# FORECASTING MONTHLY U.S. RETAIL SALES USING ARIMA IN EVIEWS

## 1. Overview

**Client:**

A U.S.-based retail analytics firm supporting major retail chains and logistics providers

**Objective:**

To develop a robust monthly retail sales forecasting model using ARIMA in EViews, allowing the client to anticipate consumer demand patterns and inform inventory and staffing strategies.

## 2. Background

Retail sales data exhibit clear seasonal and trend components, often influenced by macroeconomic shifts. The client's prior forecasts relied on simple moving averages. A statistically rigorous ARIMA model using EViews was required to improve accuracy and support automated monthly forecasting pipelines.

## 3. Data Summary

**Time Period:**

January 2000 – December 2022 (276 monthly observations)

**Variable Used:**

- **Retail_Sales_US** (USD, seasonally adjusted, log-transformed)

**Source:**

U.S. Census Bureau (Monthly Retail Trade Report)

## 4. Methodology

**Software Used:**

EViews 13

**Model Type:**

ARIMA (Autoregressive Integrated Moving Average)

**Steps in EViews:**

1. **Data Import and Preprocessing:**
    - Imported CSV from Census Bureau
    - Applied log transformation for variance stabilization
    - Visualized raw and log series trends
2. **Stationarity Checks:**
    - ADF and KPSS tests confirmed series was I(1)
    - First difference applied to achieve stationarity
3. **Model Identification:**
    - Autocorrelation Function (ACF) and Partial ACF plots examined
    - Auto ARIMA suggested ARIMA(1,1,1)
4. **Model Estimation:**
    - *Estimate Equation* > *ARIMA* using EViews
    - Diagnostics included: Ljung-Box Q-test, ARCH LM, residual normality
5. **Forecasting:**
    - 12-month out-of-sample forecast generated
    - Forecast intervals (±2 standard errors) plotted

# 5. Key Results

| Parameter | Estimate | p-value | Interpretation |
|---|---|---|---|
| AR(1) | 0.59 | 0.000 | Moderate persistence in month-to-month changes |
| MA(1) | –0.43 | 0.002 | Noise adjustment reduces short-run fluctuations |
| RMSE (in-sample) | 0.032 | – | Strong fit to historical log-scale sales data |
| MAPE (12-mo. forecast) | 2.9% | – | Forecast accuracy within acceptable business thresholds |

**Residuals:**

- No autocorrelation (Ljung-Box p = 0.312)
- No ARCH effect (p = 0.475)
- Residuals approximately normal

## 6. Visual Outputs (EViews)

- Forecast vs. Actual Sales Line Chart
- Confidence Interval Band Plot (Forecast Horizon)
- Residual Histogram and Normality Test Plot
- ACF and PACF comparison pre- and post-differencing

## 7. Deliverables

- EViews .wf1 file containing model, diagnostics, and forecast
- Full forecasting report (15 pages), including:
    - ARIMA model theory and EViews workflow
    - Detailed results, tables, and residual checks
    - Forecast graphs and business implications
- Excel summary for integration with business dashboards

## 8. Application & Outcomes

- Used by the client's supply chain team to optimize distribution during peak seasons
- Integrated into a Tableau dashboard for monthly forecast review
- Informed marketing spend allocation for product launches and sales events

## 9. Strategic Value Delivered

- Delivered a **statistically robust, automated forecasting tool**
- Enabled **proactive demand planning** across inventory and logistics
- Enhanced the client's **strategic forecasting credibility** with stakeholders