

Trading Strategy Report

Step 1

The daily dividend adjusted prices of the SPX5.L, SC0E.DE and SGLD.L products were downloaded from Yahoo Finance into a Pandas DataFrame. The time range of the data is between 31/10/2013 and 31/10/2018. The columns are the High, Low, Open and Close prices of the day, as well as Volume of daily transactions and Adjusted Closing Price to account for events that happened between the closing time and the following day's opening. Below is an image of the data format.

Attributes	High			Low			Open			Close			Volume
Symbols	SC0E.DE	SGLD.L	SPX5.L	SC0E.DE	SGLD.L	SPX5.L	SC0E.DE	SGLD.L	SPX5.L	SC0E.DE	SGLD.L	SPX5.L	SC0E.DE
Date													
2013-10-31	160.419998	82.203598	176.490005	160.419998	81.732002	176.110001	160.419998	82.203598	176.330002	160.419998	81.309998	176.544998	(
2013-11-01	NaN	81.339996	176.800003	NaN	81.306297	175.990005	NaN	81.306297	175.990005	NaN	81.445000	175.750000	Ni
2013-11-04	NaN	81.626701	176.880005	NaN	81.626701	176.520004	NaN	81.626701	176.610001	NaN	81.485001	176.520004	Ni
2013-11-05	NaN	80.760002	176.649994	NaN	80.654503	176.429993	NaN	80.760002	176.520004	NaN	80.635002	176.485001	Ni
2013-11-06	NaN	80.949997	177.619995	NaN	80.949997	177.619995	NaN	80.949997	177.619995	NaN	80.855003	177.139999	Ni

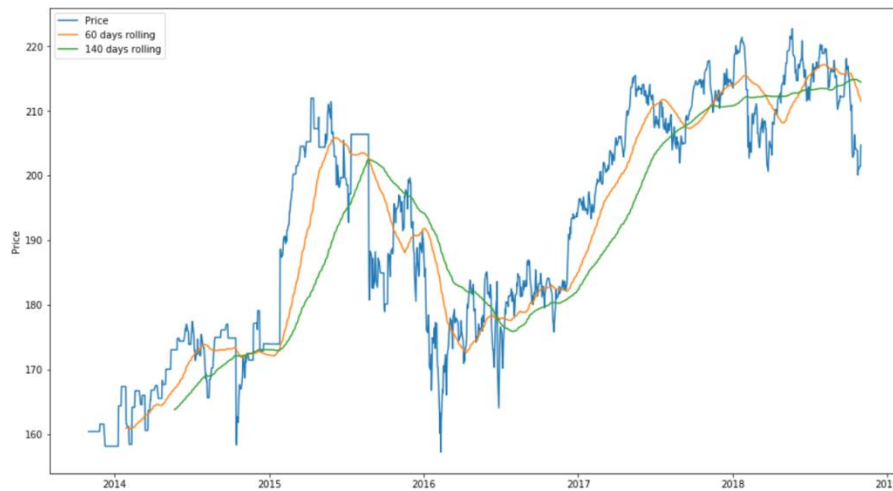
Step 2

The annual compounded growth rate, annual volatilities and yearly rolling averages of volume were calculated for each product. Since there are only 252 trading days in a year, this is the number used for the yearly rolling average.

Step 3

The trading strategy was created based on the Adjusted Closing prices in the DataFrame. Using this variable, the short-rolling and long-rolling averages were calculated for each time step. The parameters of this strategy are therefore the periods of the two rolling averages. The rationale of the strategy is the following:

