

Retail Forecasting

Name: Olena Panchenko

Email: hel.panchenko@gmail.com

Country: United Kingdom

Specialisation: Data Science

Link: https://github.com/helenapanchenko/DS_Internship_Glacier/tree/master/Week7

Problem Description.....	1
Business understanding.....	2
Objective:.....	2
Product specification.....	3
Value Proposition.....	3
Target Market.....	3
Revenue Models.....	3
Functional requirements.....	4
Forecasting Features.....	5
Data Ingestion and Integration.....	5
User Interface and Usability.....	6
Alerts and Notifications.....	6
Collaboration Features.....	6
Non-functional requirements.....	7
Performance.....	7
Security.....	7
Reliability.....	7
Maintainability.....	8
Usability.....	8
Compliance:.....	8
Project life cycle.....	8
Data Intake Report.....	9

Problem Description

The large company is in the beverages business in Australia. They sell their products through various supermarkets and engage in heavy promotions throughout the year. Various factors like holidays and seasonality also influence their demand. They needed a forecast of each of the products at the item level every week in weekly buckets.

Business understanding

Objective:

Develop a data science model that provides accurate, item-level demand forecasts on a weekly basis. The model will help the company optimise its supply chain, reduce stockouts and overstocking, and plan more efficient promotional strategies while considering holidays, seasonality, and other demand influencers.

The core functionality of the model is meant to be utilised on different levels, but we'll narrow it down to the customer-facing product, which in turn is:

- **Mobile App**

The forecasting model can be made accessible via a mobile app that allows supply chain managers, sales teams, and executives to:

- View weekly forecast summaries for each product.
- Monitor forecast accuracy through performance dashboards.
- Receive notifications about upcoming demand spikes, stockouts, or the need for replenishment.
- Adjust demand predictions by inputting upcoming promotional campaigns or market events directly from the mobile app.
- Filter data by store, region, or product category, making it easier for field sales reps to focus on localised insights.

- **Website/Browser Dashboard**

A web-based platform could provide a wider and richer, interactive dashboard compared to mobile clients. Also, it will enhance the system with content management possibilities. Main product features:

- Visualise product forecasts on a weekly, monthly, and seasonal basis.
- Drill down into specific products or product groups.
- Analyse historical data and compare it with forecasted demand to see trends.
- Set up custom alerts (e.g., email/SMS alerts) for key thresholds, such as when forecast accuracy drops below a certain percentage or when a stockout is predicted.
- Modify promotional schedules and assess the real-time impact on forecasts.

Still, the technical and business aspect in conjunction has huge potential for growth as well as scalability of the solution. Even though the model itself is contained in the very core of the product, but can outgrow the needs of a single company and might find its purpose on different integration levels:

- [SAAS](#) - where the solution might be used by other companies in this business domain. Usually, it happens on subscription bases where the user has access to some kind of cloud service with the possibility to perform any needed setup, have access to a dashboard and have the ability to obtain predictions based on personalised data. On the other hand, based on the actual implementation of the solution it might be a pluggable solution or even a scalable sandbox that can live on-premise(customer local setup). There are many variations of the actual SAAS variation around the core model.

- API - might be considered a better option for customisation, higher visibility and control over the actual data(predictions) in terms of integration into an existing system.
- ERP - The forecasting model can be integrated directly into the company's existing Enterprise Resource Planning (ERP) system, supply chain management tools, or inventory management platforms. Data from these systems (e.g., sales history, inventory levels, promotional calendars) will be fed into the forecasting engine to generate real-time demand forecasts. Integration with ERP ensures that decision-makers can access forecasts in the systems they already use for procurement, production, and distribution planning.

Product specification

In this section, we'll describe the main product features and potential business use cases. First of all, we introduce you to the "value proposition" section which will describe key factors that customers(or current company) will benefit from.

Value Proposition

- **Accurate Demand Forecasting:** Provide highly granular demand forecasts at the product-item level on a weekly basis, accounting for promotions, holidays, and seasonality.
- **Optimised Inventory Management:** Improve inventory levels, leading to reduced stockouts, waste, and associated costs.
- **Promotion Effectiveness:** Enhance promotional planning and ROI by forecasting the impact of various promotional activities on demand.
- **Supply Chain Efficiency:** Reduce lead times and optimise distribution across supermarkets, leading to cost savings in logistics.
- **Revenue Growth:** Increase sales by ensuring that the right products are in the right places at the right times.

Target Market

Even though this solution, as stated earlier, will be utilised by a single company it still can target large beverage companies with extensive product portfolios. So the initial usage of the model will be shipped as an MVP and further will be monetised to scale its business area or simply say clientele.

