



# BUSINESS REPORT

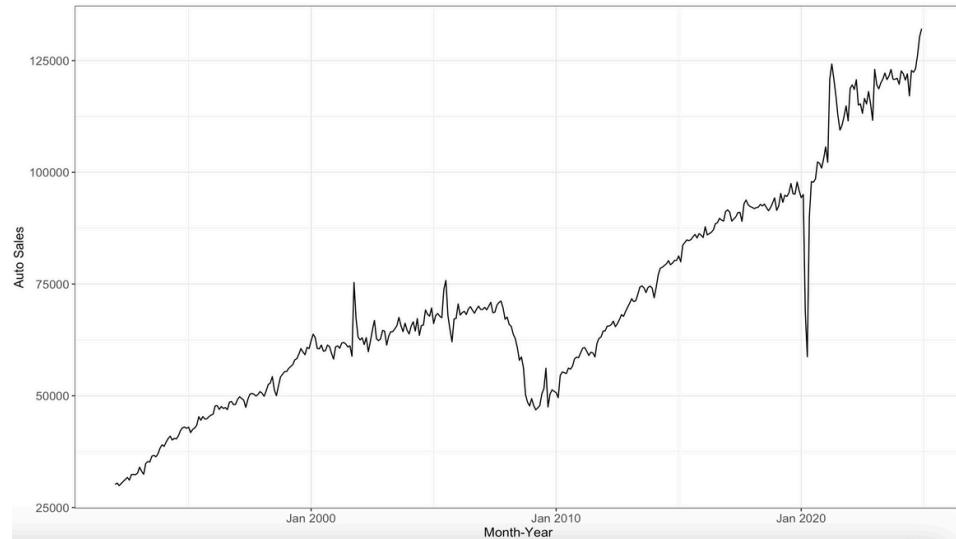
## SALES FORECASTING

This report aims to provide a forecast of automotive sector sales in the United States from January to March 2025.

### Dataset Overview

The dataset contains the historical series of monthly sales (in millions of dollars) for the U.S. automotive sector from January 1992 to December 2024.

**Figure 1: Time Series of Automotive Sales**



The chart shows a generally **increasing trend** over the years, with some exceptions. For example, in 2008 there was a sharp decline due to the global financial crisis. In 2020, another significant drop occurred as a result of the Covid-19 pandemic.

Analysis of the sales series indicates the presence of **annual seasonality**, likely due to climatic and regulatory factors that periodically influence demand.<sup>1</sup>

<sup>1</sup>. The time series was decomposed into its components: trend, seasonality, and irregularity. This allowed for the identification of a 12-month seasonality.

Three additional time series were selected<sup>2</sup> to support the model construction and the forecast development:

- **Fuel prices** may impact motorists' purchasing decisions: during periods of increase, consumers tend to postpone purchases or prefer alternative modes of transportation;
- **Industrial production index** is a macroeconomic indicator: an increase in production suggests a favorable economic environment, with positive effects on the propensity to purchase durable goods, such as automobiles;
- **Unemployment rate** may affect consumer confidence and their ability to afford significant expenses, such as purchasing a car.

## Forecasting model

Based on the analyses and evaluations conducted<sup>3</sup>, a model was selected that predicts sales by taking into account the trend of the previous three months, as well as the three aforementioned exogenous variables.

**Figure 2: Forecast & Projections (USD Million) for Q1 2025**

Month	Lower estimate	Central estimate	Upper estimate
January 2025	120149.7	128176.1	136202.5
February 2025	118902.8	129454.5	140006.3
March 2025	117073.0	128257.0	139441.0

With **95% probability**, automotive sector sales for Q1 2025 are expected to fall within the lower and upper estimates indicated in the table.

By the end of the quarter, growth compared to December 2024 could reach up to USD 7,288 million, while in the worst-case scenario, a contraction of USD 15,080 million would be recorded.

