The aspects of choosing the time series length when constructing a fuzzy regression model

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Analysis of the TS phase portrait

The analysis of the TS phase portrait allows us to identify existing states (development phases) and transitions between them (bifurcation). The analysis of phase portraits can be useful, if it is necessary to single out the subsequence of indeed relevant data of acceptable length from the analyzed TS. It can be further used to develop the models of forecasting. An acceptable length is a length, which can be recommended for use in developing of a forecasting model, based on the application of certain mathematical tools. The use of extremely long TS, for example, in case of work with a forecasting model, based on fuzzy sets, can lead not only to a significant growth of time spending, but also to obtain a model of low quality. The analysis of the TS phase portrait will allow us to identify all the attractors, that are present in the analyzed TS, and also to evaluate their length and limit the length of TS applied for the development of a forecasting model.

TRIANGLE FUZZY NUMBERS

The methods of identifying the relevant TS length can be used to solve the problem of the analysis and forecasting of TS with application of fuzzy regression equation. In this case it is possible to obtain a more accurate TS trend equation (with the evaluation of uncertainty level of TS behavior based on the fuzzy similarity measure of the analyzed TS to the chosen trend equation) and adequate values of the pessimistic and optimistic forecasts for future elements of the analyzed TS.

Analysis and forecasting of TS with application of fuzzy regression equation use Triangle Fuzzy Numbers (*TFN*):

$$TFN = (e, e_{-}, e_{+}).$$

Fuzzy regression equation

The equations of linear, quadratic, exponential and logarithmic fuzzy regressions corresponding to the homonym forecasting models, can be recorded as following :

$$Y(x) = TFN_a \cdot x + TFN_b$$
$$Y(x) = TFN_a \cdot x^2 + TFN_b \cdot x + TFN_c$$
$$Y(x) = TFN_a \cdot exp(TFN_b \cdot x) + TFN_c$$
$$Y(x) = TFN_a \cdot log(TFN_b + x) + TFN_c$$

We can calculate the value of fuzzy similarity measure for the point of the analyzed TS and the TS corresponding to the equation of classical regression (CR):

$$f = 1 - \frac{\sum_{j=1}^{m}(1 - u_{TS}(x_j, y'_j))}{\sum_{j=1}^{m}(1 + u_{TS}(x_j, y'_j))}$$

EXPERIMENTAL PART

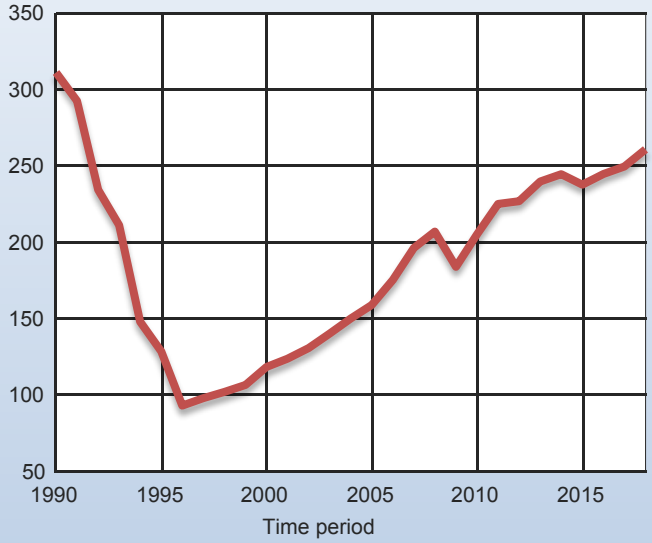
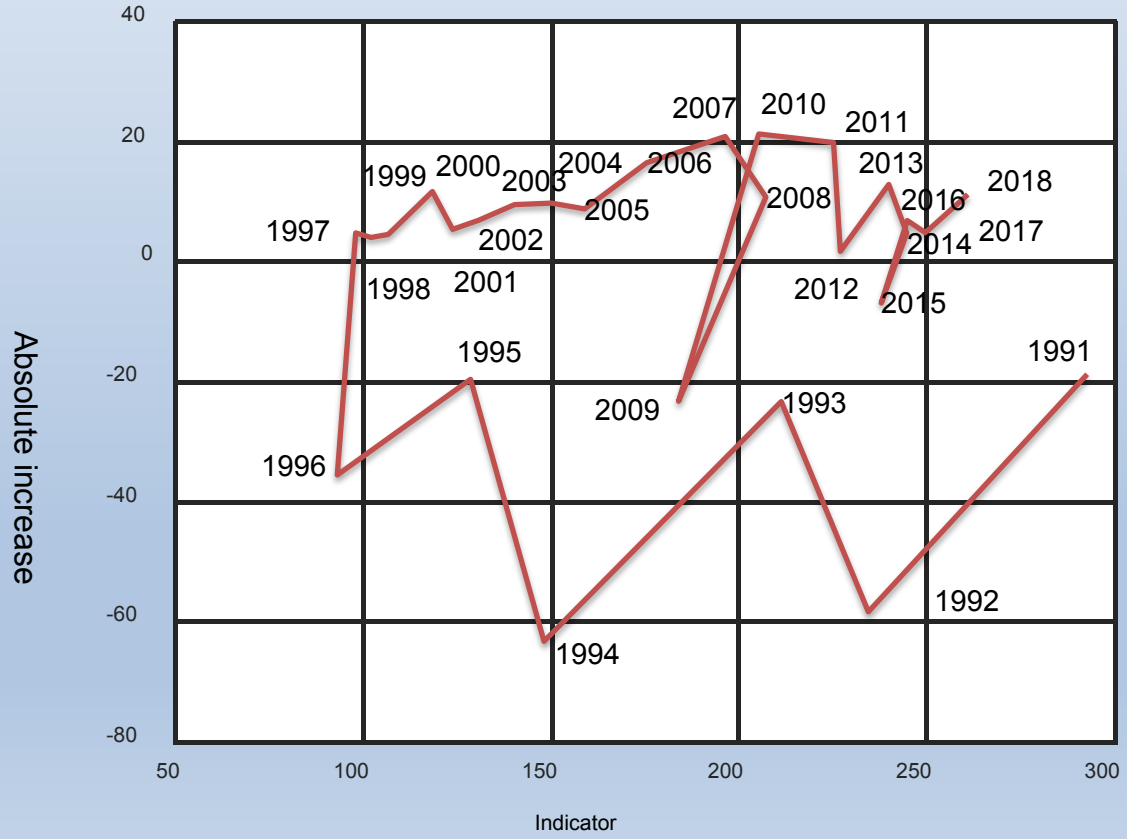


