Universe Selection

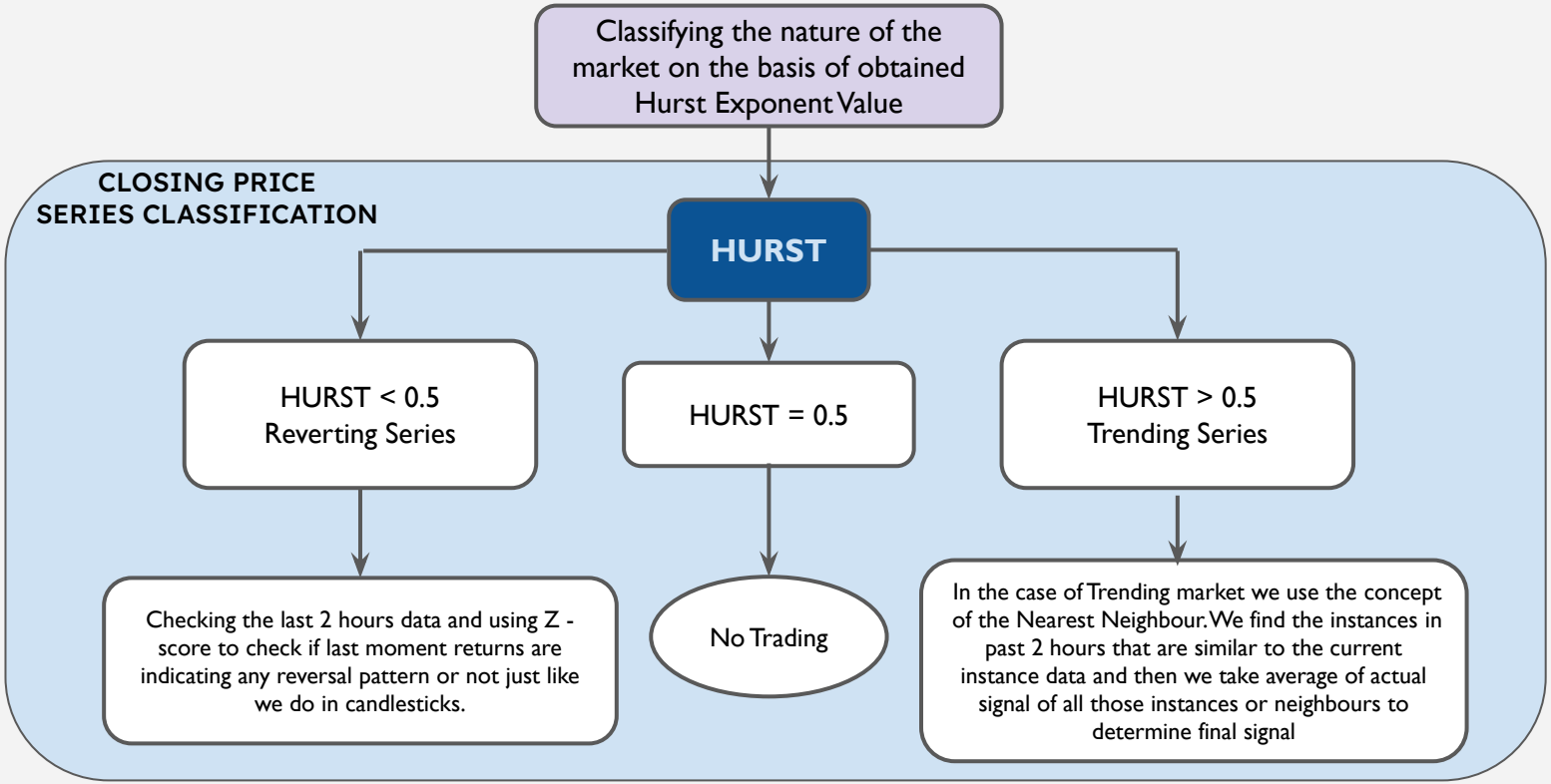
Universe - BANK NIFTY Futures

- Bank Nifty has shown all types of trends in the past five years, thus ample diversity.
- The stocks of this index have been prominent constituents of most traded stocks in the past few years.
- Banks are closest to the economy and thus have very high importance.
- These stocks are very liquid and have seen high trade volumes, thus comparatively lower slippage.

STRATEGY

- First evaluate the Hurst Exponent, in order to account for the **nature of the market.**

- The Hurst Exponent is used as a measure of **long-term memory of time series**. It quantifies the relative tendency of a time series either to regress strongly to the mean or to cluster in a direction. The threshold used for classifying time series as Pure Random Walk or Mean-Reverting or Trending is H = 0.5 (conventional).