Retailers and manufacturers in the broader consumer goods sector, particularly those involved in fast-moving consumer goods (FMCG), should also benefit. This level of scale will be considered as subsequent development phases.

Revenue Models

In this section, we'll describe the main sources of profit based on different business models that were mentioned earlier.

1. **Subscription-Based Pricing:**

- Monthly or yearly subscription pricing for access to the forecasting platform, tiered based on the number of SKUs and the complexity of the forecasting required. We can evolve to this model as phase 2, as that's when we can scale.
 - Examples:
 - **Basic:** Up to 1000 SKUs.
 - **Pro:** Up to 5000 SKUs.
 - **Enterprise:** 5000+ SKUs.
2. **Custom Development Fee:**
- A one-time fee for the initial consulting, model development, and integration of the forecasting solution. This fee is based on the complexity of the product portfolio and IT system integration.
 - This business model can be valid in the case when we would reuse our solution for a different client but still will involve lots of customisations and the end result is a tailored solution.
3. **Performance-Based Incentives:**
- Optional performance-based contracts, where the company pays a bonus for improved forecast accuracy or supply chain efficiency (e.g., bonuses linked to reductions in stockouts or inventory costs). That is mainly support on a contract basis.
4. **Selling SAAS:**
- Allow customers to log in securely and manage their demand forecasting with minimal setup.
 - Support multiple user roles with varying access levels (e.g., executives, supply chain managers, and sales reps).
 - Offer flexible pricing models (pay-per-SKU or pay-per-forecast).
 - Provide usage analytics, enabling customers to see how often forecasts are accessed and how forecasts impact key business decisions.
 - And lots of other features that a traditional SAAS like Amazon/Azure/etc. has. The main idea is to build a whole reusable infrastructure.
5. **Providing developer console access:**
- We'll be providing an API layer to enable data exchange between the forecasting model and various systems like sales platforms, marketing tools, or CRM systems. APIs would allow other applications to pull forecast data or push new inputs like promotional events or sales data in real time. This allows seamless integration without needing extensive changes to the current infrastructure.

Note: Our MVP will have a single intent and will cover the essential needs of our customer(company from Australia). All of the provided options are considered potential directions for scaling the business.

Functional requirements

This section will describe **all possible features** that are considered to be implemented in different phases and stages of the project. Still, **stressing out** the MVP will consist of simple forecasting and features described here are purely provided for consideration and identification of potential future product directions.

Forecasting Features

1. **Item-Level Demand Forecasting:**
 - Generate weekly demand forecasts at the **SKU** (Stock Keeping Unit) level for each product, segmented by store, region, and channel.
 - Incorporate seasonality trends, holidays, and other time-based factors.
 - Account for promotional activities and events that affect demand (price cuts, advertising, special displays).
 - Provide a forecast horizon of up to 6 months, with a primary focus on weekly forecasts.
2. **Promotions and External Data Integration:**
 - Ability to integrate promotional calendars and adjust demand forecasts based on upcoming sales events.
 - Account for external factors such as holidays, weather patterns, and regional variations in demand.
3. **Sensitivity Analysis and Scenario Planning:**
 - "What-if" simulations to assess how changes (e.g., new promotions, pricing strategies) will impact demand.
 - Real-time feedback on how forecast accuracy is affected by adjustments in input variables.
4. **Seasonality and Trend Modeling:**
 - Detect seasonal patterns and automatically adjust forecasts to reflect changes in demand throughout the year (e.g., summer increases for cold drinks).
 - Track long-term demand trends to anticipate shifts in consumer preferences.
5. **Forecast Accuracy Monitoring:**
 - Monitor the performance of the forecasting model with metrics like Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE).
 - Provide ongoing feedback loops for model refinement to improve forecast accuracy over time.

Data Ingestion and Integration

1. **Historical Data Import:**
 - Ability to upload historical sales data (CSV, Excel) or pull data from existing company databases via API integrations.
 - Support for data integration from multiple sources, including ERP, CRM, and point-of-sale (POS) systems from supermarkets.
2. **External Data Sources:**
 - API-based integration with third-party data providers (e.g., weather, holidays, consumer behaviour trends) to refine forecasts.
 - Support for supermarket-specific sales data to enhance localised forecast accuracy.
3. **API for Real-Time Data Exchange:**
 - Provide RESTful APIs to allow real-time data exchange with the company's internal systems.
 - Open API Access -
Provide API access so that other systems (e.g., CRM, ERP, inventory

management tools) can pull forecast data or push updates (e.g., sales and promotional data) in real time. So this is a bit different from

User Interface and Usability

1. Web-Based Dashboard:

- An interactive web dashboard that provides a clear view of weekly forecasts, trends, and insights.
- Drill-down capabilities to explore data at various levels (product, region, store, category).
- Exportable reports (CSV, PDF) for custom analyses.

