
TAILWIND TRADERS

Report - ME 781

Group 7

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Problem Definition

Customer Requirement	Fast, reasonably accurate and thorough analysis of the real-time market data to provide the optimum pairs of securities to trade in.
Market Survey	• PairTrade (Automatic or semi-automatic online pair trading) • Karvy Group (Stock broking, pair trading, data analysis) • Motley Fool Stock Advisor (Stock recommendation, analysis of companies) • ZACKS Premium (Stocks, ETFs, mutual funds).
Key Differentiator	• Optimum and accurate pair trading services are not provided by many major stock advisors. • Using complex machine learning techniques which provide good accuracies instead of conventional algorithmic techniques used by competitors.
USP	• First FinTech company to provide consulting services in pair trading strategies in India. • Easy-to-use user interface which requires minimal intervention by end-user.
Protect the USP	• Powerful branding and marketing with fast-customer service. • Continuous research and integration of new developments. • Patenting and copyrighting of our codebase and pair trading solutions.
Barrier to entry	• High advertising costs and sunk costs in presence of FinTech giants. • High compliance and licensure costs. • Lack of understanding about pair trading among common public.

What is pairs trading?

- Pairs trade is a strategy that involves matching a long position with a short position In two stocks which have a high correlation. PS trading goes back to the front fundamental Principle of investing i.e. Buy undervalued and sell overvalued stocks.
- This practice helps in hedging an thereby lowers the overall risk while trading in the volatile market.
- A time series is known to exhibit mean reversion when, over a certain period, it reverts to a constant mean. If a price time series is a random walk, then any shock is permanent and in the long run, the volatility of the process will continue to grow without bound. On the other hand, if a time series of stock prices follow a mean-reverting process, there is a tendency for the price level to return to a constant mean over time. This provides a good opportunity to trade using pairs.

Problem Objective

1. We are a Mumbai based Fintech startup aiming to refine the financial services in India and making Indian markets more strong and developed.
2. We are developing a platform which helps people identify the companies which can be used as pairs in **pair trading** and also in future development to identify such trades and recommend to our users.
3. We plan to enter the B2C market of the Indian financial industry providing consulting services to users for pair trading methods.
4. Our current aim is to provide fast and accurate results (pairs of securities) which ensure high liquidity, profitability and reduce computational time.

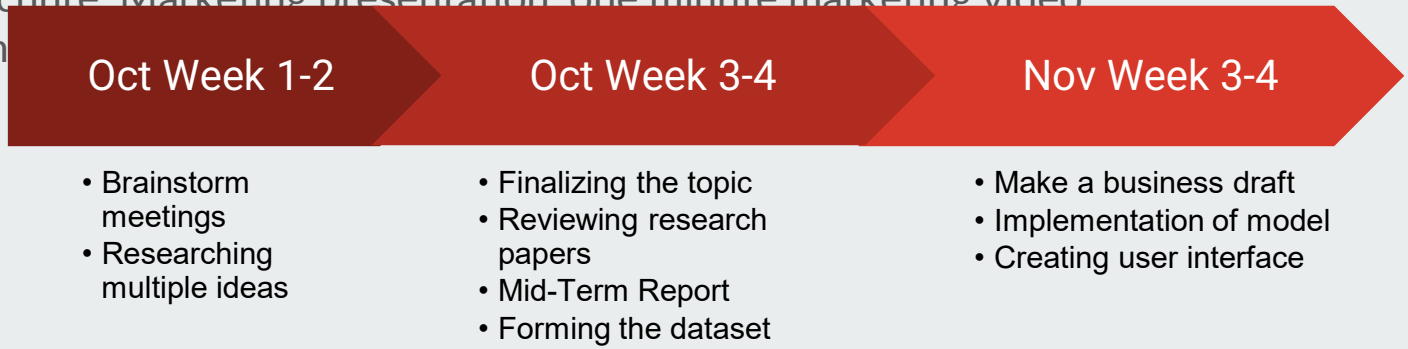
Technology Landscape Assessment

- Published Literature: good literature mainly focusing on pair selection and then predicting the price action is available already.
  - https://hudsonthames.org/employing-machine-learning-for-trading-pairs-selection/
  - https://www.hindawi.com/journals/complexity/2019/3582516/
  - https://thesis.eur.nl/pub/41548/Have-van-der.pdf
  - https://blog.quantinsti.com/pairs-trading-basics/
- Open Libraries:
  - SciKit-Learn- provides almost all functionalities needed for clustering, such as **K-Means** clustering and **DBSCAN**. Sklearn also provides **PCA** method for decomposition.
  - Tensorflow and PyTorch- for creating Deep Learning models for prediction task.
  - Other libraries such as NumPy, SciPy, statsmodels provide tools for math and statistics
- Proprietary libraries:

Project Plan

Project Task Breakdown:

1. Choosing the target sectors, and the firms to be analysed in each sector
2. Consolidating the dataset - daily returns for every firm over a period of 2 years
3. Finalizing model type and hyperparameters
4. Dimensionality Reduction using PCA
5. Application of Clustering Algorithm
6. Definition of a set of rules to select pairs (based on inferences from literature)
7. Identification of pairs
8. Designing Web Portal to interface with users
9. Brochure, Marketing presentation, one minute marketing video dem



RASIC Chart - Roles and Responsibilities

R - responsible, A - approve, S - supporting, I - informed, C - consulted

Tasks	Aditya	Parth	Gyandev	Swarada	Anirudha
1	R	S, A	R	S, A	S, A
2	S, A	R	S, A	R	S, A
3	R	R	R	R	R
4	S, A	S, A	S, A	R	S, A
5	R	S, A	S, A	S, A	S, A
6	R	S, A	R	S, A	R
8	S, A	S, A	S, A	S, A	R
9	R	R	R	R	R

Methodology and Design

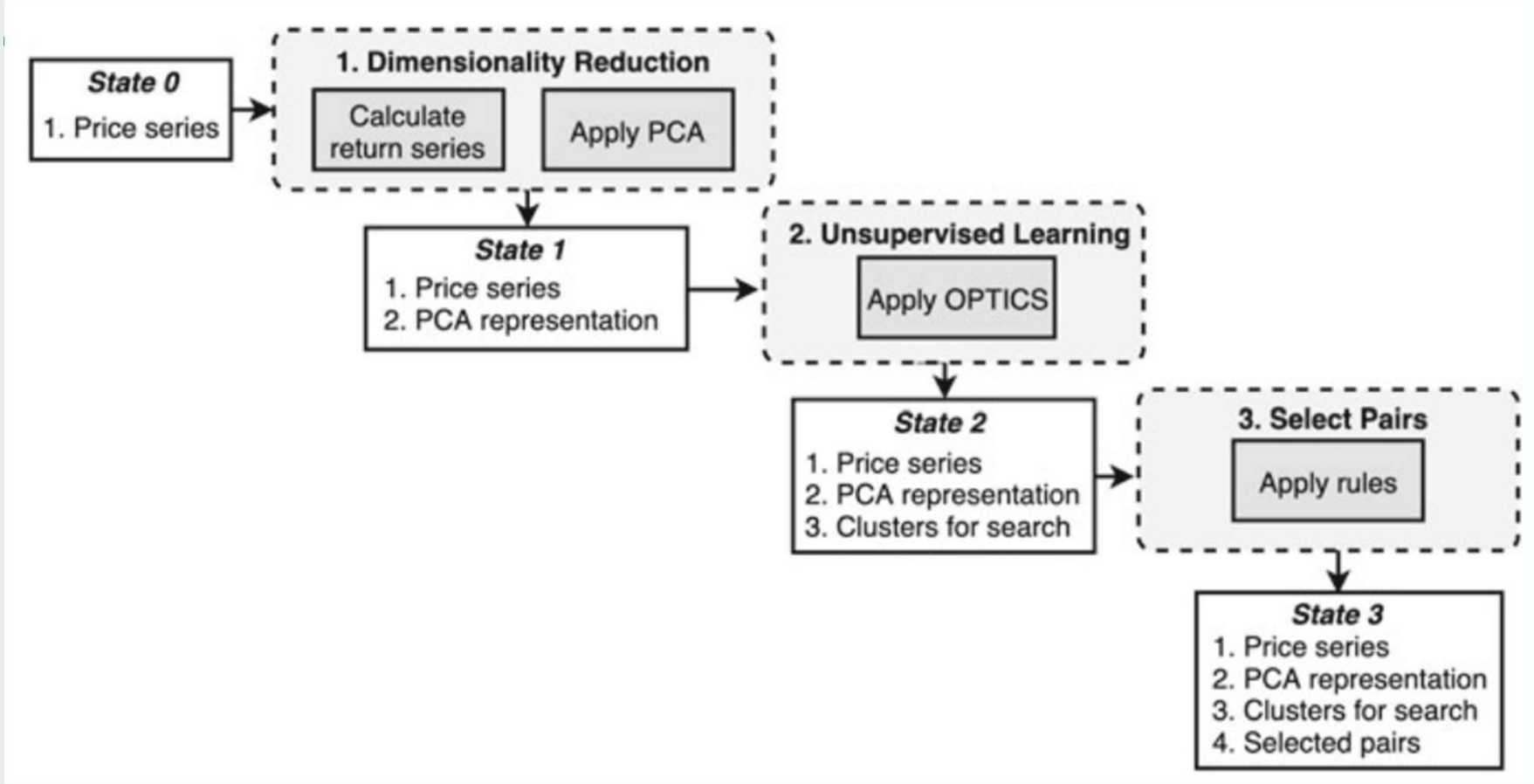
- A simple procedure commonly applied is to generate all possible candidate pairs by considering the combination from every security to every other security in the dataset. But there are problems associated with this approach-
  - High computational cost
  - Multiple comparison problem with hypothesis

