The use of Information Technologies for the implementation of the statistical analysis of Polymer product prices

Gulnara A. Gareeva[1], Diana R. Grigoreva[2]

1. Kazan Federal University, gagareeva1977@mail.ru

2. Kazan Federal University

ABSTRACT

A wide introduction of computer technology in all spheres of activity of organizations and enterprises creates the prerequisites for an active use of information technologies to implement the statistical analysis.

This article is devoted to the use of information technologies in statistical methods on the example of price analysis for polymer products. The statistical analysis was performed using the "Statistica" software on the basis of available data.

In this work they used the method of exponential smoothing and neural network methods of system analysis. On the basis of monthly data, during the period from January 2012 to December 2016, the production volume prediction was developed until December 2017.

Comparing the results of two methods application - neural networks and exponential smoothing, it follows that both methods predict the trend of production volume growth, and their greatest volume will be in December 2017. However, in the course of prediction by the method of exponential smoothing, the model showed that in December 2017 the production volume will make just over 125 thousand tons, which is 5 thousand tons more than the selected neural network model showed. At the same time, during the exponential smoothing method, a larger error (5.49%) was observed on the cross-check, than within the model obtained during the application of neural networks (2.47%).

Key words: computer technologies, software product, statistical analysis, polymeric products, statistical methods.

Articulo recibido: 05-11-2017
Aprobación definitiva: 06-12-2017

1. INTRODUCTION

The capabilities of computers in the processing of large volumes of information made the most modern methods of statistical analysis accessible to users. Currently, a large number of statistical software packages have been developed. Among the universal systems of statistical data analysis, the statistical package "Statistica" [Borovikov V.P. 2000] is the most popular one.

In recent decades ehe development of prognostics as a science has led to the creation of a multitude of methods, procedures, forecasting methods that are unequal in importance, and therefore specialists are faced with the task of method selection that would provide adequate predictions for the processes under study and this conditions the choice of software products for the implementation of statistical analysis. In this paper, the methods of forecasting were considered using the "Statistica" package and it was determined which of them is the most effective and gives more accurate predictions. The theoretical base of the work was the works of such foreign and domestic authors as Borovikov V.P., Eliseeva I.I., Orlova I.V. et al.

In this work, the method of exponential smoothing and neural network methods of system analysis are implemented.

2. METHODS

Forecasting describes the emergence of processes and objects in the future, which are not available to an immediate perception and verification in practice at the moment. The classifications of forecasting methods and models are considered. The method of forecasting is chosen best of all depending on the required length of a forecast.

The methods of forecasting were considered: exponential smoothing, neural network modeling. The method of exponential smoothing can take into account seasonality or not [Afanasyev V.N., Yuzbashev M.M. 2010, Eliseeva I.I. 2010.].

A distinctive feature of neural networks is the ability to learn and generalize the accumulated knowledge [Kruglov V.V. 2001].

3. RESULTS

The study analyzed the state of the polymer film market in Russian Federation. In the work they realized the statistical methods of forecasting: the method of exponential smoothing and neural network methods of system analysis using the "Statistica" package. On the basis of monthly data, during the period from January 2012 to

Articulo recibido: 05-11-2017
Aprobación definitiva: 06-12-2017

December 2016, the forecast is made for the year ahead in terms of production volumes, i.e. until December 2017. For this let's use the method of exponential smoothing. Let's visualize it for preliminary analysis of the series.

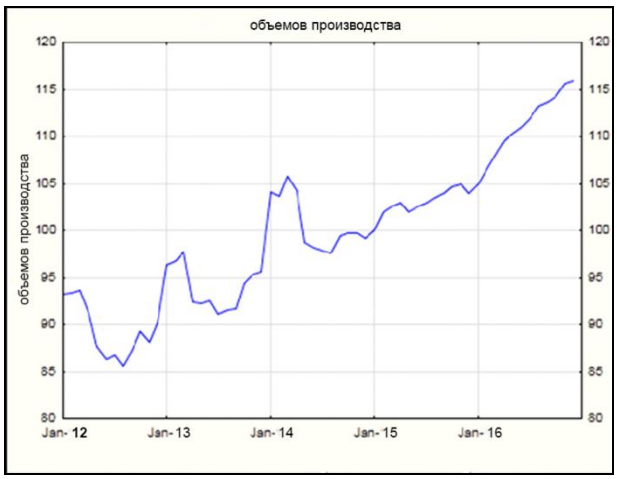

Figure 1 - Initial series of sales volumes (thousands of tons)

The figure shows that the time series contains a trend, but it is difficult to draw conclusions about the availability of seasonality using this graph. Besides, it is clear that the model in our case is not an additive one, because the amplitude of the oscillations is different.

