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Rong Zeng

College of mechanical and electrical engineering JING HAN University, Wuhan, 430056, China

Abstract: In order to optimize the inventory of auto aftermarket parts, the second weighted moving average method is used to forecast the demand of auto aftermarket parts. Compared with the traditional weighted moving average method, the results show that the improved method is better than the traditional method.

1. Introduction
The prediction of auto parts inventory demand is the premise of determining reasonable parts inventory, and the prediction method directly affects the accuracy of the prediction.

The methods of demand forecasting mainly include qualitative forecasting and quantitative forecasting. Qualitative methods include regression analysis and time series method, etc. [1]. Regression analysis mainly considers influencing factors, and the selection of future values of independent variables and dependent variables is predictive to a certain extent, which will interfere with the predicted values. However, the time series method does not consider the factors that affect the demand, including the moving average method, exponential smoothing method, etc.

Automobile aftermarket parts demand is affected by many factors, the degree of influence is difficult to predict, so this paper adopts the improved moving average method to predict it.

2. Influence factors of automobile aftermarket parts
The influencing factors of automobile after-sales parts are very complex, which are not only affected by supply lead time, inventory cycle, cost and other factors, but also affected by seasonal factors, political factors, economic level and so on [2]. Therefore, its demand forecasting is not large, forecasting accuracy is not high. Combined with the above characteristics, this paper proposes an improved forecasting method to predict the demand for auto aftersales parts, which can solve the problem of inventory control, reduce enterprise cost, improve management efficiency and improve customer relationship to a certain extent.

3. Improved forecasting methods

3.1 The traditional weighted moving average method
Taking the actual sales data of a company's product M-H-VVT from 2010 to 2013 [3] as an example, the effectiveness of the improved weighted moving average method is illustrated.

Table 1 M-H-VVT sales data of a company

month	2011	2012	2013
January	13612	10100	13313

February	12665	13796	12187
March	14515	12472	13955
April	10539	11788	17391
May	11730	7569	12524
June	8131	4394	10534
July	8478	6486	8414
August	8794	7052	9036
September	13634	15301	15793
October	14791	12487	15600
November	19358	13735	23179
December	17782	15318	24936

Through the traditional weighted moving average method, it is found that the results still have a certain lag, the curve variance is smaller than the actual value, the curve is more gentle, but the accuracy is obviously better than the simple moving average method. The error of the weighted moving average method is large, and there is room for improvement in the selection of weight. The better weight can be selected by empirical method and trial method.

3.2 Improved weighted moving average forecasting method
The weighted moving average method is a very typical short-term prediction, which is used to predict the parameter values in a period of time in the future through the past historical data. This method needs enough data to calculate the prediction result, otherwise, the calculation error may be too large due to the lack of data. From the data in Table 1, it can be seen that the storage demand of auto parts is obviously affected by the seasonality. From January to May of each year, the demand of this product is more than 10000. In June August, the demand obviously drops to about 7000, and then it increases obviously from September to December. In this paper, considering the seasonal periodic change of automobile parts storage demand, the corresponding parameters are added to the weighted moving average method to improve the prediction accuracy of the method.

The model is modified by the difference value to reduce the influence of lag. Based on the influence of seasonal periodicity of auto parts storage, W is set as the percentage of the average value of seasonal periodic months to the overall average value, and M is the demand forecast month. Then:

Table 2 Error values of product sales based on seasonal cyclical changes

time	Actual sales Xn	Periodic mean	W
2011.1	13612		
2011.2	12665		
2011.3	14515		
2011.4	10539		
2011.5	11730	12612	98.4%
…	…	…	…
2013.8	9036	9328	72.8%
2013.9	15793		
2013.1	15600		
2013.11	23179		
2013.12	24936	19877	155.1%
Average	12816	12431	

Because multiple calculation of weight will lead to over fitting of predicted data and tend to be stable, the improved formula is as follows:

$$\bar{x} = w_i f_1 x_1 + w_i f_2 x_2 + \cdots + w_i f_n x_n$$

where: $f_1 + f_2 + \cdots + f_n = 1$

If M is January, $W_i = W_1$;

If M is June, $W_i = W_2$;

If M is September, $W_i = W_3$;

If M is other months, $W_i = 1$.

Then, by adding seasonal and cyclical factors into the forecast of automobile parts storage demand, the calculation results are as follows:

Table 3 Calculation of the error rate of the weighted average method for seasonal periodic prediction

time	Actual sales Xn	Cyclical factor weighted moving average forecast results	Forecast error	Forecast error rate
2011.1	13612			
2011.2	12665			
2011.3	14515			
2011.4	10539	13779	3240	30.7%
2011.5	11730	12157	427	3.6%
…	…	…	…	…
2013.9	15793	9149	6644	42.1%
2013.10	15600	12290	3310	21.2%
2013.11	23179	14345	8834	38.1%
2013.12	24936	30133	5197	20.8%
Average	12816	12276	2571	19.2%

3.3 Results and analysis

After considering the weight of seasonal factors, the predicted value is closer to the actual value, and the volatility is stronger than the traditional weighted moving average method. The monthly average error rate is 19.2%, which is better than the previous model. The model eliminates the influence of lag to some extent. But the variance is large and the uncertainty is high. Because the model uses point-to-point value, the accuracy is very high in a certain range, but the error value is large in the range of gentle demand.

4. Conclusions

The forecast of the inventory demand of automobile after-sales parts is related to the inventory optimization and decision-making, the sales of parts, and more importantly, the satisfaction of consumers [4]. In view of the limitation of the traditional moving average method, the improved method is used to predict the sales volume of automobile aftermarket parts, so as to control the inventory reasonably. The results show that the improved method has a certain improvement in the prediction accuracy. However, this model is not universal, but only considers the cyclical impact of warehousing demand for auto parts, and the specific assignment needs to be determined by the inherent law of specific data.

Acknowledgments

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