Research on Sales Forecast of Electronic Products Based on BP Neural Network Algorithm

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Abstract. In order to solve the problem that the production volume and sales volume of electronic products cannot be matched in time, it is necessary to predict the order and sales volume, and then effectively control the production volume of manufacturers. This article first introduces the basic steps of implementing the BP neural network algorithm, and then uses MATLAB software to fit the original data based on the BP neural network algorithm to predict the sales volume of the latest generation of products sold by customers to customers in the next 20 weeks and the latest generation of products in different sales. The region's order volume in the next 20 weeks, and according to the forecast results to provide enterprises with production decisions to achieve timely matching of production volume and sales volume.

Keywords: BP neural network · Production volume · Sales volume

1 Introduction

With the rapid development of science and technology, electronic products have entered millions of households and become necessities for people's daily work and life. The rapid replacement of electronic products often makes product output and sales volume not match in time, resulting in product backlog or Deficit affects earnings. For this reason, the electronics industry urgently needs an effective product sales forecasting method to provide scientific decision support for its production plan. Orders and sales volume are important basis for forecasting production volume. Therefore, this article will build a sales forecast model and order forecast model for electronic products, and predict the sales volume of the latest generation of products sold by sellers to customers in the next 20 weeks based on the existing sales data of a certain brand of electronic products. Order volume for the next 20 weeks in different sales regions.

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2 BP Neural Network Algorithm

Among the neural networks, the most representative and widely used is the BP (Bake-Propagation) neural network (multi-layer feed forward error) proposed by Rumel Hart and McClelland of the University of California in 1985. Back Propagation Neural Network). This model is a supervised learning model with a strong self-organizing and adaptive ability. It can grasp the essential characteristics of the research system after learning and training on a representative sample, and has a simple structure and strong operability. Can simulate arbitrary non-linear input-output relationships. The specific implementation steps of the BP neural network algorithm are as follows:

The first step is to select the structure of the BP neural network based on the data signs. The BP neural network model used in this article The number of network layers is 2 and the number of hidden layer neurons is 10. The hidden layer and output layer neuron functions are selected as tansig function and purelin function, the network training method uses gradient descent method, gradient descent method with momentum and adaptive should lr the gradient descent method; The second step is to normalize the input data and output data; The third step is to construct a neural network using the function newff(); In the fourth step, before training the neural network, first set related parameters, such as the maximum number of training times, the accuracy required for training, and the learning rate; The fifth step is to train the BP neural network; The sixth step is to repeat the training until the requirements are met; The seventh step is to save the trained neural network and use the trained neural network to make predictions; In the eighth step, the predicted value is compared with the actual output value to analyze the stability of the model.

3 Sales Forecast

This section uses MATLAB software to fit the original data using the BP neural network algorithm, and finally completes the forecast of the sales volume of the latest series of each product. The specific program code is as follows:

```
p=(1:n);
t=[t1 t2 ......tn];
%Data normalization
[pn,minp,maxp,tn,mint,maxt]=premnmx(p,t);
%BP network training
net=newff(minmax(pn),[32,1],{'tansig','tansig','purelin'},'traingdx');
net.trainParam.show=1000;
net.trainParam.Lr=0.1;
net.trainParam.epochs=5000;
net.trainParam.goal=1e-2;
net=train(net,pn,tn);
%Simulation of raw data
an=sim(net,pn);
a=postmnmx(an,mint,maxt);
%Compared with actual data
x=1:n;
newk=a(1,:);
figure;
plot(x,newk,'r-o',x,t,'b--+');
legend('预测值','实际值');
xlabel('周数');
ylabel('销售量');
%Make predictions on new data
pnew=[n+1:n+20];
pnewn=tramnmx(pnew,minp,maxp);
anewn=sim(net,pnewn);
anew=postmnmx(anewn,mint,maxt)
```

Enter the original data into the above code, and obtain the fitting curve of the sales volume of the a-3 generation products (see Fig. 1).

