**Predicting Ingredient Requirements for Dominos**

**Problem Statement:**

Dominos aims to optimize its ingredient ordering process by predicting future sales and creating an efficient purchase order system. The primary goal is to accurately forecast pizza sales using historical data and determine the required ingredient quantities to minimize waste and avoid stockouts.

**Methodology:**

The project leveraged historical sales data and ingredient information to build predictive models and generate weekly forecasts for sales and ingredient requirements. The following steps were performed:

**1. Data Collection and Preprocessing:**

* **Datasets Used**:
  + **Pizza\_ingredients.xlsx**: Contains ingredient details for pizzas.
  + **Pizza\_Sale.xlsx**: Contains historical sales data.
* **Key Preprocessing Steps**:
  + Parsed the order\_date column to ensure proper date-time formats.
  + Filled missing values using forward fill to handle incomplete data.
  + Standardized invalid ingredient values in the pizza\_ingredients column by stripping extra spaces and replacing multiple spaces with a single space.
  + Removed invalid date entries and outliers in the quantity column using the IQR method.

**2. Feature Engineering:**

* Aggregated sales data:
  + Created daily and weekly sales summaries.
  + Added lag features (e.g., lag\_1, lag\_7) to capture temporal patterns.
  + Calculated moving averages to smooth sales trends.
* Enhanced the dataset with additional columns:
  + day\_of\_week, is\_weekend, and month for temporal analysis.
  + Computed total revenue and categorized sales by pizza type.

**3. Exploratory Data Analysis (EDA):**

* **Insights from EDA**:
  + Classic pizzas showed the highest variability in daily sales and profitability.
  + Significant cyclicality was observed in monthly revenue trends, indicating seasonality.
  + Ingredients like Chicken, Red Onions, and Capocollo were identified as crucial due to their frequent usage.

**4. Model Development and Evaluation:**

Four models were implemented to forecast weekly pizza sales:

1. **Prophet**:
   * Captures seasonality and holiday effects.
   * Performance (MAPE): 1.2618
2. **ARIMA (AutoRegressive Integrated Moving Average)**:
   * Suitable for stationary time series data.
   * Performance (MAPE): 0.8999 (Best Model)
3. **SARIMA (Seasonal ARIMA)**:
   * Extends ARIMA to handle seasonality.
   * Performance (MAPE): 1.2805
4. **XGBoost**:
   * Gradient boosting model for predictive analytics.
   * Performance (MAPE): 1.1956

**5. Best Model Selection:**

The **ARIMA** model achieved the best performance with a **MAPE of 0.8999**, making it the most suitable choice for forecasting weekly sales.

**6. Weekly Forecasting and Ingredient Requirements:**

* Forecasted weekly sales quantities for each pizza type.
* Merged forecasts with ingredient data to compute total ingredient quantities needed for production:
  + Calculated total ingredient usage using predicted\_quantity and Items\_Qty\_In\_Grams.

**7. Results:**

* Final forecasts included predicted weekly sales and the required quantities of each ingredient.
* Generated a comprehensive purchase order file: (Total\_Weekly\_Ingredients\_Quantity.xlsx).

**Conclusion:**

By leveraging predictive models, Dominos can effectively optimize its inventory management, ensuring sufficient ingredient availability without overstocking. The ARIMA model's superior performance provides accurate forecasts for operational planning and decision-making.