Advanced Demand Forecasting with Time Series Approaches

1. Introduction:

We want to implement and compare novel forecasting techniques, such as Prophet and XGBoost to the traditional methods, evaluating their performance in predicting demands of product. Accurate demand forecasting is very crucial and important for effective supply chain management and effective planning related to product operations. There are some traditional methods such as Moving Average, ARIME (Autoregressive integrated moving average), Exponential Smoothing, which are widely used but may not show the complex patterns in data as it may have complex and non-linear trends. Therefore, we want to implement, evaluate and visualise the aforementioned techniques.

2. Literature Review:

- **Prophet**: Prophet has been developed by Facebook and designed for forecasting time series data with daily observations that display seasonal patterns including the holiday effects. It is better than ARIMA and Exponential Smoothing in handling complex, non-linear trends and seasonal patterns.
- **XGBoost**: An optimized gradient boosting framework specifically designed for predictions, including time series forecasting. Comparative studies have shown mixed results, with ARIMA sometimes better than XGBoost in some very specific contexts.

3. Methodology:

Dataset: "Product Demand Forecasting" dataset from Kaggle will be used in this project. This dataset provides historical product demand data which is ideal for developing and evaluating forecasting methods. This dataset of 1.048.544 data contains the following columns:

- Product_Code
- Warehouse
- Product_Category
- Date
- Order_Demand

Dataset Link: https://www.kaggle.com/datasets/felixzhao/productdemandforecasting

4. Implementation:

- **Prophet**: Use the prophet library in python to develop a time series model capable of handling seasonality and trends.
- **XGBoost**: Develop the xgboost model using python library for time series forecasting
- **Visualization**: Integrate results into an interactive Streamlit app for dynamic visualisation. The following will be implemented with stramlit:
    - **Forecast Graphs**: Display forecast results from Prophet and XGBoost with confidence intervals.
    - **Comparison Visuals**: Show error metrics (e.g., MAE, RMSE) and side-by-side performance comparison charts.
    - **Dynamic Tables**: Display detailed numerical outputs, such as forecasted values and errors, in interactive tables.

- **Comparison**:
    - Evaluate forecasting accuracy using error measures such as Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and/or Mean Absolute Percentage Error (MAPE).
    - Benchmark results against traditional methods like Moving Average, ARIMA and Exponential Smoothing.

5. **Expected Outcomes**

- **Model Comparison**: Identify the best-performing forecasting model for the choosen dataset.
- **Streamlit Application**: Develop and deploy an app for visualizing forecasting results and comparing model performance.
- **Practical Insights**: Find some practical insights about the Models and Dataset.

References

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