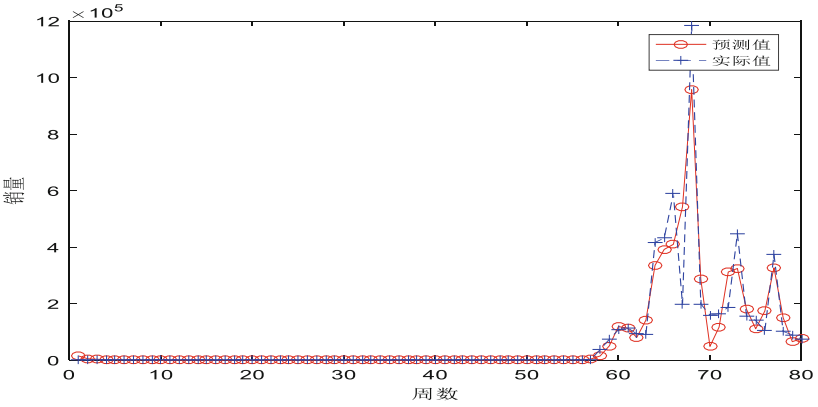

Fig. 1. Actual value and forecast value of sales of a-3 generation product sellers to customers.

After error analysis, the model is suitable for forecasting the sales volume of the product, and the original program is further improved to predict the sales volume of the a-3 generation products to the customers in the next 20 weeks(see Table 1).

Table 1. Sales value of a-3 generation product sellers to customers next 20 weeks.

Week number	1	2	3	4	5
Sales	143359	172831	176172	176463	176488
Week number	6	7	8	9	10
Sales	176490	176579	178659	175433	187642
Week number	11	12	13	14	15
Sales	196321	176440	176466	178762	176490
Week number	16	17	18	19	20
Sales	176490	163252	153621	14668	133695

The same processing method can predict the sales volume of the b-2 and c-1 products from the seller to the customer in the next 20 weeks. The fitting graphs of the actual and predicted values (see Fig. 2 and 3). Sales forecast values (see Table 2 and 3).

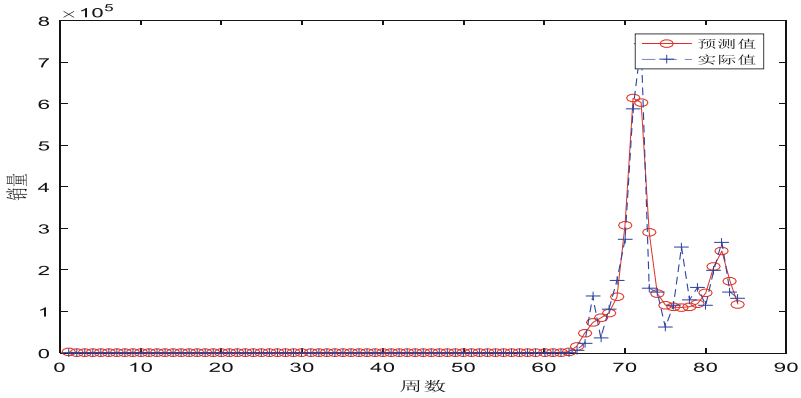

Fig. 2. The actual and predicted sales volume of the b2 generation product sellers to customers.

Through the above analysis, it is found that the BP neural network algorithm has a good fitting degree, the relative error between the predicted value and the actual value is small, the prediction result is more accurate, and it can be used for short-term and medium-term prediction.

