Algothon 2019– Phase 3

Welcome to phase 3 of Algothon 2019. In this phase you will take your model from a predictive score towards a trading strategy.

Phase 3 Objectives:

1. Use the predictive scores to construct a portfolio. Scores serve as input to the asset allocation in the portfolio.

2. Construct the portfolio allocation at regular periods. Calculate the cumulative return of the model portfolio.

3. Calculate the cumulative return of the portfolio, less estimated trading costs at each period.

4. Explore strategies to minimise trading costs and improve portfolio returns.

This phase is all about trading, and how timing and costs associated with trading affect the performance of a predictive model in the market. You should aim to test different strategies for trading the same predictive model. This will help you identify how each parameter affects both costs and gains – e.g. trading more rarely may incur smaller costs but it might also reduce the gains by missing important opportunities.

Start with a straight-forward strategy that is relevant to your predictive model. If relevant to your model, e.g. a good place to start is a long-only fully invested portfolio trading at regular intervals. You can implement this on top of the backtest from phase 2. You can use the predictive score as an indicator of how much of the portfolio's allocation goes to each asset. Feel free to improve on this but don't spend too much effort on it – focus on the tasks below.

Look for a trading cost estimation for your universe of assets. This can sometimes be as simple as a percentage of each transaction. More complex estimators will give more realistic results in the final steps of this phase. Some backtesting tools also offer trading costs out of the box.

You will be asked to explain how portfolio values and trading costs are calculated based on your chosen trading cost estimation. As in the previous phase, avoid look-ahead bias. Please ensure you store portfolio holdings as units of assets, since their values will change from one period to the next one. Also ensure the trading costs are reflected when exchanging units for monetary value.

You will notice that the traded portfolio will differ from the model portfolio. This will usually mean that in addition to costs of trading, the performance of the portfolio is also driven down by imperfect allocation. It is quite common that any expected returns of the predictive model disappear when introducing trading costs. Your focus for this phase is to minimise the costs. Improvements to the predictive model and allocation will be made at a later phase.

Explore strategies to manage the costs. Try different periods for trading and compare the results against each other. For each trading period, you should produce the performance of the model portfolio and the performance of the traded portfolio. Use these results to discuss and recommend the ideal period for minimising trading costs while maintaining gains.

Analyse the trade lists that are produced by the backtests. Can you find any unreasonable trades, e.g. too small to transact in the market, and how are the previous results affected by their exclusion? You should also discuss if and how the size of the fund could affect the costs and performance.

Instructions and Requirements

1. Produce a time series of the portfolio allocation based on the predictive scores. An allocation should specify the number of units against each asset in the universe.

2. Backtest and calculate the cumulative returns of this portfolio assuming no trading costs. This serves as the baseline in the next steps.

3. Estimate trading costs for the assets in the universe. Calculate the cumulative returns less the trading costs. At each consecutive period you should produce a trade list and apply the loss when changing the allocation.

4. Change the period in your model and re-run the backtests. Analyse and report the effect on performance. Explain this effect and choose your preferred period.

5. Find and explain other potential improvements, e.g. by analysing trading costs vs asset gains.

Learning Resources

If you are eager to understand more, we also recommend the following:

- Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk (McGraw-Hill Library of Investment & Finance) by Richard C. Grinold, Ronald N. Kahn. Book available in the Central Library of Imperial College
- Arnott, Robert D. and Harvey, Campbell R. and Markowitz, Harry, A Backtesting Protocol in the Era of Machine Learning (November 21, 2018). Available at SSRN: https://ssrn.com/abstract=3275654 or http://dx.doi.org/10.2139/ssrn.3275654
- López de Prado, Marcos, What to Look for in a Backtest (August 11, 2013). Available at SSRN: https://ssrn.com/abstract=2308682 or http://dx.doi.org/10.2139/ssrn.2308682
- Lo, Andrew. (2003). The Statistics of Sharpe Ratios. Financial Analysts Journal. 58. 10.2469/faj.v58.n4.2453. Available at: https://www.researchgate.net/publication/228139699_The_Statistics_of_Sharpe_Ratios
- Garleanu and Pedersen (2013). "Dynamic trading with predictable returns and transaction costs," Journal of Finance. Available at: http://www.lhpedersen.com/research