

The background of the slide is a blurred image of a financial market data screen. It features various stock indices and their values, such as 'OMX COPENHAGEN 25 INDEX' with a value of 1172.94, 'OMX RIGA GI' with 984.13, and 'OMX18' with 27956.04. There are also line charts showing price fluctuations and 'Buy' or 'Sell' indicators. The overall color scheme is dark with blue and red highlights.

Algorithmic Trading Strategy for BTC- USD Market Zelta Labs (Mid-Prep)

A bit about Bitcoin Market

Bitcoin Overview:

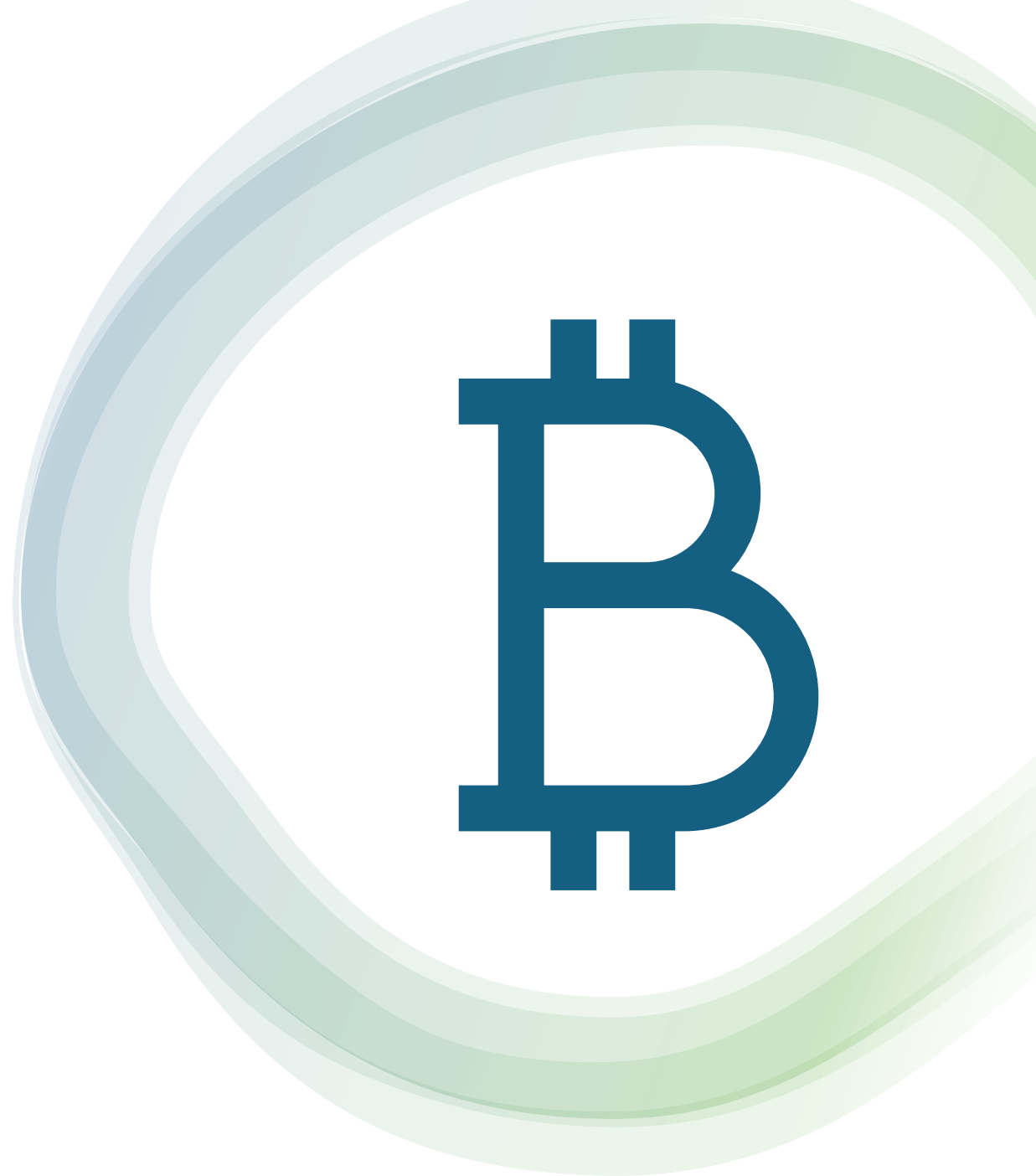
- **Launched:** 2009 by Satoshi Nakamoto.
- **Nature:** Decentralized digital currency with no central authority.
- **Blockchain Technology:** Secure, transparent, and immutable transactions.

Why Bitcoin is Important:

- **Market Leader:** Largest cryptocurrency by market capitalization.
- **High Volatility:** Known for significant price swings, offering trading opportunities.
- **Growing Adoption:** Institutional investors, hedge funds, and retail traders participate actively.

