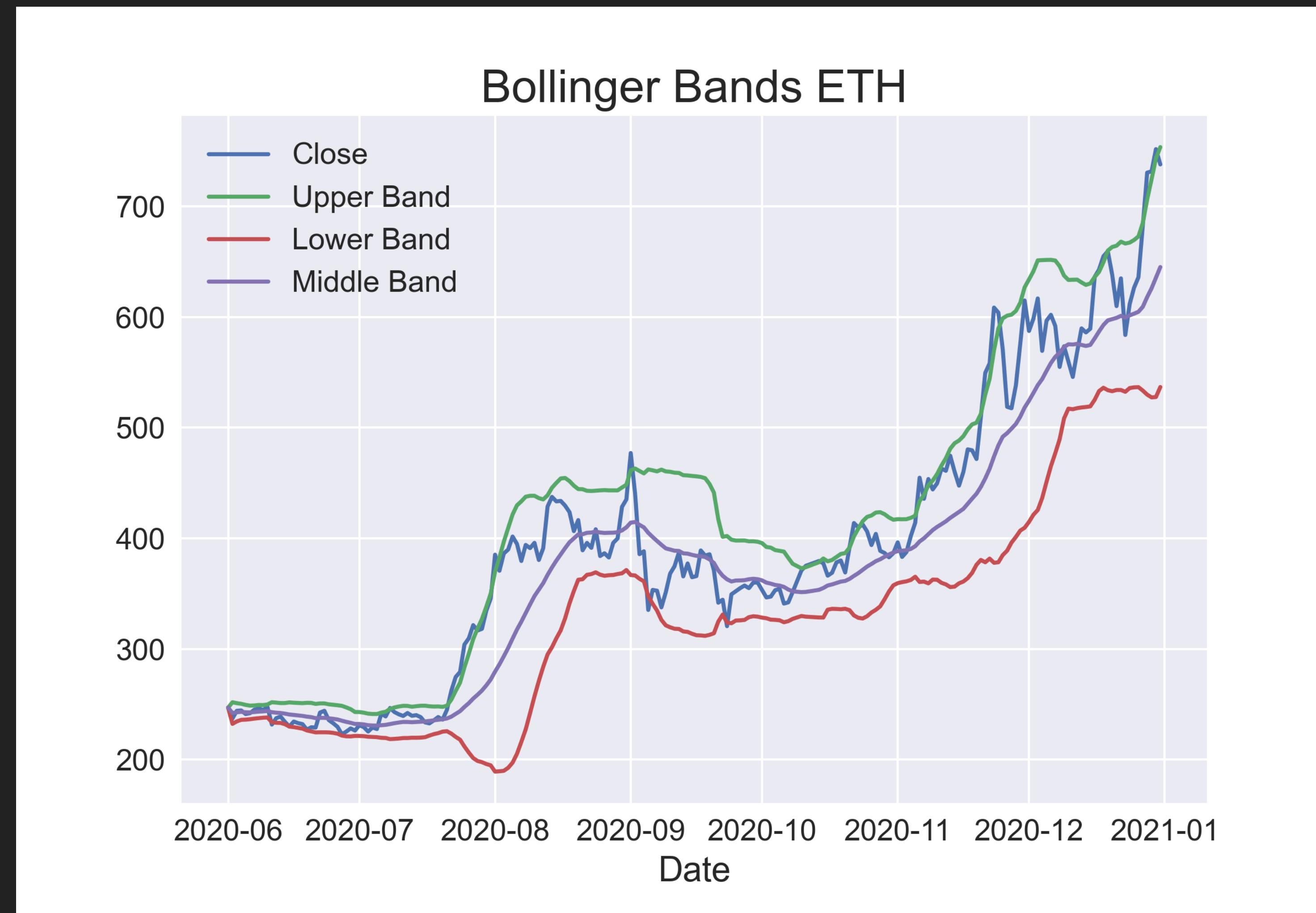
Momentum

- Relative Strength Index (RSI)
- Stochastic RSI (SRSI)
- True strength index (TSI)
- Ultimate Oscillator (UO)
- Stochastic Oscillator (SR)
- Williams %R (WR)
- Awesome Oscillator (AO)
- Kaufman's Adaptive Moving Average (KAMA)
- Rate of Change (ROC)
- Percentage Price Oscillator (PPO)
- Percentage Volume Oscillator (PVO)

