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An Approach to Find the Point of Buying Stock Based on Big Data

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1. Introduction

Since China developed its stock market, the scale has continuously expanded, the number of quoted companies has steadily increased. As the institutional construction has gradually perfected, the participants have become more and more. By the development of many years, now the stock market has become an important pillar of China’s socialist economy with Chinese characteristics, which extremely adapts to the development of China’s economy, and greatly promotes its prosperity, development and stability. The trade of stock has also become a major investment channel for China’s people. Stock market is a huge complex system. A lot of theoretical work is needed to do for how to effectively build the system. Therefore, the China’s stock market has received extensive attention and research since it came into being in the 1990s. For example, D.W.Tian discussed whether the reform of the divisional of stock right has an impact on the effectiveness of China’s stock market, which provided a reference for the formulating of relevant policies [1]. S.Wang et al. predicted the feasibility of changes of stock price by Markov chain [2]. X.K.Li used the Copula function to analyze the correlation of Shanghai stock market and Shenzhen stock market [3]. X.L.Ren et al. argued the spillover effect of fluctuations between international energy market and China’s stock market, as well make an empirical analysis [4]. R.W.Lin et al., based on multi-dimensional interactive verification, tried to predict the trend of the stock market from multiple dimensions and tested the method by establishing a relevant model [5]. X.P.Teng et al. proposed a method of predicting stock price trend based on the deep multiple regression model [6].

The moving average is often used to show the average level of historical fluctuations of stock prices, thus, to a certain extent, reflects the future development trend of stock prices. Therefore moving averages are an import-
by changing the simple moving average as the weighted moving average, and the finding suitable scale according to the expected success probability as the finding suitable scale according to the maximum total profit. We will, based on quantitative the technique, propose an algorithm to, through big data analysis and weighted moving average curve, find the buy point of stock; and conduct a digital experiment to further explain the algorithm and verify its performance.

2. Mathematical Programming

In order to clarify the problem that will be considered, we provide a preparation from the perspective of mathematical modeling in this section.

Let $S$ be a stock. We denote $P_i^l$, $P_i^h$ and $P_i^c$ to represent the lowest price, highest price and closing price with trading day $i$ respectively, and use $i - j$ to represent the $j$th trading day before trading day $i$. Here, $i - 1$ refers to the first trading day before trading day $i$, $i - 2$, ..., $(i - j)$ refers to the $j$th trading day before trading day $i$. We call

$$P(i) = \frac{1}{1 + 2 + \cdots + l} \sum_{j=1}^{l} P_{i-j}(l - j + 1)$$

as linear weighted average stock price with the previous $l$ trading days of trading day $i$; and call the smooth curve formed by the points $\{i, P(i)\}$ as linear weighted moving average curve, as weighted moving average for simplicity and clearness.

For stock $S$, assume that we buy one share in trading day $i$, and the period we hold shall not exceed $f$ trading days. Use $O(i, f)$ to represent the profit in the future $f$ trading days afterwards. We consider the problem how to make $O(i, f) \geq v$ with a high probability, and denote it as $S-SPMP(f, v)$, abbreviated as $SPMP(f, v)$. Here $v$ is an appropriate positive real number, which indicates the expected profit we hope to obtain.

Next, we tentatively establish an approach to solve the problem and conduct a digital experiment to further explain the algorithm and verify its performance.

Remark 1: In order to be convenience, for buying stock mentioned in present work, the number of buy is understood as one share. In practice, for to use the approach we proposed, the number can be adjusted through multiplying by the corresponding coefficient.

3. Algorithm

In this section, we try to, through establishing the follow-
ing algorithm SPMO, propose an approach to solve the
problem SPMP(\(f, v\)).

Obviously all the stock investor hope that the stock
bought can get more profit within a certain period of time.
A most popular approach is to buy stocks at the price below
certain moving average. It is a difficult question to tackle
with that at what position in the region of stock price below
the moving average we should buy the stock for, on the one
hand, that the difference between the moving average and
the buying price is less will result in the profit of buy stock
reducing; on the other hand, that the difference is more will
result in the chance to buy stock reducing. So, it is the bot-
tleneck for the investors buy stocks according the approach
to determine the buying point.

Given a problem SPMP(\(f, v\)), let
\(P^r_i, P^h_i, P^l_i, i = 1, 2, \cdots, l + L + f,\)
be respectively the lowest price, highest price and closing
price with trading day \(i\) for the latest \((l + L + f)\) historical
data, and \(P_0\) be the current price. We try to find an suit-
able \(\delta > 0\) basing on these data such that it is possible to
guarantee the profit \(v\) with a high probability within the
next \(f\) trading days that the investors buy stocks when
\(P_0 < [\bar{P}(1) - \delta].\)