Classifying the nature of the market on the basis of obtained Hurst Exponent Value
CLOSING PRICE SERIES CLASSIFICATION
HURST
HURST < 0.5 Reverting Series
HURST = 0.5
HURST > 0.5 Trending Series
Checking the last 2 hours data and using Z - score to check if last moment returns are indicating any reversal pattern or not just like we do in candlesticks.
No Trading
In the case of Trending market we use the concept of the Nearest Neighbour. We find the instances in past 2 hours that are similar to the current instance data and then we take average of actual signal of all those instances or neighbours to determine final signal

HURST EXPONENT

The Hurst Exponent Calculation is used to asses the **Rate of Diffusive Behaviour** by the Variance of a Log Price Series. For an arbitrary time lag $\boldsymbol{\tau}$, the variance is given by -

$$\mathrm{Var}(\tau) = \langle |\log(t+\tau) - \log(t)|^2 \rangle$$

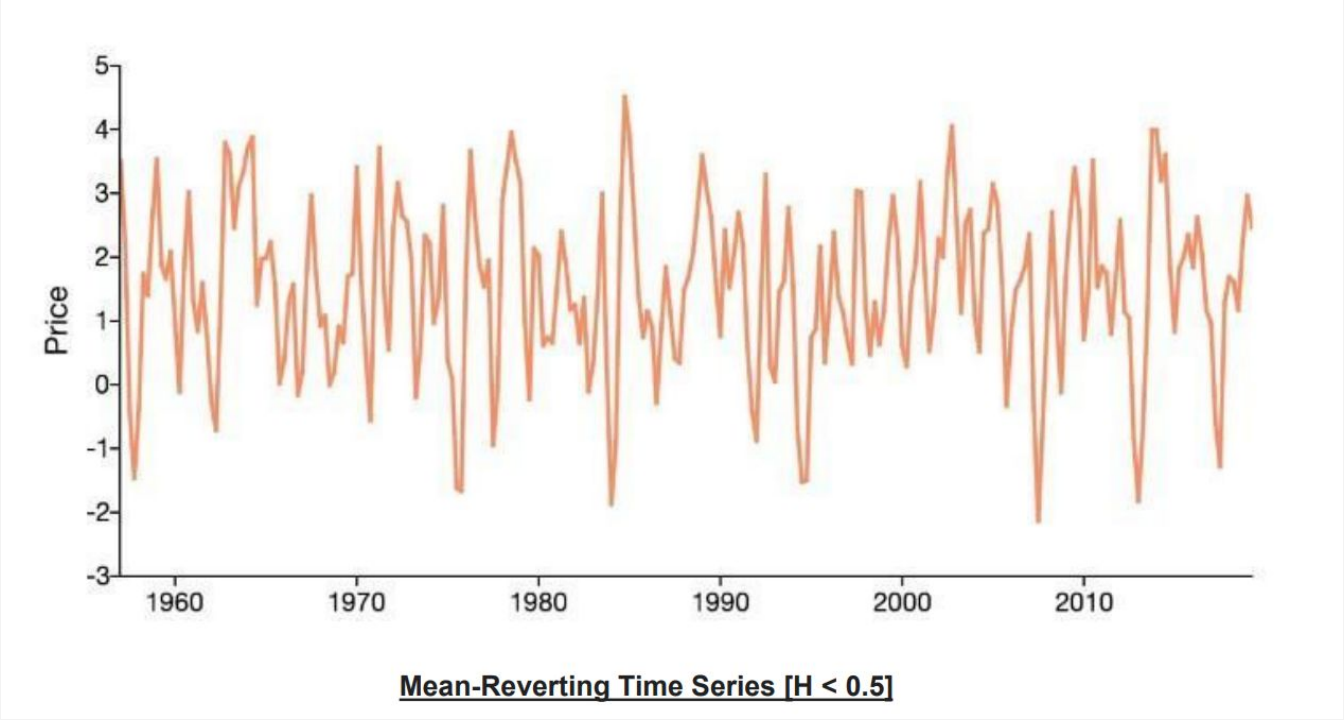
In case of a random walk, variance of log of price series is linearly related to the time lag.

