Project Report: UnORG Supply Chain

Contingent - Bitmask

- Aman Kumar Kailaneya (23115010)
- Vanisha Choudhary(23117143)
- Hemant Bhakar(23113066)
- Parijat (23124020)

1. Introduction

UNORG is a fast-scaling B2B grocery delivery platform connecting traditional producers and modern F&B businesses with essential goods. With a client base ranging from Petha and Daalmoth manufacturers to restaurants and general stores, the platform manages a complex supply chain that requires accurate forecasting for optimized operations. This report outlines a predictive framework developed to help UNORG improve demand forecasting, streamline inventory planning, and reduce operational inefficiencies.

2. Problem Understanding & Background

In the B2B grocery domain, demand is:

- **Bulk-based**, not individual units
- **Irregular**, with long inactive gaps
- **Seasonal** and highly dependent on external factors like footfall, festivals, and business type

Unlike B2C models, traditional time-series and trend-following techniques fail to capture the volatility and granularity in B2B patterns. Misjudging demand results in:

- **Overstocking** → spoilage, cash flow issues
- **Understocking** → lost orders, poor service quality

UNORG thus needs:

- **Customer-level order predictions**
- **SKU-level demand forecasts**
- **Aggregated inventory plans**

3. Solution Overview

Our approach is divided into three modules:

A. Customer Order Prediction Model

Objective: Predict the daily probability of each customer placing an order over the next 14 days.

- **Model Type:** Binary classification (Order = 1, No order = 0)
- **Best Performing Model:** LightGBM
- **Key Features:**
    - Recency metrics (days_since_last_order)
    - Frequency metrics (orders_last_14_days)
    - Temporal attributes (day_of_week, is_weekend)
- **Outcome:** F1-score (Class 1): **0.24** | Helps identify active clients early and tailor retention efforts

B. SKU-Level Forecasting

Objective: Predict which SKUs a customer will order and in what quantity.

- **Model Type:** Multi-output regression (SKU selection + quantity prediction)
- **Best Performing Model:** LightGBM
- **Key Features:**
    - Historical purchase patterns
    - Quantity variability
    - Time since last SKU order
- **Outcome:** F1-score (Class 1): **0.49** | Enables targeted stocking and personalized SKU suggestions

C. Inventory Planning Engine

Objective: Aggregate SKU-level predictions across all customers to build a 14-day stocking plan.

- **Strategy:**
    - Combine SKU forecasts from each customer

    - Identify demand peaks
    - Apply buffers for high-variance SKUs
- **Impact:** Reduces over/understocking and drives efficient procurement & logistics

4. Data Handling & Feature Engineering

- **Handling Sparsity:** Used lag-based recency/frequency features to accommodate gaps in B2B ordering
- **SKU Encoding:** Identified top SKUs and encoded common patterns to capture preference
- **Temporal Dynamics:** Included weekday/weekend patterns and monthly effects for seasonal alignment
- **Segmentation:** Custom strategies for high-volume, seasonal, and dormant customers

5. Business Impact & Scalability

Fulfillment Rate (Increase): Accurate demand forecasting at the SKU level allows UNORG to proactively stock items in warehouses based on predicted need. This minimizes last-minute stockouts and improves order completion rates.

Waste Reduction (Decrease): Predictive inventory planning ensures that excess stock is not ordered or warehoused. This reduces the risk of spoilage, especially for perishable goods, and frees up working capital.

SLA Compliance (Increase): By aligning demand forecasts with warehouse-level availability, UNORG can commit to tighter delivery windows and meet service level agreements more consistently.

Profitability Boost: The system reduces reliance on high discounts to push excess inventory. Forecast-driven stocking enables more stable pricing and lowers losses from reactive procurement and fulfillment.

Scalability Potential:

- **Modular Architecture:** The system's design allows for gradual implementation and scaling. Each component (customer prediction, SKU forecasting, inventory optimization) can be deployed independently or together.

- **Cloud-Ready Infrastructure:** Models are optimized for both real-time and batch execution, making them compatible with scalable cloud platforms such as AWS or GCP.
- **Process Automation:** Forecasting insights can feed into automated replenishment, targeted marketing, and smarter procurement, reducing manual effort as the business grows.

6. Cost-Benefit Analysis

Implementation Cost Breakdown

- **Data Engineering:** 2–3 weeks of effort to prepare pipelines and ensure data cleanliness
- **Model Development & Testing:** ~1 month of work for training, hyperparameter tuning, and validation
- **System Integration:** Moderate backend integration effort with inventory and procurement platforms
- **Operational Rollout:** Low cost, as it leverages internal teams with guided onboarding and documentation

ROI Outlook

- **Breakeven Point:** Expected within 2–3 months post-implementation, due to quick impact on waste and stockouts
- **Long-Term Value:** Improvements are compounding as model accuracy increases with data volume
- **Scalability:** Minimal marginal costs to expand across regions, warehouses, or new product categories

7. Conclusion

Our proposed AI-driven demand forecasting system transforms UNORG's inventory management into a proactive, data-informed process. By aligning forecasting accuracy with fulfillment capability and procurement cycles, the solution addresses existing inefficiencies and lays the groundwork for scalable, profitable growth. The model is adaptable to business fluctuations, seasonality, and customer diversity, making it a sustainable long-term investment

8. References & Appendix

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