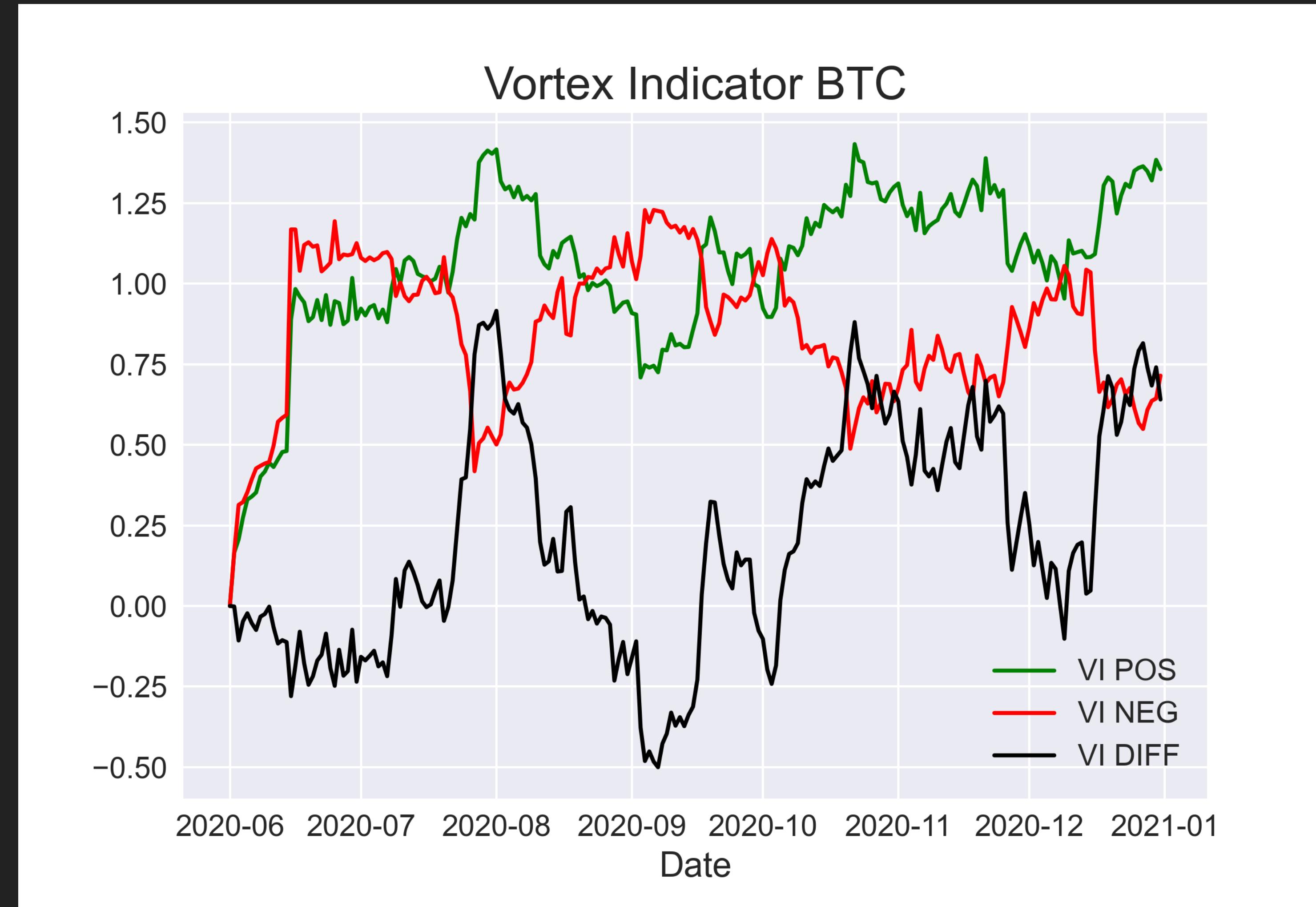
VOLUME SAMPLE



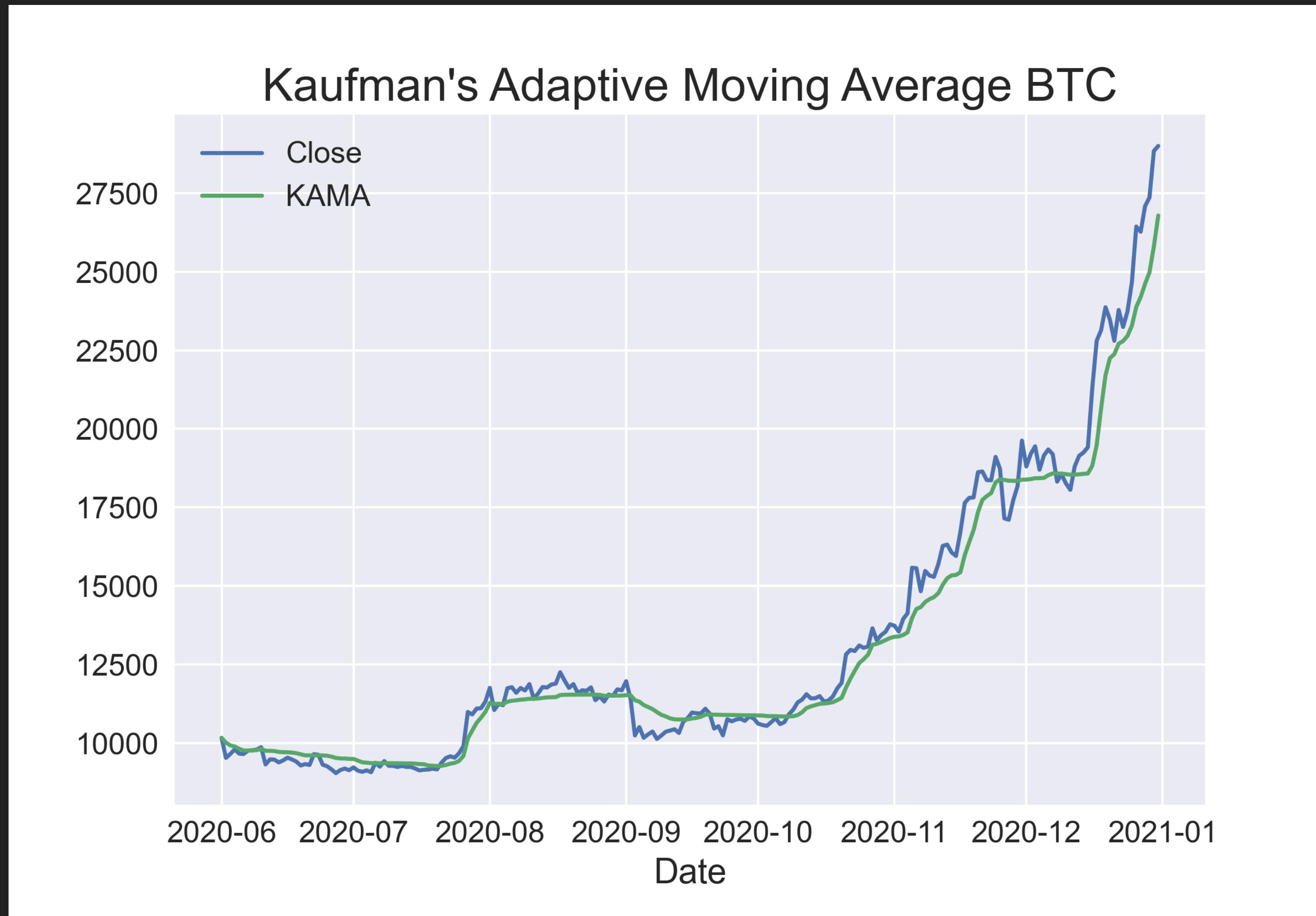
VOLATILITY SAMPLE



TREND SAMPLE



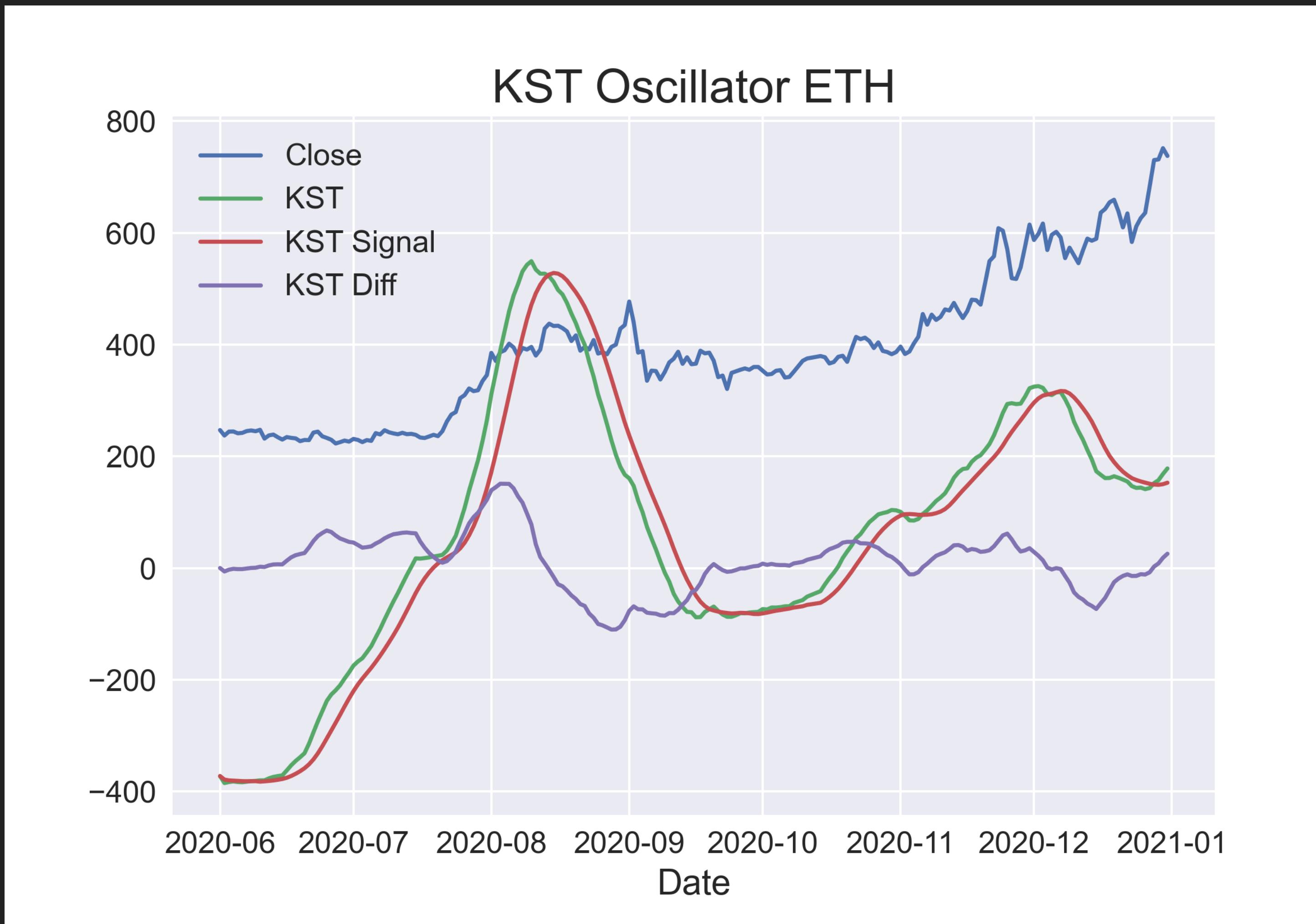
MOMENTUM SAMPLE



ANALYSIS

- ▶ Graph the available TA methods and evaluate their effectiveness based off analysis of the charts
- ▶ Proceeded to create combinations of these methods to examine their combined reliability

SAMPLE ANALYSIS: KST OSCILLATOR



- ▶ When KST crosses above signal line, that is a buy
- ▶ When KST crosses below signal line, that is a sell