Hurst Exponent Value H :

$$\langle |\log(t+\tau) - \log(t)|^2 \rangle \sim \tau^{2H}$$

If Hurst Exponent < 0.5, consider the series to be Reverting

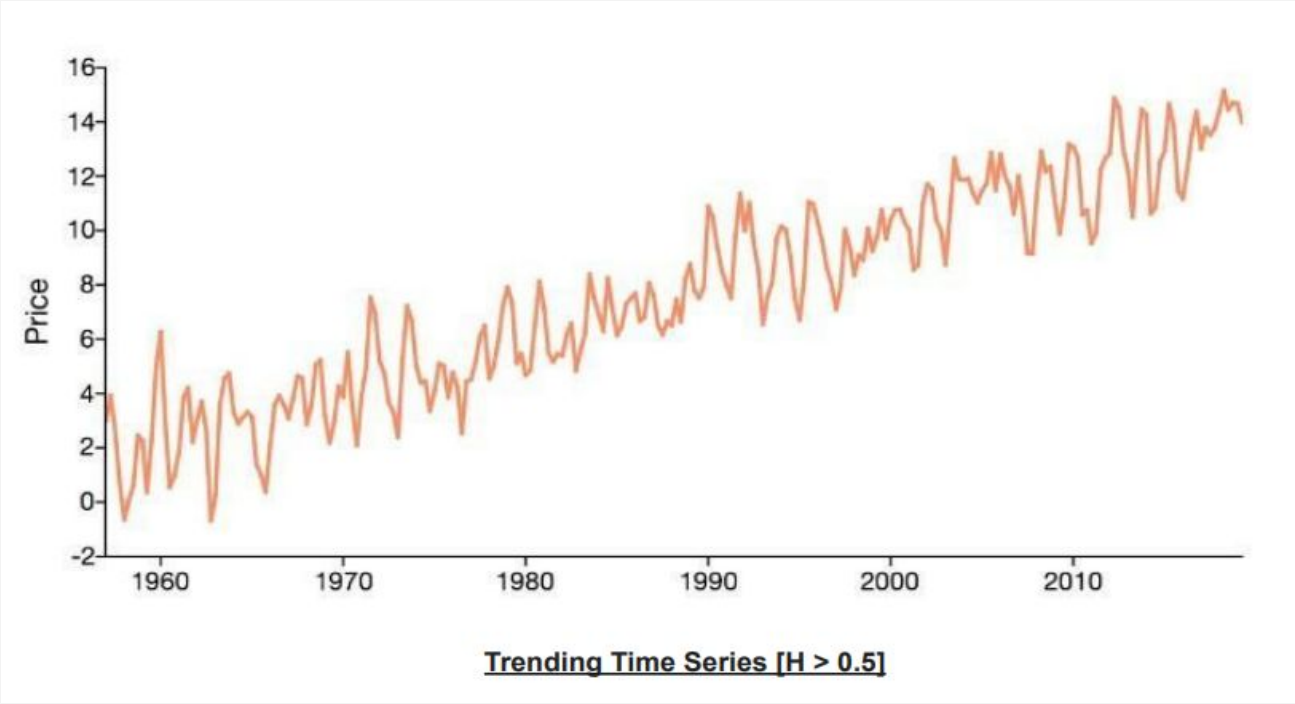
The time series is considered as **Mean-Reverting**. If the series was following a bullish trend, then the direction is going to revert, thus we are going to enter a short position, else we are going to take a long position.



Mean-Reverting Time Series [H < 0.5]

If Hurst Exponent > 0.5, consider the series to be Trending

The time series is considered **Trending** in nature. If the closing price was following a bullish trend, we are going to take a long position, else if there was a bearish trend, we are going to take a short position.

