W U T I S

Trading and Investment Society

Constructing portfolios with the network representation of assets

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Structure of the presentation

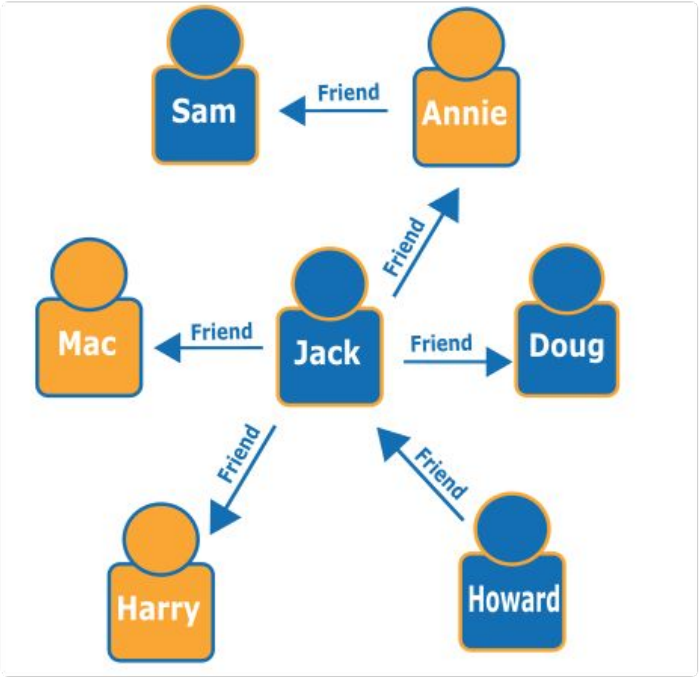
- Networks
- Utilizing networks in trading
- Trading strategy
- Results and conclusions

Introduction - what are networks (graphs)?

- Mathematical representations that are useful for analyzing complex systems and group behaviors.

- **Examples:** social networks, biological networks, financial networks etc.

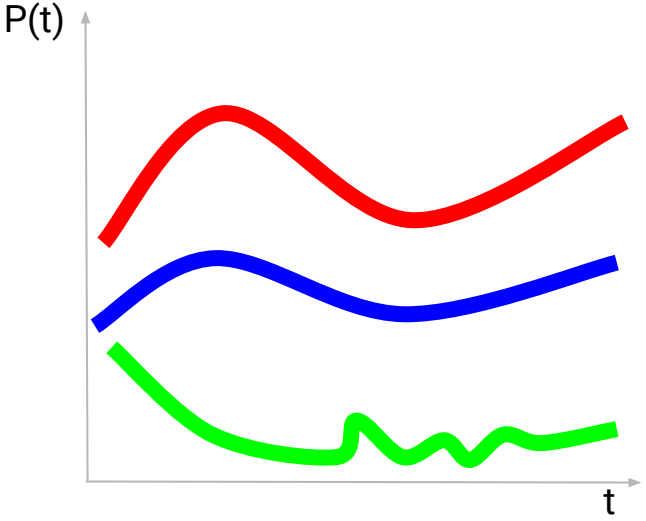
- They are composed of **nodes** and **links** that connect them.



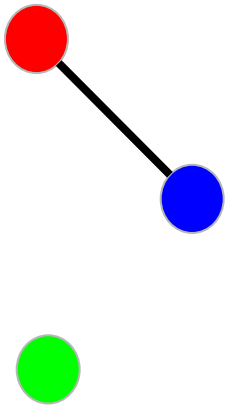
Networks and algorithmic trading

- Utilize networks to predict asset group trends.
- Similar classes of strategies in the past (statistical arbitrage).
- Assumption 1: There are asset group trends, which are “stronger” than individual asset trends.
- Assumption 2: If an asset has been part of the group trend in the past, it will tend to stay within the same group trend in the future.

Correlation between assets = link



Correlation above the threshold

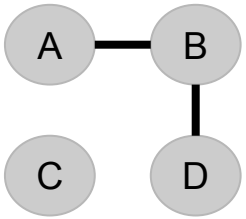


Red and **blue** have a high correlation (but not **green**).