BTC/USDT Pair:

- **Liquidity:** BTC/USDT is the most traded cryptocurrency pair due to USDT's stable value.
- **Volatility:** Offers great potential for short- and long-term trading strategies.



Introduction to Algorithmic Trading

- Algorithmic trading involves the use of computer programs to automatically execute trades based on predetermined rules and market data. These algorithms analyze price, volume, and time to optimize trade execution and reduce human error.
- **BTC/USDT Pair:**
 - **High Liquidity:** Most traded stablecoin-crypto pair.
 - **Volatility:** Offers numerous trading opportunities.
 - **24/7 Market:** Always open, ideal for automated strategies.

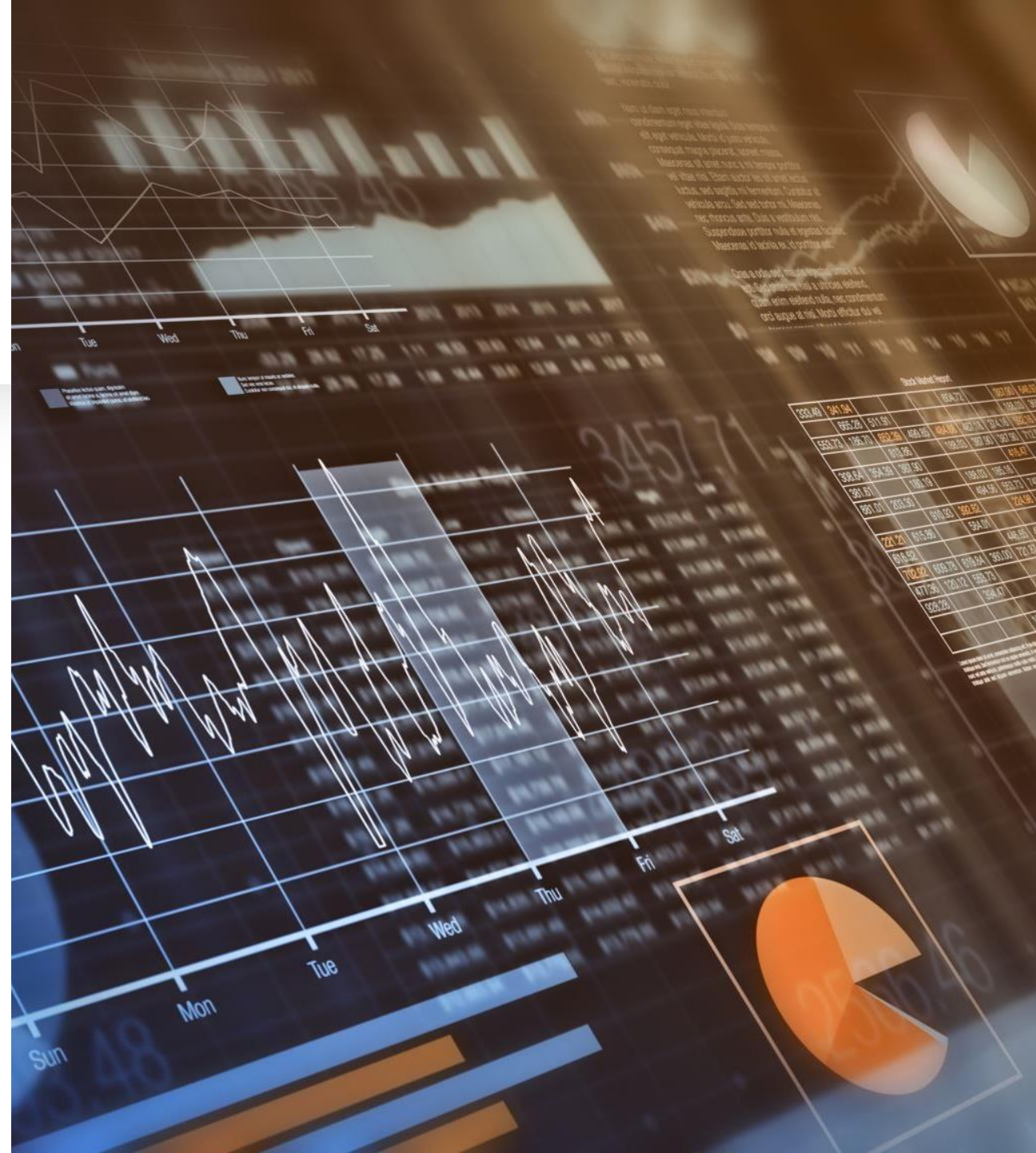


Trading Strategy Overview

Technical Indicators Implemented

We initially implemented over 50 technical indicators to identify which ones best fit our model for maximizing profits while minimizing risk. Using heat maps of correlation coefficients, we analyzed each pair of indicators within a particular category to determine their effectiveness.