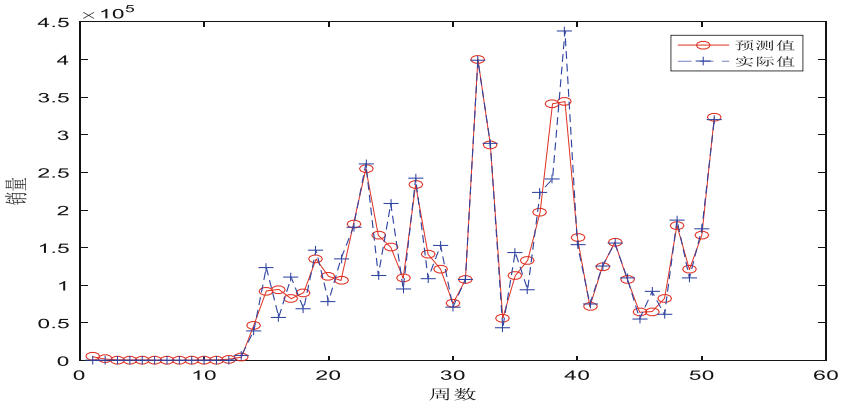

Fig. 3. Actual and predicted sales volume of c1 generation product sellers to customers.

Table 2. The sales value of the b-2 generation product sellers to customers next 20 weeks.

Week number	1	2	3	4	5
Sales	99359	94754	93600	93314	93243
Week number	6	7	8	9	10
Sales	93226	93222	93221	93762	99623
Week number	11	12	13	14	15
Sales	922168	95623	93256	93322	94563
Week number	16	17	18	19	20
Sales	977649	95321	93266	91237	91229

Table 3. Sales volume of c1 generation products sold to customers next 20 weeks.

Week number	1	2	3	4	5
Sales	336756	337216	3345662	339462	345982
Week number	6	7	8	9	10
Sales	345219	332346	337185	3373268	334232
Week number	11	12	13	14	15
Sales	335232	346259	363554	322496	332369
Week number	16	17	18	19	20
Sales	346813	345612	335694	321687	337432

4 Order Volume Forecast

This paper first uses EXCEL software to screen the d-3, e-2, and f-generation products by sales area and order type. According to the analysis of the characteristics of the filtered data, it is found that the prediction of the order volume can still use the BP neural network algorithm. The difference between the algorithm in this part and the second part lies in the selection of parameters and hidden layer neurons. The accuracy and training times of this part are higher than the second part. Another 30 hidden layer neurons are selected, which achieves a better simulation results. The effect. The results of fitting and prediction using MATLAB software are as follows: First of all, we carried out the order volume of the a-3, b-2, c-1 three-generation products that are not divided into sales areas in the next twenty weeks. Manufacturers received orders (type B + C) and sellers placed orders (type A + B). The specific prediction results are as follows (Fig. 4 and Table 4):

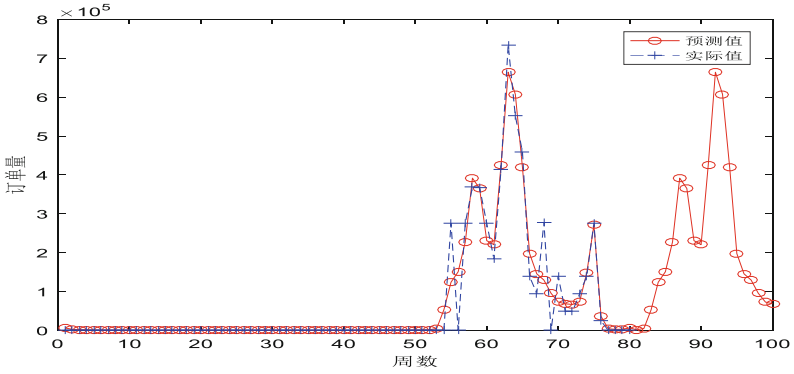

Fig. 4. A-3 generation product sellers' order quantity (A + B) actual data and forecast data.

Table 4. The forecast value of orders placed by a-3 generation product sellers next 20 weeks.

Week number	1	2	3	4	5
Order volume	1618	5331	52913	123943	150899
Week number	6	7	8	9	10
Order volume	227658	391698	365267	230814	220677
Week number	11	12	13	14	15
Order volume	425240	664172	607428	419209	197741
Week number	16	17	18	19	20
Order volume	145659	129577	95670	73021	68400

The forecast results show that in the next 20 weeks, the order volume of a-3 generation product sellers will first increase significantly, and will fall after reaching a certain number (Fig. 5 and Table 5).