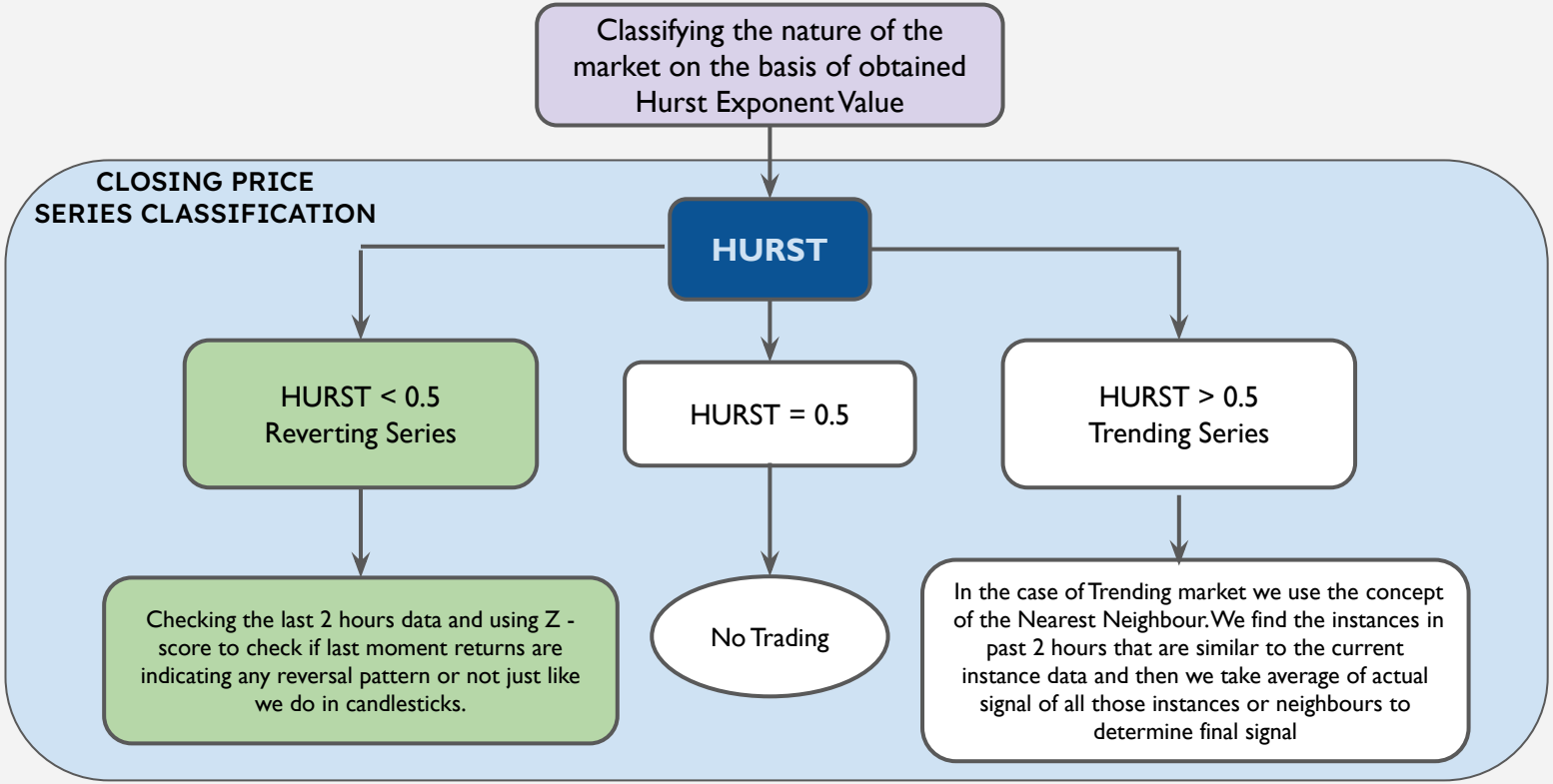


If Hurst Exponent is equal to 0.5

The closing price movement is **Pure Random Walk** or following **Geometric Brownian Motion** and thus the market remains indecisive. We are not going to take any position in such a scenario.

Random Walk Time Series [H = 0.5 (approx.)]

Reverting Series



Reverting Series

We apply a reverting strategy based on the behavior of candlesticks, that trades on outliers, that is - If we get excessively high returns in the last 2-3 minutes as compared to the minute wise return in the last 30-60 minutes, then we **short** our position.

Reverting Series

We apply a reverting strategy based on the behavior of candlesticks, that trades on outliers, that is - If we get excessively low returns in the last 2-3 minutes as compared to the minute wise return in the last 30-60 minutes, then we **long** our position.

