SALES FORECASTING & INVENTORY OPTIMIZATION: STRATEGIC INSIGHTS

By Nishank

EXECUTIVE SUMMARY
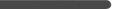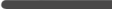
- **Current Situation:** Our sales operations face dual challenges: potential over-ordering by distributors and sub-optimal stock allocation from HQ, exacerbated by recent market disruptions (COVID-19) and supply chain issues (factory fire).
- **Objective:** To leverage data-driven sales forecasting to optimize inventory, prevent over-ordering, and inform strategic stock allocation for sustained growth.
- **Key Findings:**
  - Historical sales data reveals clear seasonality and a significant impact from external events.
  - Our robust SARIMA time series model provides reliable 24-month and 36-month sales forecasts.
  - Forecasts indicate that simply "making up for past sales" through aggressive ordering is not supported by data and risks significant overstocking.
  - Despite recent challenges, the underlying sales trend, when viewed with a stable supply assumption, shows strong potential for growth, justifying strategic and increased stock allocation.
- **Recommendations:** Implement data-backed inventory policies, align distributor orders with realistic forecasts, and advocate for HQ stock allocation based on demonstrated market potential.

INTRODUCTION: THE CHALLENGE

- **Context:** Our market has experienced unprecedented volatility, including the COVID-19 pandemic (starting March 2020) and a critical factory fire (real effects observed from 2022).

- **Impact:** These events have disrupted our supply chain and sales patterns, leading to:
  - Distributor Over-ordering: A natural tendency to over-order inventory, driven by a desire to compensate for past shortfalls or anticipate future demand, potentially leading to excess stock and financial burden.
  - HQ Stock Under-cutting: A conservative approach to stock allocation by HQ, potentially underestimating market potential and hindering our ability to capture growth opportunities.

- **Our Goal:** To bridge this gap using rigorous time series analysis and forecasting, providing a clear, data-driven perspective for both inventory management and strategic allocation.

METHODOLOGY: OUR APPROACH TO SALES FORECASTING (PART 1)

- **Data Source:** Monthly sales data from 2017-01-31 to 2022-12-31.

- **Initial Data Preparation:**
  - **Loaded raw data, assigned 'Date' and 'Sales' columns.**
  - **Converted 'Date' to datetime index and 'Sales' to numeric format.**

- **Exploratory Data Analysis (EDA):**
  - **Visualization: Plotted historical sales to observe trends and seasonality.**
  - **Event Marking: Clearly identified the onset of COVID-19 impact (March 2020) and factory issue impact (January 2022) on the sales trend.**

