An Intelligent Forecasting Model for Rowing

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***Abstract*—According to the current International Rowing Federation, the distance from the rowing competition is 2000 meters, the match time depending on the different items. The boating operation relies on the paddle hand of the boat to push the boat forward quickly with the work done by the paddle hand. As a result, boating wants to pass the endpoint at less time in a specified distance, and must increase the frequency of rowing per minute on the ship as a power paddle. Increasing the strength of each paddle allows the ship to paddle at the most force of each oar. Each oar hand puts forward the required quality requirements, that is, strength, speed, muscular endurance and rhythm. At present, many scholars have put forward many methods to study sports monitoring at home and abroad, but this sport is rarer in rowing.**

Therefore, this study will present the intelligent prediction of rowing performance model to predict the performance of the contestants, including:

(1) We use four weight methods to defuzzify: (a) dynamic weight forecasting, (b) equal weight, (c) sequential weight, and (d) trends weight.

(2) Finally, the forecasting value is optimized by the adaptive adjustment method.

Finally, this study uses the public information provided by the International Rowing Alliance website as a training prediction model. The test results are compared with the weight-cutting and forecasting methods.

***Key words* — Rowing, Fuzzy, Time series, Forecasting.**

I. Introduction

According to the International Rowing Union, the distance from the rowing competition is 2000 meters. Match time depending on different items, the time is approximately 5 minutes 30 seconds to 9 minutes. The boating operation is to rely on the paddle hand of the boat to do the work of the paddle to promote the ship to make the boat fast forward, throughout the race, the rower's paddle hand to do 220 to 250 times to paddle. To finish the 2000-meter race. Thus, if a rower wishes to cross the finish line in less time within the specified distance, he / she must increase the frequency of the paddle per minute as a paddler on the vessel. Increasing the intensity of each paddle enables the boat to paddle rapidly under the optimum strength of each paddle. The necessary quality requirements for each paddler are: strength, speed, endurance and rhythm.

Therefore, this study will present the intelligent prediction of rowing performance model to predict the performance of the contestants, including:

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II. Literature Review

A. Rowing

Rowing was founded in 1892 by the Union Turlin to form the International Rowing Federation, known simply as FISA, initially in France, Belgium, Italy, Switzerland, Australia and other countries. The 1892 International Rowing Federation created and unified the rules for the 1900 Olympic Games. The 1976 Olympic Games were the first official competition in which female rowers entered the Olympic Games. Before the first Olympic Games, rowing was gradually gaining popularity among some enthusiasts. Rowing was the first sport to start in Europe. Each race showed that whoever learned the longest and who had better motor skills would naturally win.

The United Kingdom, one of the cradles of rowing in the world, once occupied a dominant position in the ancient Chinese regattas. In the history of the Olympic centenary, it is stated that 1900 years of rowing were officially added to the Olympic Games at the Second Olympic Games held in France, which not only enabled rowing to move towards the official competition but also brought sport into the world.

B. Fuzzy time series

Song and Chissom (1993b) proposed a Fuzzy Time Series model to deal with the problems involving historical data with linguistic expression(Ross, 1995; Zadeh, 1975a; 1975b; 1976). In the following research, they continued to discuss the difference between time-invariant and time-variant models (Song and Chissom, 1993a; 1994). Besides the above researchers, Chen (1996)presented a method to forecast the enrollments of the University of Alabama based on fuzzy time series.

Over the past fourteen years, many fuzzy time-series models have been proposed by following Song and Chissom's definitions (Bollerslev, 1986; Song and Chissom,

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1993a; 1994). Among these models, Chen's model is very conventional one because of easy calculations and good forecasting performance (Chen, 1996; Chen and Hwang, 2000). Therefore, this dissertation briefly review some concepts of fuzzy time series from Song et al.'s definitions (Song and Chissom, 1993b) and Chen's algorithm(Chen, 1996). Generally, a fuzzy set is a class with fuzzy boundaries. Let U be the universe of discourse, $U = \{u_1, u_2, \ldots, u_n\}$. A fuzzy set A of U is defined by $A = f_A(u_1)/u_1 + f_A(u_2)/u_2 + \ldots + f_A(u_n)/u_n$, where f_A is the membership function of fuzzy set A, $f_A : U \to [0, 1]$, u_i is an element of fuzzy set A, $f_A(u_i)$ indicates the degree of membership of u_i in A, $f_A(u_i) \in [0, 1]$ and $1 \leq i \leq n$. The definitions of fuzzy time series are reviewed as follows.

Definition 1: fuzzy time-series

Let Y(t) (t =… 0, 1, 2,…), a subset of real numbers, be the universe of discourse on which fuzzy sets Fi(t)(i =1, 2,…) are defined and let F(t) be a collection of Fi(t)(i =1, 2,…). Then F(t) is called a fuzzy time-series defined on Y(t) (t =… 0, 1, 2,…).

Definition 2: fuzzy time-series relationships

Suppose that F() is caused only by $F(t-1)$, then the relationship can be expressed as: $F(t) = F(t-1) * R(t, t-1)$, where $R(t, t-1)$ represents a fuzzy relationship between F(t) and F(t-1), * is an operator.

To sum up, let F(t-1=A_i) and F(t)=A_j the fuzzy logical relationship between F(t) and F(t-1) can be denoted as Ai $\rightarrow$ Aj where Ai refers to the left-hand side of the fuzzy logical relationship and Aj refers to the right-hand side. Furthermore, these fuzzy logical relationships can be grouped together by the same left-hand sides to establish grouped fuzzy relationships.

Due to the heavy calculations both in Establishing the fuzzy relationships and forecasting , and defuzzifying the forecasting results, Chen(1996) proposed arithmetic operations to simply the calculations in Song and Chissom's model(Song and Chissom, 1993b).