Z-Score Slowdown Hypothesis

Z - Score > 2

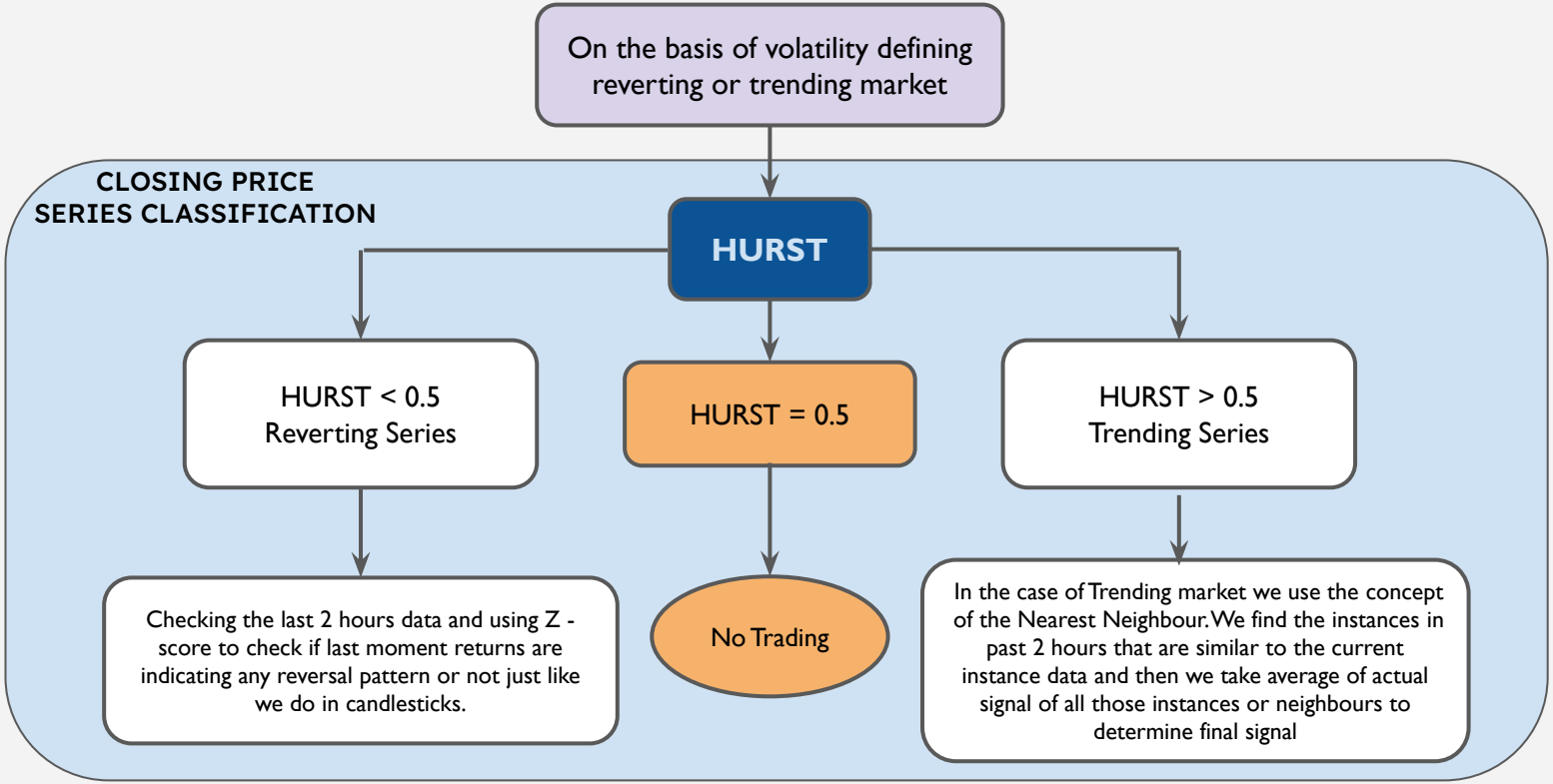
If we get excessively high returns in the last 2-3 minutes as compared to the minute wise return in the last 30-60 minutes, then we **short** our position.

Z - Score < -2

If we get very low returns in last 2-3 minutes as compared to the minute wise return in the last 30-60 minutes, then we **long** our position

- Return = **[Close - Open]** (minute wise)
- Z-score = (Return - Rolling mean of Return (last 40 minutes)) / standard_deviation of Return for last 40 minutes
- Slowdown = **[Mean of Z-score]** (last 3 minutes)
- Signal = **[-Slowdown]**

