Forecasting Best-Selling Products of Esfahan Steel Company

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ABSTRACT

Sale is one of the most important marketing activities of companies. For this reason, success in a particular service analysis and accurate prediction of sales can lead the company to its marketing and financial objectives. In this paper, we use the time series method of sales forecasting, which, in this paper, is autoregressive. In this model by using AIC, SBIC, HQIC statistical tests, the autoregressive rank for time series of products is selected and the prediction is made. To evaluate the model presented in this paper, the sale data related to 7 products of Isfahan Steel Company was used.

INTRODUCTION

The twenty-first century is looking for those types of technological development which offers safer and more practical systems for supporting the management decisions. There is no doubt that forecasting is a key factor in financial and managing decisions. Thus, developed systems that have the ability to perform properly in the chaotic and changing world in which effectiveness and speed in doing things are a priority are pursued by the researchers. With development of calculating technology and computers, the concern about speed and exactitude have been eliminated. But the methods of increasing effectiveness and functionality of forecasting modes have become a concern for the scientists and researchers.

Forecasting techniques can be ranked by the easy methods which are implemented easily and the complex methods which are time consuming and costly. Basically, the forecasting methods are categorized into qualitative and quantitative methods. The basis of some of them is investigation of the past data for the purpose of forecasting future values. Contrary to previous three or four decades when a new unique method was introduced everyday, which, in most cases, operated better than the older methods, in recent two decades a big deal of combinational methods have been offered which use both classic heritage and exploiting software and hardware technology. Sale is one of the most important criterions for assessing the marketing activities of companies and this is the reason why sales forecasting have become significant. Forecasting should determine the present and future of the company's market, especially when it finds an active and lively market.

To arrange the effective strategies for specifying a goal and managing marketing attempts in an effective way, the companies must have the ability and enough skills to measure the present market demands and forecast the future demands. In this process, responding models are considered to be important tools in forecasting the companies' sales and market share and also in determining the companies' strategic effects which are implemented in marketing combination. A model of marketing response shows a relationship between a response variable and one or more than one descriptive variables. The response variable can be the amount of company's sale or its market share. The descriptive variable is treated as influential factors on the response variable.

1. The competitive and lively atmosphere which is dominant in present market, sales forecasting, as a useful tool and a necessary strategy, is important to the continuation of the companies’ activities. The companies that use the appropriate sales forecasting process enjoy these advantages.
2. they know when and how much they should order materials
3. they are able to gain a deep understanding of the consumer’s behavior and their reactions to the policies taken by companies.

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4. They have production planning and proper capacity.
5. They can identify the models and sales approaches

The combination of all of these advantages will able the companies to:
1) Increase their profit
2) Provide the customer’s satisfaction.
3) Decrease their costs.
4) Increase their productivity.

Thus, if a company is successful in analysis and forecasting a sale item or particular service, this will increase the company’s chance to achieve its business financial goals and also can be as a strategic tool in business competition.

2. Methodology:
The steps followed in this study are:

2-1 Data collection:
Data collection from records and documents registered in sales assistance and marketing in Esfahan Steel Company sales data gathered monthly from seven best-seller products since Farvardin 2002 until Shahrivar 2014 are available that generally contain the data of 150 months on a whole. The first three-month set of data, out of the whole set, which have the potential of auto regressive models and the results of statistical test for making data collection are put aside, therefore, data related to 147 months are used in modeling. From this amount of data, 20% of data-final for each product are used as test data and the rest are used as educational data. The functions of selected models in assessment of their accuracy in forecasting test data is studied.

2-2 The model instruction contains the following three steps:
i) Application of statistical test for auto regressive selection rank:
Selecting a lag is a selective process of a subset of better lags from the potentially usable lags that can be accessible in forecasting time series. In time series modeling, the number of lagged observation is very important. One of the of the best criteria for selecting a number of lagged observations are statistical tests based on information criteria like AIC, BIC, SBIC. Hayashi (2000) discusses these criteria and proves that SBIC, HQIC, can provide suitable lag estimation where AIC is lag rank with a positive possibility. In this study SBIC, HQIC are used as the criteria for selection lags. In sum, information criterion compares the results from a lag structure in regression with presented cost by losing freedom degree. The purpose of selecting lag rank p is to minimize an attribute in (1) equation

$$IC(p) = T \ln \hat{\sigma}^2(p) + p[f(T)] \quad (1)$$

In which \( \hat{\sigma}^2(p) \) is the estimated regression variance that depends upon the size of sample and rank of P, and T is the number of observable observation (Burnham & Anderson, 2004). \( p[f(T)] \) is fine subordinate for increasing the rank of model. Different selections of \( f(T) \) criterion give a different information criterion. The result in ideal mode AIC from putting \( f(T) = 2 \) and the results if SBIC of \( f(T) = \ln(T) \) hypothesis and finally HQIC is equivalent to \( f(T) = \ln(\ln(T)) \). In an ideal condition, AIC SBIC HQIC can be small (note: all will be negative) therefore the selected model must be with the least amount of information criterion test.

