



# CRYPTO TRADING CHALLENGE

**PROBLEM STATEMENT:**ALGORITHMIC  
TRADING STRATEGY DEVELOPMENT FOR  
BTC/USDT CRYPTO MARKET.

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# 1.Introduction

## **Problem description**

The problem consists of developing algorithmic trading strategies for the BTC/USDT cryptocurrency market, aiming to outperform benchmark(buy and hold) returns. Participants are required to create trading algorithms that can generate returns while managing risk effectively in the specific BTC/USDT market.

## 2. Methodology

### **Data Preparation**

The analysis was performed on BTC/USD hourly/30 min/15 min OHLCV data (O: Open, H: High, C: Close, V: Volume). We filter out rows with zero volume to avoid meaningless data points.

Next, we check for any NaN values, and remove all such occurrences. Also, we make a list of our time series data, namely, the open, high, low and close prices.

### **Trading Logic and associated functions**

The Strategy is to find the local maxima and minima of btc/usdt close prices and to label them as the pivot points. The way we do this is : we find the candle whose high price is highest among the high prices of a specific number of past candles (Back Candles) and the high of the same number of future(predicted) candles (Forward Candles) and short.

### ***Shorting Condition :***

Current High Price > High prices of n past candles and  
Current High Price > High prices of n future(predicted) candles

Similarly when we find that the current low price is the lowest among 10 past candles and 10 future(predicted) candles, we buy.

### ***Buying Condition :***

Current Low Price < Low prices of n past candles and  
Current Low Price < Low prices of n future(predicted) candles

### ***Motivation for the strategy***

If the current price is found to be the highest high or lowest low among a specific range of candles, we can make profit by going long/short on meeting these conditions, and since we'll remain in trade only when the condition is met, and stop loss or take profit is not triggered, we have efficient risk management along with profit generation.

For predicting future prices, we performed some statistical tests on the data and found that it was non stationary (Dickey - Fuller test), and we decomposed the data into its trend, seasonal and error components, and found that the data had seasonal component. We identified the parameters p, d, and q for an ARIMA model by defining a function that determined d by measuring stationarity of the data and kept differencing it unless it was proven stationary by ADF test. Similarly we found the values of p and q by determining the number of lags that was higher than the significant level. The root mean squared error of the predicted values were low and the predicted data matched with the actual one to a high degree.

## Backtesting of the Strategy

Backtesting was performed with the help of Backtesting.py module.

The two main statistics that were used to evaluate the performances of our strategy:

- Sharpe Ratio:- The definition used in this was:

$$\text{Sharpe ratio} = \frac{\text{mean daily returns}}{\text{annualized volatility}}$$

where annualized volatility is defined by annualized volatility = standard deviation of daily return  $\cdot \sqrt{365}$

- Sortino Ratio:- The definition used in this was:

$$\text{Sortino ratio} = \frac{\text{Average excess return}}{\text{Downside deviation}}$$

1. Average excess return: The average return above the risk-free rate over a specific period.
2. Downside deviation: The standard deviation of only the negative returns over the same period.

Other statistics that were asked in the PS to analyze and improve the strategies were:

1. Gross Profit
2. Net Profit
3. Total Closed Trades
4. Win Rate (Profitability %)
5. Max Drawdown
6. Gross Loss
7. Average Winning Trade (in USDT)
8. Average Losing Trade (in USDT)
9. Buy and Hold Return of BTC
10. Largest Losing Trade (in USDT)
11. Largest Winning Trade (in USDT)
12. Sharpe Ratio
13. Sortino Ratio
14. Average Holding Duration per Trade

## Improving the Strategy

- **Stoploss:** The stop-loss applied here is 3% which means a person cannot lose more than 3% of their applied capital in a trade

**$\text{Last candle(close)} - 0.03 * \text{last candle(close)}$**

- **Take Profit:** The Take Profit is set to be 1.5 times the difference between the SL level and the Close price of the candle

**Last candle close-[abs{SL-Last candle(Close)}]\*1.5**

**Fig-1:** Plot for the **1st Strategy** here pink circles is the pivot points i.e. the entry points for the trade





# 3. Result

## Long Short Strategy

The Pseudo codes for the following are given below.

### Long

<pre>i f "n" no. of back candles below and "n" no. of front candles below :     long  i f Stoploss hits or take profit hits:     c lose</pre>	-
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### Short

<pre>i f "n" no. of back candles above and "n" no. of front candles above :     Short  i f Stoploss hits or take profit hits:     c lose</pre>	-
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The strategy results shown below are tested on three different values of n=5/10/15.