METHODOLOGY: OUR APPROACH TO SALES FORECASTING (PART 1)
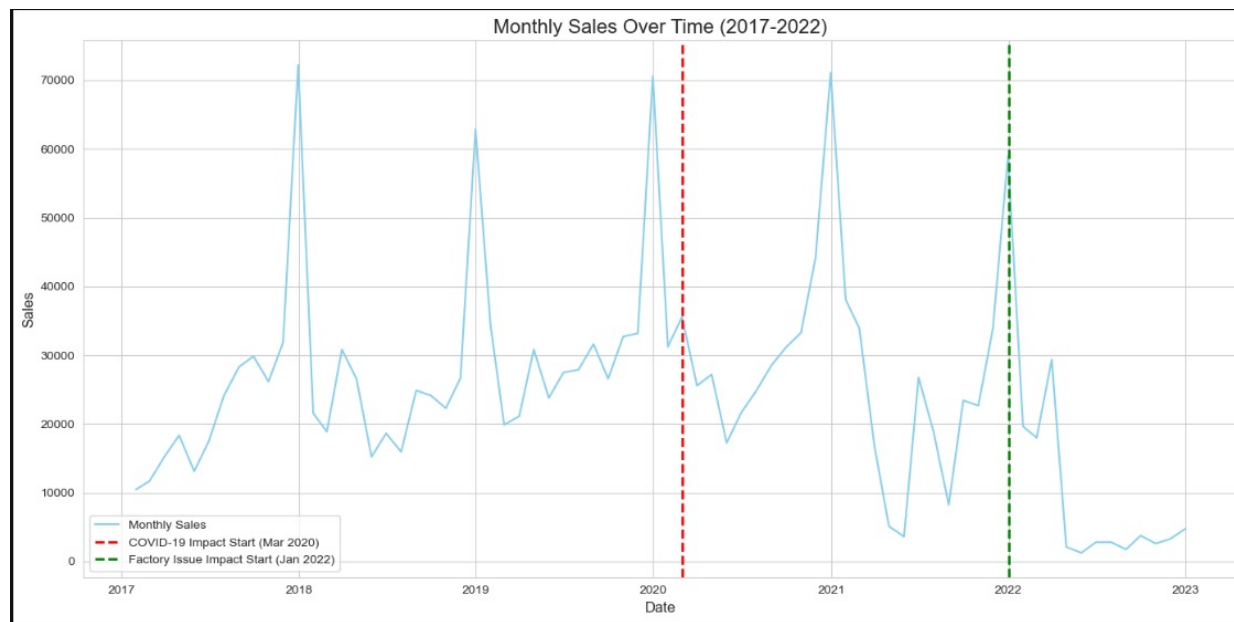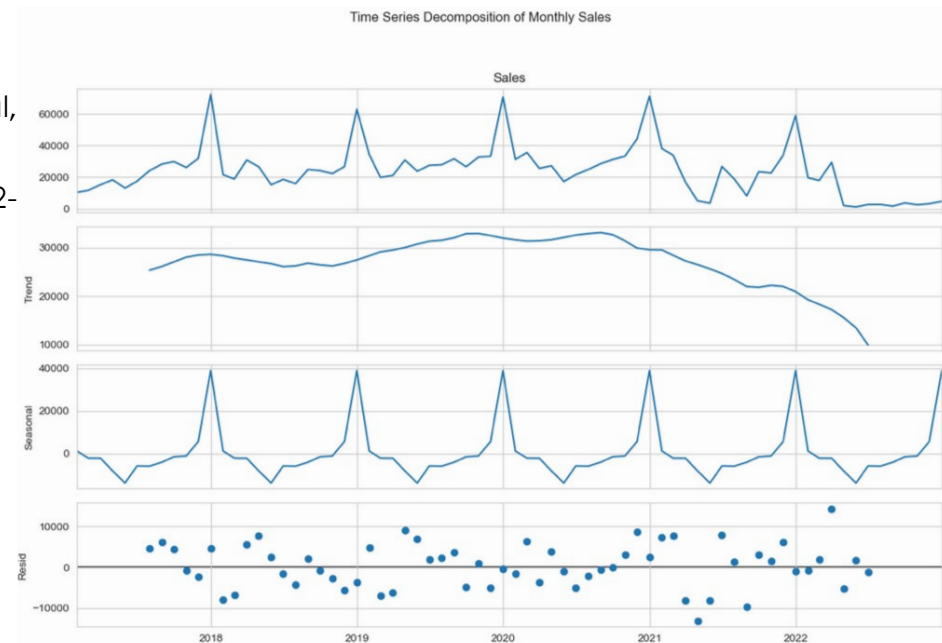

Figure 1: Monthly Sales Data with Key Event Markers. Note the significant disruptions post-March 2020 and especially from 2022.

METHODOLOGY: OUR APPROACH TO SALES FORECASTING (PART 2)

Time Series Decomposition:

- Separated sales data into Trend, Seasonal, and Residual components.
- Confirmed strong annual seasonality (12-month cycle).

"Figure 2: Decomposition reveals strong seasonality and an underlying trend affected by external factors."

# METHODOLOGY: OUR APPROACH TO SALES FORECASTING (PART 2)

Stationarity Testing:

- Used Augmented Dickey-Fuller (ADF) test to check if the series' statistical properties change over time.
- **Initial finding:** Sales data was non-stationary.
- **Differencing:** Applied first-order regular differencing and then first-order seasonal differencing to achieve stationarity. This transformation is crucial for many forecasting models.
- **Result:** The differenced series was confirmed as stationary (p-value < 0.05).