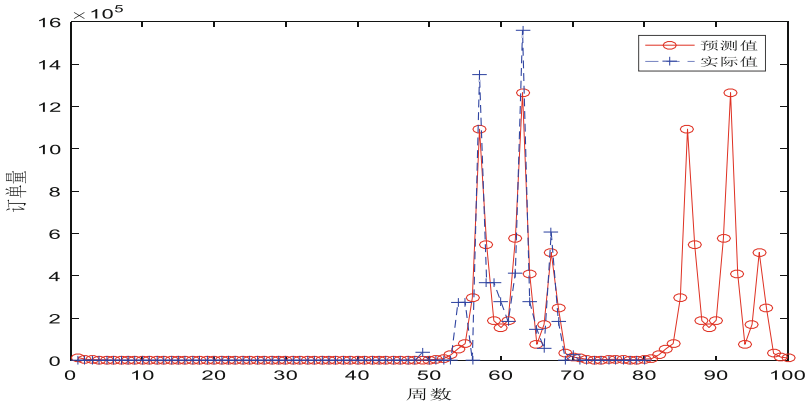

Fig. 5. Order data received by a-3 generation product manufacturers (B + C) actual data and forecast data.

Table 5. The forecast value of orders received by a-3 generation product manufacturers next 20 weeks

Week number	1	2	3	4	5
Order volume	9308	27117	55685	80166	296643
Week number	6	7	8	9	10
Order volume	1093835	546376	188619	156178	190653
Week number	11	12	13	14	15
Order volume	575802	1265769	409594	76835	171005
Week number	16	17	18	19	20
Order volume	510875	249303	33922	16593	12007

The forecast results show that the order volume of a-3 generation product manufacturers will have two peak periods in the next 20 weeks, and manufacturers can appropriately adjust their production strategies based on the forecast results (Fig. 6).

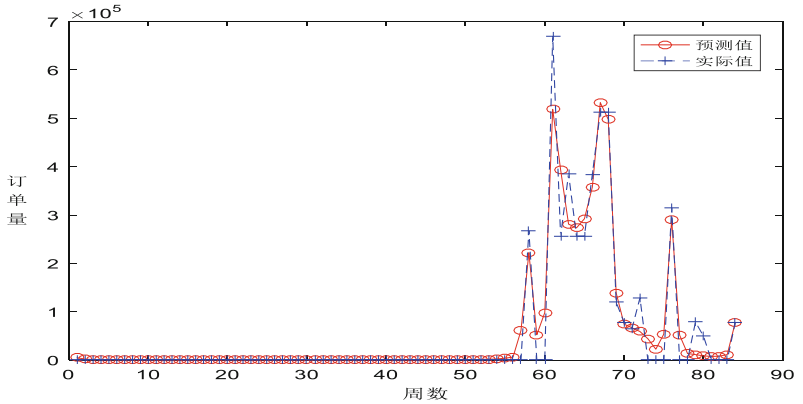

Fig. 6. B-2 generation product sellers' orders (A + B) actual data and forecast data.

It can be seen from the above figure that the fitting effect of the BP neural network model is better. After further error checking, it was found that the error was small, so the program was further improved for prediction. The predicted value.(see Table 6).

Table 6. B-2 generation product sellers' order volume forecast values for the next 20 weeks

Week number	1	2	3	4	5
Order volume	241864	293642	301244	302257	302390
Week number	6	7	8	9	10
Order volume	302408	302410	301345	302401	300411
Week number	11	12	13	14	15
Order volume	302345	312651	332461	313421	302011
Week number	16	17	18	19	20
Order volume	313541	245911	162111	92411	20411

The forecast results show that the order quantity of b-2 generation product sellers will pick up in the next 20 weeks, but the range is not large, and it will decline rapidly after the 17th week (Table 7 and Fig. 7).