ii) Normalization of data in [-1 1] equation:
One of the approaches that are used before neural network is normalization of data. Noting that the fact that the neural network applied in this research uses Tanh that has [-1 1] outcome and because the scales of inputs are different, we normalize all the input and output [-1 1] by using the following relation:

$$X_{new} = \left( X_{old} - X_{min} \right) \frac{(X_{max} - X_{min})}{X_{max} - X_{min}} + X_{min}$$

in which \( X_{min}, X_{max}, X_{old} \) and \( X_{new} \) in the new data are the minimum and maximum of data in original criteria and \( X_{old} \) and \( X_{new} \) are the amount of data in original and changed criteria respectively. As it is obvious, with inversion of this formula, we can get the amount of data in old criterion. Therefore, the neural network is educated and does the forecasting duty. After finishing the forecasting, by changing this formula, the real amount of forecasting is obtained in the real criterion.

iii) The neural network instruction in auto-regressive modeling rank P:
In this study, we will implement the multi-layer Persipton neural network, which is instructed after noticing the error, in time-series modeling. In this study, we will employ the multi-layer Persipton neural network, which
is instructed after noticing the error, in auto-regressive time-series modeling n rank, in which the auto-regressive place are used based on statistical tests to select the numbers of logs. Therefore, the neural network simulates the following f function:

\[ f : (TA(k - 1), TA(k - 1), ..., TA(k - 1)) \rightarrow TA(k) \]

2.3 Testing model and forecasting:
   i. the testing data collection (new data)
   ii. goal forecasting by using the related neural network

3 The status of steel marketing:
   The time span between 1391 and the first nine months of 2014 were turbulent times for most industries in the country. The country's steel industry was not immune from this instability. The price of bars and steel products were influenced by factors such as the foreign currency, national and international policies and the price of raw material, and it experienced many ups and downs that made the managers of this industry more sensitive about the changes. But the question is what conditions do the environmental changes and supply factors, and the demand of this industry have in forthcoming years' policy? Are the production agents, like scrap, limited? How many of steel projects will begin and enter the market?

   Today the main challenge of corporations is obtaining a right outlook and a rational analysis of future factors affecting the demand and supply in steel industry. It is natural that forecasting the future of an industry, even in the most stable economics, is a difficult but investigation of all factors of demand and supply in steel industry provides a context for diminution of risks and helps planning to use opportunities and encounter the potential threats. This study does not try to obtain a general conclusion and forecast the conditions of steel industry at next year. It is a study, which is based on statistics, and tries to analyze the effective factors on demand and supply of steel industry in year 1393. Obviously, the upcoming research and awareness of the changes of market and supply factors and demand must be a priority for chief managers of steel industry and a support for their strategic plans.

3.1 The factors in supply and demand of the country's steel:
   According to the world association of statistics of steel, Iran, by overtaking some countries such as England, Spain and Canada could make a record in steel production growth throughout the world in the first months of 2013 and could achieve 15th rank in production of steel throughout the world. The production of raw steel in 1391 with 10% of growth in comparison to the last year achieved 14.8 million tons. The entrance of major and minor steel manufacturers in state and private parts, accompanying with extensive projects of major steel manufacturers like Esfahan Steel Company, Morakeh Steel Company, Khuzestan Steel and Khorasan Steel which open up in 93, are all a sign of continuation of raw steel production in upcoming years. According to the formal statistics of the minister of industry, the numbers of the projects in mine and business are nearly 100 projects with capacity of 32 million ton from which 21 projects have 61% to 99% progress. Furthermore, 255 projects are executed for steel products from which 69 projects have had 61-99% progress.

