Usecase	Demand Forecasting System for Optimizing Inventory and Supply Chain Efficiency Using Historical Sales Data
Problem Statement	The company has accumulated transactional data from **December 2021 to December 2023**, consisting of stock code, transaction dates, and quantities sold and etc. The company requires a system to forecast the demand for the next 15 weeks for its top 10 best-selling products. The goal is to estimate future demand accurately to maintain optimal stock levels, ensuring that the supply chain remains efficient and meets customer demands. The solution should leverage the historical data to predict future demand trends and support inventory management decisions.
Data	Transactional_data_retail01.csv, Transactional_data_retail_02.csv, CustomerDemographics.csv, ProductInfo.csv
Deliverables	Design an app that shows the forecasted values for the next few weeks based on the user-input stock id, no. of weeks and allows the download of a CSV file
Note	• Perform necessary preprocessing • Derive the attributes depending on the requirement • Come up with a validation strategy for better generalization of model. • Assumptions could be made based on domain understanding.

Key Requirements:

1. **Exploratory Data Analysis (EDA)**:
   a. Perform customer, item, and transaction-level summary statistics.
   b. Utilize SQL join queries to retrieve necessary data (e.g., customer and product information) without explicit data merging.
   c. Consolidate transactional data where necessary to ensure accurate summary metrics for each level (customer, item, transaction).
   d. Design and develop visualizations which should help to explain the data and summary statistics
2. **Top 10 Stock Codes**: Use transactional data to identify the top 10 stock codes based on the total quantity sold, ensuring the analysis reflects actual sale performance.
3. **Top 10 High Revenue Products**: Identify the top 10 products that generate the highest revenue by considering both price and quantity sold.
4. **Time Series Analysis (TS)**:
   a. Develop and compare various time series models, such as ARIMA, Exponential Smoothing (ETS), Prophet, and advanced models like LSTM
      Note: The modeling will focus on the **top 10 products** based on quantity sold or revenue to ensure detailed and accurate forecasting (Explain your reasoning how and why use selected top 10 products).
5. **Non-Time Series Techniques**: Apply machine learning models (e.g., DecisionTree, XGBoost) that leverage non-time series features, such as customer demographics and product features, to predict demand.

6. **Training and Validation Strategy**: Define robust training and validation strategies, such as time-based cross-validation, to ensure the models generalize well to unseen data.
7. **Forecasting Horizon**: Provide a weekly forecast for the next 15 weeks for the **top 10 products**.
8. **Error and Evaluation Metrics**: Use appropriate error metrics (e.g., RMSE, MAE) and evaluation criteria to assess model performance.
9. **ACF and PACF Plots**: Analyze Auto-Correlation Function (ACF) and Partial Auto-Correlation Function (PACF) plots to identify trends, seasonality, and lags in time series data.
10. **App to Host**:
    a. The app should display the top 10 products.
    b. Input: The interactive app will allow the user to input a **stock code** (from the top 10 products). Upon entering the stock code, the app will:
    c. Historical and Forecast Plot: Display a combined time series plot showing the historical demand of the selected stock code and the forecasted demand for the next 15 weeks. The plot will include both the actual historical values and the predicted values, allowing for a direct comparison of actual vs. predicted demand over the training and test periods.
    d. Error Histogram: Provide separate histograms showing error distributions for training and test datasets.
       Note: Find the sample dashboard on **page 3**.

Note:

1. Deliverables are the code files and the link to the app if you have hosted it.
2. You can create your app using the tool that you are familiar with (streamlit and dash are some of them).
3. You can host your app for free on any platform (Heroku is one free app hosting website).
4. It is **not** mandatory to answer all the questions. **Please make the submission with whatever progress has been made** – even if its not complete. We are looking for people who can take a challenging task and make progress on it.
5. Feel free to add any other insights or changes to the tasks once you are done with the given list.

Sample App output: