

TIME-SERIES FORECASTING OF MONTHLY RETAIL SALES USING SPSS IN THE APPAREL INDUSTRY

1. Background and Problem Statement

A mid-sized retail apparel chain operating across urban centers in India experienced volatile monthly sales patterns over the past three years. These fluctuations made it difficult for inventory managers to plan procurement cycles and for marketing teams to time their campaigns effectively. The company's historical data showed strong seasonality, particularly during festival months and end-of-season sales, but no forecasting system was in place. The organization sought a data-driven solution using SPSS to analyze historical sales and build a forecasting model that could assist in future inventory and sales planning.

2. Objectives

- To explore and clean monthly sales data using SPSS from January 2020 to December 2022
- To identify seasonality, trends, and cyclical patterns using time-series decomposition
- To fit an appropriate ARIMA model using SPSS for sales forecasting
- To validate the forecasting model through residual diagnostics and out-of-sample accuracy tests
- To generate a 12-month ahead forecast of sales for 2023 for strategic use by inventory and marketing teams

3. Methodology

3.1 Data Preparation and Cleaning

- Data Source: Company's ERP system (monthly sales totals)
- Time Range: Jan 2020 – Dec 2022 (36 data points)
- Variables: Month, Sales Amount (in INR)
- Actions: Checked for missing data, outliers, and ensured regular time intervals using SPSS's Time Series Wizard

3.2 Time-Series Diagnostics

- Applied Moving Average and Exponential Smoothing to understand underlying patterns

- Performed time-series decomposition to extract trend, seasonal, and residual components using SPSS's "Explore Trend" procedure

3.3 Model Estimation

- Conducted ACF and PACF analysis to identify order of AR and MA terms
- Fit ARIMA models iteratively (0,1,1), (1,1,1), (1,1,0), etc., with seasonal terms
- Used the Expert Modeler in SPSS to confirm the best-fit model using BIC, AIC, and stationary R^2
- Final Model: Seasonal ARIMA (0,1,1)(1,0,1)₁₂

3.4 Model Validation

- Examined Ljung-Box test results to ensure no autocorrelation in residuals
- Performed residual analysis (mean ~ 0 , constant variance)
- Split the data into 80% training and 20% test sets to compare predicted vs actual values (MAPE = 6.4%)

4. Key Features of the SPSS Model

- Time-Series Chart for historical, fitted, and forecasted values
- Automatic seasonal adjustment through ARIMA (12-month cycle)
- Interactive Forecast Viewer with confidence intervals
- Model summary with coefficients, error measures, and fit diagnostics

5. Results and Insights

- Clear seasonality identified during November–December and May–June
- ARIMA model captured both short-term shocks and long-term patterns effectively
- 12-month forecast showed a $\sim 15\%$ spike expected in November 2023 (aligns with Diwali sale period)
- Model accuracy confirmed by low Mean Absolute Percentage Error (MAPE $< 7\%$)

6. Deliverables

- .sav file containing cleaned and structured time-series data

- SPSS output file (.spv) containing model diagnostics, decomposition charts, and forecast graphs
- Final report in APA format, including:
 - Introduction and objectives
 - Step-by-step analysis procedure
 - Tables and figures with SPSS outputs
 - Interpretation of findings
 - Forecast values with confidence intervals
- Excel sheet of forecasted monthly sales for 2023 with visual charts

7. Stakeholder Relevance

Academic:

- Demonstrates end-to-end application of ARIMA in SPSS
- Valuable for coursework in forecasting, business analytics, or econometrics

Corporate:

- Helps retail firms implement sales forecasting without switching to complex tools
- Supports inventory optimization, marketing calendar alignment, and supply chain planning