DAILY ELECTRICITY CONSUMPTION FORECASTING FOR A MANUFACTURING PLANT USING EXCEL

1. Background and Problem Statement:

A small-scale manufacturing plant located in Gujarat, India, was experiencing erratic daily electricity usage that affected its operational efficiency and budgeting. The plant management sought a simple forecasting model in Excel to predict future electricity consumption and improve decisions related to equipment scheduling, load balancing, and energy procurement planning.

2. Objectives:

- Analyze 180 days of historical electricity consumption data

- Build an Excel-based **daily consumption forecast model** using **double exponential smoothing**

- Identify consumption trends, seasonal spikes, and operational inefficiencies

- Develop a dynamic forecasting dashboard and performance evaluation tool

3. Methodology:

3.1 Dataset Description

- **Time Period:** 01 July 2023 to 27 December 2023 (180 days)

- **Variable:** Electricity consumption per day in kWh

- **Data Format:** Excel file with columns: Date, Consumption (kWh)

3.2 Data Cleaning and Preparation in Excel

- Removed weekends from the dataset using a =TEXT(Date,"ddd") filter

- Replaced missing values with 3-day moving average using

- =AVERAGE(B2:B4)

- Created two helper columns for trend and level smoothing

3.3 Forecasting Method

Double Exponential Smoothing (Holt's method) in Excel:

- **Level (L_t)** and **Trend (T_t)** calculated recursively using:

- Level: = α * Current + (1 - α) * (Previous Level + Previous Trend)

- Trend: = β * (Current Level - Previous Level) + (1 - β) * Previous Trend

- Forecast: = Previous Level + Previous Trend

- Used smoothing constants: α = 0.5, β = 0.3

- Added user-controllable inputs for α and β via named ranges

4. Results and Visualizations

4.1 Key Metrics

- **Mean Absolute Error (MAE):** 41.3 kWh

- **Root Mean Squared Error (RMSE):** 53.8 kWh

- **MAPE:** 7.2%

- Notable daily spikes observed on Mondays and after national holidays

4.2 Charts and Dashboards

- **Line Chart:** Actual vs Forecasted consumption

- **Forecast Accuracy Panel:** MAE, MAPE, RMSE in KPI tiles

- **Weekly View:** Sparkline summary for 6-day operational blocks

- **Scenario Chart:** Projected consumption under 5% production increase

5. Excel Deliverables

- Forecast_Model Sheet with editable α and β cells

- Error_Metrics Sheet with auto-calculating forecast performance

- Consumption_Chart Sheet with dual-line graph for visual tracking

- Scenario_Simulation Sheet for adjusting future assumptions

6. Recommendations

- Shift heavy production to early weekdays when electricity rates are lower

- Use Excel dashboard for weekly operational briefings

- Increase smoothing factor β slightly to account for production trend variation

- Consider extending model to include production volume as a secondary variable

7. Stakeholder Relevance

Academic Use:

- Demonstrates double exponential smoothing implementation in Excel without VBA

- Can be used to teach forecasting error metrics and parameter tuning

Corporate Use:

- Supports real-time utility cost management

- Enables energy planning without complex software tools