- Applying ML-
  - first step is to clean and preprocess the data which includes identifying and eliminating the stocks with too few data points, calculating the returns from Close price, normalizing the returns and merging normalized returns for different stocks in a single dataframe with appropriate date stamps.
  - Here returns only are used due to the fact that they are supposed to be I(0) i.e. integrated time series of order 0 which are “weak-sense stationary” whereas prices are not.

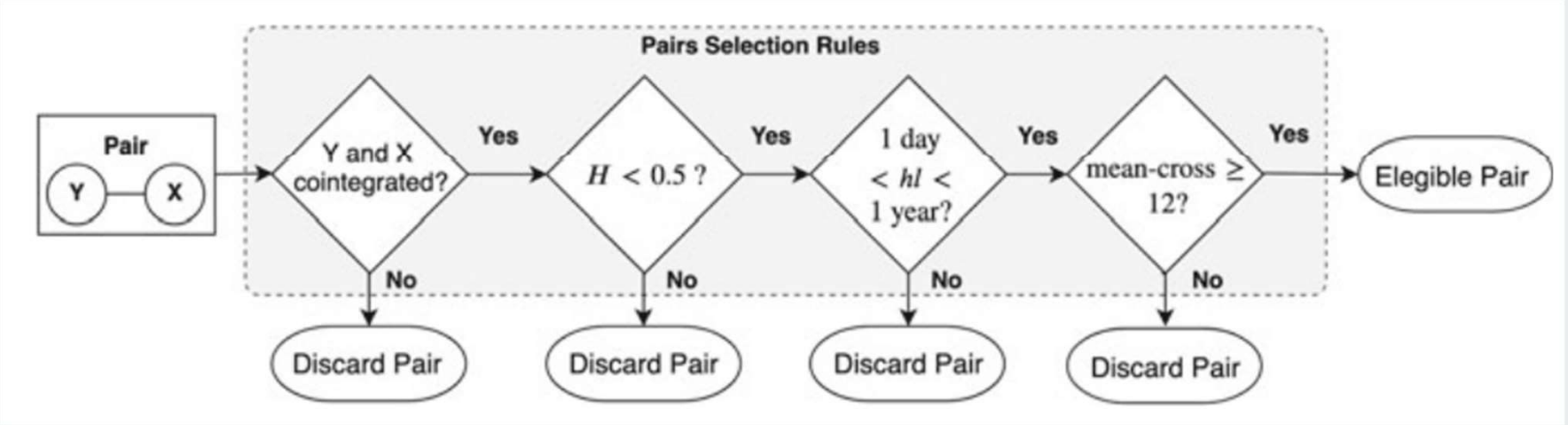
- Performing PCA-
  - on the preprocessed data frame PCA is performed in order to reduce the dimensionality and capture the most of the variance.

- Clustering-
  - through unsupervised learning clustering is performed using the reduced dimensions.
  - OPTICS is used
  - possible cointegrated pairs are identified such that to reduce the non-stationary component of the spread between them
- Final selection of pairs based on-
  - Hurst exponent associated with the spread
  - Half-life
  - Mean reversion and mean cross timeline.

Pair Selection Diagram :



Selecting Pairs Rule - ARODS



Results and Outputs

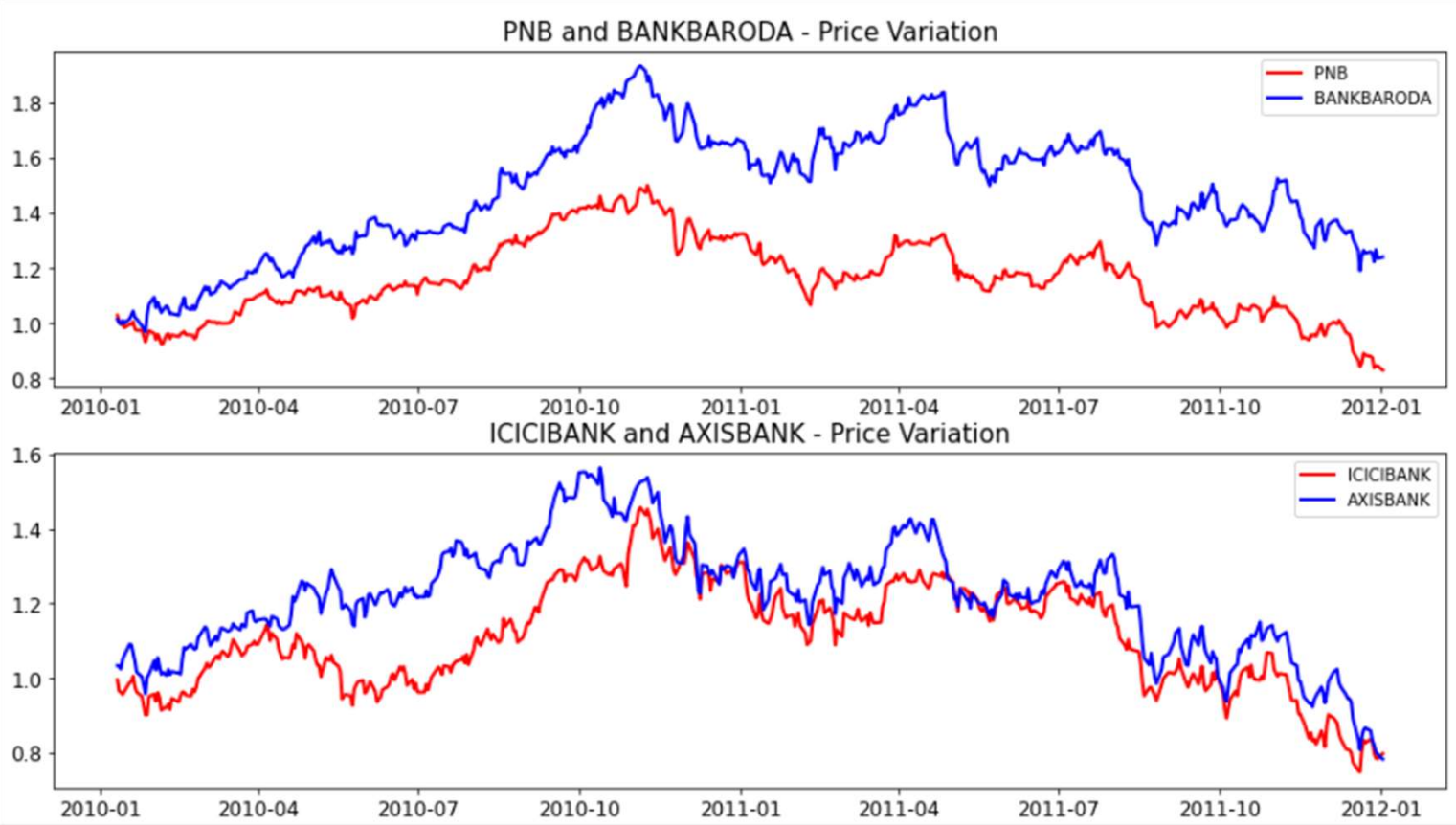
Out of the 100 stocks present from which 4950 pairs are possible, we have found 4 pairs which have successful results in trading.

