**Interactive Forecasting Tool Documentation**

**1. Overview**

This document provides guidance on using the Interactive Forecasting Tool developed for analyzing and forecasting the volumes of Products X and Y. The tool combines data insights, statistical modeling, and interactive visualizations to enable data-driven business decisions.

**2. Features**

* **Exploratory Data Analysis (EDA):**
  1. Insights into key trends and correlations between variables affecting Products X and Y.
  2. Heatmaps, statistical summaries, and pair plots for in-depth understanding.
* **Forecasting Models:**
  1. Ridge regression for Product X and Decision Tree for Product Y.
  2. Fine-tuned hyperparameters for high accuracy and robust predictions.
* **Interactive Forecasting:**
  1. User-friendly interface built using Streamlit.
  2. Allows users to:
     1. Input custom assumptions for FY25 drivers.
     2. Visualize historical and forecasted volumes dynamically.
     3. Perform year-wise and month-wise analysis.
* **Performance Metrics:**
  1. Metrics such as RMSE and MAPE are displayed to evaluate model accuracy.

**3. Navigation**

**Sidebar Options**

* **Forecasting Tool:** Main page for adjusting assumptions and visualizing forecasts.
* **Forecasting Tool - Manual Entry:** Input or edit specific values for assumptions to manually drive the forecast.
* **Exploratory Data Analysis (EDA):** Visual and statistical exploration of the data for Products X and Y.
* **Year and Month-wise Analysis:** Trend analysis based on selected months or fiscal years.

**4. How to Use the Tool**

**4.1. Interactive Forecasting Tool**

1. Open the tool and navigate to the **Forecasting Tool** page.
2. **Adjust Assumptions:**
   1. Enter percentage changes for:
      1. Counterfeit percentage.
      2. Alternative category market share.
      3. Price per unit for Products X and Y.
3. View dynamically updated forecasts for the next 12 months.
4. Interpret the forecast using visualizations that overlay historical data with projections.

**4.2. Manual Entry for Forecasting**

1. Navigate to **Forecasting Tool - Manual Entry.**
2. Input custom values for predictors like income levels, counterfeit percentages, etc.
3. View forecasts based on your manually entered assumptions.

**4.3. Exploratory Data Analysis**

1. Select **EDA** from the sidebar.
2. Choose between Products X and Y for analysis.
3. View correlation heatmaps, pairplots, and statistical summaries.

**4.4. Year and Month-wise Analysis**

1. Choose **Year and Month-wise Analysis.**
2. Select:
   1. A specific month to compare metrics across years.
   2. Two fiscal years to compare metrics side-by-side.
3. View trends and insights dynamically.

**5. Key Insights**

**Exploratory Data Analysis**

* Highlight key trends and correlations, e.g.:
  1. The impact of counterfeit percentages and alternative category market share on volumes.
  2. Correlation strength between price changes and volume fluctuations.

**Forecasting Results**

* **Model Performance Metrics:**
  1. Product X: RMSE = 22,777.63; MAPE = 4.20%.
  2. Product Y: RMSE = 3,020.62; MAPE = 3.57%.
* **Model Performance Metrics:**

1. Training Performance for Product X: RMSE: 19466.44, MAPE: 3.88%
2. Training Performance for Product Y: RMSE: 2447.22, MAPE: 2.94%

**The difference between the training and testing metrics for Product X is moderate:**

* The RMSE increased by about 3,311 units from training to testing, which is within an acceptable range, considering the complexity of the model.
* The MAPE increased slightly (0.32%), indicating consistent performance between training and testing.

**The performance for Product Y is consistent:**

* The RMSE increased by only 573 units, which is negligible for this scale of data.
* The MAPE difference is just 0.63%, reflecting minimal degradation from training to testing.

**6. Business Recommendations**

* **Pricing Strategy:** Consider targeted adjustments based on sensitivity analysis.
* **Counterfeit Mitigation:** Explore interventions to reduce counterfeit percentages, enhancing volume retention.
* **Market Competition:** Monitor the penetration of the alternative category and adapt marketing strategies.

**7. Assumptions and Limitations**

* **Assumptions:** Drivers such as counterfeit percentages and alternative category penetration remain within realistic ranges.
* **Limitations:** Forecasts rely on historical data and may not fully capture unprecedented market changes.

**8. Technical Details**

**Models Used**

* **Product X:** Ridge regression, optimized for minimizing RMSE.
* **Product Y:** Decision Tree regression with fine-tuned depth and split parameters.

**Dataset Preparation**

* Columns standardized and renamed for clarity.
* Time-series transformations applied for temporal analysis.