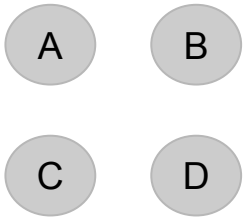
This results in a link in the network structure (no link with the **green**).

Finding correlation groups in the training periods

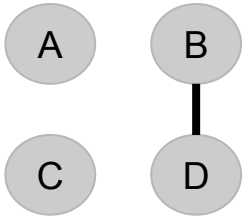
Period 1 (30 days)



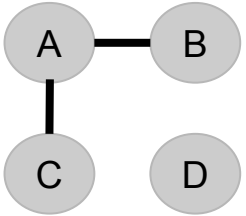
Period 2 (30 days)



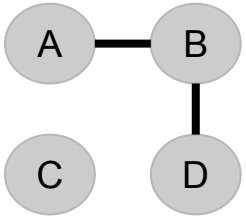
Period 3 (30 days)



Period 4 (30 days)



Correlation groups (0.5 frequency threshold)

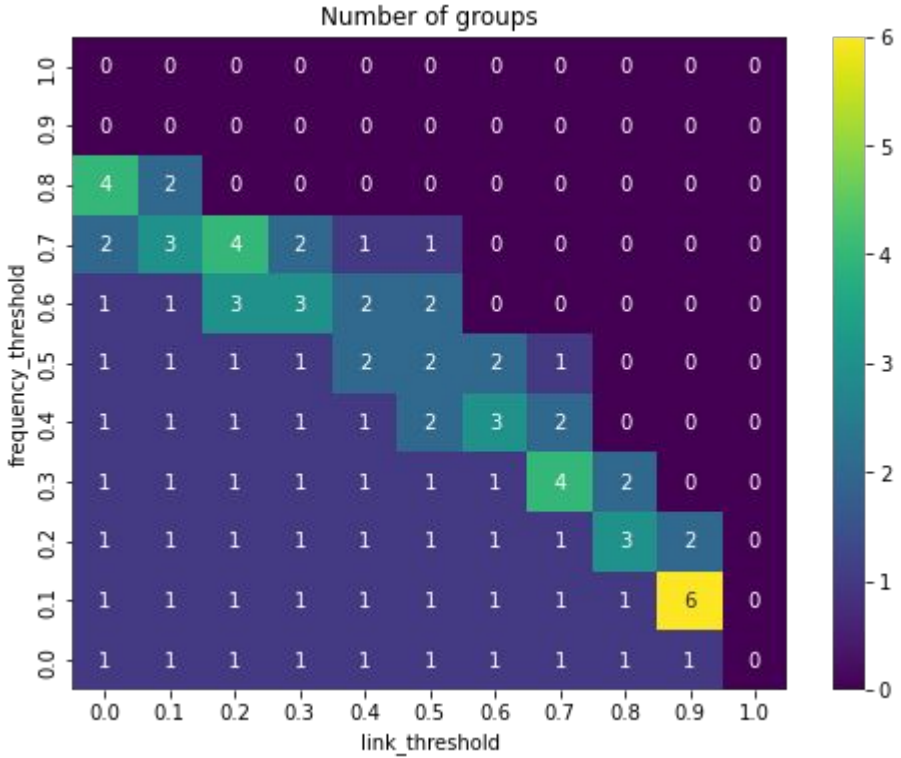


Group parameters

Frequency threshold:

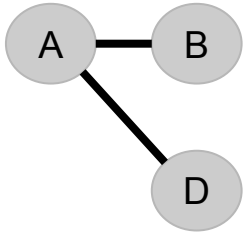
“How often they appear together?

Link threshold:
“How strong the correlation
is between them?”