HURST = 0.5


On the basis of volatility defining reverting or trending market
CLOSING PRICE SERIES CLASSIFICATION
HURST
HURST < 0.5 Reverting Series
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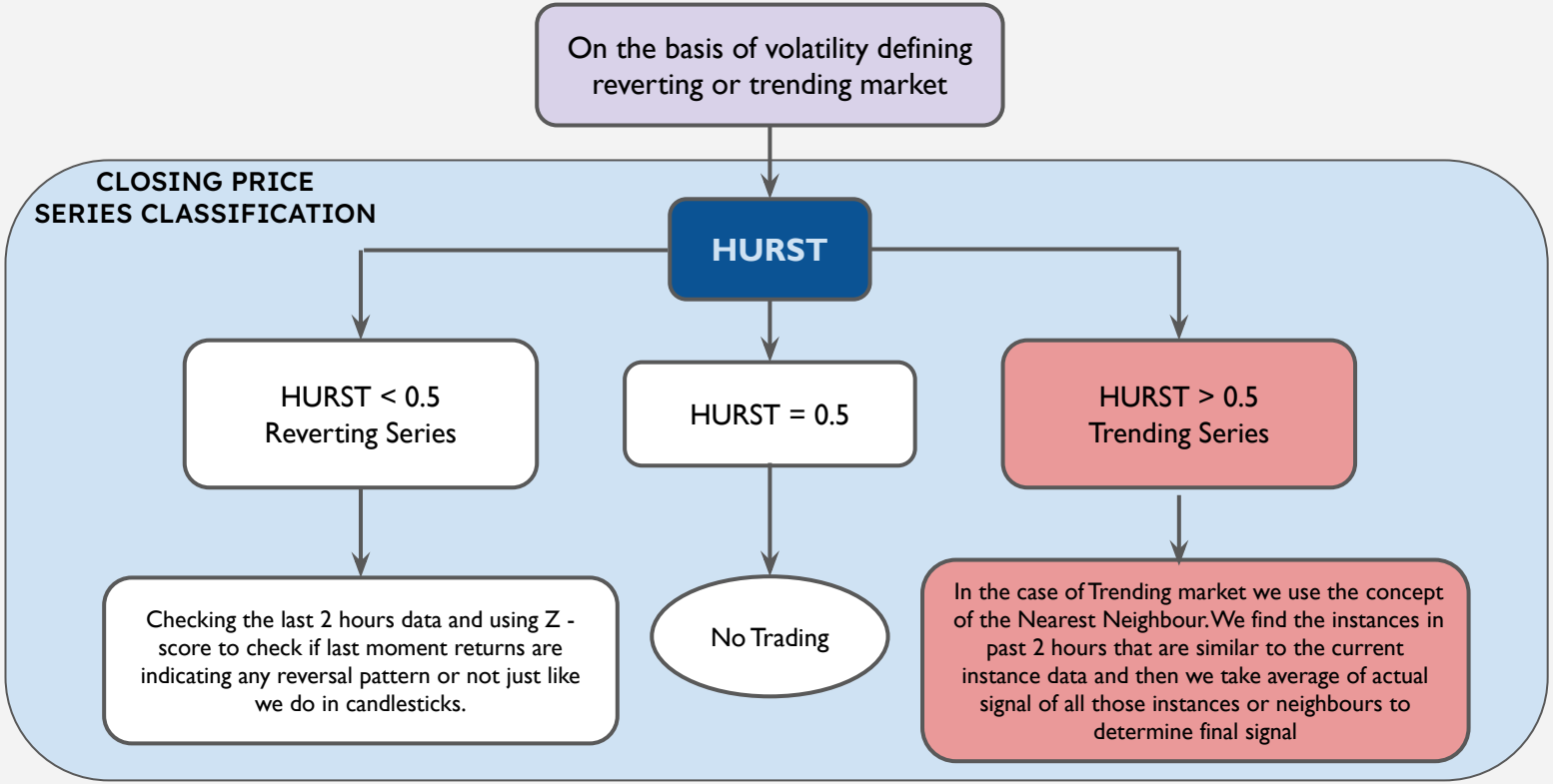
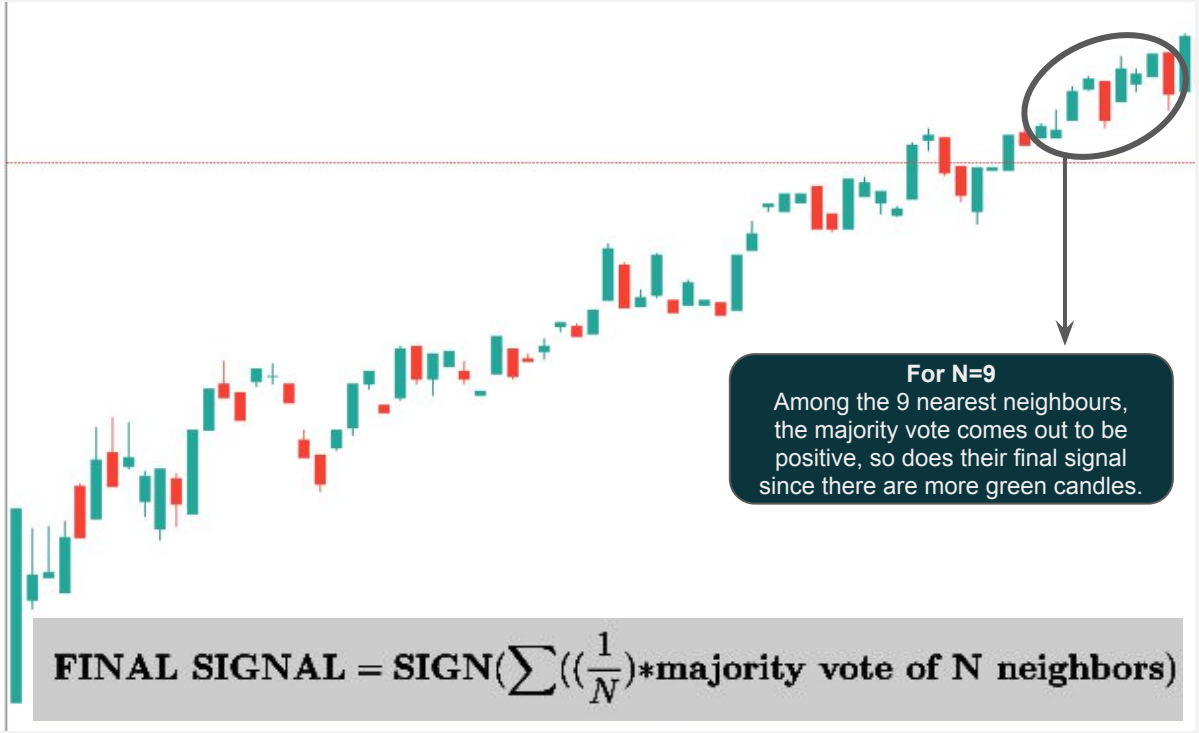
No Trading
In the case of Trending market we use the concept of the Nearest Neighbour. We find the instances in past 2 hours that are similar to the current instance data and then we take average of actual signal of all those instances or neighbours to determine final signal

