SALES FORECASTING AND INVENTORY PLANNING FOR A BEVERAGE BRAND USING TIME SERIES MODELS

1. Background and Problem Statement:

A regional beverage brand distributing soft drinks, energy beverages, and flavored water across 12 cities in western India faced frequent inventory mismatches—leading to both stockouts and excess warehouse costs. Sales were seasonal and influenced by festivals, weather, and promotions. The supply chain team lacked a systematic method to forecast demand and align inventory decisions. The objective was to create **accurate sales forecasts at the SKU level** and translate them into data-driven inventory planning.

2. Objectives:

- Forecast monthly sales of 12 SKUs for the upcoming quarter using statistical models
- Identify seasonal and trend components across beverage categories
- Generate inventory replenishment guidelines using forecast outputs
- Recommend stock control strategies to minimize overstock and shortage risks

3. Methodology:

3.1 Data Collection and Processing

- **Data Source:** Internal ERP system
- **Data Period:** Jan 2021 – Dec 2023 (36 months)
- **Data Scope:** Monthly sales by SKU, city, and channel (retail vs. wholesale)
- Data preparation steps included:
    - Handling missing months via linear interpolation
    - Detecting and flagging promotional spikes
    - Creating additional features: moving average, month, quarter, event flags

3.2 Modeling Techniques

- Built time series models using Python:

    - **ARIMA** for SKUs with strong autoregressive properties
    - **Exponential Smoothing (ETS)** for SKUs with trend/seasonality
    - Evaluated models using MAPE (Mean Absolute Percentage Error)
- Models selected per SKU based on AIC/BIC and forecast accuracy
- Final forecasts visualized in Tableau

3.3 Inventory Planning

- Calculated safety stock using historical standard deviation and service level target (95%)
- Determined reorder points using:
    - Forecasted demand × lead time
    -
        - safety stock buffer
- Developed dynamic Excel inventory sheet linked to monthly forecast updates

4. Results:

4.1 Forecast Accuracy

SKU	Best Model	MAPE (%)	Seasonality Identified
Orange Spark Drink	ETS	8.2	Yes (summer & Diwali)
Energy Shot 100ml	ARIMA	6.7	Yes (month-end spikes)
Lemon Cooler (PET)	ETS	5.9	Yes (summer)
Cola Classic 300ml	ARIMA	7.8	None (stable baseline)

- Forecasts captured sales surges around **April–June (heat months)** and **October–November (festivals)**
- Category-level accuracy: **MAPE < 10% for 10 of 12 SKUs**

4.2 Inventory Impact Simulation

- Simulated two scenarios:
    - Old fixed-stock model vs. new forecast-driven model
- Results (next quarter):

- **Reduction in stockouts:** –38%
- **Reduction in overstock (holding cost):** –21%
- **Improved fill rate:** +14%

5. Recommendations:

5.1 Forecasting Operations

- Refresh forecasts **monthly** using rolling 36-month window
- Build a dashboard showing forecast vs. actual by SKU and city
- Add temperature data as an external variable in future models

5.2 Inventory Process

- Adopt dynamic reorder points based on most recent forecast
- Include channel split (retail vs. wholesale) to fine-tune SKU-specific thresholds
- Train warehouse team on using Excel-based stock planning template

5.3 Cross-Functional Alignment

- Use forecast reports in S\&OP (Sales & Operations Planning) meetings
- Sync promotional calendar with forecast models to flag spikes
- Add margin data to prioritize SKUs with higher profitability in ordering

6. Future Work:

- Shift from ARIMA to **Prophet or LSTM models** for longer-term multi-SKU forecasting
- Incorporate **weather APIs** to dynamically adjust summer beverage forecasts
- Automate alerts when forecast deviation exceeds a tolerance band

7. Stakeholder Relevance:

Academic:

- Demonstrates use of time series forecasting techniques (ARIMA, ETS) for SKU-level planning
- Ideal for teaching applications in operations research, inventory control, and demand forecasting

Corporate:

- Builds a bridge between sales forecasting and working inventory management
- Helps FMCG supply chains reduce inefficiencies and better align with demand patterns
- Offers an Excel-ready implementation plan supported by statistical rigor