Table 7. The forecast value of orders received by b-2 generation product manufacturers next 20 weeks.

Week number	1	2	3	4	5
Order volume	86486	90897	91573	91664	91676
Week number	6	7	8	9	10
Order volume	91677	91319	96678	91346	83461
Week number	11	12	13	14	15
Order volume	83497	76153	91699	91795	91278
Week number	16	17	18	19	20
Order volume	70325	66354	53196	63485	33467

The fitting and forecasting results show that the number of the two types of orders in the previous period of the product basically match, and the trend in the next 20 weeks is similar, but the number is different (Fig. 8 and Table 8).

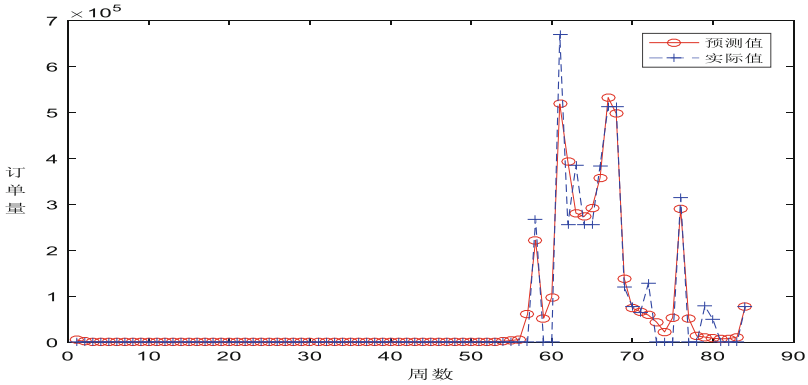

Fig. 7. The actual and forecast data of orders received by b-2 generation product manufacturers (type B + C).

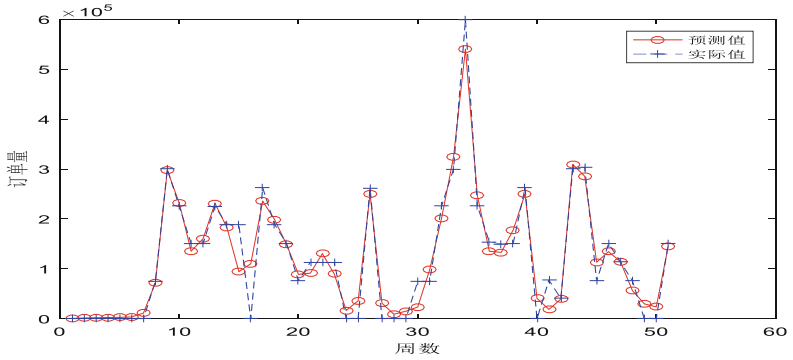

Fig. 8. The actual and forecast data of orders received by c-1 generation product manufacturers (type B + C).

Table 8. The forecast value of orders for c-1 generation product sellers in the next 20 weeks.

Week number	1	2	3	4	5
Order volume	194654	262736	302138	324758	316325
Week number	6	7	8	9	10
Order volume	315003	332587	69857	52867	42569
Week number	11	12	13	14	15
Order volume	158296	205432	241123	269158	85269
Week number	16	17	18	19	20
Order volume	52639	45891	234357	36985	25647

The forecast results show that the order volume of c-1 generation product sellers will fluctuate greatly in the next 20 weeks (Fig. 9 and Table 9).

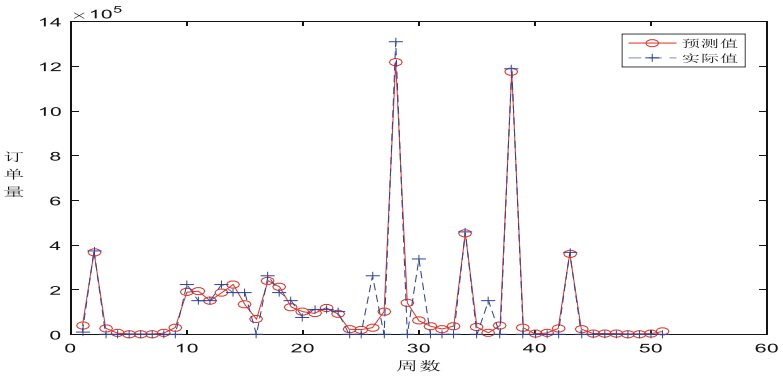

Fig. 9. The actual and forecast data of orders received by c-1 generation product manufacturers (type B + C).