RESULTS

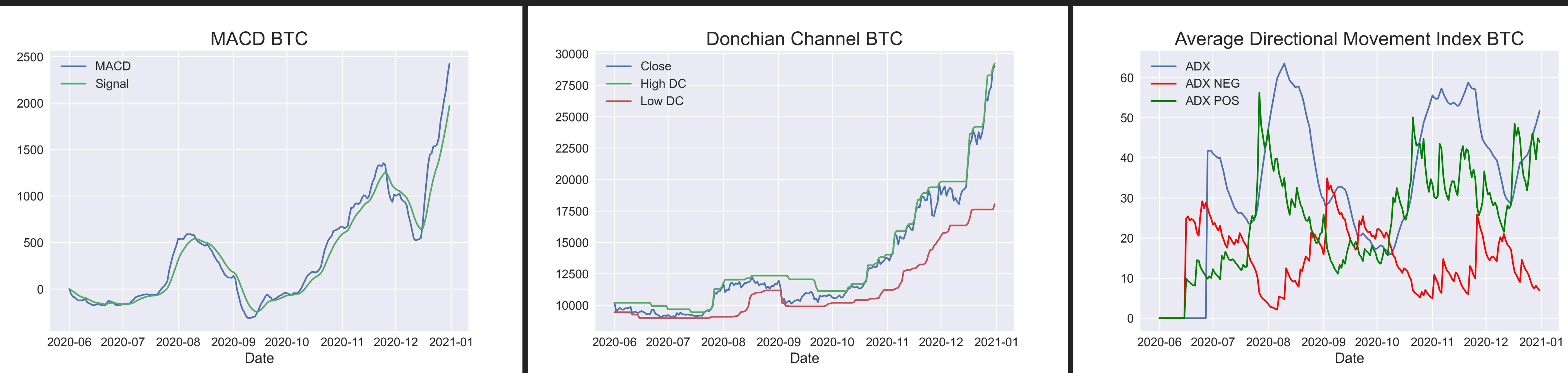
Indicator	Description	Rating
Bollinger Bands	If price breaks the lower band, this is a buy signal	Not Reliable
Keltner Channels	If price crosses under the lower band, this is a buy signal	Not Reliable
Donchian Channels	If price falls to the lower bound, this is a buy signal	Reliable
Ulcer Index	If there is a spike in the ulcer index, this is a sell signal	Reliable
Money Flow Index	If indicator is rising while price is falling, this is a buy signal	Not Reliable
Accumulation Distribution Index	If the line is rising, this confirms a price uptrend, and if the line is falling this confirms a downtrend	Not Reliable

Standalone Analysis

Combination	Description	Rating
RSI + OBV + Bollinger Bands	If price rises above the middle BB, and the RSI is above 50, and OBV is on a rise, this is a buy signal	Very Reliable
SMA + Stochastic Oscillator	If the price breaks the SMA line from under to above, and the green line of the SO crosses the blue line	Very Reliable
MACD + MFI	If the MFI is around 20 and MACD goes from near negative to positive, this is a buy signal	Very Reliable
Donchian Channels + MACD + ADX	If the ADX is above 30, and MACD crosses above the signal line, and there is a breakout at the upper Donchian Channel band, this is a buy signal.	Very Reliable

Combination Analysis

RESULTS: MACD + DONCHIAN CHANNEL + ADX COMBINATION



Donchian Channels +
MACD + ADX

If the ADX is above 30, and MACD crosses above the signal line, and there is a breakout at the upper Donchian Channel band, this is a buy signal.

Very Reliable

CONCLUSIONS

- ▶ Ethereum and Bitcoin behave EXTREMELY similarly in terms of price movement
- ▶ Many traditional TA methods that see success in the stock market can also see success in the cryptocurrency market:
 - ▶ 22 total reliable indicators
 - ▶ This is even amplified further when creating a combined indicator that incorporates multiple effective methods together
- ▶ Many false positives and a certain, almost guaranteed degree of randomness in a lot of charts, which affirms the extreme volatility of the cryptocurrency market
- ▶ 20 unreliable indicators

FUTURE WORK

- ▶ Development of new, cryptocurrency specific indicators as metrics
- ▶ Combine several unreliable methods to see if they can be made reliable

ACKNOWLEDGMENTS

- ▶ Special thanks to Professor Pranay Anchuri for helping me find inspiration for this project and supporting its development along the way
- ▶ Bitcoin dataset: <https://www.kaggle.com/mczielinski/bitcoin-historical-data>
- ▶ Ethereum dataset: <https://www.kaggle.com/varpit94/ethereum-data>
- ▶ Technical analysis library: <https://github.com/bukosabino/ta>
- ▶ Project GitHub Repository: <https://github.com/malqudah/Technical-Analysis-of-Cryptocurrencies>