

COMPARISON OF SPARE PARTS DEMAND CALCULATION RESULTS USING MATHEMATICAL MODELS

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Abstract: In this article, using mathematical models for forecasting the need of motor transport enterprises for spare parts, by performing practical calculations using a personal computer and using the Regrel.O program, the need for steering wheels, GTM belts, injectors, and bumpers at motor transport enterprises was calculated and compared with practical indicators.

Keywords: auto service enterprises, mathematical models, regression models, computer, program, technical service, repair, need, time, operational factors, spare parts, actual consumption, steering gear, bumper, nonlinear regression model, forecast, sliding, GTM belt.

СРАВНЕНИЕ РЕЗУЛЬТАТОВ РАСЧЕТА ПОТРЕБНОСТИ В ЗАПАСНЫХ ЧАСТЯХ С ИСПОЛЬЗОВАНИЕМ МАТЕМАТИЧЕСКИХ МОДЕЛЕЙ

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Аннотация: В данной статье с использованием математических моделей прогнозирования потребности автосервисных предприятий в запасных частях, путем выполнения практических расчетов с помощью персонального компьютера и с помощью программы Regrel.O рассчитана потребность в

рулевых тягах, ремнях GTM, инжекторах и бамперах на автосервисных предприятиях и сопоставлена с практическими показателями.

Ключевые слова: автосервисные предприятия, математические модели, регрессионные модели, компьютер, программа, технический сервис, ремонт, потребность, время, эксплуатационные факторы, запасные части, фактический расход, рулевая тяга, бампер, модель нелинейной регрессии, прогноз, скользящий, ремень GTM.

Using mathematical models to forecast the demand for spare parts in auto service enterprises is convenient for practical calculations with the help of a personal computer. To implement these models, data on spare parts consumption for at least the previous 12 months of the enterprise is required.

Using the developed model and the Regrel.O software, we calculate the demand for steering racks. In this case, we use the forecasted values of factor indicators for January 2024 (Table 1).

Table 1. Forecasted values of factor indicators

month	Distance	Number of inputs	Age of the car	Seasonality of usage	Inventory balance	New car production	Output and number of days
1	65	90	5	-10	45	120	13

After entering the data, we obtain the following result: $Y=22.71Y = 22.71Y=22.71$.

The diagram showing the impact of factor indicators on the dependent variable, generated by the program, is presented in Figure 1.

Using the STADIA 6.3 software, we apply a nonlinear forecasting model to predict the demand for steering racks. The forecasted values of the factor indicators for January 2024 are entered into the program (see Table 1). After inputting the data, the nonlinear model yields the following result: $Y=22.71Y = 22.71Y=22.71$.

We compare the forecasted demand values for steering racks obtained using Regre 1.0 (22.71) and STADIA 6.3 (23.30) for January 2024 at the “AVTOTEXXIZMAT-F” JSC auto service enterprise located in Margilan city. Although the STADIA 6.3 program takes into account the combined effect of all factors, the difference between the forecasts is relatively small. The actual consumption of the studied spare part was 20 units; however, this does not indicate the accuracy of either method, as at least one year of spare parts consumption data analysis is required for such an assessment.

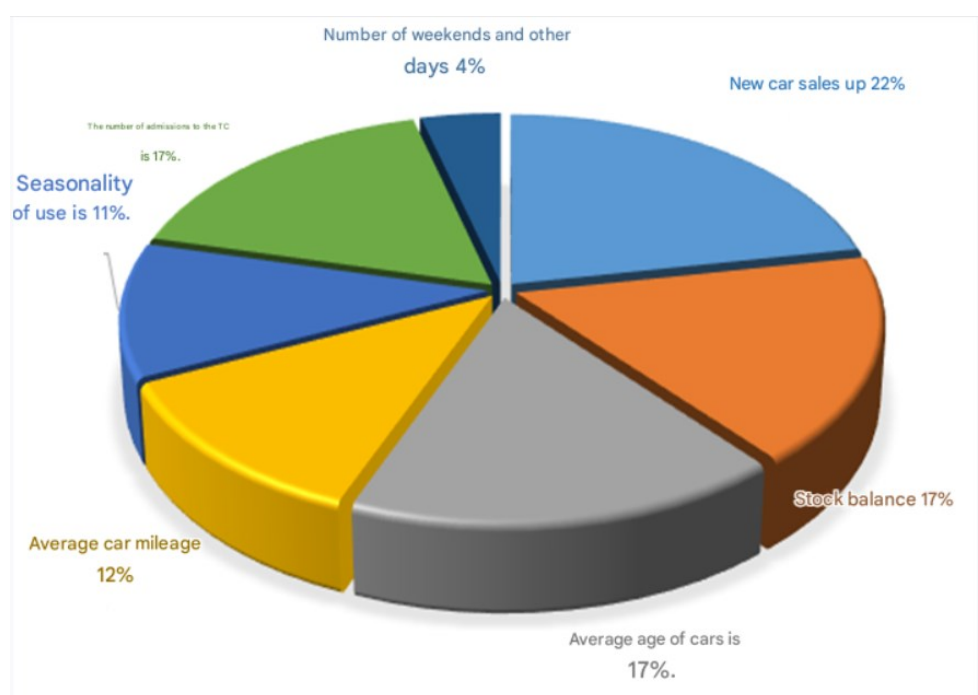


Figure 1. The influence levels of key factors on the consumption of steering racks.

