**ELEC7082 Artificial Intelligence in Finance**

**Assignment 3**

**Design and Evaluate a trading algorithm**

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**Introduction**

In this assignment, I will exploit directional changes and related data-driven techniques to develop my trading strategy, to step onto the untraveled roads. I implemented different strategies and evaluated their performance throughout the whole period to achieve more generality.

**Development of Trading Algorithm**

There are quite a few trading algorithms derived from directional changes, for example, Trend-Following Directional Change (TFDC), Trend-Following Directional Change with Trailing Stop (TFTSDC), etc. (Paniangtong, 2015), and most of them are executed on the FX market. The performance indicators could include cumulative return, maximum drawdown, profit factor and winning rate.

Firstly, we carry out the naïve TFDC algorithm, which is when there is an upturn event confirmed, we buy 1 share; when there is a downturn event confirmed, we sell it. We can define this as Strategy 0 and then revise it a little bit to form Strategy 1 by executing long and short. Admittedly, this naïve trend following strategy give us quite good returns, but we would keep exploring the opportunity by developing the strategy.

After this first trial with directional changes, we can try more complicated algorithms. According to the Average Overshoot Length scaling law (AOL scaling law), the mean absolute length of the overshoots is approximately equal to the chosen threshold on average (Glattfelder et al., 2011). Although its effectiveness in the stock market is unproved, we can dig deeper into this statistical observation. Firstly, I tried to stop loss when the trend reverses, so I developed Strategy 2 and used two thresholds in order to separate opening and closing. However, this strategy didn’t give me better returns and I found that using two sets of thresholds might be impractical and costs you some profit opportunities. Therefore, I decided to introduce TMV and formed Strategy 3.

**Summary of Trading Algorithm and results**

Strategy 0 (TFDCv0.py): Threshold (). When there is downturn confirmed, buy 1 share; when there is upturn confirmed, sell this 1 share.

Strategy 1 (TFDCvLS.py): Threshold (*θ*). When there is downturn, enter Short & exit Long; when there is upturn, enter Long & exit Short.

Strategy 2 (TFDCvStoploss.py): Threshold (). When there is downturn with , enter Short; when there is upturn with , enter Long. When there is downturn with , exit Long; when there is upturn with , exit Short. Strategy 2, 2.1: = 5.0%, = 2.5%, 4.0%.

Strategy 3 (TFDCvTMV.py): Threshold (), N. When there is downturn or upturn with , enter Short or enter Long; when there TMV is bigger than N, exit Long & exit Short.

Table 1 Trading Results of Strategy 0 and Strategy 1with different thresholds

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Strategy 0 | | | | Strategy 1 | | | |
| Threshold | Return | Max Drawdown | Winning rate | Profit Factor | Return | Max Drawdown | Winning rate | Profit Factor |
| 0.05% | 1276.062 | 1.438 | 0.322 | 1.082 | 3855.822 | 1.489 | 0.357 | 1.117 |
| 0.1% | 1702.938 | 1.438 | 0.327 | 1.112 | 4730.772 | 1.489 | 0.364 | 1.148 |
| 0.5% | 853.187 | 1.438 | 0.330 | 1.061 | 3031.692 | 1.453 | 0.364 | 1.103 |
| 1.0% | 736.835 | 1.430 | 0.349 | 1.064 | 2798.989 | 1.112 | 0.368 | 1.112 |
| 1.5% | 704.612 | 1.381 | 0.364 | 1.067 | 2734.542 | 1.310 | 0.374 | 1.123 |
| 2.5% | 783.789 | 1.402 | 0.392 | 1.084 | 2841.770 | 1.299 | 0.395 | 1.157 |
| 3.5% | 511.360 | 1.392 | 0.398 | 1.068 | 2269.113 | 1.144 | 0.386 | 1.144 |
| 5.0% | 2795.876 | 1.463 | 0.459 | 1.574 | 6936.932 | 1.281 | 0.432 | 1.660 |
| 6.0% | 1617.242 | 1.439 | 0.381 | 1.318 | 4598.870 | 1.223 | 0.357 | 1.415 |
| 7.0% | 978.992 | 1.432 | 0.392 | 1.206 | 3359.001 | 1.286 | 0.363 | 1.319 |
| 10.0% | 1999.487 | 1.302 | 0.491 | 1.869 | 5886.051 | 1.213 | 0.453 | 2.076 |
| 20.0% | 881.284 | 1.552 | 0.421 | 1.559 | 3503.082 | 1.221 | 0.368 | 1.719 |

Figure 1 Trading Results of all strategies with selected parameters

**Conclusions**

Different thresholds may perform best under different periods and different markets. Higher winning rate and higher profit factor does not necessarily bring about higher returns. From the results, we can see that Strategy 1 greatly improves over Strategy 0 in terms of Return, also Max Drawdown and Profit Factor, maybe because it exploits opportunities both in upturn and downturn. However, Strategy 2 doesn’t improve the return of Strategy 1 and some of the original profit opportunities were lost in Strategy 2. Strategy 3 improves over Strategy 2, and although it doesn’t beat Strategy 1, it is safer and might outperform others when right period is chosen. As for me, I would choose this cautious strategy because it both generates lower risk and gives quite good returns.

**Limitations and Prospect**

One limitation of my algorithm is that I apply it to the whole period of 2004 – 2018 in order to prove its generality. Generally, the trading algorithm should be different under different circumstances, for example, for short-term and long-term. Also, different market characteristics must be considered. Furthermore, parameters like NDC, VT, OSV, Sigma (Tsang et al., 2017) should be introduced in order to monitor the trend better, and volatility should be included if risk-free rate is available. I will continue to develop new strategies under different conditions in order to achieve a higher return and lower volatility.***References***

Glattfelder, J., Dupuis, A., & Olsen, R. (2011). Patterns in high-frequency FX data: Discovery of 12 empirical scaling laws. *Quantitative Finance*, 11(4), 599-614.

Paniangtong, S. (2015). The Evaluation of the Trend-Following Directional Change with the Trailing Stop and Major-Trend-Adjusted Strategies on Algorithmic Trading in the Foreign Exchange Markets (Doctoral dissertation, University of Essex). *Trading in the Foreign Exchange Markets*[D]. University of Essex, 2015.

Tsang, E., Tao, R., Serguieva, A., & Ma, S. (2017). Profiling high-frequency equity price movements in directional changes. *Quantitative Finance*, 17(2), 217-225.