We use the intensive search method to accomplish this
Task. Take an appropriate small \(\varepsilon > 0\). Then, we replay the
trades, in turn, on \(L\) trading days \(i = f + 1, f + 2, \cdots, f + L,\)
for
\[
\delta = \varepsilon, 2\varepsilon, 3\varepsilon, \cdots, \max_{f+1 \leq i \leq f+L} \{P^h_i\}
\]
respectively. Assume \(P^l_i\) to be the current price when
we replay the trade for trading day \(i\). On the trading
day \(i\), we first consider whether the stock can be
buy at a price lower than \([\bar{P}(1 + i) - \delta]\), namely,
\(P^l_i < [\bar{P}(1 + i) - \delta].\) If it is not possible, \(0\) is used as
the profit of trading day \(i\); otherwise, we further consider
in two cases that the profit can reach \(v\), namely
\([\bar{P}(1 + i) - \delta + v] < \max_{f+i+1 \leq j \leq f+i+L} \{P^h_j\}\); and the profit can not
reach \(v\), namely, \([\bar{P}(1 + i) - \delta + v] \geq \max_{f+i+1 \leq j \leq f+i+L} \{P^h_j\}\). In
the first case, \(v\) is regarded as the profit of this trading
day. In the second case, \({P^h_i - [\bar{P}(1 + i) - \delta + v]}\) is regarded as the profit of this trading day. For an
\(\delta\) determined , after the replaying trade completes for
each of the \(L\) trading days, take the sum of the profits of each trading day as the total profit with
\(\delta\) for the \(L\) trading days, and indicated it as \(R_k\),
where \(k = \frac{\delta}{\varepsilon}\). Finally, we find the \(k^*\) that satisfies
\(R_{k^*} = \max \{R_k\}\), and use \(\delta^* = k^*\varepsilon\) as the \(\delta\) we want
to find.

From the states above, we can obtain the following
observation. On the one hand, if the historical data used is
less, namely \(l\) and \(L\) are too small, from the viewpoint of
statistic, the found \(\delta\) is too difficult to guarantee suc-
cess of high probability, that is, when the investors buy
stocks under the condition \(P_0 < [\bar{P}(1) - \delta]\), they do not
easily obtain profit \(v\) within the next \(f\) trading days, so
the amount of historical data used should be sufficiently
large. On the other hand, it does not meet the actual needs
that the speed of calculation is too slow, so the speed of
calculation should be sufficiently fast. That is to say, in or-
der to effectively achieve the above ideas, we must use the
big data technology. For processing big data at high speed,
it is impossible to do without computers. Next, according
to the above ideas, we design an algorithm SPMO to
solve SPMP(\(f, v\)) with high probability, which can be
executed by a computer and can better illustrate our meth-
dod too.

**SPMO Algorithm**

**Question:** S-SPMP(\(f, v\)).

**Input:**
\(f, l, L, v, \varepsilon, P^r_i, P^h_i, P^l_i, i = 1, 2, \cdots, l + L + f; P_0.\) \((f, l, L, v, \varepsilon > 0)\)

\((Here, \ f\ is the number of the trading days within
which the investor expects to profit \(v\), \ l\ is the number
of trading days for \(\bar{P}(i)\), \ L\ is the number of training days;
\(v\) is the expected profits; \(\varepsilon\) is a parameter variable repre-
senting a kind of operation gap; \(P^l_i\) is the lowest price on
trading day \(i\), \(P^h_i\) is the highest price, \(P^l_i\) is the closing
price on trading day \(i\); \(L + L + f\) \ is the number of his-
torical data used; \(P_0\) is the current price.)

**Output:** Yes (The investor can buy stocks at the current
price); No (The investor cannot buy stocks at the current
price).

**Process:**
1. Calculate \(\bar{P}(i)\) \(i = f + 1, f + 2, \cdots, f + L.\)
2. \(k := 0; \ \delta := 0, \ \delta_0 := 0.\)
3. \(k := k + 1; \ \delta_k = \delta_{k-1} + \varepsilon, \ \delta = \delta_k.\)
If \(\max \{\bar{P}(i) - \delta - P^l_i\} = 0.\) \(i = i + 1, \cdots, L + f > 0,\)
go to the step 4; otherwise, go to the step 7.
4. Put \(R_k := 0,\) then go to the step 5.
5. For \(i = f + 1, f + 2, \cdots, f + L,\) proceed to the fol-
lowing items.
  1. If \(P^l_i \geq \bar{P}(i) - \delta,\) return to the step 5.
② If $P_i^l < \bar{P}(i) - \delta$, proceed the next item.

③ If $\bar{P}(i) - \delta + v \leq \max_{i=15, j=1+} \{P_k^b\}$, put $R_k := R_k + v$; otherwise, put $R_k^* := R_k + (P_k^c - \bar{P}(i) + \delta)$.

(6) After completing the loop, return to the step 3.

(7) Find $k^*$ such that $R_k^* = \max \{R_k\}$. Then, make $\delta^* = \delta_k^*$.

(8) If $P_0 < \bar{P}(0) - \delta^*$, output Yes; otherwise, output No. Stop.