The parameters Alpha, and Gamma were obtained and set as the result of exponential smoothing. A number of residues is stationary, which indicates the adequacy of the constructed model. A rather high quality of the forecast and the model is confirmed by an average absolute error, which makes approximately 5.79%. Let's visualize the results of the forecast for the next 12 months in the form of a graph (Figure 2).

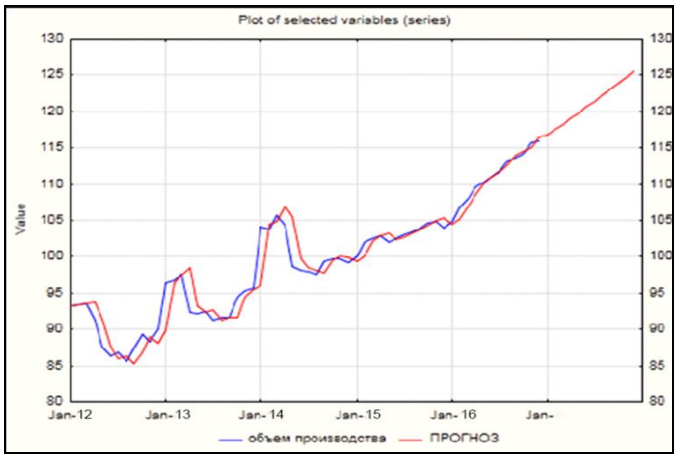

Figure 2 – Prediction graph of original series

Articulo recibido: 05-11-2017
Aprobación definitiva: 06-12-2017

According to the developed forecast, production volumes will continue to grow in the near future, and by December 2017 they will make more than 125 thousand tons.

Let's forecast the volumes of production based on the initial data using neural networks. Let's develop neural networks using 60 observations, the last 12 levels of the series will be used for cross-checking. We train several networks and save 5 best ones. All networks showed almost the same performance.

Having examined the histograms of residual distribution and the dispersion diagram of networks, it can be said that all networks have approximately normal distribution of residues, i.e. all of them are qualitative ones. In order to assess the accuracy of networks, let's consider the graph on which the source row and the predicted series are shown - Figure 3.

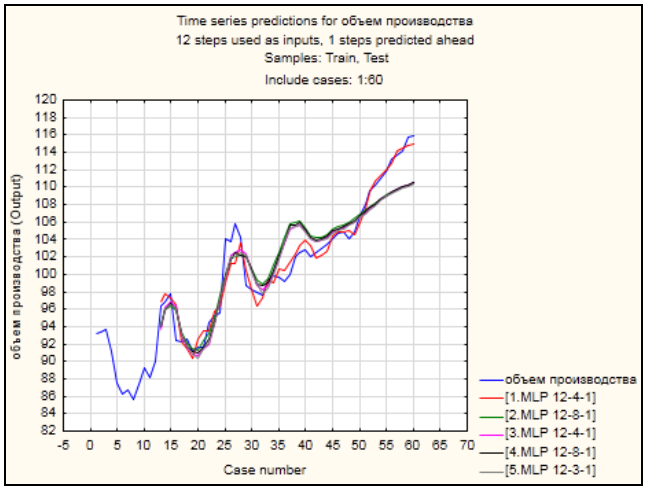

Figure 3 - Predicted series

The lines belonging to different networks are very close to each other, which indicates that the models are almost identical by quality. Therefore, let's choose a network that showed the best performance (network 1), it is the closest one to the original row and let's analyze its quality by comparing the values predicted by it with the observations left for the cross-check. To do this, let's construct the projection of the series with the values from 1 to 60. The model gives a good enough forecast by quality. A more accurate measurement of the forecast quality and the mean absolute error is calculated and makes 0.024793 [Gareeva G.A., Grigorieva D.R., Ishimova A.Yu. 2017].

According to the forecast, the production volumes of the polymer film will continue to grow and it is assumed that the highest peak will be reached in December 2017, when the production volume will make more than 120 thousand tons (Figure 4).