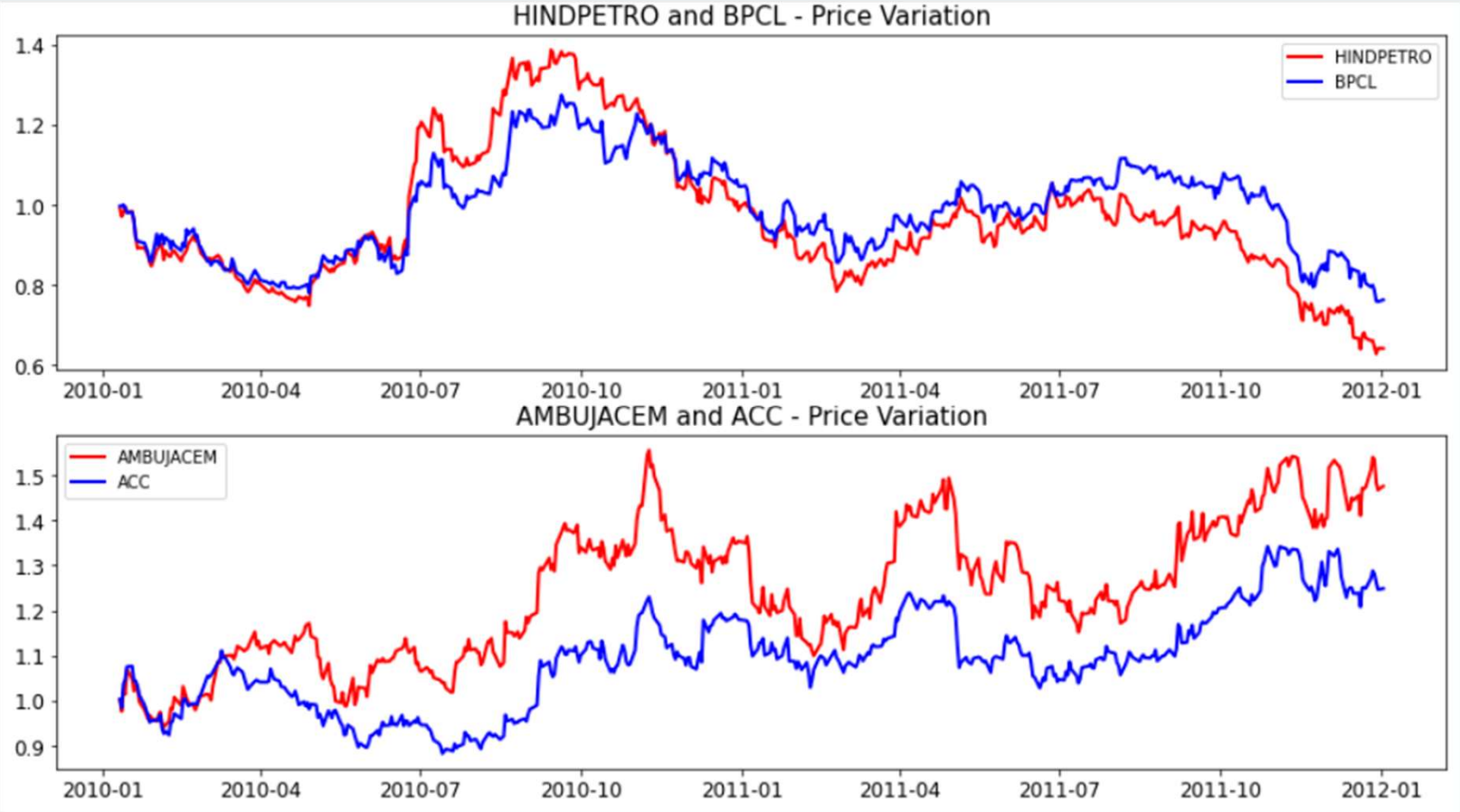
```
[['PNB', 'BANKBARODA'], ['ICICIBANK', 'AXISBANK'], ['HINDPETRO', 'BPCL'], ['AMBUJACEM', 'ACC']]
```

Training

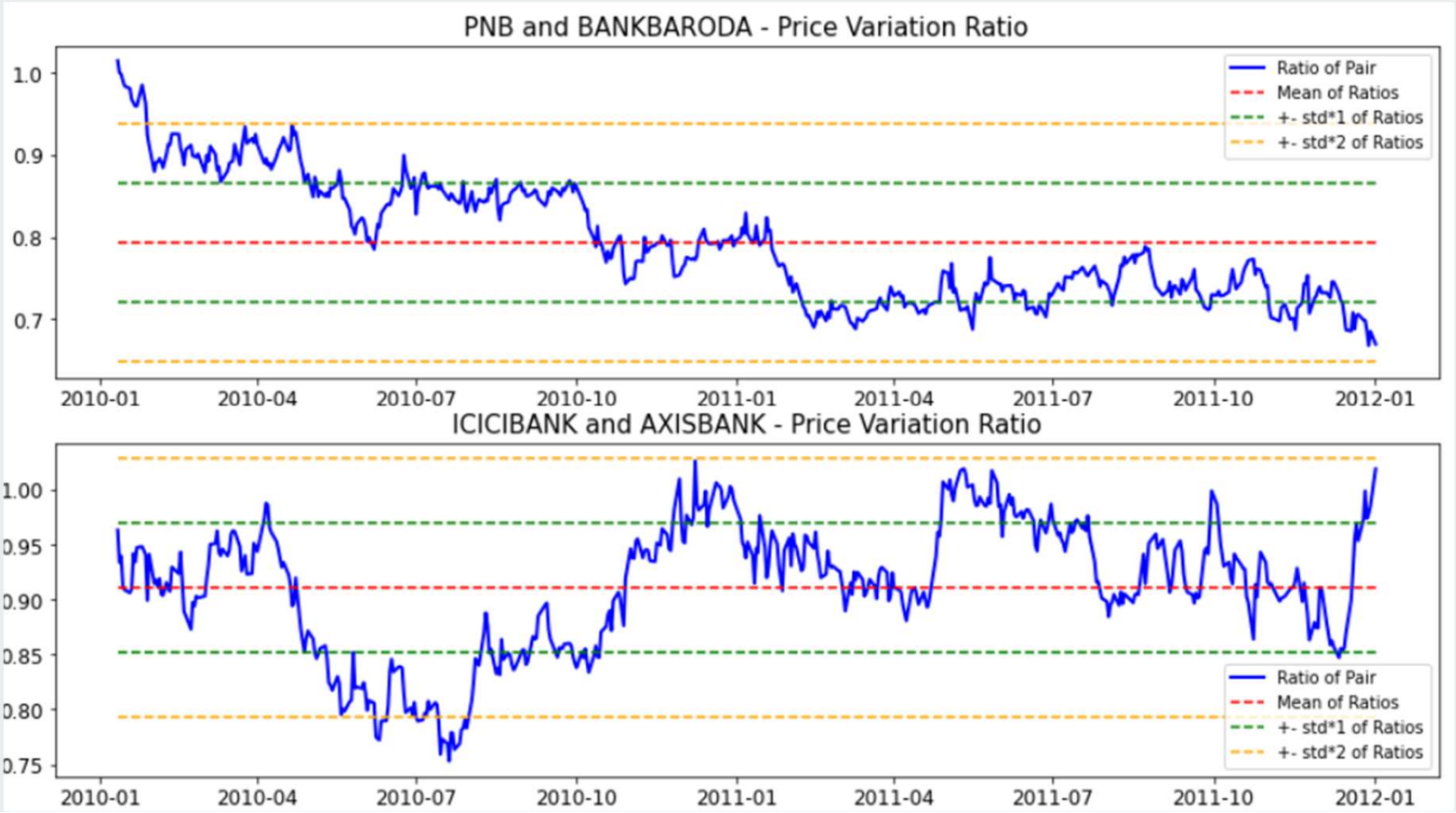
We find the pairs from all possible pairs that can give successful trades using pair trading strategy.