   We can mention Fulade Ghadir Iranian Project, Arefae Steel, Hormozgan Steel, Ezna Steel, Kish Kave Steel, Extensive Project of Mobarakhe Steel Company and Saba Steel, Extensive project of Esfahan phase2, Khuzestan Steel Extensive project, Ghaen Steel, Gharmahal Steel. Therefore it is expected that in the least pessimistic condition 2, and in the most optimistic way, 5 million tons are added to the capacity of raw steel production in 1393. Thus, to consume these products and capacities mentioned above, it would be better to provide the national and international markets. On the one hand, the consumption of steel products in the first 11 months in 1391 was about 18 million. Comparing this amount with the time span in last year, it has 9% reduction.

   Steel consumption in the last month in 2013 is about 19.6 million tons and general steel consumption in 2013 is 261 kilograms (considering the population which was 75 millions) that has a diminutive trend in comparison to last year. Though the statistics presented by some industrial managers show the increase in the amount of steel consumption of almost 350, 400 or even 500 kilograms, achieving this goal in short term period is inaccessible. Also in the outlook of 2014 there is no indication of growth in steel consumption. During previous years, the most important consumers of steel in our country have been government and their constructive projects. While in the Budget of 2014, the proportion of constructive projects has been decreased and the proportion of current costs has been increased.

   In last months, the government thinks about finishing the projects rather than starting new ones. Regarding housing section, the experts predict that, after ups and downs in this year or upcoming years, the housing market will experience a recess like 87, 88. Mehr House Project is about to finish. Finally, car industry, as another major consumer of steel production, has diminished in 2013, at the most optimistic condition, can achieve its
previous state. Thus, it is predicted that in 2014, a notable growth is not expected in our country, such that we did not witness any growth even when we passed 9 months of the current year.

3-2 The national steel market condition:

As you know, the determining factor in prices of products in the level of world market depends on some factors among which supply and demand are the most significant and well-known. Besides supply and demand, other factors (such as natural factors, political factors, political and other) have a great impact upon the price of products. We will have a short introduction on the price of iron material in the country, and then we will present analysis. As many economical experts and activists and steel authorities believe that iron market is not influenced by supply and demand and, at the present time, the market consciousness, political issues, sanctions and local crisis are the factors which increase the steel price because, until now, there is no real and major demand on the market, in spite of the steel producers’ supply. The majority of the buyers were those businessmen who keep the bought iron, and in this condition, even if there was a major demand on the market with all the stockpiled iron, the price must not increase, however, why do the prices increase without a real demand?

The most important factors in price increase in the present situation is inability of businessmen in importing raw materials, and especially bar, lack of enough bar in the stocks of steel manufacturer and also the problems of foreign currency, despite central Bank’s promises to provide enough currency required by businessmen and steel manufacturers to import raw material which result in price increase. Furthermore, the sanctions on Iran’s banks and Chinese sabotage, as the biggest business partner of Iran, and lack of bargain or difficulties in business with Iranian businessmen, because they are afraid of getting currency for Iranian banks and emphasis on goods transaction are the other significant factors in price increase. All in all, even if there is a purchase of raw material with a higher price, the producer companies are forced to increase the price of their productions. With these issues, it is predicted that whether the negotiation between Iran and 5+1 will end with positive outcomes, it can lead to decrease in price about 1000 Rials because there is a possibility of acceptance of LC. In these conditions, the businessmen can import raw material. With the beginning of a new season and reduction of demand and the possibility of removing sanctions the price can reach 17000 Rials.

3-3 Marginal benefit improvement of Chinese steel producers at the beginning of 2014:

In November the price difference between the national flat steel and imported iron stone reached to the least figure since 2911 in China, where the steel production led to the reduction until now. For this reason, Chinese iron and steel companies reduced their production from 2/111 million tons in October to 2/090 million tons in last days of November. Hebei Group, the biggest manufacturer of flat steel products in China decreased their production to 58800 tons a day. Metal Expert predicts that, as the result of the rise in announced price in national steel production, marginal benefits of steel manufacturer increase in the beginning of 2014. In January, businessmen witness support and reinforcement of price growth due to the high demand rate and the hope for more activity in consumptive industry in March and April with regards to the stockpiling their products and bought more steel products before the New Year in China (31 Jan2014). Due to the insufficient demand in Middle east, which is because of low usage of products in this area, the CIC bullions sellers could increase their prices in December. Only in February, there is expectation of success in Middle Eastern construction work. In January, due to the good condition of US markets and the increase in the amount of demands in Far East, the price of scrap will increase, while there is a slight decrease in February in the middle of new year holiday in China.