2. Mobile Application:

- Mobile app for on-the-go access to forecast data, with features such as:
 - Weekly forecast summaries.
 - Customizable push notifications for key events (e.g., expected demand spikes).
 - Easy navigation and filtering by store, region, or product category.

3. Custom Reports:

- Generate custom reports based on specific needs (e.g., product line forecasts, store-specific reports).
- Automated report scheduling, where users can receive reports directly via email or app notifications.

4. User Roles and Permissions:

- Role-based access control with user management features:
 - Admin users can manage data imports, configure models, and view all products.
 - Sales and supply chain teams can access relevant forecasts and make adjustments.
 - Executives can view high-level summaries and drill into more granular data.

Alerts and Notifications

1. Custom Alerts:

- Alerts for demand spikes, stockouts, or deviations from expected trends.
- Real-time email and mobile app notifications for urgent actions, such as potential overstocking or understocking.

2. Event-Based Alerts:

- Notifications based on changes in sales patterns during promotional periods or upcoming holidays.
- Suggestions for replenishment or changes in promotional strategies based on forecast deviations.

Collaboration Features

1. Comments and Notes:

- Users can leave notes and comments on specific forecasts for collaboration within teams.

- Ability to share custom reports and insights with other users within the organisation.
- 2. **Forecast Adjustments:**
 - Supply chain and sales teams can manually adjust forecasts based on local knowledge or new events, with the ability to track changes and compare them to the automated forecast.

Non-functional requirements

These requirements ensure the system is robust, scalable, and provides a seamless user experience.

Performance

1. **Scalability**

The system must be able to scale horizontally to handle thousands of SKUs and large datasets without performance degradation.

 - Must support multiple concurrent users with no impact on performance.
 - Capable of handling real-time updates, especially during promotional periods with heavy traffic.
2. **Low Latency**

Forecasts should be generated and available for user access with minimal delay, even during peak times when multiple users are querying the system.

Security

1. **Data Security**

The system must provide secure data storage, and encryption for data in transit and at rest, and adhere to industry security standards (e.g., ISO 27001, GDPR compliance).
2. **User Authentication**

Implement strong user authentication (e.g., two-factor authentication) to protect access to the platform.
3. **Role-Based Access Control**

Ensure that sensitive data is accessible only to authorised users, based on roles defined within the organisation.

Reliability

1. **Availability**

The SaaS platform should offer at least 99.9% uptime to ensure that forecasts are always accessible, especially during critical times like promotional events.
2. **Disaster Recovery**

The system should include automated backups and a disaster recovery plan to ensure that forecasts and historical data are not lost due to system failures.

Maintainability

1. **Modular Architecture**

The system should be built with a modular architecture so that updates or modifications can be made without disrupting the entire platform.

2. **Documentation**

The system should be well-documented for both internal teams (data scientists, developers) and end-users, providing guidelines on usage, integration, and troubleshooting.

Usability

1. **Intuitive Interface**

The web and mobile app interfaces should be user-friendly, allowing non-technical users (e.g., sales reps) to easily interact with the forecasting data.

2. **Multi-Language Support/Localisation**

If the product is scaled internationally, the platform should support multiple languages to cater to global users.

Compliance:

1. **Regulatory Compliance**

Ensure that the platform complies with relevant industry standards and regulations, including data privacy (e.g., GDPR) and financial reporting requirements.

Project life cycle

- | | |
|---------------------------------------|-------------------------|
| 1. Business Understanding | 13-19 August |
| 2. Data Acquisition and Understanding | 20-26 August |
| 3. Data Cleaning and Processing | 27 August - 2 September |
| 4. Exploratory Data Analysis | 3-9 September |
| 5. EDA Presentation | 10-16 September |
| 6. Model Building and Evaluation | 17-23 September |
| 7. Project Presentation | 24-30 September |

Data Intake Report

Name: Retail Forecasting

Report date: 2024-09-04

Internship Batch: LIMSUM35

Version: 1.0

Data intake by: Olena Panchenko

Data intake reviewer: Data Glacier

Data storage location:

https://docs.google.com/spreadsheets/d/1sOTsmkY4ZeNzww_yDGePGYt1iXtZjNHb/edit?gid=721815828#gid=721815828

Tabular data details: **forecasting_case_study**

Total number of observations	1218
Total number of files	1
Total number of features	12
Base format of the file	.csv
Size of the data	50.3KB