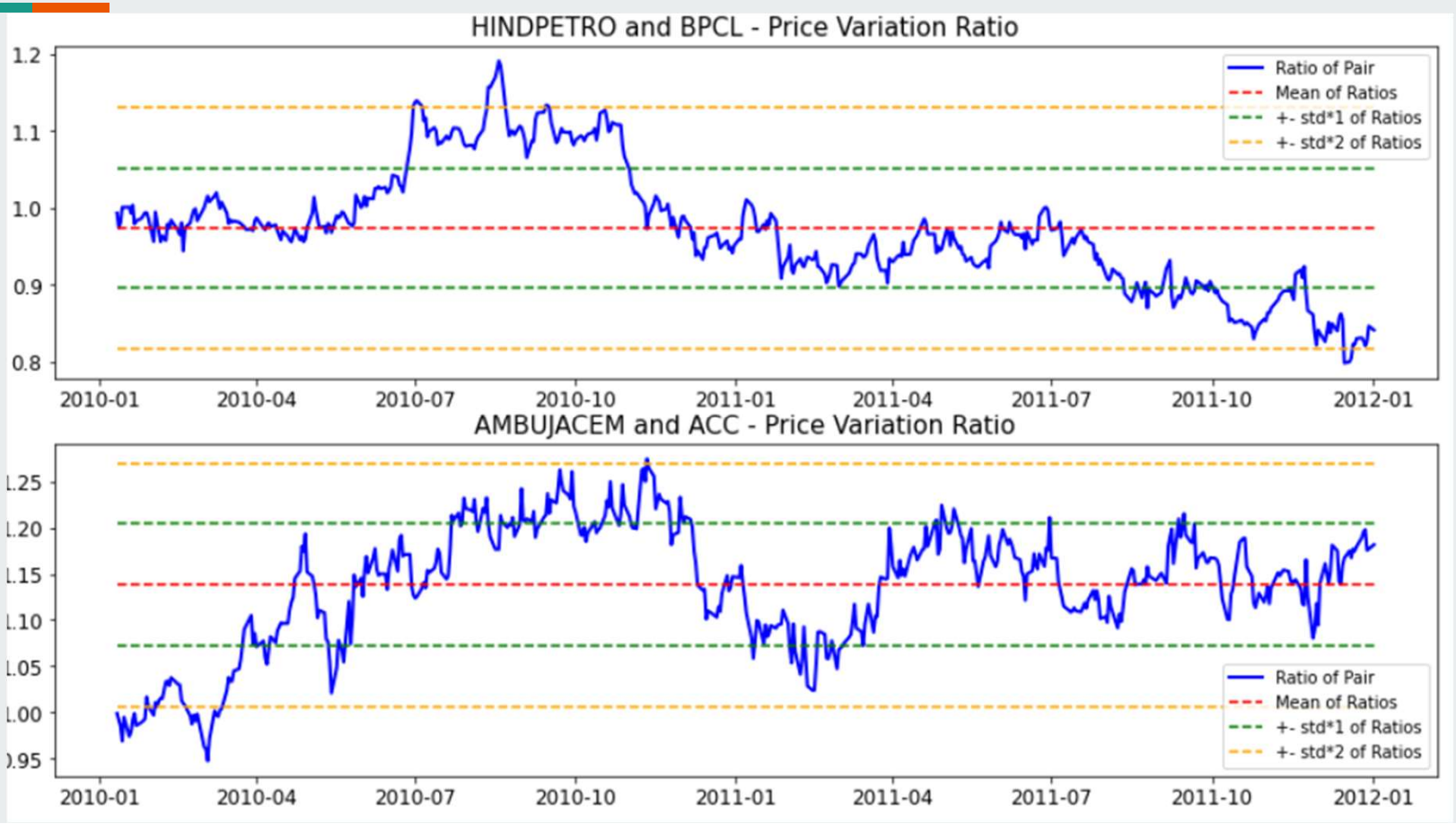
Price Variation




HINDPETRO and BPCL - Price Variation
HINDPETRO
BPCL
1.4
1.2
1.0
0.8
0.6
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01
AMBUJACEM and ACC - Price Variation
AMBUJACEM
ACC
1.5
1.4
1.3
1.2
1.1
1.0
0.9
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01

Ratio Variation

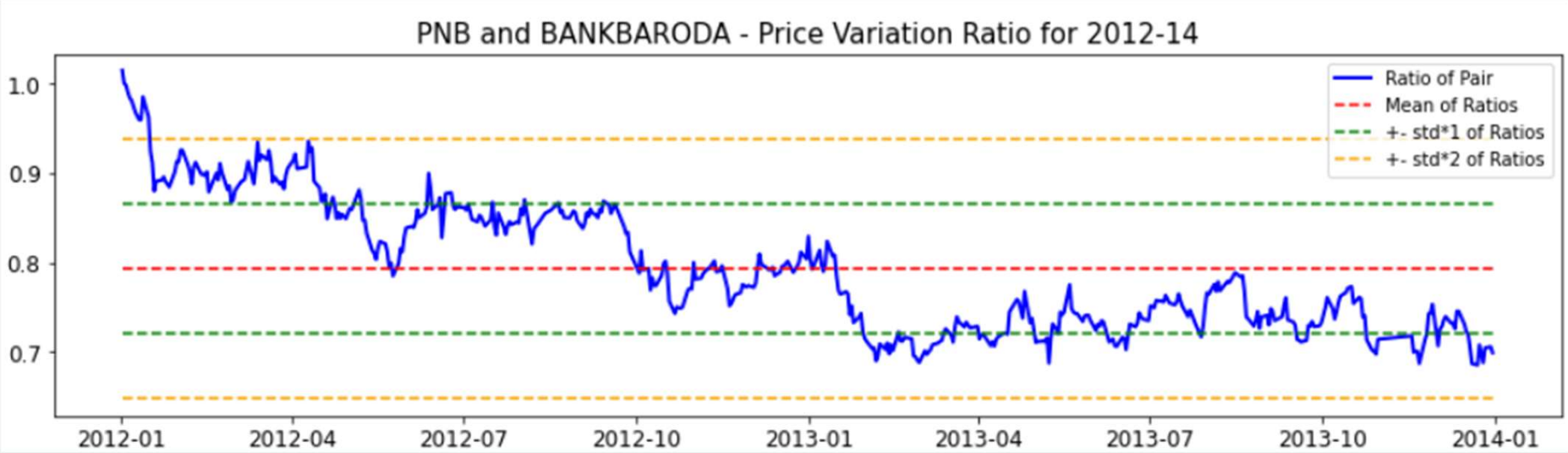



HINDPETRO and BPCL - Price Variation Ratio
1.2
1.1
1.0
0.9
0.8
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01
Ratio of Pair
Mean of Ratios
+- std*1 of Ratios
+- std*2 of Ratios
AMBUJACEM and ACC - Price Variation Ratio
1.25
1.20
1.15
1.10
1.05
1.00
0.95
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01
Ratio of Pair
Mean of Ratios
+- std*1 of Ratios
+- std*2 of Ratios

Testing

We plot the ratios of normalized time-series prices of the pairs in future years against the values of mean and standard deviation of ratios of the identified pairs from the time period in which they were identified.

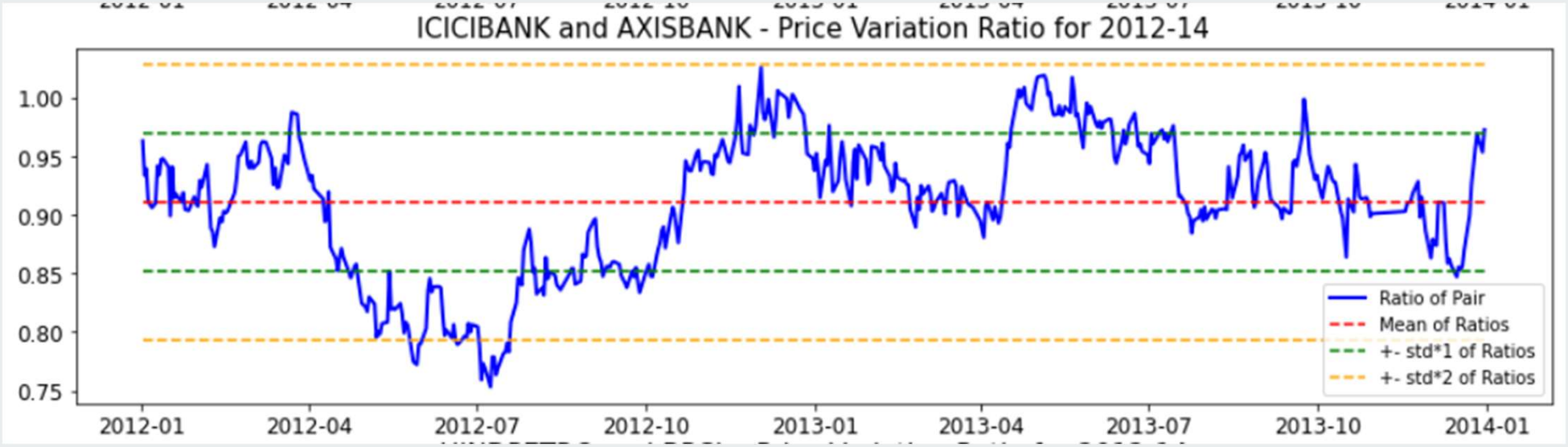
The mean value and and deviation from mean with integer multiples of standard deviation are triggering points (and also support and resistance) for making trade. We can check if we find triggering points for the 4 pairs found.