Trending Series



Nearest Neighbour (NN) Algorithm

The nearest candles on the basis of **Euclidean distance** is taken and the **cumulative sum of vote** of these candles is taken. The **sign** of the cumulative sum is eventually taken as the signal.



Derivatives introduced are -

F1= **Rolling mean of [High-Low]**

F2= **Rolling mean of [Open-Close]**

Trending Series

- The algorithm has been used to trade in trendy market conditions (Hurst > 0.5) since the nearest candles give better indications of the existing trend in the market.
- The parameters used to find the related candles are **F1, F2, Z-Score, Close and On-Balance Volume(OBV),** where F1, F2, OBV are all derivatives of OHLCV.
- Derivatives are used as parameters because they are **comparatively less correlated.**

$$\mathrm{OBV} = \mathrm{OBV}_{prev} + \begin{cases} \mathrm{volume}, & \text{if close} > \mathrm{close}_{prev} \\ 0, & \text{if close} = \mathrm{close}_{prev} \\ -\mathrm{volume}, & \text{if close} < \mathrm{close}_{prev} \end{cases}$$

where:

OBV = Current on-balance volume level

OBV_{prev} = Previous on-balance volume level

volume = Latest trading volume amount

Risk Management

Portfolio Sizing

Parameter tuning to balance a ratio between Returns & Drawdown.

Average True Range (ATR)

Average True Range (ATR) is the average of true ranges over the specified period. ATR measures volatility, taking into account any gaps in the price movement. Typically, the ATR calculation is based on 14 periods, which can be intraday, daily, weekly, or monthly.

