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The study of forecasting of cash flow in ATM based on cubic exponential smoothing method

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ABSTRACT

Cash in Bank ATM belongs to Interest free funds, to ensure there is sufficient cash in ATM for people to extract, at the same time, waste of resources that we do not wish to see. Daily ATM cash surplus in the less is better. Combined Matlbe programming techniques to optimize smoothing parameter α of cubic exponential smoothing forecast model, compared with the relevant literature, without human trials, it will soon be able to determine the optimal α values, thereby establishing the optimal parameters of three exponential smoothing forecasting model. Bank ATM cash flows were forecast by three exponential smoothing, and calculated by Matlab. The results showed that the prediction error was minimal, and it can well play a guiding role on how much cash input the ATM a day.

KEYWORDS

Matlab software; Cash flow projections; Cubic exponential smoothing.

INTRODUCTION

All along, Bank ATM cash flow is a difficult and hot issues in the bank's cash management. Since the 1990s, many domestic and foreign scholars on this issue were ever in-depth study. Quantitative prediction methods commonly used regression analysis and forecasting, time series forecasting, trend extrapolation forecasting and gray system prediction[1,2]. [3]proposed to strike a relative error of the least squares method for the control of the target method, but this paper is to select a few special values through the spreadsheet approach to roughly determine the parameters A, but did not give exponential smoothing parameter a quantitative method for solving; literature[4] proposed to use the ratio of the mean difference method of obtaining a method of testing by several sets of data, does not have a general, but also theoretically flawed, very limited applicability; there is also the literature[4,5] calculation method to take control of the target relative error, but limited to the original data was a certain inherent relationship model, so there are theoretical and practical defects. Through Matlab programming techniques, it is more simple to determine the optimal exponential smoothing parameters α.

Since this study is the bank ATM cash flow[6], in fact, the measured value of the existence of a stable relationship with a more fitting time series. Exponential smoothing compared with other prediction method, the advantage of simple, easy to master, able to take full advantage of the original time series data, calculation speed and the ability to dynamically determine the model parameters, the accuracy is better. In the current banking improve efficiency, strengthen cash management business environment, in accordance with the streamlined, efficient principles for effective cash flow forecasts for the bank's ATM cubic exponential smoothing. Improved cash operating various types of data in real time, accuracy, lower inter-bank ATM to improve cash flow forecasting and cash management information data linkage, to strengthen operational management of cash operations, improve work efficiency is enhanced business banking cash management level.

INTRODUCTION A METHOD OF EXPONENTIAL SMOOTHING FORECAST

Exponential smoothing is a kind of prediction method of time series analysis. Prediction method of time series analysis model according to their applicability can be divided into periods average, moving average, single exponential smoothing method, second exponential smoothing method and the cubic exponential smoothing method. Simple full period average method is that all the time series data in the past can be used for the same without skipping; Moving average rules does not consider the long-term data, and given the recent data in the weighted moving average method more weight; while exponential smoothing method is compatible with the whole period average and moving average, and don't give up the past data, but it only give the influence degree of the waning, with the data far away, the weight gradually converge to zero. When data is pure random jumping around a certain level, single smooth forecast model should be adopted; When the data has a continuous linear growth or decline, secondary smooth forecast model should be adopted; When the data with the curve of the continuous growth or decline, exponential smoothing forecast model should be adopted. Cubic exponential smoothing model is an appropriate choice, through observation of the bank ATM cash payment data today. Exponential smoothing changes will reflect the historical statistical data, to roughly smooth, in order to examine the evolution of the variable trend. Exponential smoothing as a kind of typical time series forecasting method, it was assumed that the importance of the data depending on the time of far and near is nonlinear. The recent data affect the value. Weight is also large; the forward data value is small. Weight is also small.