METHODOLOGY: OUR APPROACH TO SALES FORECASTING (PART 2)

Model Selection - SARIMA:

- Based on the stationary series' Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots, we identified initial model parameters.
- **Chosen Model:** SARIMA(0, 1, 1)(0, 1, 1, 12) - a simplified yet robust model.
- **(p,d,q):** (0,1,1) for non-seasonal components (1st order differencing, 1st order moving average).
- **(P,D,Q,s)**: (0,1,1,12) for seasonal components (1st order seasonal differencing, 1st order seasonal moving average, 12-month seasonality).
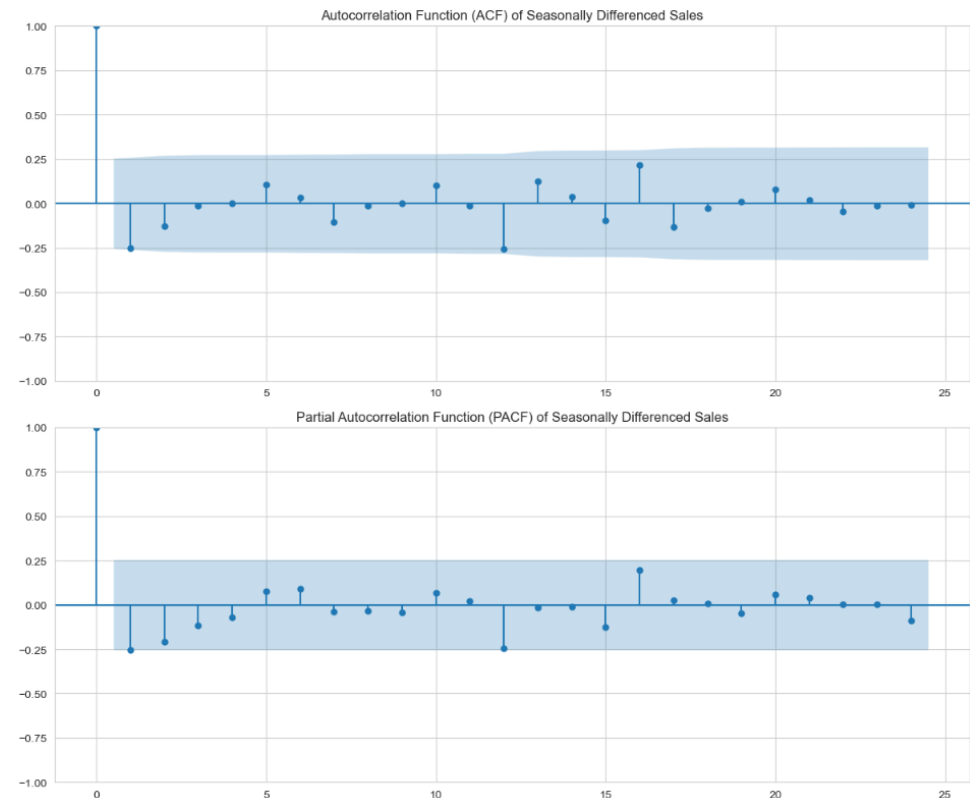
"Figure 3: ACF and PACF plots guided our SARIMA parameter selection."

KEY INSIGHT 1: WHY OVER-ORDERING IS DETRIMENTAL (DISTRIBUTOR PERSPECTIVE)

