FEFO Waste Projection

Minimizing Inventory Waste in a Complex Supply Chain

Project Overview

Abstract

In the fast-paced **meal-kit industry**, managing perishable inventory is a constant challenge. With thousands of recipes and weekly menu changes, predicting and handling short shelf-life products—like fresh produce, meat, and dairy—can be particularly difficult. For companies like HelloFresh, which deliver curated recipes to customers' doorsteps, maintaining operational efficiency while minimizing waste is critical.

The **FEFO (First Expiry, First Out) Waste Projection** project was created to address this challenge. By providing transparency into inventory expiration and aligning it with demand forecasts, the project empowers stakeholders to make proactive decisions in **menu planning, supply chain operations, and purchasing**.

This initiative showcases the intersection of real-world supply chain problems with advanced data analytics, underpinned by a high-level automated data pipeline.

Problem Context

Unlike traditional supermarkets, meal kit companies must manage inventory with short shelf lives in a highly dynamic environment. Large volumes of fresh ingredients must align precisely with fluctuating weekly demand. The challenges are magnified by:

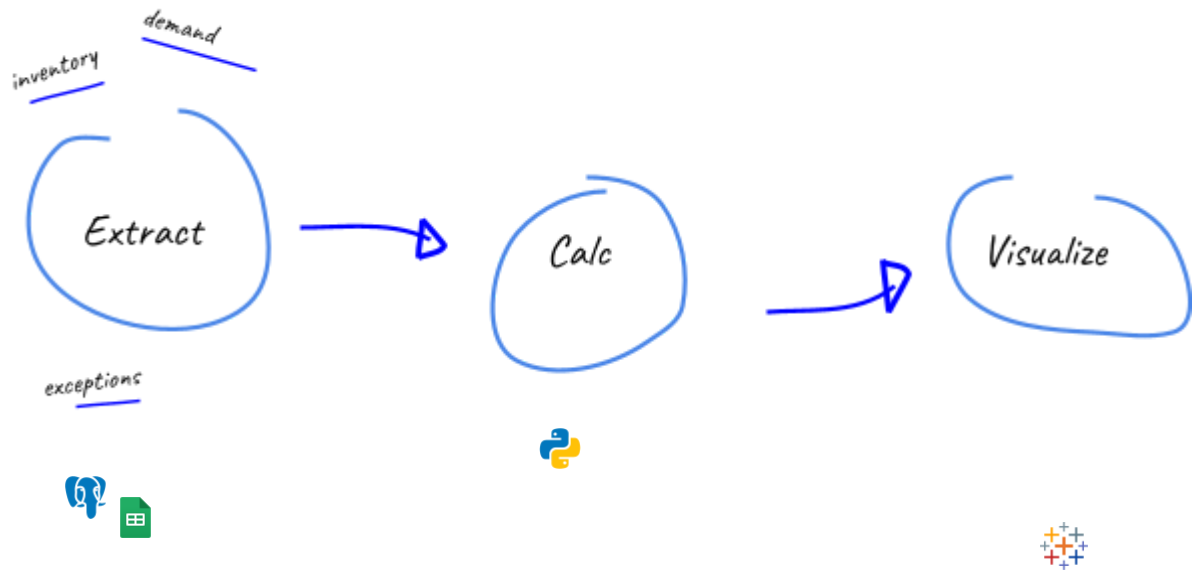
Fast-paced operations: Weekly menus are locked in advance, but ingredient demand can shift rapidly.
Perishable inventory: Meat, dairy, and fresh produce have strict expiration timelines.
Warehouse constraints: Balancing storage space against incoming stock and outgoing orders.

Without a clear projection of inventory waste, overstocking or underutilization becomes inevitable, leading to financial losses and sustainability concerns.

High-Level Data Pipeline

Turning Data into Decisions

The FEFO Waste Projection pipeline automates the end-to-end process of extracting, calculating, and visualizing waste projections. By aligning operational complexity with advanced SQL techniques and Python logic, the pipeline delivers actionable insights to supply chain teams.



> All data sources and output have been **anonymized** by masking and randomising sensitive information, as well as reducing the scope of the data. In order to showcase the real-life challenges and solutions of data extraction, the SQL query responsible to handle the inventory source is available at this link, without it being used by the GitHub main repository (which relies on local csv files).