- Trend Following
- Momentum Following
- Volume Following
- Volatility Following



Trend Following Indicators

These indicators help us to identify overall market direction in which the market is heading into.

Advantages:

1. Captures Large Price Movements
2. Reduces Emotional Trading

Disadvantages:

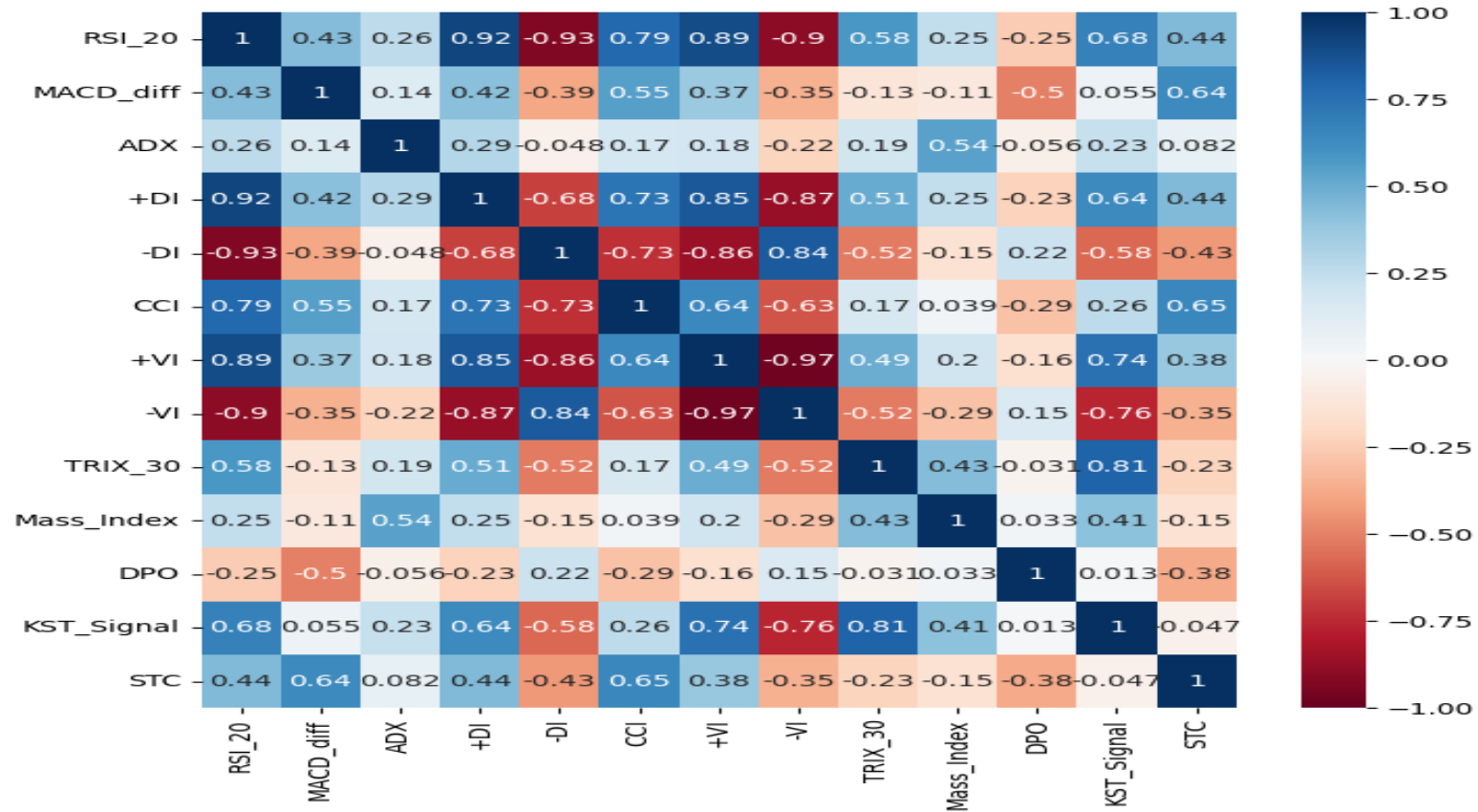
1. Lag in Entry and Exit
2. Can trigger false signals in sideways markets



MACD Graph



Trend Following Heat Map



Trend Following Shortlisted Indicators

Moving Average Convergence Divergence (MACD)

Average Directional Movement Index (ADX)

Trix (TRIX)

Mass Index (MI)

Detrended Price Oscillator (DPO)

Schaff Trend Cycle (STC)

Momentum Indicator

These indicators help us understand if a trend is gaining or losing strength hinting towards overbought or oversold conditions.