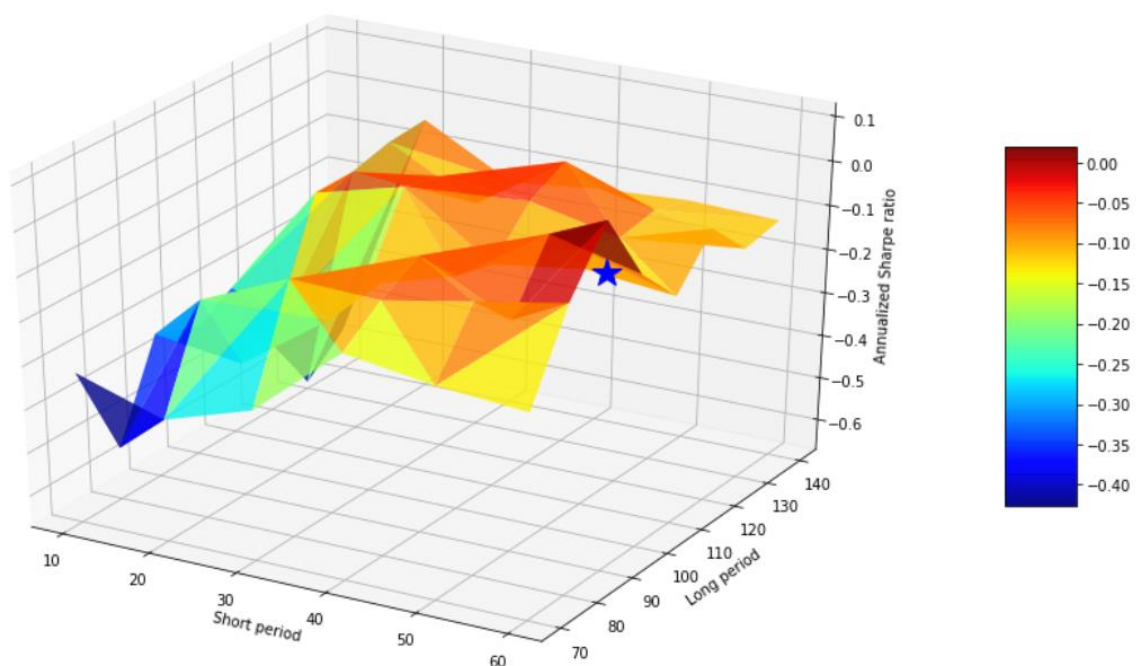
Whenever the value of the short rolling mean is higher than that of the long rolling mean, it means there is a temporary spike in the prices and it is a clue to buy shares (go long). Whenever the opposite is true, it means there is a temporary drop in the prices and it is a clue to sell shares (go short). Below is a graph illustrating the price, short-rolling and long-rolling values of the SC0E.DE product between 10-2013 and 10-2018.



Once the trading strategy was defined, a backtest was performed on the trading basket, in order to check the quality of the strategy. The metric used to evaluate the strategy was the annualized Sharpe ratio, calculated on total cash + shares owned throughout the 5 years. In other words, it is a measure of how much the profits increase over time, taking into account the volatility/risk of the products.

The optimization phase uses a brute force approach to backtest the trading strategy on several different values of the parameters and find the combination that yields the highest annualized Sharpe ratio. This optimization was performed independently for each of the 3 products.

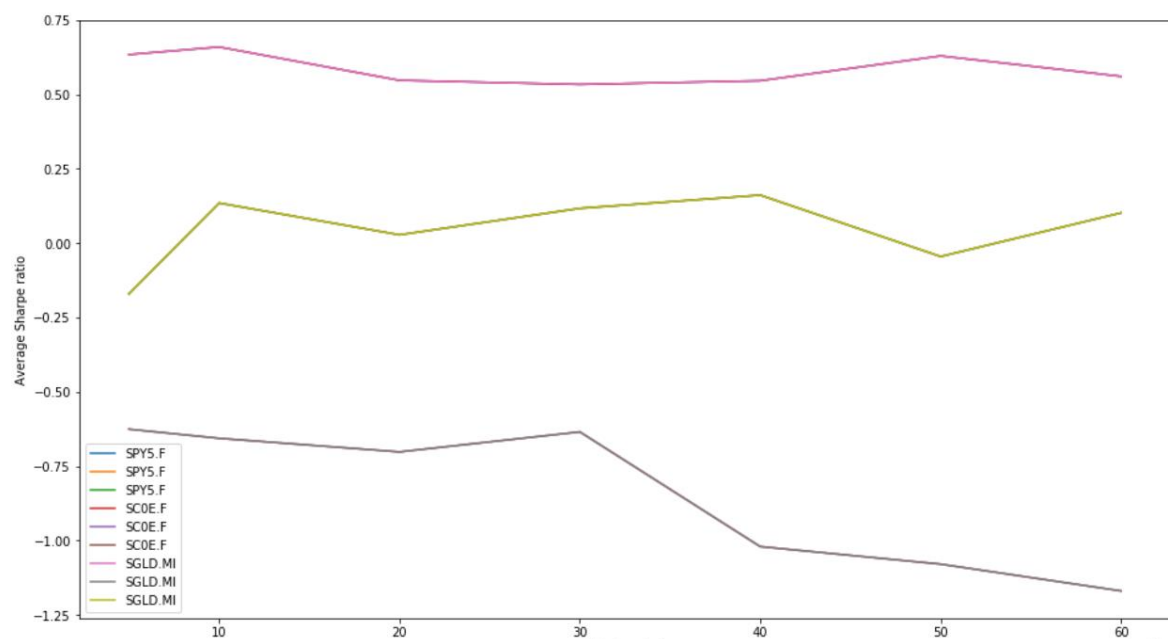
This entire process was illustrated step-by-step in the Jupyter Notebook, with an initial backtest performed for parameter values 60 and 140 for the short and long periods, respectively. Once parameter optimization is performed, 3D plots of the parameter surface and the resulting Sharpe ratios are created for each product. Below is a graph showing the 3D plot for the SGLD.L product, with a star emphasizing the maximum ratio.