We can see 2 successful trades using this pair.

1. When ratio hits mean +2*std line, we open out position and when it reaches mean we close it. (January'12 - June'12)

1. When ratio increases from mean -1*std to mean. (February'13 - September'13)

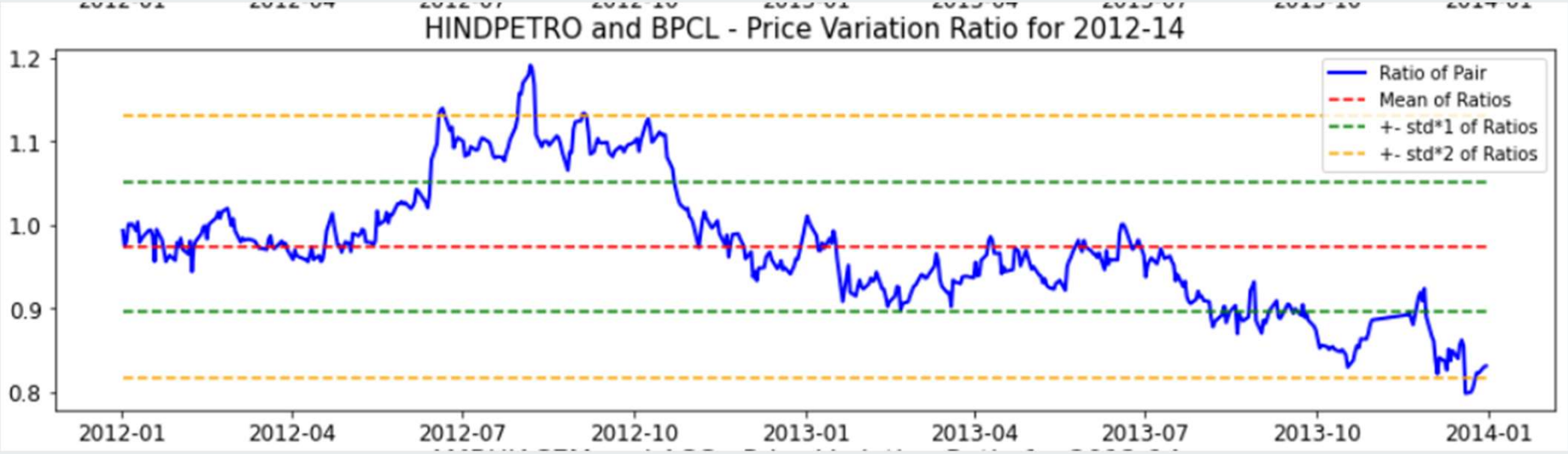


We can see multiple successful trades using this pair..

1. July'12 - November'12

1. December'12 - March'13

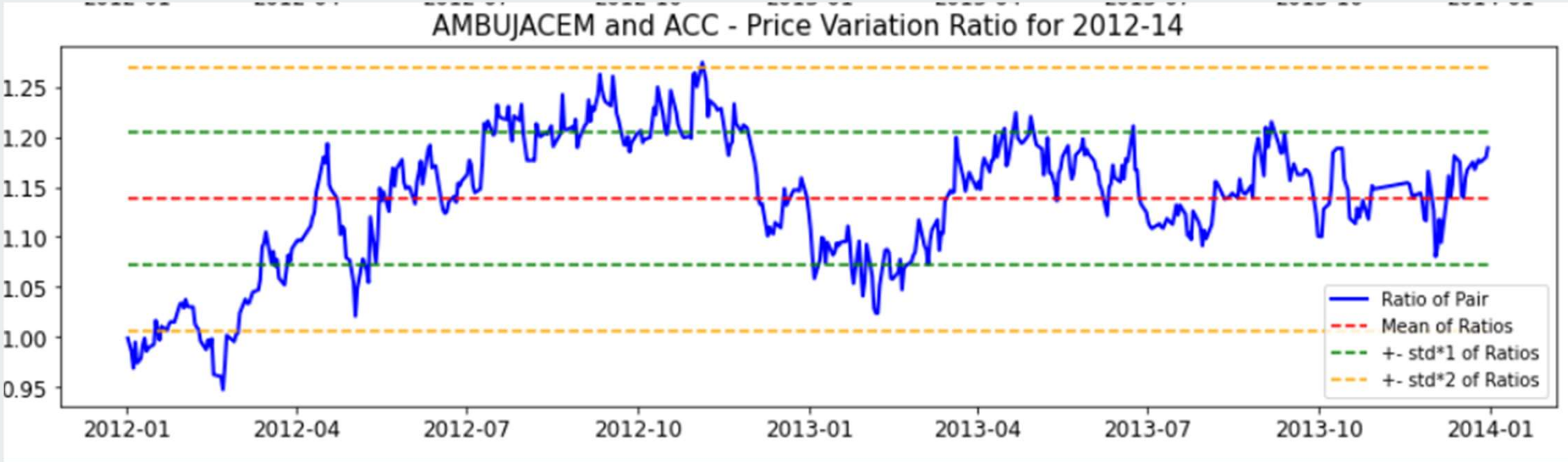
1. May'13 - August'13



We can see multiple successful trades using this pair.

1. June'12 - December'12

1. March'13 - June'13



We can see multiple successful trades using this pair.

1. February'12 - May'12

1. September'12 - December'12

1. February'13 - April'13

Note:
Since this is unsupervised learning, we cannot calculate numerical accuracy for the model.

However, as we can see that each pair selected have successful trades possible.

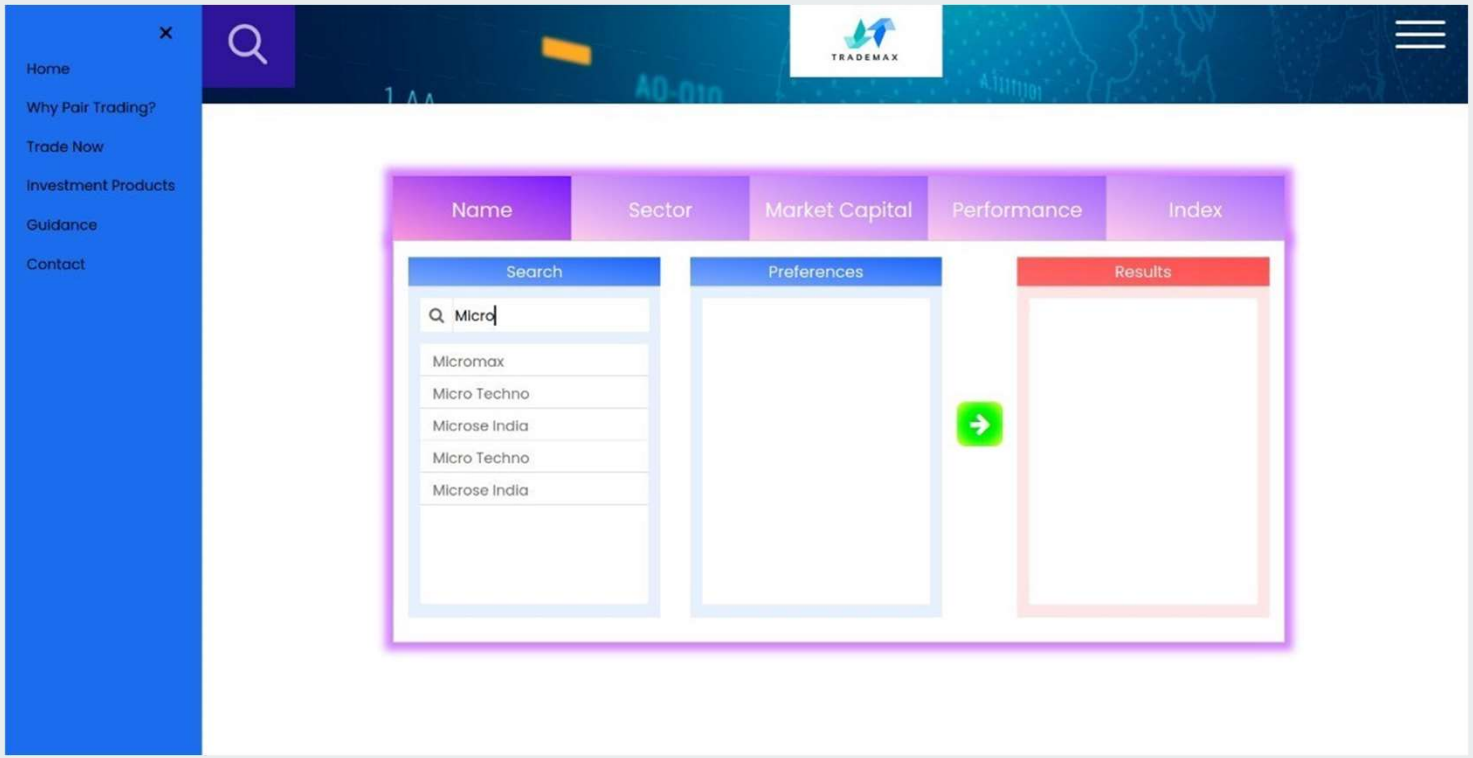
Note: Successful trades means that after deviation it return back to its mean value.