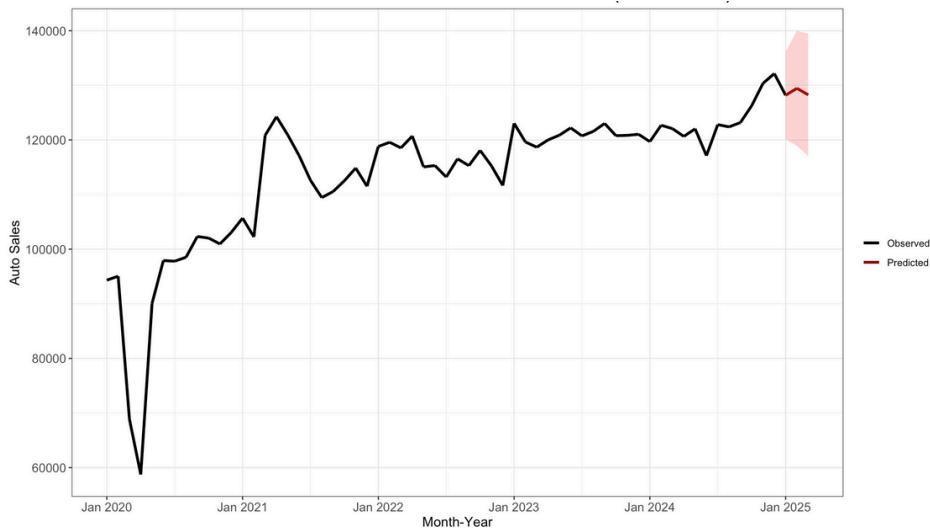
The model confirmed that the impact of macroeconomic factors on automotive sector sales is consistent with the hypotheses outlined in the final section of the Dataset Overview.

2. The significance of the influence of the selected variables on the target variable was tested using the Granger Causality test.

3. Residual analysis and the significance of the coefficients suggest that the MA component does not provide meaningful informational contribution; therefore, it was excluded from the final model, resulting in an ARX(3). The ACF plot of the ARX model and the results of the Ljung-Box test on the residuals supported this decision. Model comparison using the Likelihood Ratio Test (LRT) indicated that the more comprehensive version is preferable in terms of explanatory power. The choice of the model's lag order was guided by information criteria (AIC, BIC).

# Highlights

**Figure 3: Observed Series (from 2020) + Forecast (from Jan to Mar 2025) with 95% CI**



Based on the forecasts for U.S. automotive sector sales for Q1 2025, the following strategic considerations are proposed:

## ► Product Mix Optimization

The estimates indicate a stable trend in sales over the period under consideration. In this context, companies could prioritize offering vehicles with higher margins, as the expected stability may reduce the risk of unsold inventory.

## ► Proactive Supply Chain Management

Given the expected stability in sales, it may be advisable to adopt a less conservative approach in supply chain management, particularly for critical raw materials, in order to respond promptly to demand without facing supply shortages.

## ► Strategic Use of Macroeconomic Indicators in Marketing

Since the forecasting model highlights the significance of the selected macroeconomic variables, it may be advisable to integrate these indicators into decision-making processes. In particular, promotional and pricing strategies can be improved by adapting them to the economic conditions of specific geographic areas or periods of the year, thereby more effectively addressing consumers' needs and purchasing power.

Below are some examples of potential scenarios:

- If fuel prices increase, the focus could shift towards electric vehicles or low-consumption models;
- If the industrial production index rises, the offering of mid-to-high-end models could be strengthened, targeting consumers with higher purchase willingness;
- If unemployment is low in certain areas, preferential financing options for new cars could be promoted.

# Appendix

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The time series (target and covariates) were made stationary and deseasonalized through annual differencing (Lag = 12). The model was trained on data up to December 2023 and tested on 2024 values. No autocorrelation was observed in the residuals. After reversing the standardization and differencing transformations on the forecasts, the obtained metrics are: **MAE = 4,476.95; MAPE = 3.89%**.

For Q1 2025, the forecasts are based on estimated values of the covariates (unemployment rate and fuel cost predicted using ARMA(1,1), and industrial production index with MA(2)). In this case as well, the results were converted back to the original scale.