Portfolio Optimization Using Preference Relation Based on Statistical Arbitrage

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Introduction

Introduction

- portfolio optimization
- enhancement of present methods of **statistical arbitrage**
- modeling *asset interactions* using **preference flow graph**

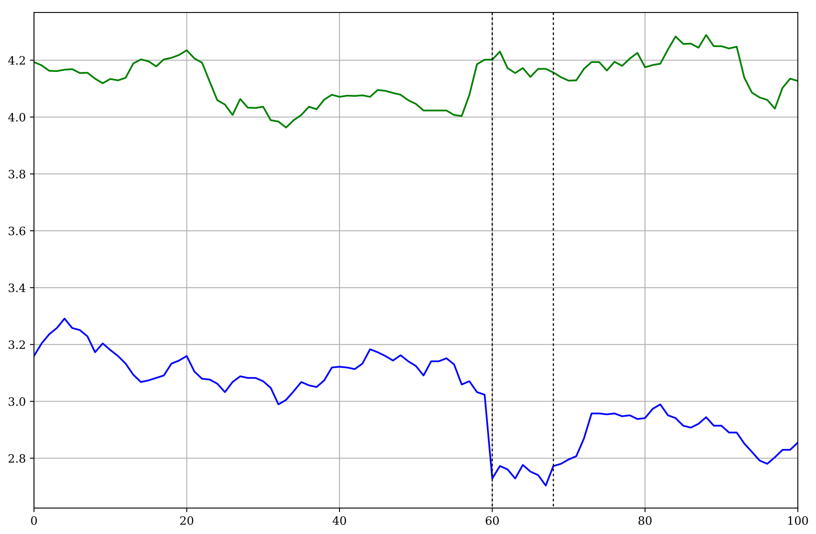
Concepts and methods

Statistical arbitrage

Outline of statistical arbitrage methods:

1. **identifying** pairs of assets whose prices behave *similarly* during the past period,
2. **choosing** pairs which demonstrate a *statistically significant deviation* at the present moment,
3. **assuming** *short* position in one asset of a pair and *long* position in other asset of pair for each pair,
4. **closing** positions once deviation is no longer present.

Statistical arbitrage



Log prices of a pair of assets.

Cons of statistical arbitrage method

- low precision (in the sense of predicting price rise/fall): in most simulations **less than 50%**
- doesn't expand well to more pairs
- frequent changes of the portfolio result in **significant transaction costs**

Algorithm

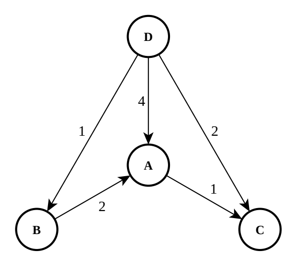
Preference relation

- **binary relation:** $a \succ b$
- *incomparability* of entities: $a \sim b$
- a more *natural* way of comparing entities
- it is *irreflexive*, *asymmetric*, *transitive*, and *transitive in incomparability*

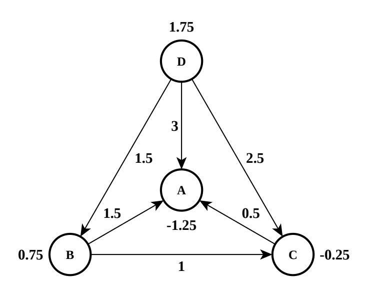
Preference flow graph

- *preference relation* does not define *ordering* of goods, no *intensities* of preference are specified
- **preference flow graph** introduces *intensities* of preference, and models *asset interaction*
- utility structure for obtaining explicit ordering of assets
- may be intrinsically **inconsistent**

Preference flow graph



Inconsistent graph.

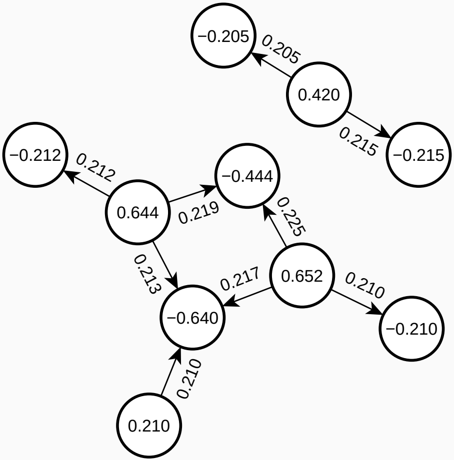


Consistent graph.

Potential method

- **potential method** introduces *ordering* of goods, and gives a **consistency measure** of the graph
- *consistency measure* describes *confidence* in a trading decision

Potential method



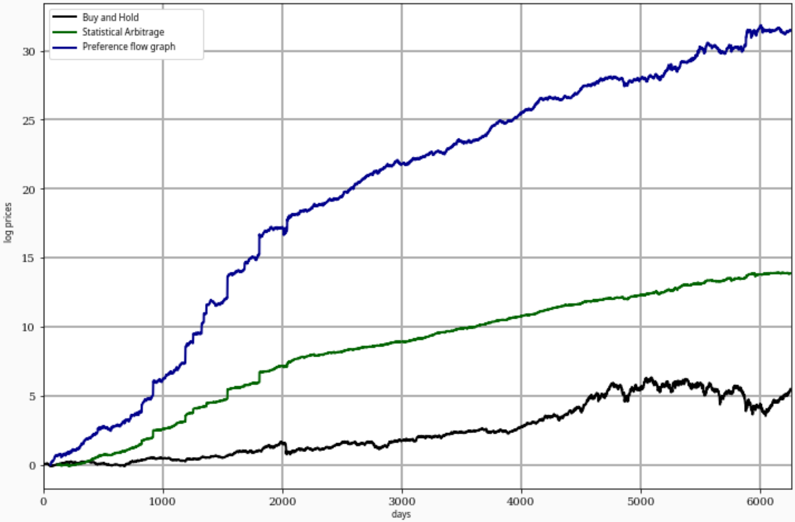
Results of applying the *potential method* on a *preference flow graph*.

Summary of trading algorithm

1. obtain preference flows among the assets using *statistical arbitrage method*
2. construct *preference flow graph*, then apply the *potential method* to impose ordering by *preference*
3. take **long** position in assets with the **highest** preference, and **short** position in assets with the **lowest** preference (if short position is allowed)

Results

Simulation results — subset from S&P 500



Simulation results on a subset of 203 assets from S&P 500 index.

Simulation results — subset from S&P 500

Simulation results on a subset of 203 assets from S&P 500 index.

Method	Buy & Hold	Statistical arbitrage	Preference flow
Annual return	0.07622	0.63033	**1.28000**
Volatility	**0.15069**	0.33532	0.78373
Sharpe ratio	0.50582	**1.87981**	1.63322
Average turnover rate	/	1.473211	**0.55112**
Net profit with 0.10% transaction costs	5.49572	−2.74051	24.66204

Conclusion

Conclusion

- **enhancement** of present methods of statistical arbitrage
- algorithm performs **better** when there is **more** assets available, allows for portfolio diversification
- algorithm works **well** even if *short position* is not allowed

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