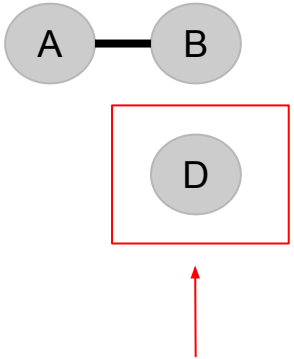


Finding dropout assets in the testing period

Period 6 (30 days)

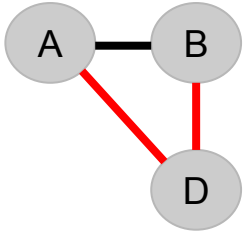


Period 7 (30 days)



Dropout signal:
There is no correlation between B-D or D–A

Period 8 (30 days)

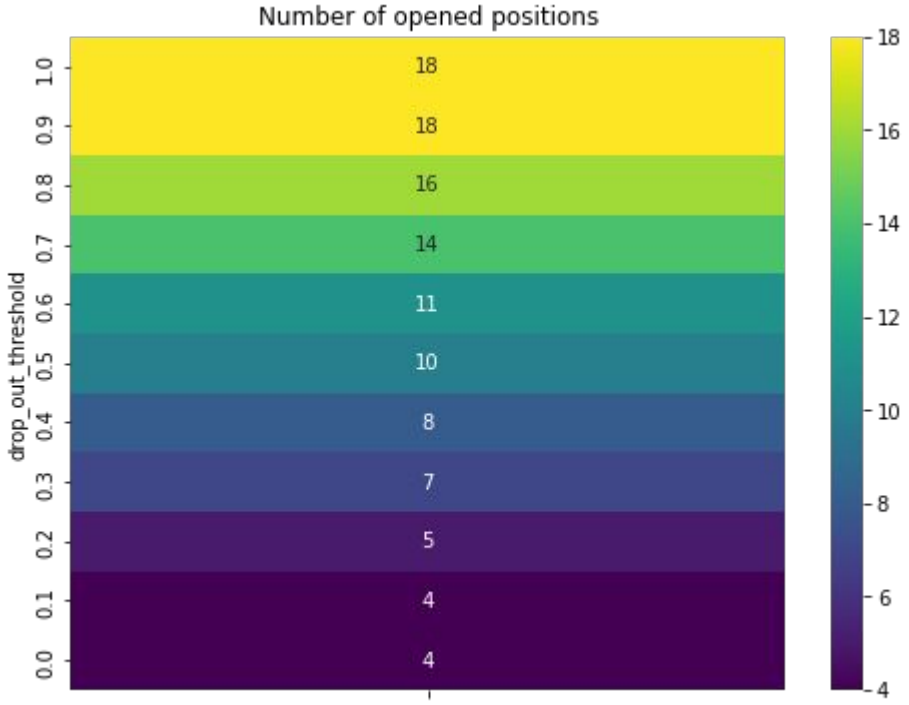


Anticipation:
Correlation will come back

Dropout parameter

Dropout threshold:

“ How low does the correlation need to be, before it’s an outlier?”



How should we use the network representations to create and execute a trading strategy?