User Interface and User Manual

User Interface and user manual

We provide as input our preferred stocks, sectors, market capital, performance or index.

The output is received in the form of the pairs optimal for pair trading.



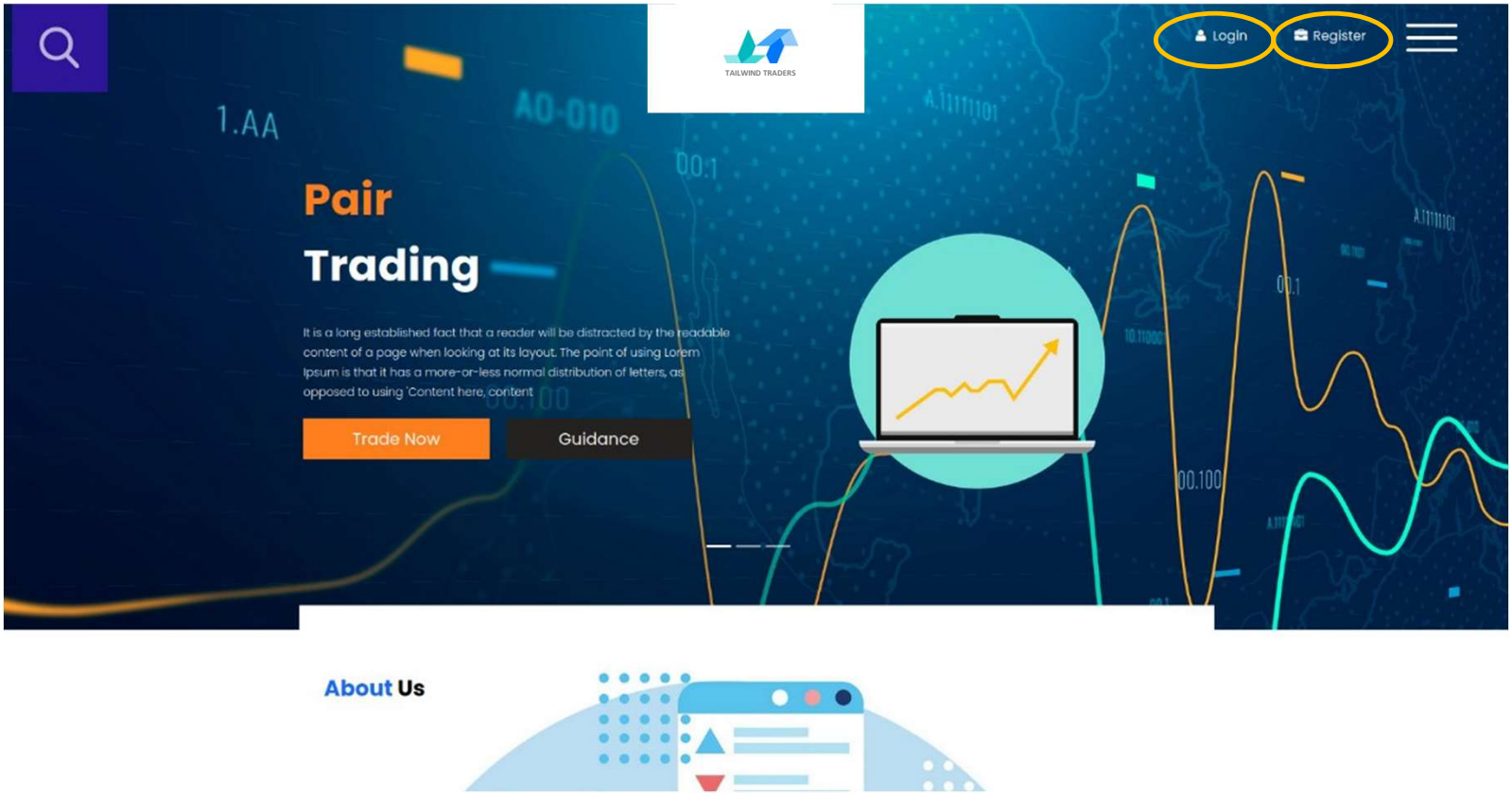
Pair Trading Solutions

User Manual

TAILWIND TRADERS

- ✔ Simple trading strategy for pair trading using complex ML techniques
- ✔ Selection of most optimal pairs
- ✔ Different options for choosing pairs according to preference

Website Trading Instructions

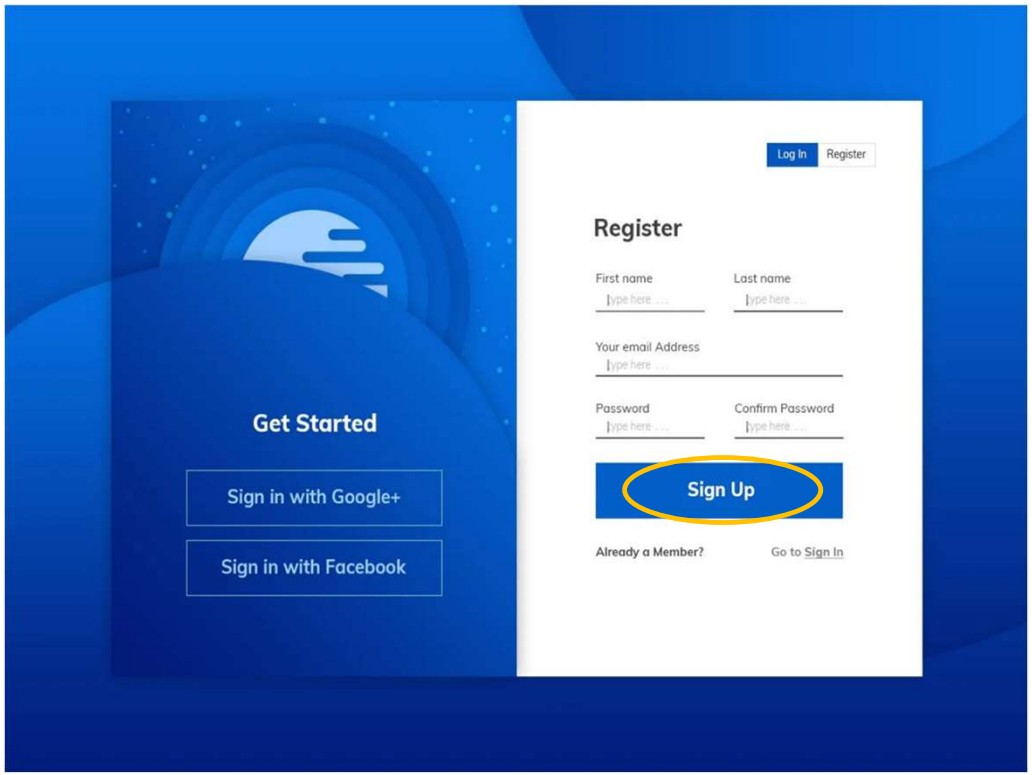


Step 1:

- First open the website `www.tailwindtraders.com` in your preferred browser.
- If you have not registered before, Click on `Register`.
- Otherwise, click on Login and go to step 3.