ESTABLISHING THREE EXPONENTIAL SMOOTHING PREDICTION MODEL

Forecast data set consisting of a time series:y_1, y_2, y_3, …, y_t ; raw data sequence: Y_1, Y_2, Y_3,...,Yt; cubic exponential smoothing model is:

$$y_{(t+m)} = a_t + b_t m + c_t m^2 \quad (1)$$

Where: y(t+m) to predict target; t is the time series; m units for future time periods; a_t is a smoothing factor; b_t for the second smoothing coefficient; c_t for times smoothing factor.
Smoothing factor to determine:

$$a_t = 3s_t' - 3s_t'' + s_t''' \quad (2)$$

$$b_t = \frac{\alpha}{2(1-\alpha)^2}[(6-5\alpha)s_t' - (10-8\alpha)s_t'' + (4-3\alpha)s_t'''] \quad (3)$$

$$c_t = \frac{\alpha^2}{2(1-\alpha)^2}(s_t' - 2s_t'' + s_t''') \quad (4)$$

The smoothed value is determined:

$$s_t' = \alpha x_t + (1-\alpha)s_{t-1}' \quad (5)$$

$$s_t'' = \alpha s_t' + (1-\alpha)s_{t-1}'' \quad (6)$$

$$s_t''' = \alpha s_t'' + (1-\alpha)s_{t-1}'' \quad (7)$$

Where: s_t' is once exponential Smoothing value, s_t'' for the second exponential smoothing value, s_t''' for cubic exponential smoothing value. Due to fluctuations in the data, s_0', s_0'', s_0''' have chosen the initial value of the original time series data, ie $s_0'=s_0''=s_0'''=Y_1$, α weighting coefficient, the range of (0,1). α new and old data is actually different from the predicted effects of the scale factor, α greater the effect of the new data from the larger, and the sensitivity of the model prediction of (0,1). α new and old data is actually different from the predicted effects of the scale factor, α greater the effect of the new data from the larger, and the sensitivity of the model prediction of high, high, it is easy to forecast model of allergic reaction. Conversely contrast, α is too small, relatively table values predicted by the model appear to be more conservative, it is difficult to catch up with new trends.

ATM CASH FLOW FORECAST AND ANALYSIS

Original data

Three exponential smoothing model in ATM cash flow forecasting, time series data is April 2012 a bank ATM cash today to pay the value shown in TABLE 1.

TABLE 1 : April 2012 a bank ATM cash today to pay value

Date	Unit/Yuan	Date	Unit/Yuan	Unit/Yuan	Date	Unit/Yuan	Date	Unit/Yuan	Date	Unit/Yuan
1	2434300	7	2434300	2552500	13	2357200	19	2718000	25	2711200
2	2074500	8	2074500	2946700	14	2772900	20	3749800	26	3102500
3	1848700	9	1848700	1801600	15	2353900	21	2610500	27	2807900
4	1697600	10	1697600	1737600	16	2609100	22	3058900	28	2550700
5	1485000	11	1485000	2587100	17	1968200	23	2000800	29	3638300
6	3035400	12	3035400	2201000	18	2597700	24	2484400	30	2137400

Optimal smoothing factor and smooth initial selection

Smoothing the initial choose raw data that the first number $s_0' = s_0'' = s_0''' = 2434300$. α result parameter is essentially a weighting parameter, which should be the maximum range of 0 to 1, that is, its initial value $\alpha_0 = 0$, the final value of $\alpha_n = 1$. Based on the kinds of considerations, combined with computer technology, are made to control the variance based on MSE minimum principle, to determine the parameters α:

$$\mathbf{MSE} = \frac{\sum (y_t - Y_t)^2}{n} \qquad \mathbf{(8)}$$

Literature[7,8] α values are to two decimal places, which is accurate to 0.01. Of course, after α get more decimal digits, the more precise value of α. Found by computing accurate to 0.01, the optimal α value 0.35, MSE = 3.476e +010; accurate to 0.001, α the optimal value of 0.351, MSE = 3.47601e +010. MSE value changes little. In this paper, α accurate to 0.01 forecast.

Matlab simulation

According to cubic exponential smoothing models written Matlab procedures, Matlab simulation[9].

Matlab simulation results shown in Figure 1, Figure 2.