Training - Validation (optimization) - Testing

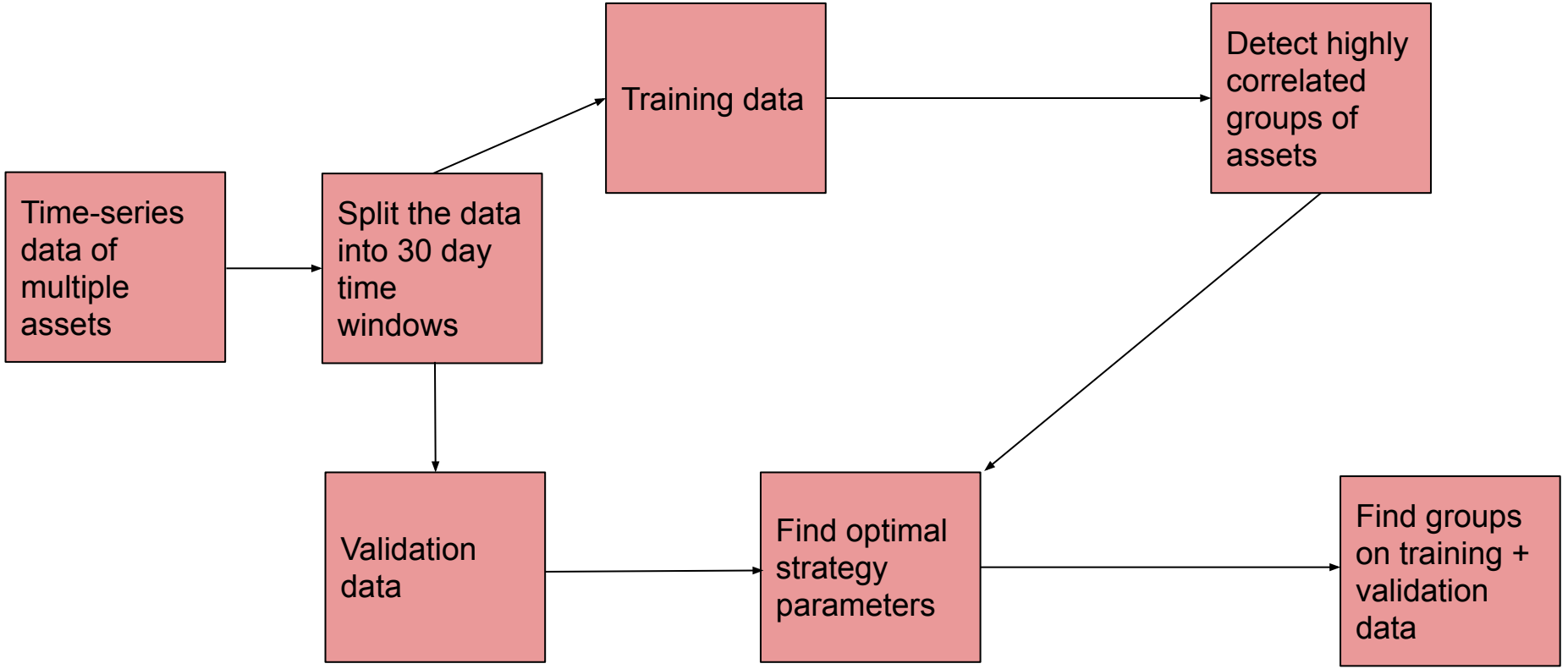
Common assets across all sets: 1333 from the NASDAQ list

Training set: 2010. Jan. 03 - 2019. Jan. 01 ~ 9 years
Finding correlations groups

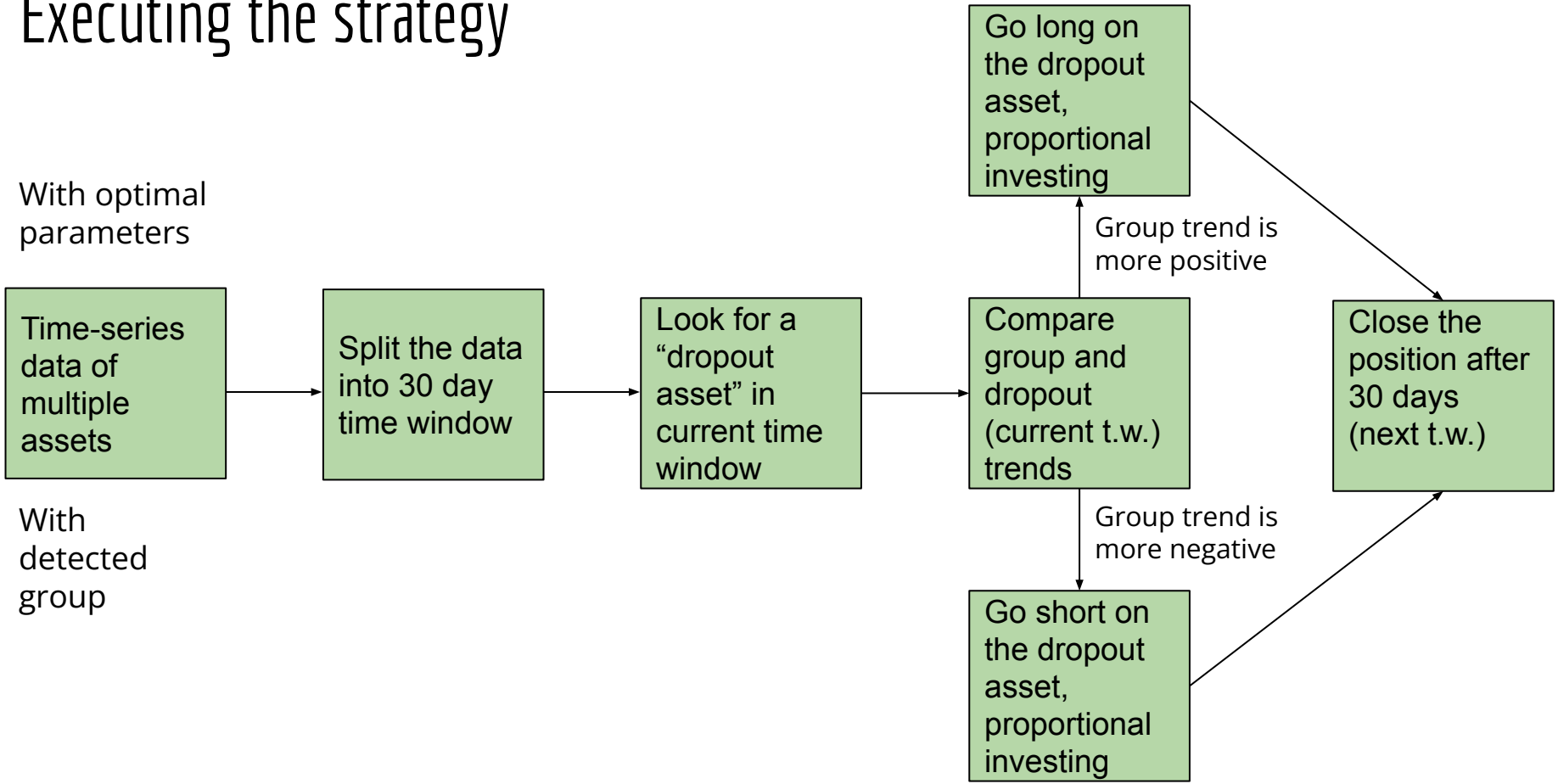
Validation set: 2019. Jan. 01. - 2021. Jan. 01 ~ 2 years
Finding optimal parameters