Table 9. The forecast value of orders received by c-1 generation product manufacturers next 20 weeks.

Week number	1	2	3	4	5
Order volume	234873	321728	325511	325646	313549
Week number	6	7	8	9	10
Order volume	324637	346257	313425	315679	302467
Week number	11	12	13	14	15
Order volume	294637	237684	264359	334672	231467
Week number	16	17	18	19	20
Order volume	234678	297435	234357	224367	204367

The forecast results show that the orders received by c-1 generation product manufacturers in the next 20 weeks will remain high.

Secondly, according to the filtered data, predict the order volume of d-3, e-2, f products in different sales regions in the next 1 to 20 weeks. The specific fitting chart is as follows. The forecast results of the order volume in the next 20 weeks are not listed here. Now, readers can make their own predictions based on the program codes listed above, and the operation is simple and easy (Fig. 10).

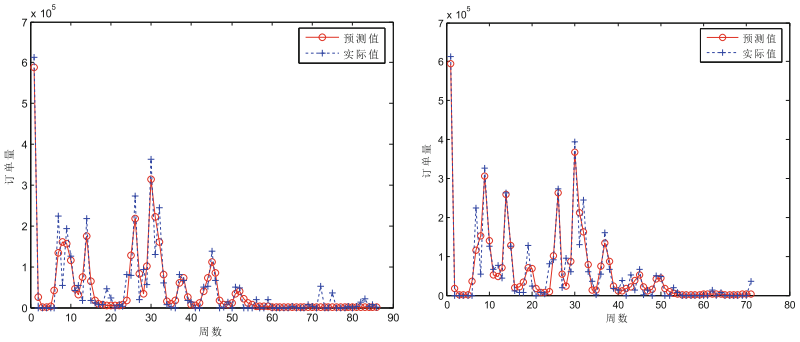

Fig. 10. (Left) Actual and predicted order quantities of sellers of d-3 products in the sales area a (Right) Actual and predicted orders for d-3 products in the sales area of the manufacturer.

The fitting and prediction results show that the two orders of d-3 products in the a sales region will enter a stable recession in the next 20 weeks, which indicates that these products will soon exit the market (Fig. 11).

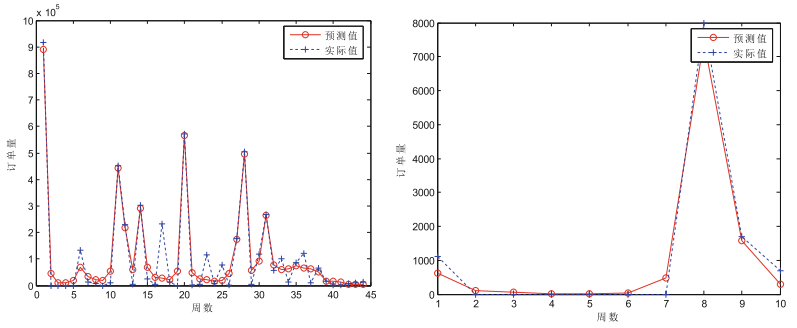

Fig. 11. (Left) Actual and predicted orders for d-3 products in c sales area; (Right) Actual value and forecast value of order quantity of sellers of d-3 products in b sales area.