1. Data Extraction

The process begins with pulling inventory and demand data from centralized systems, accommodating the distinct operational strategies of different distribution centers (DCs):

Operational challenges: Daily Updates: DCs with live stock management provide daily inventory snapshots. Differently, **Weekly Snapshots**: For DCs with weekly updates (e.g., post-cleardown snapshots on Fridays), historical data is incorporated to maintain accuracy.

> SQL: a conditional logic (`CASE`) dynamically adjusts for operational disparities.

Future inventory bookings: Additionally, **Purchase Orders (POs)** are treated as a part of the inventory source. To ensure uniformity:

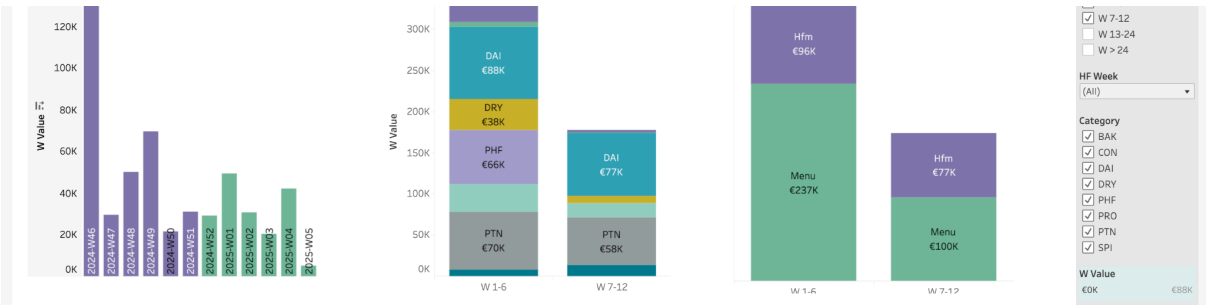
> SQL: Unioning datasets with different data_source to include POs to owned stock. Expiration dates for POs are calculated based on the Minimum Life On Receipt (MLOR), using a fallback logic to handle inaccurate data, `fallback_mlor`.

2. FEFO Calculation

The extracted data is fed into a Python-based FEFO model that aligns inventory to forecasted demand in order of expiration. This ensures that existing and incoming inventory is allocated to demand while prioritising batches expiring first. Finally the dataset is enriched with cost, SKU master data and business categories.

3. Data Visualization and Automation

The results are fed into Tableau so to provide stakeholders with fresh and accurate modeling of the waste projections. Additionally we also log top waste drivers SKUs per distribution center, allowing for more actionable insights.



The entire pipeline operates on an automated schedule, refreshing daily.

Use Cases

The insights generated by the FEFO Waste Projection pipeline support a variety of use cases:

Menu Planning Scenario: A spike in waste projections for a specific product (e.g., dairy) during the offline planning window (weeks 7-12). **Action**: Reintroduce surplus items into upcoming recipes to reduce waste.
Supply Planning Scenario: Excess inventory identified in the online window (weeks 1-6) with minimal opportunity for menu changes. **Action**: Free up warehouse space by prioritizing discardment activities or reallocating stock to other DCs.
Purchasing Decisions Scenario: High projected waste for specific SKUs highlights over-purchasing trends. **Action**: Adjust purchasing volumes for future weeks to avoid recurring waste.

These use cases underscore the project's impact on aligning operational efficiency with waste reduction goals.

Results and Value

The FEFO Waste Projection delivered tangible and actionable insights that significantly enhanced operational efficiency and waste management. Here's what the project achieved. **Savings Estimation** While it is challenging to directly quantify the project's impact due to external factors (e.g., demand fluctuations, inventory adjustments), a **manual tracking initiative** provided valuable insights. By following specific SKUs flagged in the **Top Waste Drivers** report, we assessed:

Latest Projection: The waste scenario at the time of the latest

modeling.
vs
Outcome: The actual waste after the discardment date.

This analysis revealed an estimated **€55.00 in weekly savings** for the SKUs monitored, underscoring the project's role in driving measurable improvements. Also, it's important to mention that real accurate tracking of quantities and cost awareness, are also added values of this pipeline, in that they support the organisation's effort to *understand* the roots and potential of its procedures.

Resources

- **Tableau Dashboard**: Live visualization of waste projections.
- **Github repository**: anonymized sample Notebook plus sources
- **SQL Documentation**: Complete SQL extract for the Inventory source[1]

[1] Not used by the Notebook, provided just for reference and display of SQL skills