

QUANTIFIED MOVING AVERAGE STRATEGY OF CRUDE OIL FUTURES MARKET BASED ON FUZZY LOGIC RULES

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Overview

Studies on crude oil futures market are mostly focus on the qualities, while quantity is a very important aspect especially in calculating handling charge.

In this paper, we use three kinds of moving average and different time period length to compose fuzzy logic rule base. Previous year's data are used to decide fuzzy degree. Ten fuzzy logic rules compose as a fuzzy set. Genetic algorithms are used to find optimal fuzzy logic rule set. We use crude oil futures prices from New York Mercantile Exchange (NYMEX) and repeat the experiment for three times. From all the results, we conclude that compared with using moving average strategies directly, using fuzzy logic rules can get more stable rate of return. Holding amount generated by tend to be conservative. Volatile price series generate small amount deals. Since the fuzzy logic rules consider the previous data effect, SMA become the most effective moving average strategy. The results from this study could provide additional aid in investment decisions.

Methods

Moving average strategy is wildly used in financial market technical analysis. It is a mathematic smooth tool. Moving average method is trying to using moving average line of prices to predict the market and makes it possible for computer to generate buying and selling signals automatically. Buying signals and selling signals are generated by the moving averages of long-term period and short-term period price series. Buy when the average of short-term period exceed the average of long-term period and sell when the average of long-term period exceed the average of short-term period. However, we can only get signals from moving average strategies. Except from signals, volume is also a key factor when making investment strategies. In this paper, a crude oil futures trading strategy based on both signals and volumes.

Fuzzy logic rule is introduced to make trading volume decision. Fuzzy logic is a very effective method for financial market trading rule finding. It is an imitation of uncertainty judgment of human brain. It is not only used for trading signal judgment in this paper but also used to solve trading volume problems. Fuzzy logic rules with moving average strategies are combined as fuzzy base, and then some of them are picked to form a fuzzy rule set. Every set gives a rating degree which decides the trading volume. In the research for the optimal fuzzy rule set, genetic algorithm is used.

To find sets with better performance, we use genetic algorithms. The genetic algorithm is a computational model used to simulate natural selection and biological evolution. Using the processes of selection, crossover, and mutation, genetic algorithms search for the optimal solution.

The sets in the genetic algorithms are called individuals. Every population contains 20 individual. After one experiment of one generation, the population need to evolve. We keep 10% best individuals from the old population as one part of new generation. We select 80% best individuals and random generate 10% to crossover and mutation as the other part of the new generation. The crossover here indicates exchange rules between two individuals. The mutation means the exchange between two rules (it is also a kind of crossover, but it happens within an individual, so we would call it mutation) and genetic change in a rule.

Results

The data used in this paper are crude oil futures prices from New York Mercantile Exchange (NYMEX). We downloaded the data from Energy Information Administration (EIA) website on November 7th, 2014. (http://www.eia.gov/dnav/pet/pet_pri_fut_s1_d.htm). We choose contract 1 prices from EIA data. That is to say, every month we choose the most active contract data from 12 crude oil futures contracts. The experiment time period in this paper is from 2000 to 2013. The genetic algorithms need some training and selecting data, the moving average strategies and fuzzy logic rules also need to set aside a portion data as background. Finally, we use the data from Jan 09, 1995-Dec 16, 2013, a total of 4750 trading days as the experimental data. The

experimental data divide into 14 groups. In this paper, 750 trading days are set aside. Train period contains 500 trading days. Select period and test period are both 250 trading days, which is approximately one year. Fig. 1 shows the group situation.

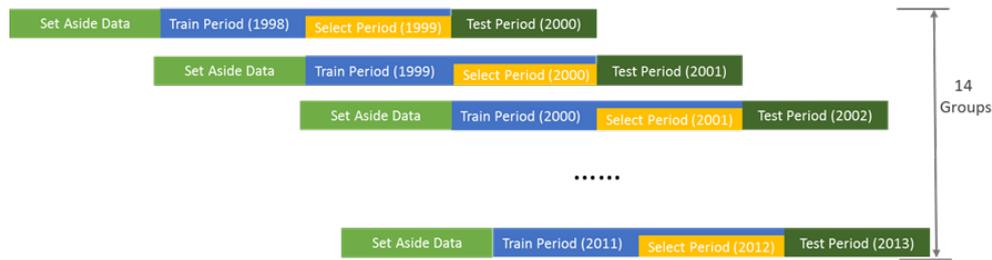


Fig. 1 experimental groups

We did 3 repeated experiments when this abstract finished, since the every time of the experiment lasts about 20 hours. We exported the average holdings everyday. with the crude oil futures prices. We can know from the figure that this trading strategy is conservative. When prices are volatile, the trading strategy take small amount deals. While when price trend is stable, the trading strategy take big amount deals.

Compared to our previous study, the quantified trading strategy gives stable rate of returns. The returns do not have much advantage over the non-quantified trading strategy, but also does not have a lot of lag behind.

We use three different moving average strategies in this paper, SMA, AMA, and TMA. Table 1 shows all the moving average strategies from best individuals in every year time period of three experiments. We can know from table 1 that the SMA is the most effective strategy from all the three experiments. That is different from our previous study.

Table1 Moving Average Strategies Statistics

| | Experiment 1 | Experiment 2 | Experiment 3 |
|-----|--------------|--------------|--------------|
| SMA | 74 | 70 | 70 |
| AMA | 40 | 26 | 38 |
| TMA | 26 | 44 | 32 |

Conclusions

In this paper, we use fuzzy logic rules to calculate the volume of trading strategies. Compared with using moving average strategies directly, using fuzzy logic rules we can get more stable rate of return. Holding amount generated by tend to be conservative. Volatile price series generate small amount deals. Since the fuzzy logic rules consider the previous data effect, SMA become the most effective moving average strategy.

We will try to filter some rules before genetic algorithm, change initial capital and repeat more experiments to find better fuzzy logic rule sets.

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