The Algorithm of Chen's model

Step 1: Define the universe of discourse and intervals for rules abstraction.

Based on the issue domain, the universe of discourse can be defined as: U = [*starting*, *ending*]. As the length of interval is determined, U can be partitioned into several equal length intervals.

Step 2: Define fuzzy sets based on the universe of discourse and fuzzify the historical data.

Step 3: Fuzzify observed rules.

For example, a datum is fuzzified to A_j if the maximal degree of membership of that datum is in A_j.

Step 4: Establish fuzzy logical relationships and group them based on the current states of the data of the fuzzy logical relationships.

For example, $A_1 \rightarrow A_2$, $A_1 \rightarrow A_1$, $A_1 \rightarrow A_3$, can be grouped as: $A_1 \rightarrow A_1, A_2, A_3$.

Step 5: Forecast.

Let $F(t\text{-}1)=A_i$.

Case 1: There is only one fuzzy logical relationship in the fuzzy logical relationship sequence. If $A_i \rightarrow A_j$, then $F(t)$, forecast value, is equal to A_j.

Case 2: If $A_i \rightarrow A_i, A_j, \ldots, A_k$, then $F(t)$, forecast value, is equal to $A_i, A_j, \ldots, A_k$.

Step 6: Defuzzify.

Apply "Centroid" method to get the results. This procedure (also called center of area, center of gravity) is the most often adopted method of defuzzification.

C. Momentum Weighting

Technical analysis of momentum based on the assumption of an efficient market is an important part of trading tools in major stock markets (Colby, 2002; Vandewalle et al., 1999). Tanaka-Yamawaki and Tokuoka utilized nine technical indicators to predict stock price (Tanaka-Yamawaki and Tokuoka, 2007), and the momentum indicator have better performance to predict price. The momentum indicator is the stock price variation and momentum represents the power of the market defined as follows (Tanaka-Yamawaki and Tokuoka, 2007). MO1 and MO2 are the case for n=1 and 2, respectively.

MO(t)=price(t) – price(t-n) (1)

D. Adaptive expectations method

The model presented in this study is reinforced by the Adaptive Expectations Theory (Kmenta, 1986; Chen et al., 2008). In the Adaptive Expectations Theory, the predicted future values are composed of the last period of current data values and error correction values (see Equation 2 for details). This study will prove that the model still has a valid reference even in real data.

$P(t) = P(t-1) + h_0 * e(t-1)$ (2)

where $P(t)$ is the price at time t; $P(t\text{-}1)$ is the price at time t-1; h_0 is a weighted parameter; $e(t\text{-}1)$ is the forecasting error at time t-1

III. Research Framework of Proposed Model

From the reviewed literature, there are three key processes to influence the forecasting performance of fuzzy time-series: (1) Data preprocess, (2) Build FLRs, and (3) Forecasting.

(1) Data preprocess: Firstly, define and partition the universe of discourse for selected attribute. Secondly, fuzzify the observation, and build linguistic time series.

(2) Build FLRs: Firstly, build fuzzy logical relationships (FLR). Secondly, Group fuzzy logical relationships. Finally, produce a linguistic forecast based on the grouped FLRs

(3) Forecasting: Produce the linguistic forecasts based on weighted FLR, and defuzzify to calculate forecast value.

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Therefore, this dissertation proposes an automatic spread partition algorithm to improve data preprocess, and adaptive model to enhance the forecasting value. The dissertation proposed the framework of fusion model is shown in Fig. 1

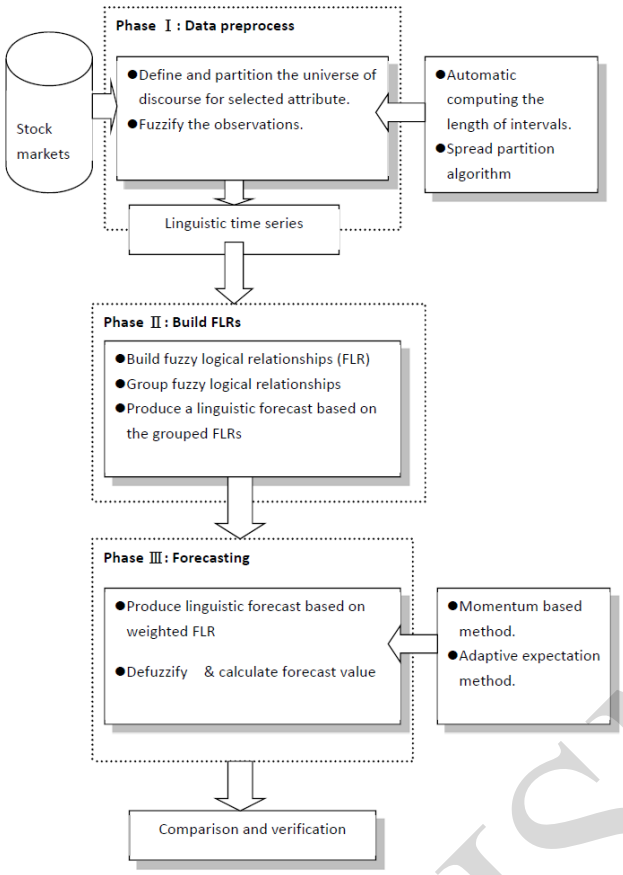


Fig. 1 Framework of fusion model based fuzzy time-series

IV. Findings and Discussions

The momentum method can consider previous periods to forecast the next period. In rowing, the rowing not only influenced by previous period but also the changes in the amount of previous rowing time is the most important influence factor for forecasting next period (Tanaka-Yamawaki and Tokuoka, 2007). The forecasting results computed by the defuzzify algorithm of momentum, which is according to different changes of momentum by defuzzified rule.

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