Testing set: 2021. Jan 04. - 2023. May 01 ~ 2.5 years
Finding strategy metrics

Preparing the strategy



Executing the strategy



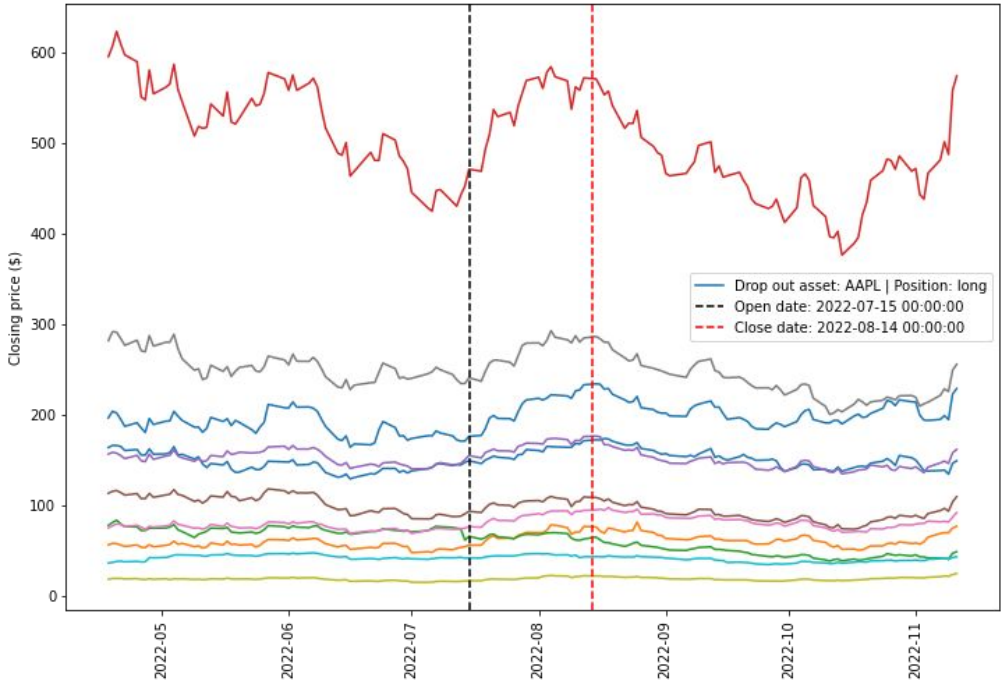
Example of taking one position

1) The group has 11 assets in total, determined in the training period

2) Before the **black dashed line**, the blue has deviated from the group trend

3) We take the long position, assuming it will come back to the group trend

4) We exit the position after 30 days, which corresponds to the **red dashed line**.