Advantages:

1. Detects Early Trend Reversals
2. Overbought/Oversold Signals

Disadvantages:

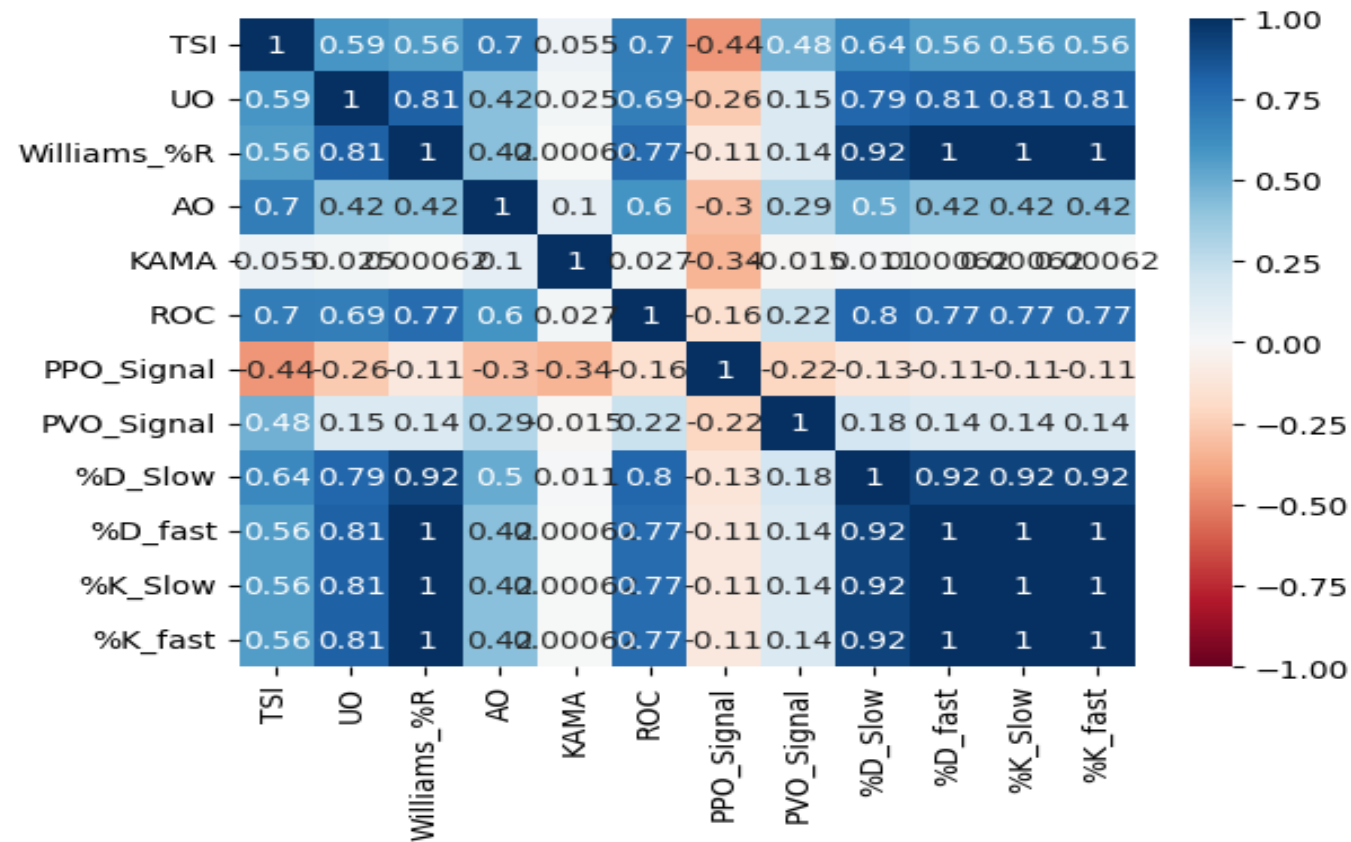
1. False Signals in Volatile Conditions
2. Limited in Sideways Markets