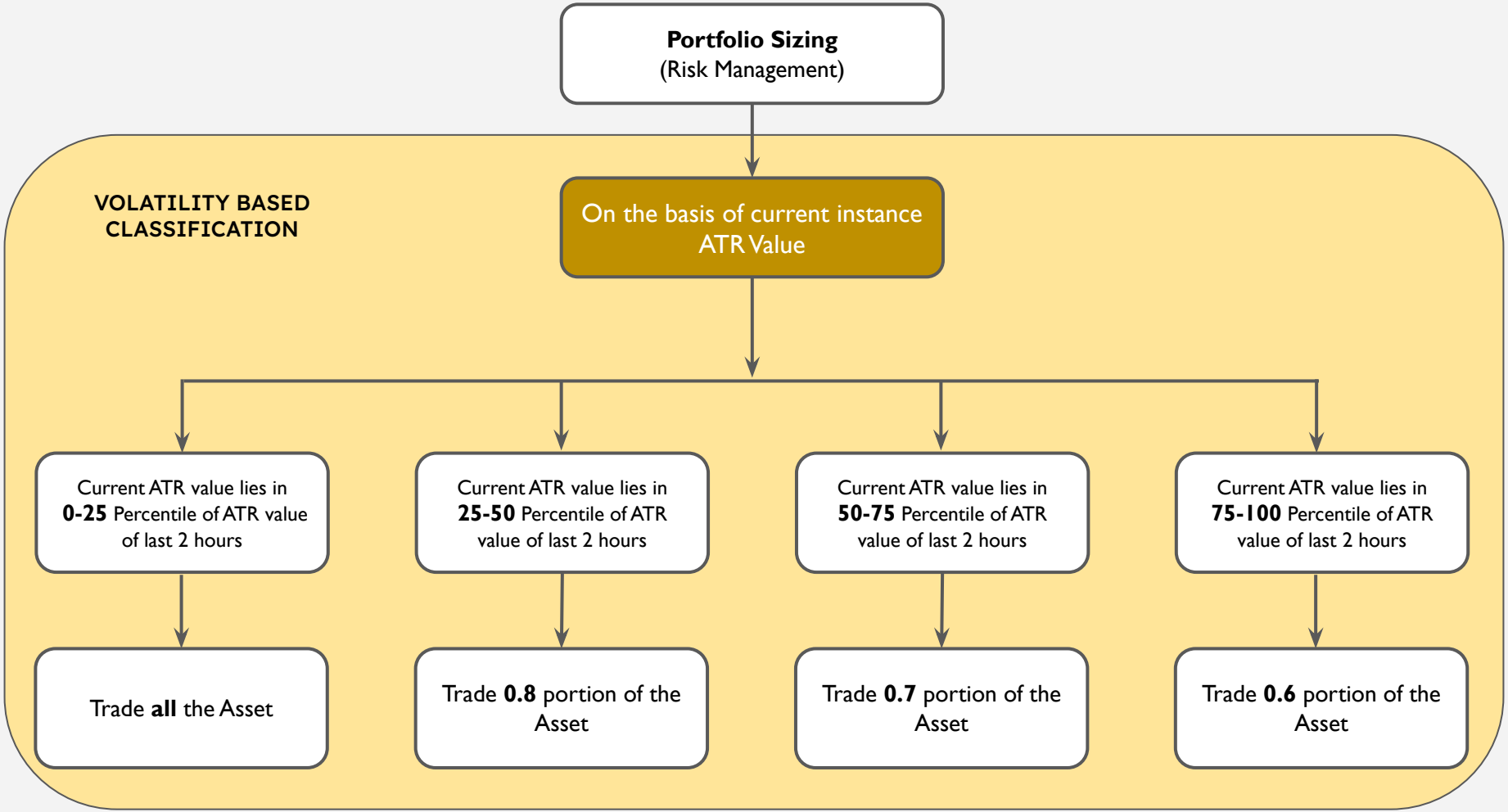
Calculation -

$$\textbf{ATR} = (\text{Previous ATR} * (n - 1) + \text{TR}) / n$$

- Where: ATR = Average True Range
- n = number of periods or bars
- TR = True Range

The True Range for today is the greatest of the following:

- [Today's High - Today's Low]
- abs[Today's high - Yesterday's close]
- abs[Today's low - Yesterday's close]


Portfolio Sizing
(Risk Management)
VOLATILITY BASED CLASSIFICATION
On the basis of current instance ATR Value
Current ATR value lies in 0-25 Percentile of ATR value of last 2 hours
Current ATR value lies in 25-50 Percentile of ATR value of last 2 hours
Current ATR value lies in 50-75 Percentile of ATR value of last 2 hours
Current ATR value lies in 75-100 Percentile of ATR value of last 2 hours
Trade all the Asset
Trade 0.8 portion of the Asset
Trade 0.7 portion of the Asset
Trade 0.6 portion of the Asset

RESULTS

[Backtest Link]

Start Date	End Date	Starting Capital	Ending Capital
Mon Jul 2 2018	Fri Jul 2 2021	1,000,000	2,571,759

Strategy vs. Benchmark Performance

Performance Metrics

Annual Returns	37.89 %
Cumulative Returns	156.86 %
Annual Volatility	22.62 %
Sharpe Ratio	1.53
Maximum Drawdown	-16.72 %
Omega Ratio	1.43
Sortino Ratio	2.28
Skew	0.18
Kurtosis	59.36
Stability of Timeseries	94.41 %

IMPROVED RESULTS

[Backtest Link]

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	1,000,000	6,489,653

Strategy vs. Benchmark Performance

Performance Metrics

Annual Returns	89.13 %
Cumulative Returns	549.67 %
Annual Volatility	40.93 %
Sharpe Ratio	1.77
Maximum Drawdown	-34.73 %
Omega Ratio	1.46
Sortino Ratio	2.52
Skew	-1.46
Kurtosis	35.6
Stability of Timeseries	96.42 %

TRANSACTION LOG SNIPPET

Date	Symbol Name	Quantity/Shares	Price
2018-07-02 09:31:00+05:30	BANKNIFTY20180726FUT	-25.0	26278
2018-07-02 09:41:00+05:30	BANKNIFTY20180726FUT	25.0	26252
2018-07-02 09:46:00+05:30	BANKNIFTY20180726FUT	-25.0	26258.65
2018-07-02 09:51:00+05:30	BANKNIFTY20180726FUT	50.0	26260.35
2018-07-02 09:56:00+05:30	BANKNIFTY20180726FUT	-25.0	26243.05
2018-07-02 10:01:00+05:30	BANKNIFTY20180726FUT	-25.0	26237.95
2018-07-02 10:11:00+05:30	BANKNIFTY20180726FUT	25.0	26240.5
2018-07-02 10:21:00+05:30	BANKNIFTY20180726FUT	-25.0	26233
2018-07-02 10:26:00+05:30	BANKNIFTY20180726FUT	25.0	26208.8
2018-07-02 10:31:00+05:30	BANKNIFTY20180726FUT	-25.0	26216

PITFALLS

- Poor performance on **shorter durations**. Hurst parameters give better results on a longer run, so if someone wants to take position for shorter time frame, it is better to rely on momentum and technical based indicators.
- It generates very few trending signals as compared to reverting signals overall, so in the trending market there is a lesser chance of profit generation.
- The trending algorithm tends to perform poorly, considering less number of neighbors.