The results of model implementation:

Implementing the statistical test for choosing auto regressive rank, we obtain the following results. As it is obvious, for the first production time series, rank 2 and for other time series, rank 3 is chosen. As it is clear in the table, the selected rank is the number with a star beside it.

Also in the figures below, the results from the forecasting model for time series of sales of three products are presented consequently in table (1-3) with the existence of non-linear trends in time series of sales of a company’s products, neural system model could predict these trends, and therefore it has a right forecast.

In figures below, the blue curve shows the real time series, and the red curve shows the presented forecasting model. Thus, the presented model is an applicable model for modeling Namana trends and non-linear in time series.

One of the significant applications of this modeling is forecasting the sales of company product for future which can be used for planning in munitions, support and production sections. This table shows the sales forecasting of products for next 15 months.
Table 1: The results of auto regressive rank selection.

<table>
<thead>
<tr>
<th>Time series</th>
<th>Lags</th>
<th>loglik</th>
<th>AIC</th>
<th>BIC</th>
<th>HQC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product 1</td>
<td>1</td>
<td>-457.51668</td>
<td>19.978986</td>
<td>20.058492*</td>
<td>20.00877</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-455.89723</td>
<td>19.952053*</td>
<td>20.011313</td>
<td>19.990729*</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-455.89706</td>
<td>19.995524</td>
<td>20.154537</td>
<td>20.055091</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-455.87540</td>
<td>20.038061</td>
<td>20.236826</td>
<td>20.112519</td>
</tr>
<tr>
<td>Product 2</td>
<td>1</td>
<td>-480.35395</td>
<td>21015389</td>
<td>21.134648</td>
<td>21.060064</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-480.35702</td>
<td>20.972044*</td>
<td>21.051551*</td>
<td>20.941828*</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-480.35297</td>
<td>21.102303</td>
<td>21.301069</td>
<td>21.176762</td>
</tr>
<tr>
<td>Product 3</td>
<td>1</td>
<td>-467.51582</td>
<td>20.457209</td>
<td>20.576469</td>
<td>20.5018852</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-467.33115</td>
<td>20.492659</td>
<td>20.651671</td>
<td>20.552226</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-468.11290</td>
<td>20.439691*</td>
<td>20.519197*</td>
<td>20.469475*</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-467.12169</td>
<td>20.527030</td>
<td>20.725795</td>
<td>20.601489</td>
</tr>
</tbody>
</table>

4. Assessment of the presented model of this study:

We assess the operation of the implemented algorithm in this section by using test data in sales forecasting of products. For this purpose, we use auto-regressive and Arima approach for comparison of applicability of this model.

After forecasting through test data, we do the first assessment of model’s functionality by MAPE. This yardstick can be calculated by
MAPE = \left( \frac{1}{n} \sum_{i=1}^{n} \frac{|p_i - A_i|}{A_i} \right) \times 100

In this formula pi is the predicted amount and \( A_i \) is the demand and n is the number of observation. If the fault of MAPE is less than 1, this model can be a better model, and the selected model has the least deficiencies. The table below shows comparisons for test data (auto regressive rank p is the number obtained from test results for time series of the products)

<table>
<thead>
<tr>
<th>Time series</th>
<th>Our model</th>
<th>AR(p)</th>
<th>ARIMA (p,1,1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product 1</td>
<td>8.49</td>
<td>21.57</td>
<td>18.12</td>
</tr>
<tr>
<td>Product 3</td>
<td>11.12</td>
<td>19.32</td>
<td>14.76</td>
</tr>
</tbody>
</table>

The results from this model in estimating complex and non-linear relations that are in time-series data and thus this model can be used for sales forecasting.

5. Results and concluding remarks:

Sales are one of the most important consequences of marketing activities of the companies. For this reason, success at appropriate sales forecasting and analysis of a product or service can help the company to achieve its marketing and financial goals. Sales forecasting can be used as a strategy for the success of companies in business competition. In this model, by using statistical test AIG, SBIC and HQIC, the auto regressive rank for time series and then forecasting was done. To assess this combinational model for this study, the sales data of 7 of best-seller products in Esfahan Steel Company which forecast three sample products in next 15 months is presented.

6. Suggestions:

1. In this research, we study the forecasting best-seller products of Esfahan Steel Company. Future researches can be conducted in other products or other artificial intelligence approaches can be exerted.
2. This research was done in Esfahan Steel Company Joint Stock Company. Other attempts can be done in other manufacturing companies and the results can be compared to this research.

REFERENCES