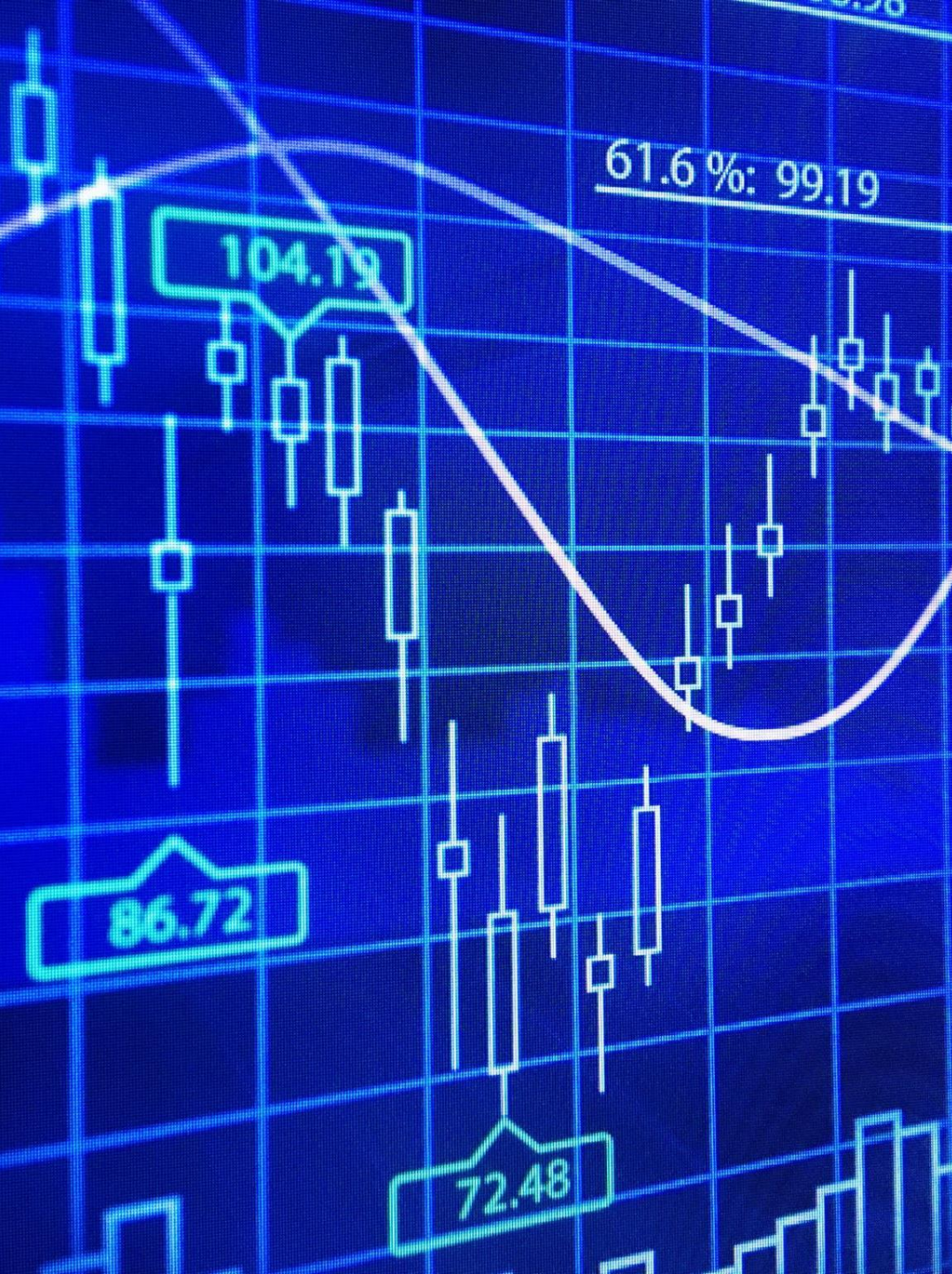


Relative Strength Index



Momentum Indicators Heat Map





Momentum Shortlisted Indicators

Relative Strength Index (RSI)

True strength index (TSI)

Ultimate Oscillator (UO)

Awesome Oscillator (AO)

Percentage Price Oscillator (PPO)

Percentage Volume Oscillator (PVO)

Volume Following Indicators

These indicators measure the volume of trading happening on the asset over a certain period.

Advantages:

1. Confirms Price Movements
2. Identifies Breakouts

Disadvantages:

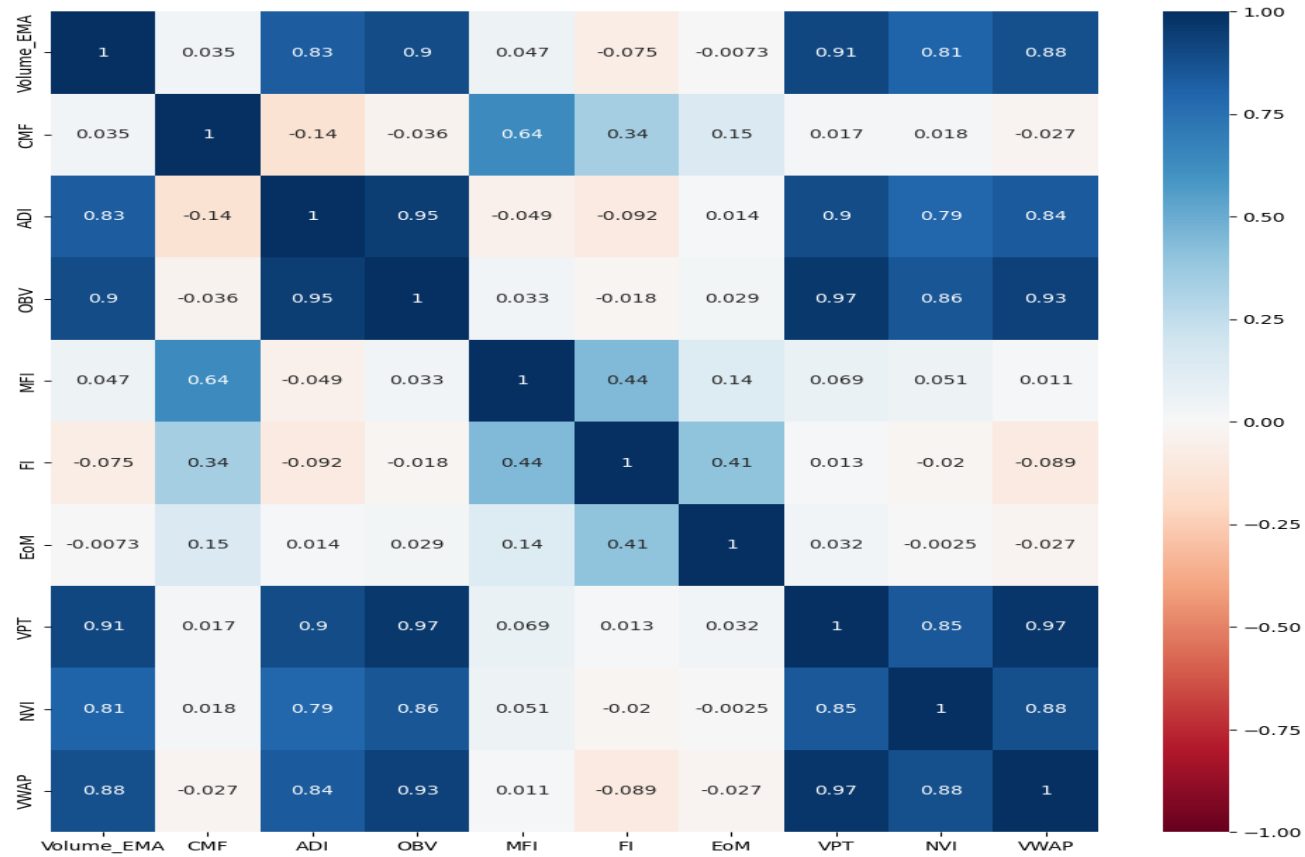
1. Volume Spikes Can Signal Market Manipulation
2. Delayed Signals