Furthermore, the win-loss ratio, maximum drawdown and volatility were calculated for each of the 3 products, using the values of the total amount owned throughout the 5-year period.

Step 4

The SCOE.DE, SGLD.L and SPX5.L index values are downloaded from Yahoo finance for the 10-2016 to 10-2018 period. This data is saved as a new DataFrame. The trading strategy is applied to these new markets and the backtest is run for several different parameters. After obtaining the annualized Sharpe ratio for each possible combination of short and long periods, a plot was created to illustrate the sensitivity of the strategy with respect to the individual parameters. It was observed that, in general, strategies with small short periods and large long periods performed better. Below is a graph showing the relation between the Sharpe ratios of all 3 products and the short-rolling period.



This could be explained by the fact that a smaller short period is better at recording temporary changes in the price, since it does not average the prices and can notice sudden sparks. On the other hand, the larger the long period, the clearer the long-term trend is, which can thus help highlight the real temporary buy/sell opportunities.

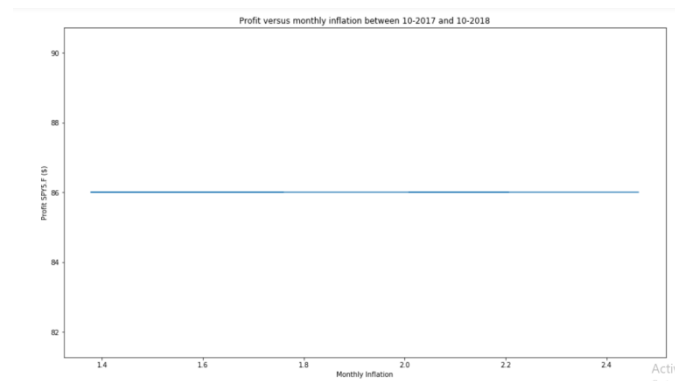
Step 5

For each product, the optimization was performed in order to obtain the best parameters. The results can be seen in the Notebook. For all products, the optimal short period was 10 days. On the other hand, the optimal long periods varied between the three products.

Step 6

The chosen macro variables were inflation, GDP, interest rate and trade. The data source was the online database of OECD Data. This data was obtained for Germany for the past year, since the index they were compared to was also German (SPY5.F). Plots of the profit were made against each of these macro variables, in order to illustrate the sensitivity of the optimal trading strategy (with optimal parameters calculated in Step 6). There seemed to be no clear relation between the

strategy profit and the macro variables. Below is a graph showing the relation between profit for the SPY5.F product and monthly inflation between 10-2017 and 10-2018.



The only event can be seen in the plot against GDP, where for higher GDP values there was lower profit. However, given that the data was averaged for three months, there were only 5 data points for the entire year, so this analysis was not relevant.

Step 7

As could be seen from the results, there are significant portions of time in which the total amount owned is constant. This was because the investor would only buy shares when the short-rolling average would overtake the long-rolling average and there are large periods of time in which this does not happen. An improvement to this model would be to buy shares not when the short average overtakes the long one, but rather when the short average starts showing a growing trend. In other words, the buy should take place at the first time point at which the current short average is higher than the previous short average. So, instead of comparing short and long averages at the current step, the investor would compare current short averages with previous short averages.

The buy would thus be made at the very low of prices, in order to minimize costs. Similarly, the sell would be made at the very high of prices, in order to maximize cash income. The sell would be made at the first sign of a starting downwards trend in the short average, instead of when the short average goes lower than the long average.