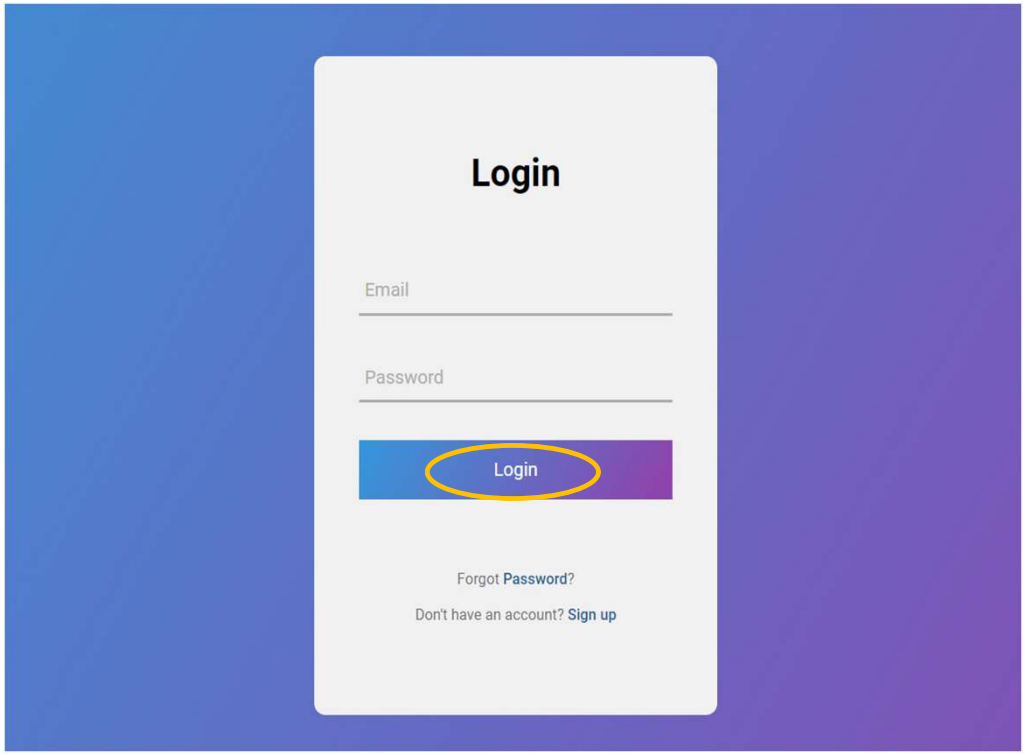
Step 2: Register

- Enter all the details in the registration form.
- Click on `Sign Up`.
- You will be redirected to the Login Form.



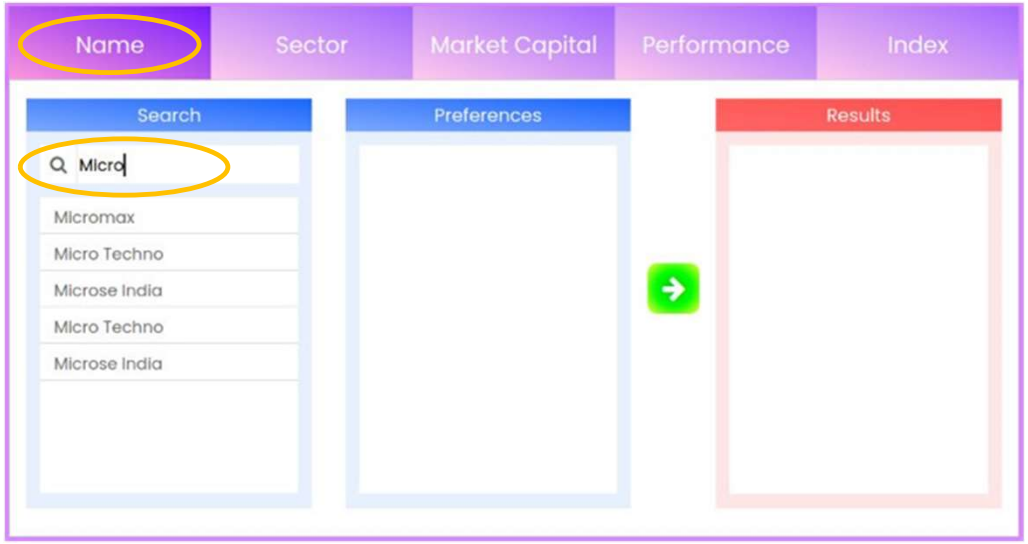
Step 3: Login

- Type in your Email and Password.
- Click on `Login`.
- You will be redirected to the Trading Page.



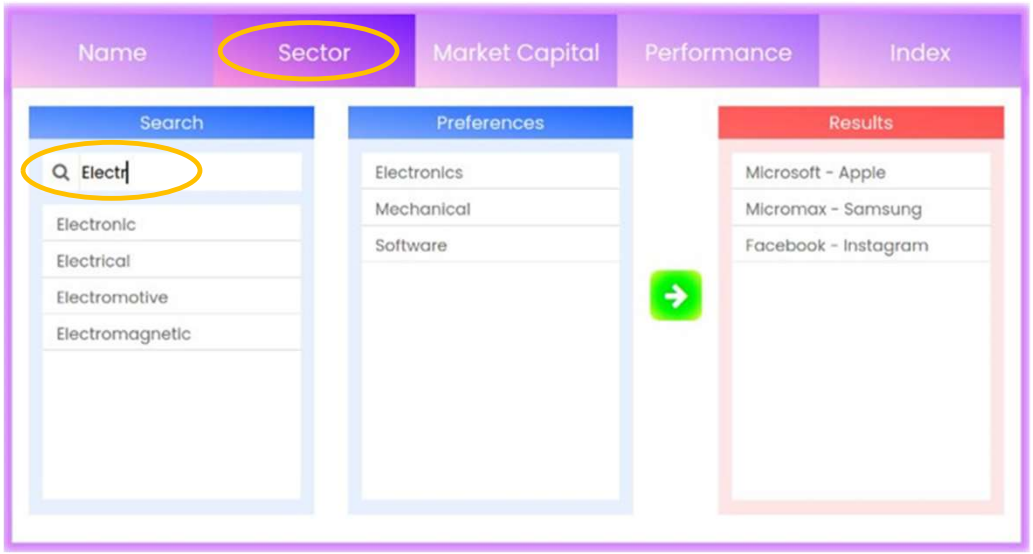
Step 4:

- You can click on any tab according to your choice.
- Click on `Name` tab to search by stock names.
- Type the stock name in the search box.
- Drag your preferred options to the `Preferences` box.



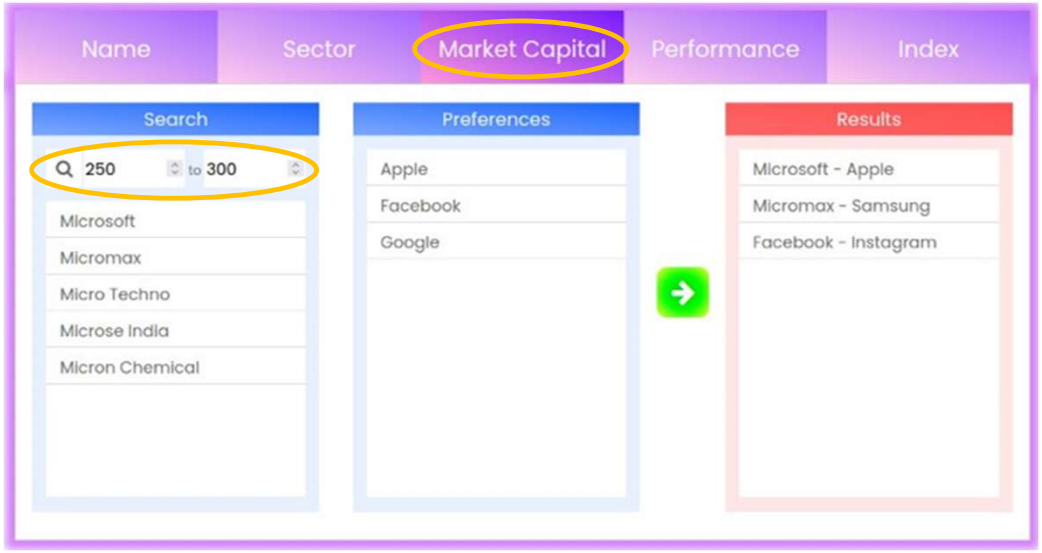
Step 5:

- Click on `Sector` tab to search by sectors.
- Type the sector in the search box.
- Drag your preferred options to the `Preferences` box.



