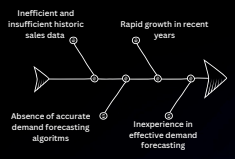
Forecasting Demand with Machine Learning Algorithms

1 Problem

Company X lacked an effective demand forecasting system leading to:

- Unfulfilled Customer Orders
- Over and understocking
- Increased delay in monthly catalogue release time

Causes



Objectives

- Analyse as-is demand forecasting process
- Identify, train and evaluate different ML algorithms
- Develop an MVP UI to enable smooth and easy demand forecasting

2 Solution Approach

1 Data ingestion and wrangling
- Understand data
- Collect relevant data (Feature extraction)
- Clean data by handling missing values and outliers

2 Model training and fine-tuning
- Select a model, convert inut data to correct type and create training and test sets
- Define the model's architecture and hyperparameters and fit it to the training set

3 Predicting and evaluating
- Make a prediction on the test set
- Evaluate the error metrics
- Plot the predictions.
- Analyse and tune algorithms if necessary

4 Integrate and Develop UI
- Save best performing models and integrate into Streamlit web application

3 Solution Models

1. Multi-Layer Perceptron

Multilayered neural network for pattern recognition and prediction.

2. FB Prophet

Time series forecasting tool handling seasonality and holiday effects.

3. LSTM

Recurrent neural network for processing sequential data and long-term dependencies.

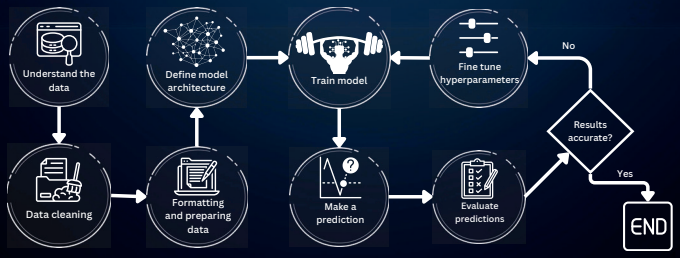
4. NBEATS

A deep neural architecture specifically designed for time series forecasting that uses backward and forward residual links to provide interpretable forecasts

5. LightGBM

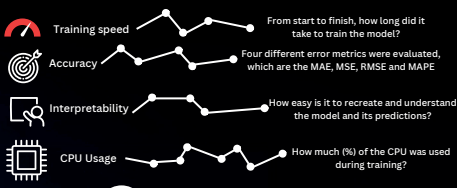
Efficient gradient boosting framework for large-scale machine learning tasks.

4 How to build an ML model?



5 Evaluation KPIs

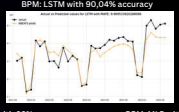
To determine the effectiveness of a model, 4 performance criteria were evaluated, each carrying a certain weight to the model's overall score



6 ML Prediction Results

Company X sell products across 4 different brands. A forecast was made for the total net sales and for each of the 4 brands. To obtain a product specific forecast, a top-down hierachical reconciliation was done. The 5 best models' predictions are shown here

BPM: LSTM with 90,04% accuracy

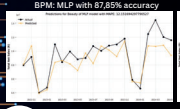


BPM: Best Performing Model

BPM: MLP with 86% accuracy

BPM: MLP with 81,89% accuracy

BPM: MLP with 87,85% accuracy



BPM: LSTM with 86,28% accuracy

7 UI Development

The agile project methodology was incorporated to build an app using Streamlit. This allowed Company X to make a forecast without the need to understand the complexities of ML