- **The Problem:** The natural inclination to aggressively order inventory to "make up" for perceived past sales shortfalls or to stockpile against future uncertainties.
- **Data-Driven Counterpoint:** Our forecast, trained on data including the initial impact of COVID-19 and supply chain issues (up to 2021-12-31), provides a more realistic outlook.
- Forecast (2022-2023) - Initial Model (SARIMA(1,1,1)(1,1,1,12)):
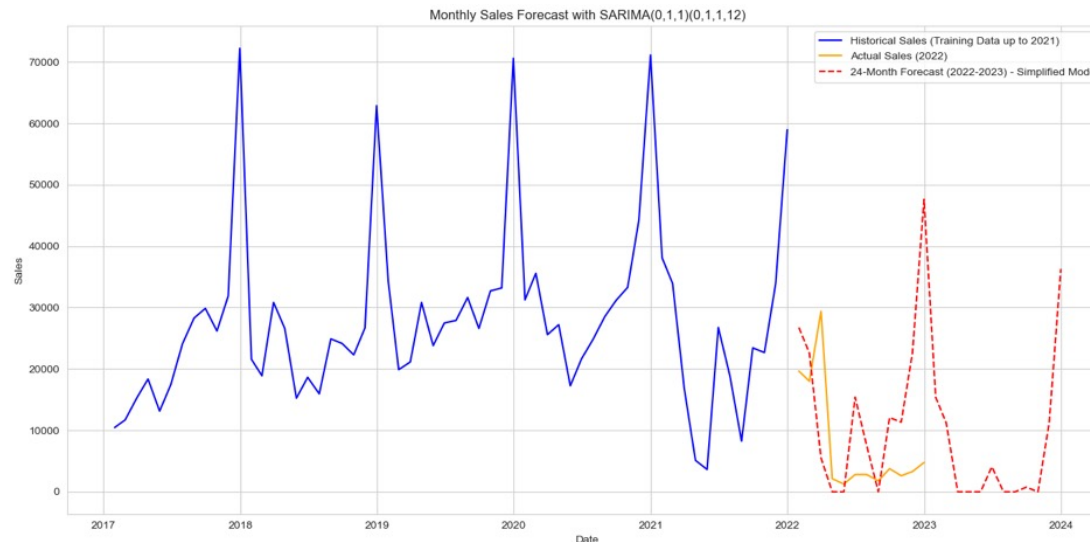

Figure 4: Initial 24-Month Forecast (2022-2023) based on data up to 2021-12-31. Note the model's struggle with the post-2021 volatility, leading to unrealistic zero-sales predictions

KEY INSIGHT 1: WHY OVER-ORDERING IS DETRIMENTAL (DISTRIBUTOR PERSPECTIVE)

- **Analysis**: This forecast, while attempting to capture the dynamics, showed instability and predicted periods of zero sales. This highlights the difficulty in simply assuming a quick rebound to pre-disruption levels. Over-ordering based on such an assumption would lead to:
    - Excess inventory holding costs
    - Increased risk of obsolescence
    - Cash flow issues for distributors
    - Unnecessary pressure on logistIcs

Conclusion: Blindly over-ordering based on historical averages or optimistic assumptions, especially after significant disruptions, is not supported by a robust time series analysis and carries substantial financial risks. Our forecasts provide a more measured and realistic demand signal.

KEY INSIGHT 2: SALES POTENTIAL & STRATEGIC ALLOCATION (HQ PERSPECTIVE)