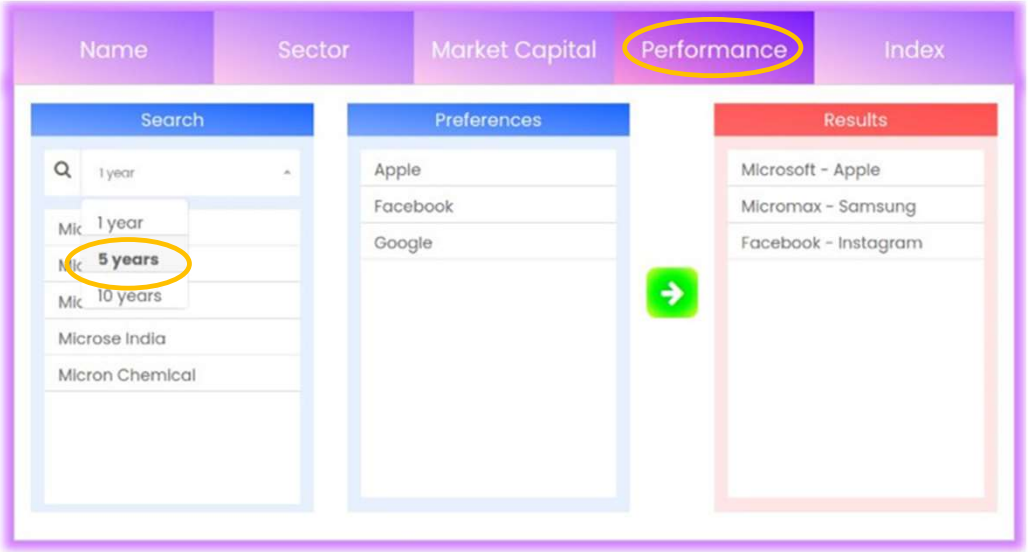
Step 6:

- Click on `Market Capital` tab to search stocks within a range of market capital.
- Type the market capital range (USD) in the search box.
- Drag your preferred options to the `Preferences` box.



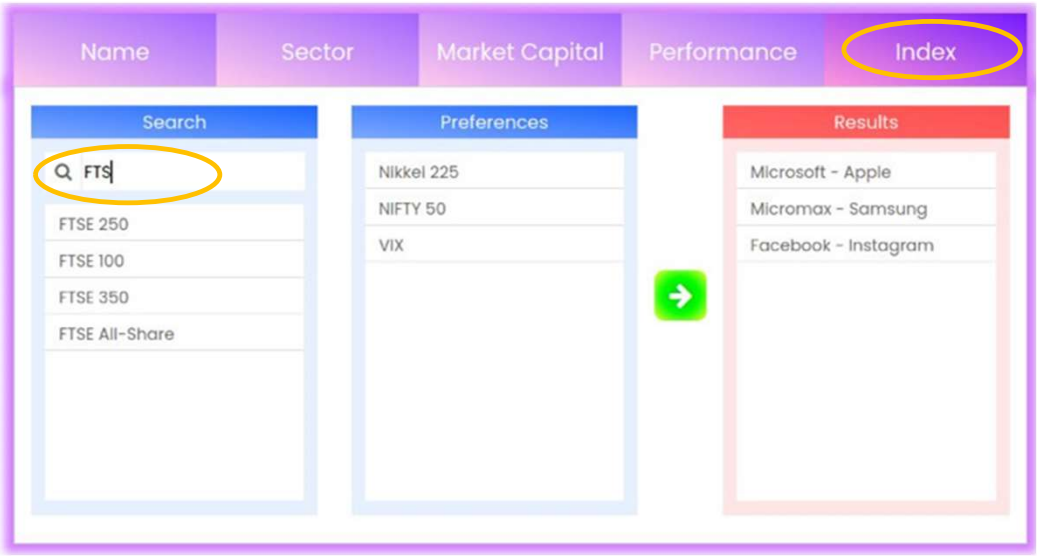
Step 7:

- Click on `Performance` tab to search by best performing stocks within a period.
- Select the period in the search box.
- Drag your preferred options to the `Preferences` box.



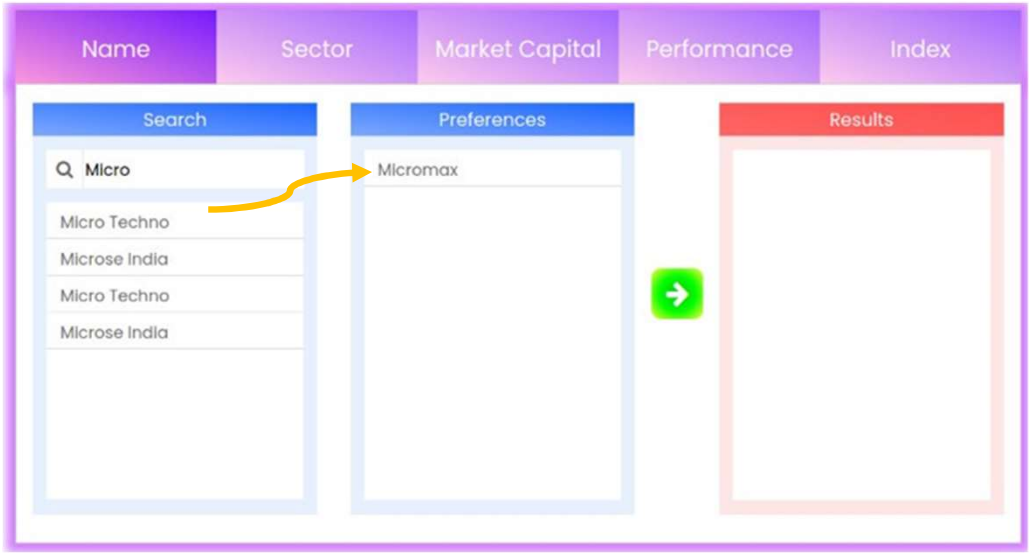
Step 8:

- Click on `Index` tab to search by stock indices.
- Type the index in the search box.
- Drag your preferred options to the `Preferences` box.



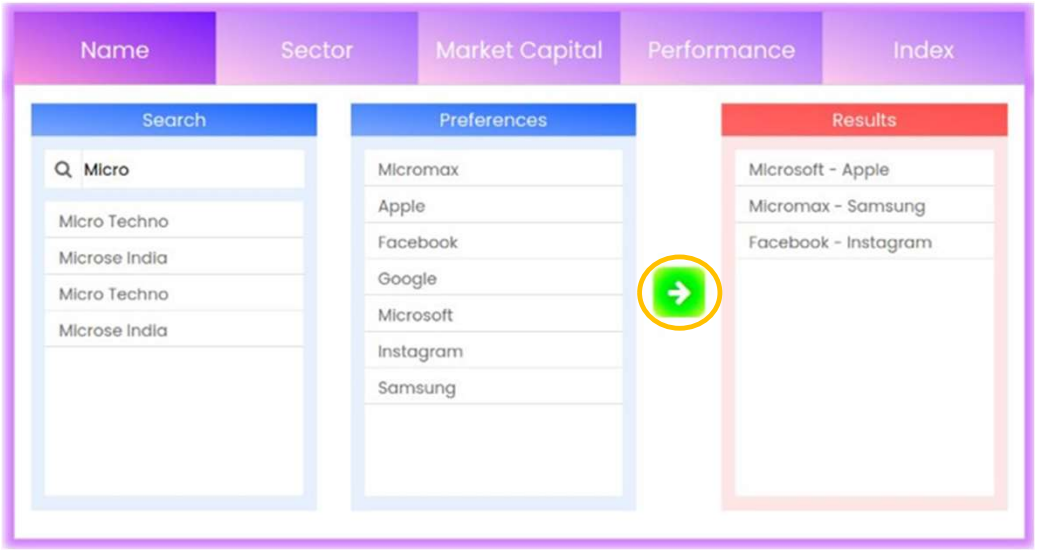
Step 9:

- Drag all of your preferred choices to the `Preferences` box.
- You can search and add as many choices as you like.



Step 10:

- After selecting all the choices, click on the green arrow to find all the optimal pairs from the set of choices you selected.



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