**n=5**

Table Showing Metrics for the 1st Long short strategy	
Start	01-01-2018 6:30
End	12-01-2022 5:30
Duration	1471 days 23:00:00
Exposure Time [%]	79.96591
Equity Final [\$]	185760.7
Equity Peak [\$]	192775
Return [%]	18476.07
Buy & Hold Return [%]	223.2205
Return (Ann.) [%]	261.8549
Volatility (Ann.) [%]	215.6844
Sharpe Ratio	1.214065
Sortino Ratio	8.186589
Calmar Ratio	5.09053
Max. Drawdown [%]	-51.4396
Avg. Drawdown [%]	-2.76884
Max. Drawdown Duration	292 days 08:00:00
Avg. Drawdown Duration	4 days 06:00:00
# Trades	854
Win Rate [%]	51.75644
Best Trade [%]	4.423327
Worst Trade [%]	-3.36105
Avg. Trade [%]	0.613639
Max. Trade Duration	16 days 22:00:00
Avg. Trade Duration	1 days 09:00:00
Profit Factor	1.442745

**n=10**

Table Showing Metrics for the 1st Long short strategy	
Start	01-01-2018 6:30
End	12-01-2022 5:30
Duration	1471 days 23:00:00
Exposure Time [%]	67.47905127
Equity Final [\$]	7622284.591
Equity Peak [\$]	8306387.052
Return [%]	762128.4591
Buy & Hold Return [%]	223.2205262
Return (Ann.) [%]	817.8864584
Volatility (Ann.) [%]	476.7444667
Sharpe Ratio	1.715565707
Sortino Ratio	31.8543237
Calmar Ratio	27.58283396
Max. Drawdown [%]	-29.65200963
Avg. Drawdown [%]	-1.770389627
Max. Drawdown Duration	121 days 11:00:00
Avg. Drawdown Duration	1 days 21:00:00
# Trades	623
Win Rate [%]	62.76083467
Best Trade [%]	4.423326893
Worst Trade [%]	-3.274666667
Avg. Trade [%]	1.446093594
Max. Trade Duration	16 days 22:00:00
Avg. Trade Duration	1 days 14:00:00
Profit Factor	2.270490094

n=15

Table Showing Metrics for the 1st Long short strateg	
Start	01-01-2018 06:30
End	12-01-2022 05:30
Duration	1471 days 23:00:00
Exposure Time [%]	57.8241727
Equity Final [\$]	9929118.543
Equity Peak [\$]	9929118.543
Return [%]	992811.8543
Buy & Hold Return [%]	223.2205262
Return (Ann.) [%]	878.1578936
Volatility (Ann.) [%]	452.8427803
Sharpe Ratio	1.939211426
Sortino Ratio	38.49999299
Calmar Ratio	28.97868776
Max. Drawdown [%]	-30.30357692
Avg. Drawdown [%]	-1.548409199
Max. Drawdown Duration	120 days 18:00:00
Avg. Drawdown Duration	1 days 14:00:00
# Trades	486
Win Rate [%]	68.93004115
Best Trade [%]	4.416794552
Worst Trade [%]	-3.246912441
Avg. Trade [%]	1.912767807
Max. Trade Duration	16 days 22:00:00
Avg. Trade Duration	1 days 17:00:00

***Here we reduced the drawdown by minimizing the exposure to our capital by 6% as the above results have 10% capital exposure***

**n=15, and Exposure to wallet=6% i.e. trading with 6% of initial capital**

	0
Start	01-01-2018 06:30
End	12-01-2022 05:30
Duration	1471 days 23:00:00
Exposure Time [%]	57.8241727
Equity Final [\$]	274611.3354
Equity Peak [\$]	274611.3354
Return [%]	27361.13354
Buy & Hold Return [%]	223.2205262
Return (Ann.) [%]	302.0674094
Volatility (Ann.) [%]	108.5027997
Sharpe Ratio	2.783959587
Sortino Ratio	21.98735265
Calmar Ratio	15.63990398
Max. Drawdown [%]	-19.31389155
Avg. Drawdown [%]	-0.941792915
Max. Drawdown Duration	120 days 05:00:00
Avg. Drawdown Duration	1 days 14:00:00
# Trades	486
Win Rate [%]	68.93004115
Best Trade [%]	4.416794552
Worst Trade [%]	-3.246912441
Avg. Trade [%]	1.912767807
Max. Trade Duration	16 days 22:00:00
Avg. Trade Duration	1 days 17:00:00

One of the Questions that left unanswered what strategy we tested before this : It was a technical Analysis based strategy it was giving good returns but have a huge drawdown percentage.

	0
Start	0
End	70194
Duration	70194
Exposure Time [%]	0.081202
Equity Final [\$]	17769.21
Equity Peak [\$]	17769.21
Return [%]	1676.921
Buy & Hold Return [%]	188.5252
Return (Ann.) [%]	0
Calmar Ratio	0
Max. Drawdown [%]	-40.923
Avg. Drawdown [%]	-6.56097
Max. Drawdown Duration	11924
Avg. Drawdown Duration	1950.909
# Trades	15
Win Rate [%]	100
Best Trade [%]	9.696154
Worst Trade [%]	0.282049
Avg. Trade [%]	2.507546
Max. Trade Duration	5
Avg. Trade Duration	2.8
Profit Factor	