Figure 1 - TS phase portrait of Indicator "The volume of industrial production in the Ryazan region, billions of rubles"



ONE-STEP-AHEAD FORECAST FOR THE INDICATOR

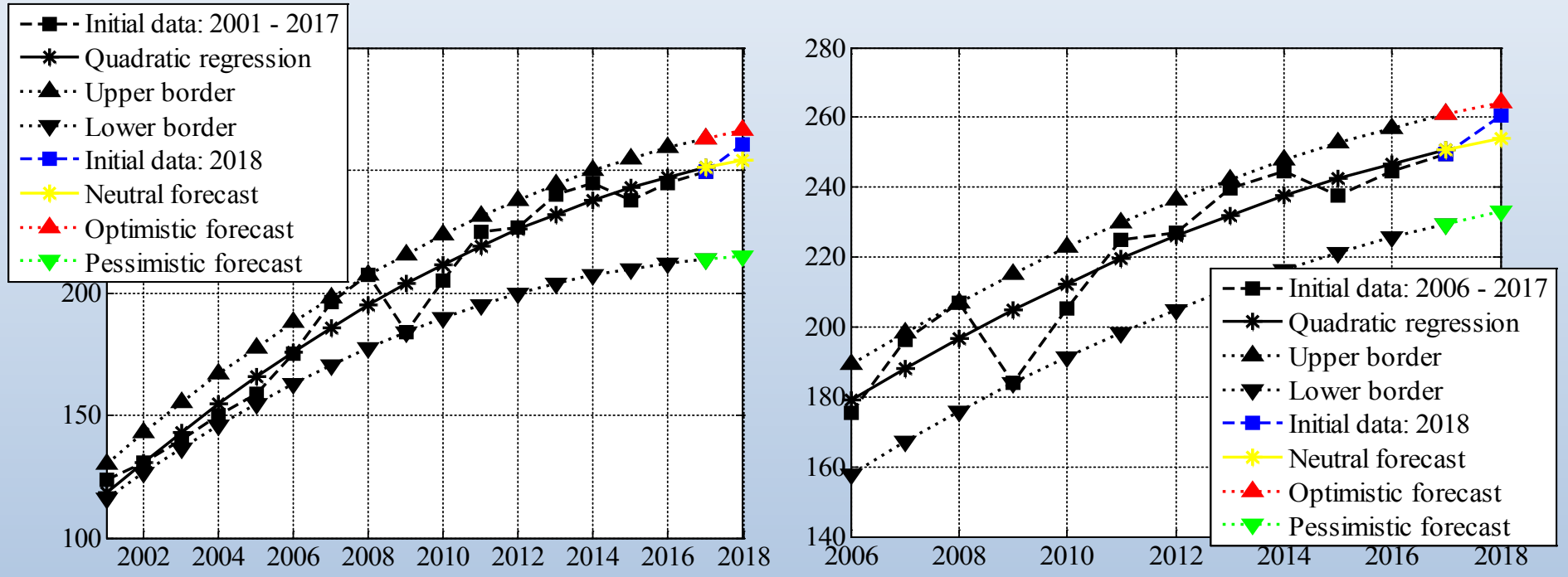


Figure 2 - Forecast “The volume of industrial production” with application of the fuzzy quadratic regression equation:
a – model based on the data for 2001 – 2017;
b – model based on the data for 2006 – 2017

CONCLUSION

The results of the experimental research allow us allow us to conclude that the proposed approach to the choice of the TS length is promising when constructing a fuzzy regression model, that allows us to ensure forming of the adequate interval one-step-ahead forecasts for the indicators of social and economic sphere.