Money Flow Index Graph

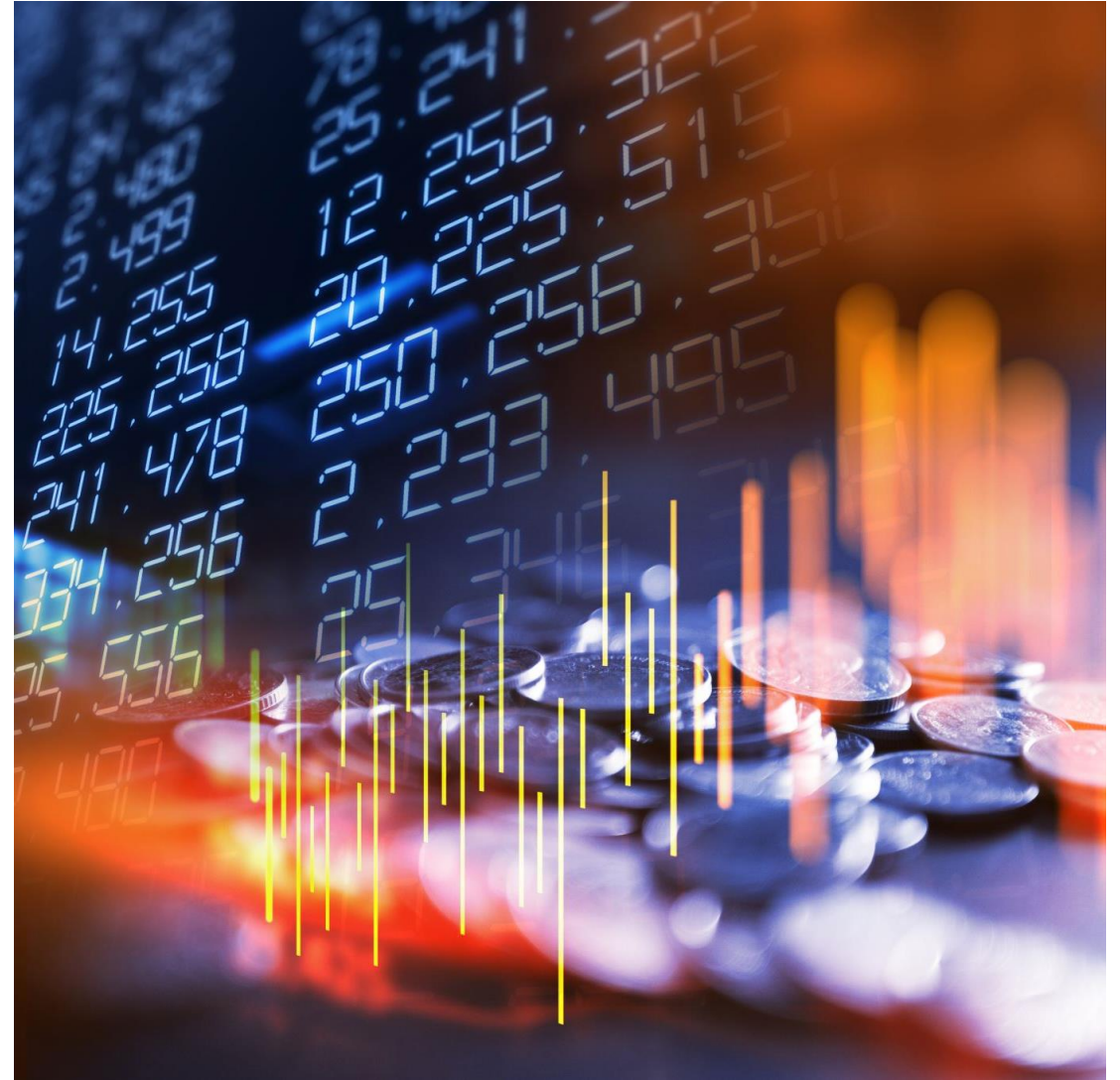


Volume Following Indicators Heat Map



Volume Following Shortlisted Indicators

- Money Flow Index (MFI)
- Chaikin Money Flow (CMF)
- Force Index (FI)
- Ease of Movement (EoM, EMV)



Volatility Indicators

These indicators measure the degree of price fluctuations on an asset over a specific period.

- Ulcer Index
- Coefficient of Variance

Advantages:

- Risk Assessment
- Identifies Breakout Opportunities

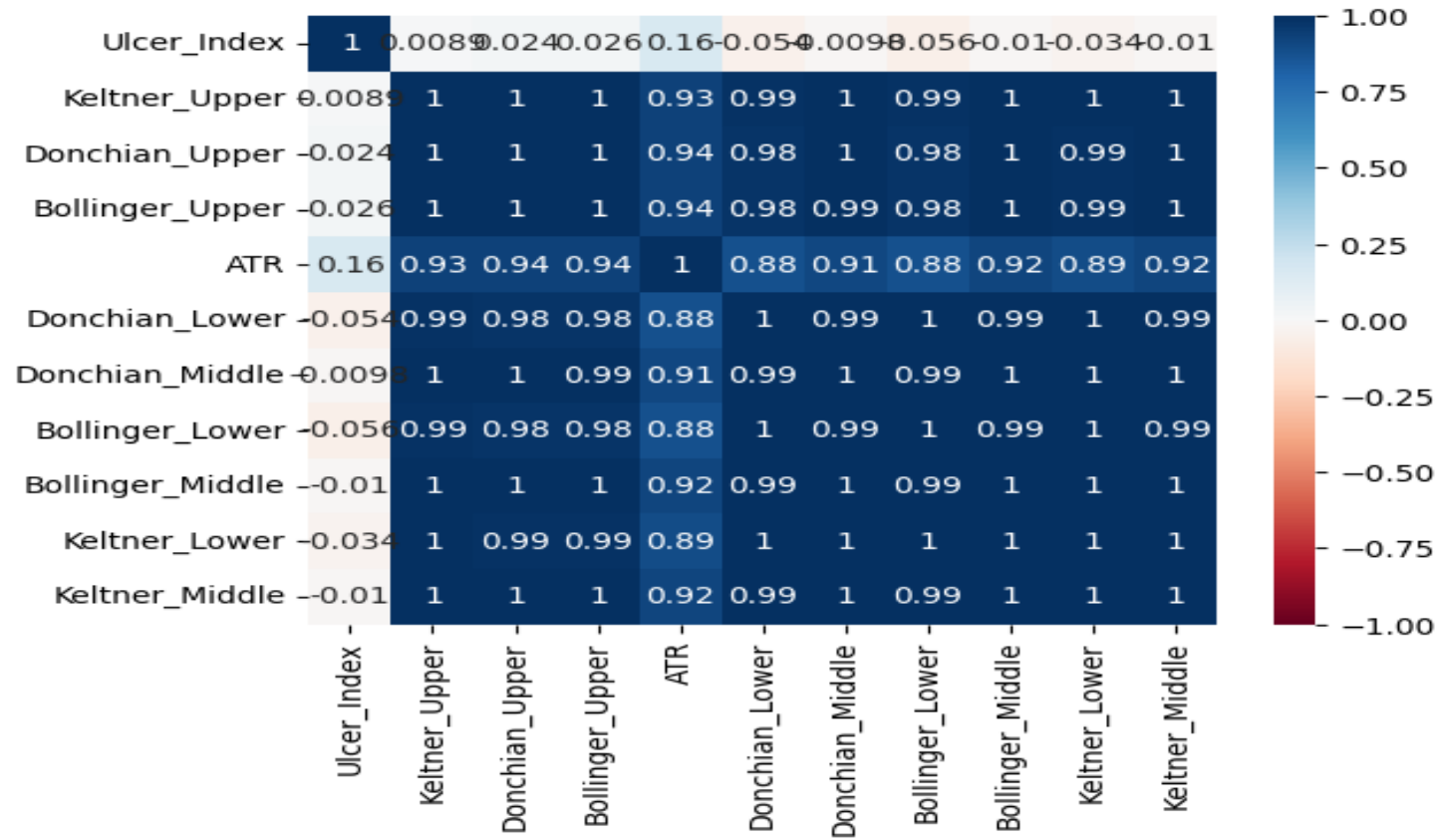
Disadvantages:

- False Signals in Low Volatility
- Difficult to Interpret Entry or Exit Positions Effectively

Bollinger Bands



Volatility Indicators Heat Map



How to set target value for model

- Here we have used the indicators as the features for the machine learning model .
- The target value is either 0 or 1 depending on whether next day's returns are negative / positive respectively.

IMPLEMENTATION OF XGBOOST MODEL

- Xgboost is a boosted tree strategy which uses an ensemble of improved trees to make predictions.
- There are two types of XGBoost models -
 - 1.XGBClassifier - We use this for classification task. Here we choose one of the two trade calls i.e short or long and hence the classifier model is used.
 - 2.XGBRegressor - We use this for regression task . Here we predict a value based on the features . We will use this in the later part to minimize maximum drawdown and realted risk.

How do Boosted Tree Models work?

- Decision tree: The model creates various splits at each node depending on factors like the information gain i.e how much imbalance of classes does a split decrease.
- Random forest- It is an upgraded version of the decision tree which uses sampling by replacement to create multiple trees and then takes an ensemble of these trees based on amount of say.
- XGBoost : It is a type of random forest model which constantly improves the decision trees in the ensemble to optimize the ensemble .

Hyper-parameter Tuning

- XGBoost has various hyper-parameters which needs to configured externally by the programmer . These specify the structure of each tree , the ensemble size , the sampling size , the learning rate and regularization coefficients to avoid overfitting.
- We have used BayesSearchCV for hyperparameter tuning , which tunes based on distribution of the hyperparameter and selects the values that optimizes the results in the best manner.

Rationale for Strategy Selection

We have used this strategy for a variety of purposes including -

- XGboost is very efficient in dealing with missing values.
- XGboost has innate hyperparameters to deal with overfitting.
- XGBoost is very efficient in finding both linear and non-linear relationships in the data and can effectively model something as complex as the cryptocurrency markets.
- The long-short strategy is more efficient (yet riskier) since we can earn returns on each day unlike a long- only strategy.

Backtesting Overview

- **Testing Period:** 1 Jan 2023 to 14 Oct 2024
- **Data Used:** 1 day BTC/USDT price data

This data includes price(Open, High, Low, Close), Volume and Market Cap(Valuation)

- XGBoost model has made significant gains on backtesting data despite overfitting the train set . This is common and is expected of an efficient method such as XGBoost.

Backtesting Results

- **Annual Returns:** 74%
- **Cumulative Returns:** 320% over 649 days
- **Annualised Sharpe Ratio:** 1.94
- **Win Ratio:** 53% wins
- **Max Drawdown:** 32%

Risk Management Approach

- In the original model , the maximum drawdown is 32% which is repulsive for risk averse investor therefore we have devised an alternate approach for such investors using assuming that log-returns follow student t's distribution .
- Here instead of choosing a pure long-short trade , investor chooses a long-short split which minimizes returns but also reduces related risk.

Student t's distribution

- We have proved that a random sample of size 38 follows t-distribution more closely than normal distribution
- The p_value is the ratio of the number of random samples of optimal sample size(found using ks test) that follows t-distribution more closely than normal distribution .
- P_value=0.94 for our data.

We use an XGBoost regressor model with tuned hyperparameter , with indicators as features and the next day's returns as target.

Such a model outputs a value instead of a trade call , based on this value we make a long-short split investment .

We divided the predicted log-returns value with the probability distribution function , the logic of which is explained in the report.

Such an approach will punish abnormal predicted results since there corresponding pdf will be smaller and hence the product lower.

We input this in the sigmoid function with $w=5$ (chosen by taking various other values)

Making Predictions and trade calls

- $\text{Sigmoid}(x) = 1 / (1 + e^{-wx})$
- Such a model will not make any call when expected returns(x) = 0 since model is invariant and sigmoid gives a 0.5 value i.e equal split between long and short
- On other values on expected returns(x) we get a long-short split and we compute results based on the returns of this split

Conclusion

- The strategy developed for the BTC/USDT market offers a robust and balanced approach leveraging the volatility and liquidity of Bitcoin. By combining various technical indicators and incorporating risk management practices, this strategy is well-suited for the dynamic and fast-paced nature of cryptocurrency markets.

Thank You!