Articulo recibido: 05-11-2017
Aprobación definitiva: 06-12-2017

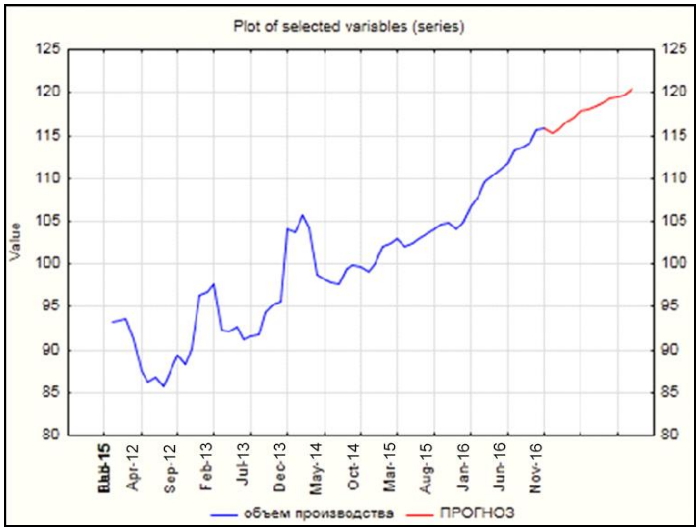

Figure 4 – Prediction graph

Comparing the results of two methods application - neural networks and exponential smoothing, it follows that both methods predict the production volume growth trend, and their greatest volume will be in December 2017. However, in the course of prediction by the method of exponential smoothing, the model showed that in December 2017 the production volume will amount to over 125 thousand tons, which is 5 thousand tons more than the indicator of selected neural network model. At the same time, during the exponential smoothing method, it showed a large error (5.49%) during the cross-check, than the model obtained during the application of neural networks (2.47%).

In time and with the arrival of new data, it is necessary to correct the functions under study in order to obtain a more accurate forecast for the future.

Thanks to the development of computer technologies for research in various fields of science and technology, economics and production, there are available scientific and statistical software packages that meet different user needs [Orlova I.V. 2007].

4. CONCLUSIONS

In this paper, the statistical analysis was carried out in the package "Statistica" on the basis of available data using the example of price analysis for polymer products.

In this work, the method of exponential smoothing and neural network methods of system analysis are implemented. On the basis of monthly data, from January 2012 to December 2016, the volume of production was predicted until December 2017.

Comparing the results of two methods application - neural networks and exponential smoothing, it follows that both methods predict the trend in the growth of production

Articulo recibido: 05-11-2017
Aprobación definitiva: 06-12-2017

volumes, and their greatest volume will be in December 2017. However, in the course of forecasting by the method of exponential smoothing, the model showed that in December 2017 the production volume will make just over 125 thousand tons, which is 5 thousand tons more than the selected neural network model showed. At the same time, during the exponential smoothing method, it showed a larger error (5.49%) within the cross-check, than the model obtained during the application of neural networks (2.47%).

5. ACKNOWLEDGEMENT

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

6. REFERENCES

Afanasyev V.N., Yuzbashev M.M. Time series analysis and forecasting. Moscow: Finance and Statistics, INFRA-M, 2010. - 320 p.

Borovikov V.P. Forecasting by "STATISTICA" system in Windows environment. Fundamentals of theory and intensive computer practice: textbook / V.P. Borovikov, G.I. Ivchenko. - Moscow: Finance and Statistics, 2000. - 384 p.: ill.

Eliseeva I.I. Statistics: Textbook / I.I. Eliseeva [and others]; Ed. by I.I. Eliseeva. - Moscow: Prospekt, 2010. - 448 p.

Gareeva G.A., Grigorieva D.R., Ishimova A.Yu. The application of computer technologies in statistical methods on the example of the analysis of prices for polymer products // Scientific and Technical Herald of the Volga Region. №1 2017. - Kazan, 2017. - pp. 77-80.

Kruglov V.V. Fuzzy logic and neural networks. Kruglov V.V., M.I. Dly, R.Yu. Golunov. - Moscow: FIZMATLIT, 2001. - 221 p.

Orlova I.V. Economic and mathematical methods and models: computer modeling: Textbook / I.V. Orlova, V.A. Polovnikov. - M.: University textbook, 2007. - 365 p.

Articulo recibido: 05-11-2017
Aprobación definitiva: 06-12-2017