Forecast of Second-hand Ship Price

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Abstract. It is extremely useful to predict the future trends of second-hand ship price for company to make decision. Fortunately, the changes of second-hand ship price have a strong regularity, so, it can be predicted. A price forecast model is introduced in this paper and proved to be reliable.

Keywords: Second-hand Ship; Price Forecast; Forecasting Model

1 Introduction

With the international shipping market developments and changes in second-hand ship prices, trade of second-hand ship is very active, the purchase of overseas second-hand ships by Chinese enterprises is also very frequent. It is because building new ships take too long, the cost is too high, usually not been adopted, however, the acquisition of foreign second-hand ships has a lower price, shorter delivery cycle, is adopted by most of the shipping enterprises including SMEs. As the existence of cyclical fluctuations in prices of second-hand ship, in this paper, the gray forecast method is used to predict second-hand ship prices, to tap the market orientation and to avoid price risks for the shipping market operators and investors.

2 Empirical Analysis AND application

2.1 Second-hand Ship Price Forecasting Model

According to the former description, the 10-year age of 30000dwt dry bulk carriers are used as the research object in this paper. GM（1,1）model is used to set up second-hand ship price forecasting model based on the data from year 1999 to 2004.

Table 1. Data of Second-hand Ship Prices

year	1999	2000	2001	2002	2003	2004
price	8	9	7.75	8.5	10.75	17

（i）Make year 1999 as the starting point, t=1 at this point, the original data sequence is as follow.

$$X^{(0)}=\{x^{(0)}_{(t)}|t=1,2,\cdots,6\}=\{x^{(0)}_{(1)},x^{(0)}_{(2)},\cdots,x^{(0)}_{(6)}\}=\{8, 9, 7.75, 8.5, 10.75, 17\} \quad (9)$$

（ii）Calculate the cumulative series to get $X^{(1)}$:

$$X^{(1)}=\{X^{(1)}_{(t)}|t=1,2,\cdots,6\}=\{8, 17, 24.75, 33.25, 44, 61\} \quad (10)$$

（iii）Calculate $Z^{(1)}$ as the close to the mean generator matrix of $X^{(1)}$

$$Z^{(1)}=\{z^{(1)}_{(2)},\cdots,z^{(1)}_{(6)}\}=\{12.5, 20.875, 29, 38.625, 52.5\} \quad (11)$$

（iv）Calculate the parameters of GM(1,1) model in

$$X^{(0)}(k)+aZ^{(1)}(k)=b\,,\ Y=\begin{pmatrix} x_s^{(0)}(2) \\ x_s^{(0)}(3) \\ \vdots \\ x_s^{(0)}(6) \end{pmatrix}=\begin{pmatrix} 9 \\ 7.75 \\ 8.5 \\ 10.75 \\ 17 \end{pmatrix}, \quad (12)$$

$$B=\begin{pmatrix} -z_s^{(1)}(2) & 1 \\ -z_s^{(1)}(3) & 1 \\ \vdots & \vdots \\ -z_s^{(1)}(n) & 1 \end{pmatrix}=\begin{pmatrix} -12.5 & 1 \\ -20.875 & 1 \\ -29 & 1 \\ -38.625 & 1 \\ -52.5 & 1 \end{pmatrix},$$

$$\hat{a}=[a,b]^T=(B^TB)^{-1}B^TY=\begin{bmatrix} -0.2079 \\ 4.2173 \end{bmatrix}$$

（v）Shadow equation of second-hand ship price based on GM（1,1）model is captured

$$\frac{dX^{(1)}}{dt}+0.2079X^{(1)}=4.2173 \quad (12)$$

Time response type of second-hand ship price based on GM（1,1）model is:

$$\hat{X}^{(1)}(k+1)=-20.285+28.285e^{0.2079k}\,,\ k=0,1\cdots,n \quad (*)$$

2.2 Model Checking

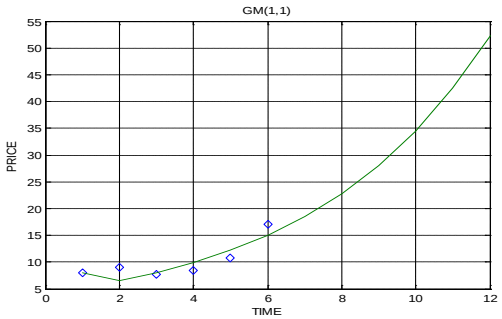
Posterior testing method is used yin this paper. The conclusion is drawn from expression of $(*)$ and （9）: simulation series $\hat{X}^{(0)}$={8, 6.54, 8.05, 9.91, 12.2, 15.01}, residual series $\varepsilon^{(0)}$ ={0, -2.46, 0.30, 1.41, 1.45, -1.99 }, average of residuals $\bar{\varepsilon}$ =-1.29, residual standard deviation S_2 =2.13, average of the original data $\bar{X}$ =10.17, the standard deviation of the raw data S_1 =7.86.

$$C=\frac{S_2}{S_1}$$

Construct variance ratio statistic C, =0.27<0.35（mean square deviation grade I level)，the accuracy of the model is superior.

2.3 Model Application

Using the model to predict the second-hand ship prices of the next six years, the results are captured as follow:



Prediction equation is as:
y =-20.2845+28.2845e^0.20791*(t-1))

Table 2. Results of Forecasting

year	2005	2006	2007	2008	2009	2010
predictive	18.48	22.76	28.02	34.49	42.46	52.27
actual	19	23				

Compare the predicted and actual values of the year 2005 and 2006, make metric analysis of the prediction accuracy of the model through calculating of mean absolute error, mean relative error and root mean square error:

MAE=[(19-18.48)+(23-22.76)]/2=0.38

$$MPE=[(19-18.48)/19+(23-22.76)/23]/2=0.019$$

$$RMSE=\sqrt{[(19-18.48)^2+(23-22.76)^2]/2}=0.405$$

Mean absolute error, mean relative error and root mean square error are little enough to tell the high prediction accuracy of the model.

3 Conclusion

The GM(1,1) model which established according to the second-hand ship prices passed relevant inspection, exhibited a high accuracy through analysis of mean absolute error, mean relative error and root mean square error, so this model is suitable of second-hand ship price prediction.

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