The fitting and forecasting results show that the orders of manufacturers of d-3 products in the c sales region will gradually rise in the next 20 weeks. The orders of sellers of d-3 products in the b sales region will be smaller and should be increased in Product promotion in the region. The forecast results of the order quantity of the e-2 products in the sales region of a and the order quantity of the manufacturer show that the former has a certain degree of rebound after entering a long trough period. The main reason for the trough period is In the previous stage, the sellers in this sales area placed large orders; the latter placed large fluctuations in order quantities, which was mainly affected by changes in the order volume of C products (Figs. 12 and 13).

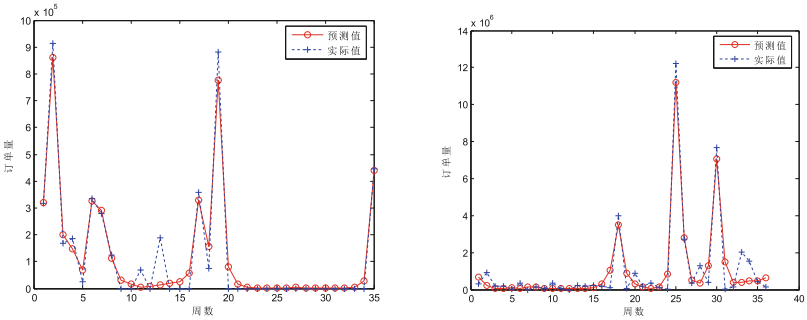

Fig. 12. (Left) Actual and predicted order quantities of sellers of e-2 products in sales area a (Right) Actual and predicted order quantities of manufacturers of e-2 products in a sales area.

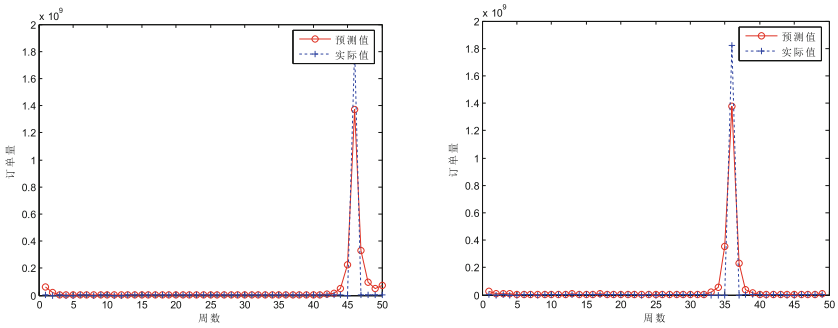

Fig. 13. (Left) Actual and predicted order quantities of sellers of product f in sales area a;(Right) Actual and predicted order quantities of producers of product f in sales region a.

The forecast results show that the order quantity of product f in sales area a has soared in a short period of time, but it has declined rapidly in the later period and continues to rise, indicating that the demand for product f in area a in the future is not high (Fig. 14).

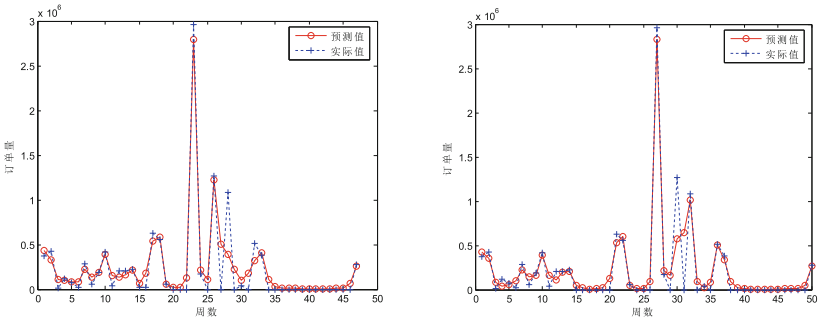

Fig. 14. (Left) Actual and predicted order quantities for manufacturers of product f in sales area c; (Right) Actual and predicted order quantities of sellers of product f in c sales area.

The fitting and forecasting results show that the two orders of f products in the c sales area have similar trends, indicating that sales of f products in this area are relatively stable.

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