4. Experiment

We take TongHuaShun (300033) of Shanghai stock market as an instance. The experiment selects 270 trading days from September 6, 2018 to October 22, 2019; takes the daily highest price, lowest price and closing price for each trading day selected as the original experimental data; chooses $l = 60, L = 120, f = 30, v = 4.5, c = 0.2$, and takes respectively each trading day of 30 trading days from July 23, 2019 to September 2, 2019 as the current trading day and the lowest price of the current trading day as the current price. Then, in turn, for each current trading day, input the related data into the MATLAB program of algorithm $\text{SPMO}$ and conduct the experiment. See the following and Table 1 for details.

(1) Take July 23, 2019 as the current trading day, or say trading day 0. On $i = 0$ (July 23, 2019), 1 (July 22, 2019), 2 (July 19, 2019), ..., $(L + f + l)$ (September 06, 2018), input the related data into the MATLAB program of algorithm $\text{SPMO}$, then obtain the result: No, i.e. can’t buy , the profit is 0.

(2) Take July 24, 2019 as the current trading day, or say trading day 0. On $i = 0$ (July 24, 2019), 1 (July 23, 2019), 2 (July 22, 2019), ..., $(L + f + l)$ (September 07, 2018), input the related data into the MATLAB program of algorithm $\text{SPMO}$, then obtain the result: No, i.e. can’t buy , the profit is 0.

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(30) Take September 02, 2019 as the current trading day, or say trading day 0. On $i = 0$ (September 02, 2019), 1 (August 30, 2019), 2 (August 29, 2019), ..., $(L + f + l)$ (October 25, 2018), input the related data into the MATLAB program of algorithm $\text{SPMO}$, then obtain the result: No, i.e. can’t buy , the profit is 0.

From table 1, it can be seen that among 30 trading days, 18 trading days can buy the stock TongHuaShun (300033), and can receive the profit $v$ within the future 30 trading days. The conclusion shows that the algorithm $\text{SPMO}$ is effective and has certain feasibility.

| Current date | Buy or not | Benefit or not | Current date | Buy or not | Benefit or not |
|--------------|-----------|---------------|--------------|-----------|---------------|
| 2019.7.23    | No        | ----          | 2019.8.12    | Yes       | Yes           |
| 2019.7.24    | No        | ----          | 2019.8.29    | Yes       | Yes           |
| 2019.7.25    | No        | ----          | 2019.8.28    | Yes       | No            |
| 2019.7.26    | No        | ----          | 2019.8.27    | No        | No            |
| 2019.7.29    | Yes       | Yes           | 2019.8.26    | No        | No            |
| 2019.7.30    | No        | ----          | 2019.8.25    | Yes       | Yes           |
| 2019.7.31    | Yes       | Yes           | 2019.8.24    | No        | No            |
| 2019.8.1     | Yes       | Yes           | 2019.8.23    | Yes       | Yes           |
| 2019.8.2     | Yes       | Yes           | 2019.8.22    | Yes       | Yes           |
| 2019.8.3     | Yes       | Yes           | 2019.8.21    | Yes       | Yes           |
| 2019.8.4     | Yes       | Yes           | 2019.8.20    | Yes       | Yes           |
| 2019.8.5     | Yes       | Yes           | 2019.8.19    | Yes       | Yes           |
| 2019.8.6     | Yes       | Yes           | 2019.8.18    | Yes       | Yes           |
| 2019.8.7     | Yes       | Yes           | 2019.8.17    | Yes       | Yes           |
| 2019.8.8     | Yes       | Yes           | 2019.8.16    | Yes       | Yes           |
| 2019.8.9     | Yes       | Yes           | 2019.8.15    | Yes       | Yes           |
| 2019.8.10    | Yes       | Yes           | 2019.8.14    | Yes       | Yes           |
| 2019.8.11    | Yes       | Yes           | 2019.8.13    | Yes       | Yes           |

Remark 2: The experimental data above comes from the stock trading software of TongHuaShun. In the experiment, the lowest price of the current trading day is taken as the current price.

Remark 3: (1) The simulation experiment above is completed through the following two steps. Firstly, write the MATLAB program of algorithm $\text{SPMO}$. Secondly, for the related data selected, run the program to perform big data operations on a computer with model of Inspiron1427FT02 and CPU of Intel(R) Core(TM)2 Duo CPU T6500 @2.10GHz.

(2) The algorithm $\text{SPMO}$ not only has many parameteric variables, but also can quickly extract a large amount of data from the stock trading software, quickly carry out calculations, and timely answer the question whether investors can buy the related stock at the current price. So, it fully reflects the characteristics of big data technology.

5. Conclusion

Influenced by the boom of big data and quantitative investment, as well as the previous related research, especially the work of X.X.Xu et al. the present work tries to based on quantitative the technique, established an approach to, through big data analysis and weighted moving average curve, find the buying point of stock, and then conducts an experiment to make a further illustration. The experiment made by us shows that the approach is effective. It is the issue worthy of further research to, from others ideas, develop the new algorithms for finding stock trading points with the big data and quantitative investment technique, as well as discuss the rate of return on the developed algorithm. We will continue to work hard. And meanwhile we extremely look forward to the present work can stimulate the interest of much friends so

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that more scholars can take delight in this research area together promoting the development of the research work of quantitative technology and trading technology!

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