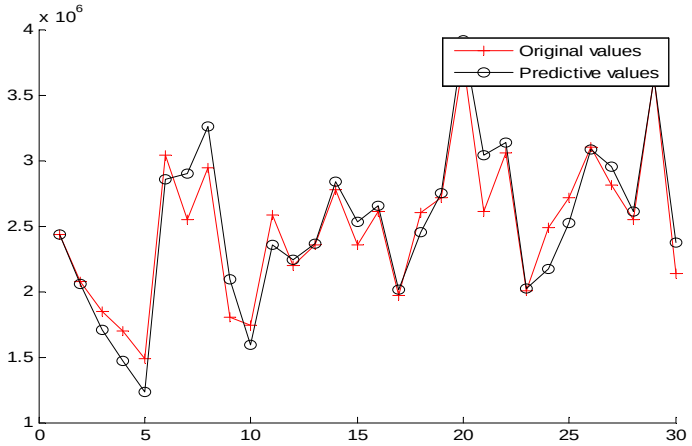

Figure 1 : April 2012 ATM cash today to pay the value of the predicted value and the original value comparison chart diagram direct vision

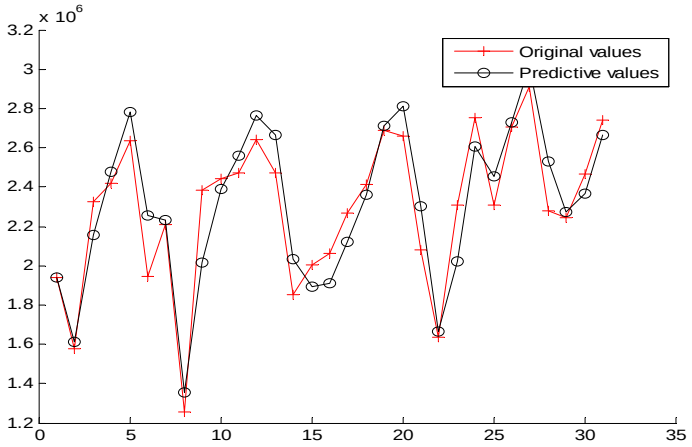

Figure 2 : May 2012 ATM cash today to pay the value of the predicted value and the original value comparison chart direct vision

Matlab conducted in April by smoothing calculations are shown in TABLE 2, the data are more rows in TABLE 2 were 3-21 hide, show only part of the data.

TABLE 2 : cubic exponential smoothing calculation table

Date	Y_t(yuan)	s_t'	s_t''	s_t'''	a_t	b_t	c_t
1	2434300	2434300	2434300	2434300	2434300	0	0
2	2074500	2308400	2390200	2418900	2173300	-109090	-7713
22	3058900	2910000	2765400	2620800	3054500	77740	-12
23	2000800	2591800	2704600	2650100	2311500	-265310	-24266
24	2484400	2554200	2652000	2650800	2357400	-173630	-14352
25	2711200	2609100	2637000	2646000	2562400	-38070	-2738
26	3102500	2781800	2687700	2660600	2943000	132570	9715
27	2807900	2790900	2723800	2682700	2884100	67910	3769
28	2550700	2706900	2717900	2695000	2661900	-47360	-4914
29	3638300	3032900	2828100	2741600	3355800	254680	17137
30	2137400	2719500	2790100	2758600	2546700	-162860	-14810

Computing prediction equations

The above table to know:

S'_{30}=2719500, S''_{30}=2790100, S'''_{30}=2758600,

a_{30}=2546700, b_{30}=-162860, c_{30}=-14810

Prediction equation is:

$$y_{30+m} = 2546700 - 162860\, m - 14810\, m^2 \quad (9)$$

Substituting different ATM daily value forecast value paid today, such as:

y_{30}=2546700元 ; y_{29} =2369030元

CONCLUSION

April 2012 a bank ATM cash pay day totals, by writing cubic exponential smoothing procedure, after Matlab software simulation to obtain the above visual map. By observing which we can easily find and get the following results: (1) ATM cash today to pay the value of the predicted value and the original value of the basic agreement, described by cubic exponential smoothing can really predict well; (2) This article by writing Matlab Matlab simulation program, can quickly determine the optimal α value, without trial, significantly saving time; (3) Cash flow analysis and forecasting can help banks more accurately direct operational decisions, improve data-based judgments made; (4) Cash flow projections to help banks strain, can improve the ability to respond to uncertain events banks, thereby reducing losses caused by adverse events is now to ensure the sustainable development of stable bank ATM.

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