Results in the test set

Measure	Validation set results	Test set results
Total return	7.00 %	6.00 %
Total return vs risk free (0.5% per annum)	5.80 %	4.74 %
Sharpe ratio	0.014	0.018

Optimal parameters:

Link threshold**:** 0.85

Frequency threshold**:** 0.2

Dropout threshold**:** 0.5

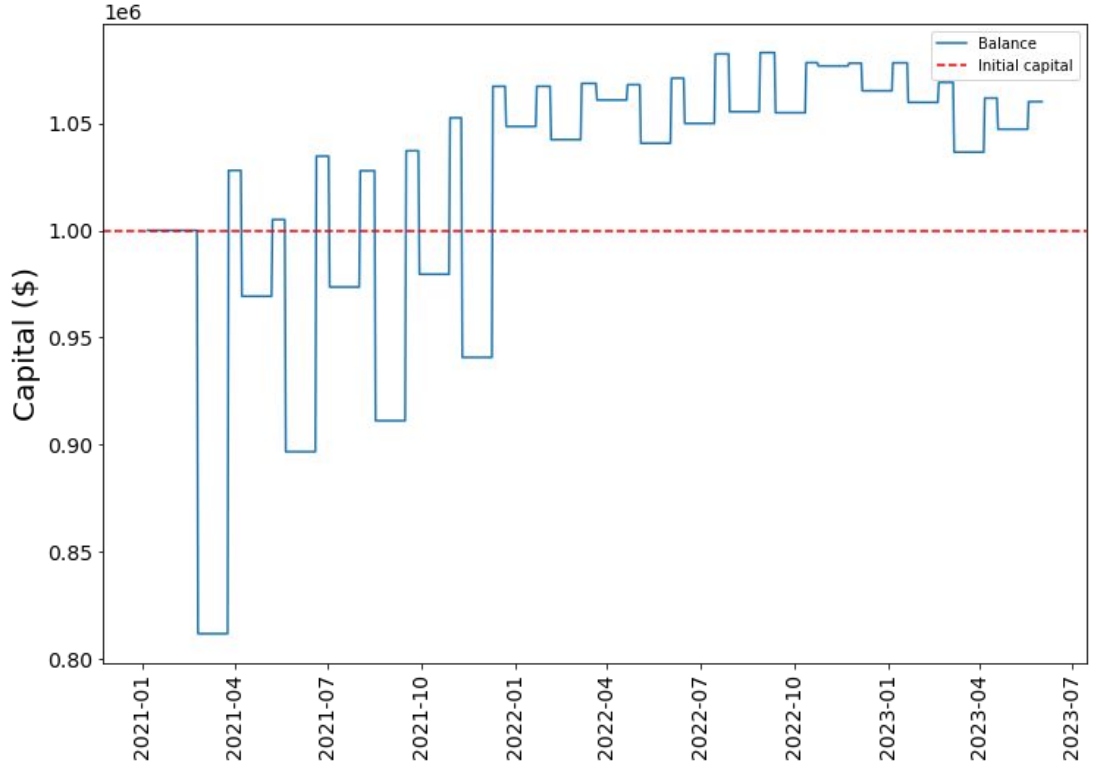
Strategy in the test set:

Number of assets: 1333

Number of detected groups: 22

Number of positions: 115

Balance change with the strategy in the test set



Limitations

- Different testing sets (i.e. by changing the train/validation/testing splits).
- Optimization with smaller steps.
- Commission fees and other costs.
- Selection bias in assets, those that didn’t survive from the start of training to the end of testing periods, were not included.

Future work & Improvements

- Benchmarking against other strategies in the same period.
- Different trading frequencies can be explored (both higher and lower).
- Exploring parameter dependence on the group sizes, asset classes and trading frequency.
- Assessing groups live, as assets disappear and appear or change in different manners.

Thank you for the attention!