- **The Problem:** HQ's conservative stock allocation, potentially under-cutting our market's true sales potential, especially when considering a return to more stable supply conditions.
- **Data-Driven Argument:** By training our SARIMA(0,1,1)(0,1,1,12) model on data prior to the most severe disruptions (up to 2020-12-31), we can project sales under a more "normalized" scenario, assuming stable supply.
- Forecast (2021-2023) - Simplified Model (SARIMA(0,1,1)(0,1,1,12)):
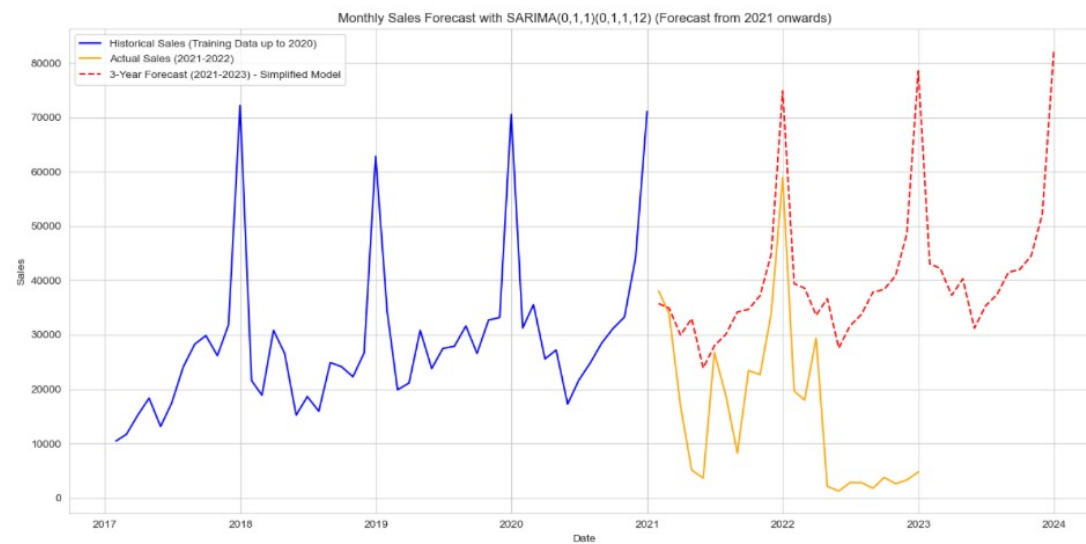

Figure 5: 3-Year Sales Forecast (2021-2023) based on pre-disruption trends (data up to 2020-12-31). This forecast assumes a more stable supply environment.

KEY INSIGHT 2: SALES POTENTIAL & STRATEGIC ALLOCATION (HQ PERSPECTIVE)

- **Analysis**: This forecast demonstrates:
  - Resilient Seasonality: The strong seasonal peaks persist, indicating inherent market demand cycles.
  - Underlying Growth Potential: Despite the challenges of 2021-2022, the model, when trained on the period before the most severe disruptions, projects a healthy sales trajectory, suggesting that with consistent supply, our sales can rebound and grow.
  - Opportunity Cost: Under-allocating stock based on a pessimistic view of recent disruptions means missing out on potential sales and market share.

Conclusion: Our analysis indicates that the market retains significant sales potential. HQ should review stock allocation policies to align with these data-backed forecasts, ensuring sufficient inventory to meet demand and capitalize on growth opportunities, assuming a more stable supply chain.

RECOMMENDATIONS

1.Educate Distributors on Forecast-Driven Ordering:
- Share simplified sales forecasts with distributors.
- Emphasize the risks of over-ordering based on emotional or reactive assumptions.
- Collaborate on inventory planning to optimize their stock levels, reducing holding costs and improving cash flow.

2. Advocate for Strategic HQ Stock Allocation:
- Present the 3-year forecast (Figure 5) to HQ, highlighting the underlying sales potential assuming stable supply.
- Argue for increased and more agile stock allocations to the Indian market to meet projected demand and avoid lost sales.
- Emphasize the long-term growth opportunities that can be realized with adequate supply.

3. Monitor & Adapt:
- Continuously monitor actual sales against forecasts.
- Regularly update the forecasting model with new data to capture evolving market dynamics.
- Maintain open communication between distributors, the Indian team, and HQ regarding supply chain status and market demand.

CONCLUSION & NEXT STEPS

- **Summary:** By leveraging robust time series analysis, we can move beyond reactive inventory management to a proactive, data-driven strategy. This approach addresses both the risks of over-ordering by distributors and the missed opportunities from conservative HQ stock allocation.
- **Benefits:**
  - Optimized inventory levels.
  - Reduced costs and improved profitability.
  - Enhanced market responsiveness.
  - Maximized sales potential.
- **Next Steps:**
  - Schedule a joint meeting with key distributors to review forecasts and implement new ordering guidelines.
  - Prepare a formal proposal for HQ, leveraging these insights to advocate for revised stock allocation targets.
  - Establish a quarterly review process for sales forecasts and inventory performance.

THANK YOU