Nevertheless, the method used to select factors for the model allows saving time by postponing the collection of information about factors that do not significantly affect the result.

The nonlinear regression model analysis results ($Y=22.71$) are very close to those of the linear model; however, prediction errors can be even higher when using the nonlinear model. Building the nonlinear model requires

additional analysis to select empirical formulas, so it is advisable to use the linear model for forecasting the demand for spare parts.

To justify the choice of forecasting model based on the nature of the spare parts consumption curve, we calculate the demand for spare parts for 2024 using the examples of the GTM belt (25195582) and the injector (25181804), and then compare the obtained values with the actual consumption of these parts.

Figure 2 shows the forecasted demand curve for spare parts and the actual consumption curve of GTM belts at the enterprise in 2024.

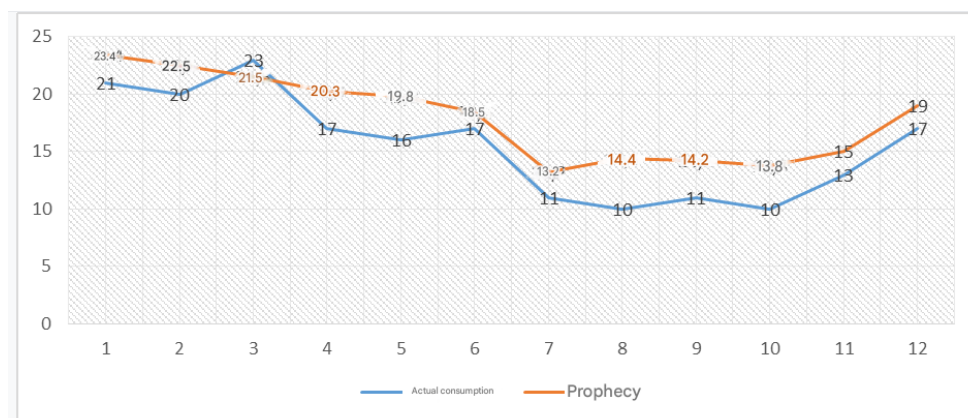


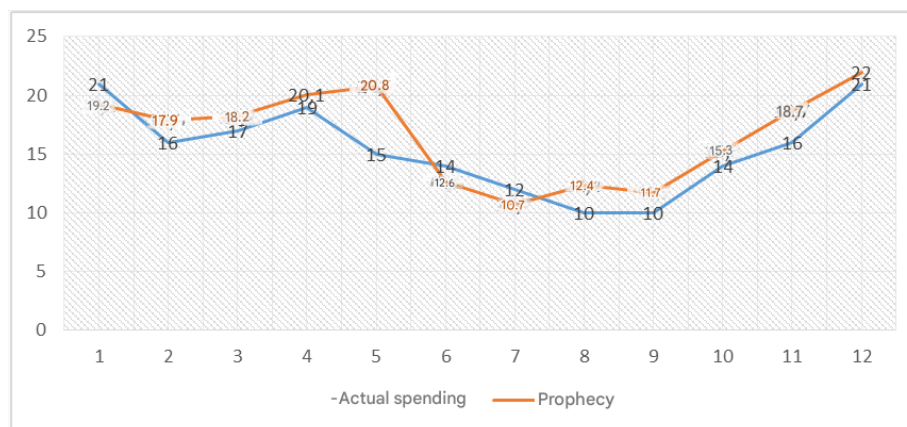
Figure 2. Actual consumption and forecasted demand of GTM belts (catalog number 25195582).

The graph shows that the consumption of GTM belts changes smoothly without sharp fluctuations. The figure also displays the consumption curve for spare parts in 2024, which was used to build the forecasting model.

The forecasting models for GTM belts and front bumpers are adequate, with both models having 6 peak points.

To evaluate the accuracy of the applied models, the average relative approximation error is calculated for each of them:

$$\varepsilon_{nis} = \frac{1}{n} \cdot \sum \left| \frac{y_t - \hat{y}_t}{y_t} \right| \cdot 100\%, \quad (1)$$



3 Figure — Actual consumption and forecasted demand of injectors (catalog number 25181804).

Conclusion. The model constructed using the Fourier series achieved an average relative approximation error of 5.4%, indicating a high level of accuracy for the model. Using the adaptive forecasting model to predict the demand for timing mechanism (GTM) belts resulted in an error value of 7.6%, which is also considered sufficiently accurate.

However, when using the adaptive model to forecast the demand for front bumpers, the error value reaches 8.8%, which is significantly higher compared to the forecast made with the Fourier series model.

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