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Application of Weighted Markov Chain in Stock Price Forecasting

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Abstract. The stock's price of China Sport Industry was studied in this paper, and the theory of Weighted Markov Chain was applied to forecast the stock's price.

Firstly, based on the historical data of China Sport Industry'stock, Spss software was used to conduct fuzzy clustering analysis, and the known data was divided into six categories.

Secondly, For the application of Weighted Markov Chain, the historical data of the stock's closing price was tested about "Markov Property".After testing that the stock's price of China industry satisfies "Markov Property", state transition matrix was constructed useing data .The weight values of every state were calculated with the metheod of Weighted Markov Chain theory and prediction intervals of the industry's future stock prices were obtained.

Keywords: Weighted Markov Chain; "Markov Property" Test; Transition Matrix; Stock Price Forecast

1 Introduction

In short, Weighted Markov Chain can be used to describe a lot of dynamic system problem in economic and social phenomenon[1-3]. From the perspective of the methods to predict, some directly use Weighted Markov Chain transition probability for prediction; some combine it with fuzzy mathematics to predict and some combine it with the linear time series model; furthermore, various kinds of the Weighted Markov Chain are also used to predict. From the point of the predicted results, the accuracy and practicability of the Weighted Markov Chain are relatively high and clear. As it is objective and easy to understand, simple to calculate, accurate and reliable, it is worthy of our study and promotion[4].

2 The Application of the Weighted Markov Chain in Forecasting the Stock Price

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2.1 Basic Step

Now taking the stock price changes of China Sports Industry in 70 trading weeks from February 6, 2012 to June 11, 2013 for example, use the Weighted Markov Chain model for prediction.

Now we use the Weighted Markov Chain prediction theory to analyze the stock prices[5]:

Step 1. Calculate the mean value $\bar{x} = 9.3879$ and mean square error $s = 1.3698$ of the sequence X_n

Step 2. The sequence index is divided into six levels. The corresponding state space is $E = \{1, 2, 3, 4, 5, 6\}$. The specific dividing results are shown in Table 1:

Table 1. State division table of stocks closing prices of Chian Sports Industry

State	Grades	Standards for Grading	Blocks of the stock prizes
1	Plunge	$x < \bar{x} - 1.0s$	$x < 8.02$
2	Flat Plunge	$\bar{x} - 1.0s \le x < \bar{x} - 0.5s$	$8.02 \le x < 8.70$
3	Downward Flat	$\bar{x} - 0.5s \le x < \bar{x}$	$8.70 \le x < 9.39$
4	Upward Flat	$\bar{x} \le x < \bar{x} + 0.5s$	$9.39 \le x < 10.07$
5	Rise	$\bar{x} + 0.5s \le x < \bar{x} + 1.0s$	$10.07 \le x < 10.76$
6	Soar	$x \ge \bar{x} + 1.0s$	$x \ge 10.76$

Step 3. Carrying out the "Markov property" inspection of the known stock's closing price sequence.The data of the closing prices of 70 weeks from February 6, 2012 to June 11,2012 was calculated, and thefrequency matrix f_{ij} of each stock prize state was concluded. The statistic value $\chi^2 = 124.3377$ was calculated by the formula

$$\chi^2 = 2\sum_{i=1}^{m}\sum_{j=1}^{m} f_{ij}\left|\ln\frac{P_{ij}}{P_{gi}}\right|$$

As the given significance level was $\alpha = 0.05$, by looking up the table, the quantile was $\chi^2_{0.05}\left((6-1)^2\right) = \chi^2_{0.05}(25) = 37.652$ .So the stock's closing prize sequence conformed to the markov property as $\chi^2 > \chi^2_{0.05}(25)$ [6]. Therefor the Weighted Markov Chain prediction theory could continue to be used to forecast the stock price.

Step 4. Calculate each order autocorrelation coefficient r_k of the sequence parameter values and the weight of Markov Chain with various formula,that is $r_k = \dfrac{\sum_{i=1}^{n-k}(x_i - \bar{x})(x_{i+k} - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$ and $w_k = \dfrac{|r_k|}{\sum_{k\in s}|r_k|}$ .where r_k is the k order autocorrelation coefficient; x_i is the stock's closing price of the i week; $\bar{x}$ is the mean stock's

closing price; n is the length of the reference sample sequence; w_k is the weight of Markov Chain with a step of k orders. Calculate each order autocorrelation coefficient and the weight of each step, as shown in the table below

Step 5. The prediction of the price range

and Table 3 was obtained

Table 2. The prediction about stock's closing price in the 71th week

State	1	2	3	4	5	6
P_i	0.0961	0.0958	0.4414	0.2092	0.1575	0

Table 2 indicated $max\{p_i, i \in E\} = 0.4414$ at this point, namely the stock's closing status of China Sports Industry in the 71th week was 3, and the closing prize met the block $8.70 \le x < 9.39$, with probability of 44.14%. Acctually, the actual closing price in 71th week was 8.70, which was consistent with the prediction block.

The stock's closing prices in the 72th ,73th ,74th ,75th and 76th weeks predicted by the above method.

2.2 Comparison of the Weighted Markov Prediction Result and Markov Prediction Result

Aiming at the problem, Markov chain theory could also be used to forecast the stock price. In the following the prediction error of the two kinds of forecasting method for the stock's closing price was compared:

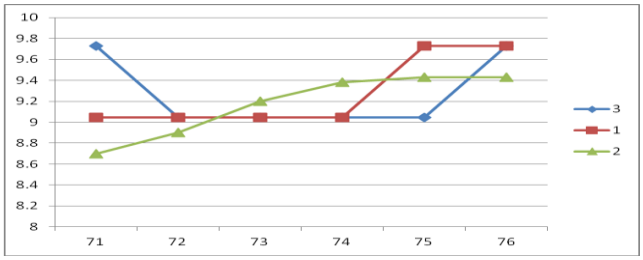

Fig. 1. Comparison Chart of the Prediction Results by the Two Methods with the Actual Value

In the Fig. 1, curve 1 represented the median of the stock price range predicted by weighted Markov,curve 2 represented the actual closing price, and curve 3 represented the median of the stock price range predicted by Markov. From the predictions by the two methods for forecasting stock's closing prices of the next several weeks we could see the prediction results by weighted Markov chain were more close to the actual value, while the error of Markov chain prediction was relatively larger.

3 Conclusion

This article bases on the markov property of the stock price sequence and uses weighted markov model to predict the stock price change block, providing certain reference value for individual or collective investment. Due to the high risk of stock and investment options and the complex factors that influence investment payback period, the change of stock prices, stock payback period and the option price could be further enriched and perfected after accumulating enough data about stock price and option price, indicating that the analysis results are consistent with the actual data. In addition, with the increase of representation of the data, autocorrelation coefficient, state transition matrix and weight will come about some changes, and this change will further perfect the forecast and further improve the prediction precision.

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