1. **Title:**

   Demand Forecasting for E-Commerce

2. **Project Statement:**

In the realm of E-Commerce, demand forecasting plays a pivotal role in ensuring business success. This project aims to develop a demand forecasting model in an E-commerce business that predicts future product demand leveraging time series analysis and multivariate regression based on historical sales data, along with Google Analytics KPIs such as Google clicks and Facebook impressions, which are valuable indicators of customer interest.

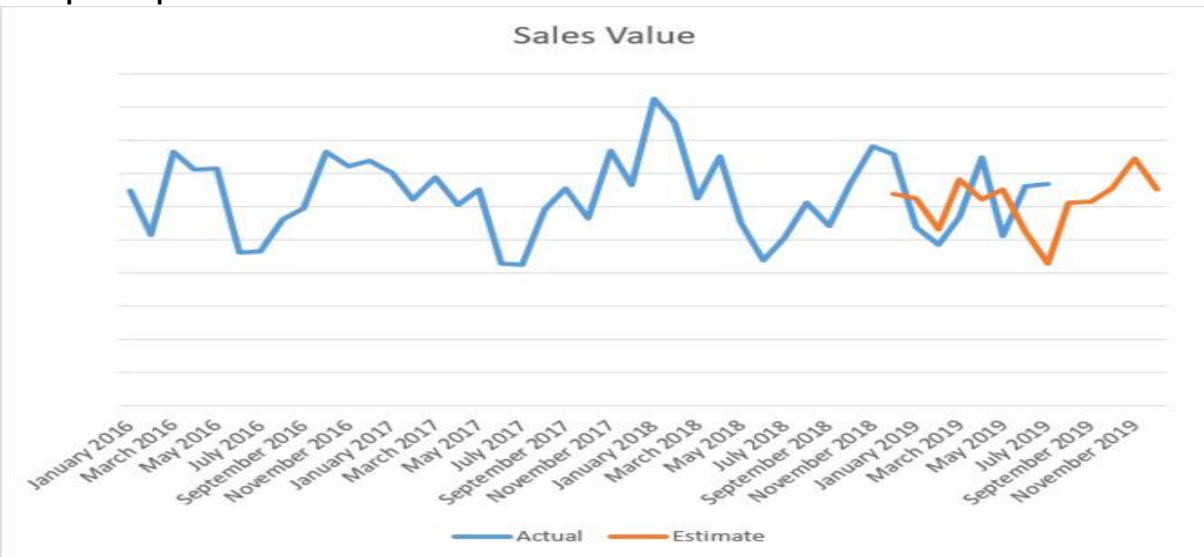
**Outcomes:**

- Improved Inventory Management: More accurate demand forecasts lead to better inventory decisions, potentially reducing stock-outs and excess inventory.
- Enhanced Marketing Efficiency: Identify periods of high demand for targeted marketing campaigns, optimizing resource allocation.
- Data-Driven Decision Making: Reliable forecasts provide a basis for business decisions, such as pricing adjustments or product promotions.
- Accurate Demand Predictions: Implement a forecasting model that achieves high accuracy in predicting future demands thereby improving customer service levels.
- Scalable Solution: Develop a solution that can scale to handle large datasets and varying demand patterns across multiple products.

**Modules to be Implemented:**

1. Data Collection
2. Exploratory Data Analysis (EDA) and Data Preprocessing
3. Time Series Modelling
4. Multivariate Regression (Dynamic)
5. Model Evaluation & Selection & Forecasting
6. Project Presentation & Documentation

**Sample Output:**



**Week-wise Implementation Plan of Modules:**

**Milestone 1: Week 1**

**Module 1: Data Collection**

- Understand the problem statement
- Gather sales data from relevant sources (database, store records)
- Collect Google Analytics and Facebook Impressions data

**Milestone 1: Week 2**

**Module 2: Exploratory Data Analysis (EDA) and Data Preprocessing**

- Ensure your sales data is in a time series format (e.g., daily, weekly, monthly) with timestamps.
- Clean and format data, handling missing values and outliers. Address them using appropriate techniques (imputation, elimination).
- Plot the distribution plots on independent variables
- Visualizations to understand trends, seasonality, and correlations
- Statistical summaries

**Milestone 2: Week 3**

**Module 3: Time Series Modelling**

**Sub Module 3.1: Model Selection**

- Within time series modelling, we'll be exploring univariate models.

**Sub Module 3.2: Model Fitting**

- To identify the optimal model parameters. This involves trying different parameter combinations and selecting the one with the lowest error metric

**Milestone 2: Week 4**

**Module 4: Time Series Modelling**

**Sub Module 4.1: Model Evaluation**

- Visualize the model fit by plotting predicted values against actual sales data.

**Sub Module 4.2: Model Diagnostics**

- Evaluate the model's performance using metrics like Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), or Mean Absolute Percentage Error (MAPE).
- Check for residual plots to ensure no systematic errors remain.

**Milestone 3: Week 5**

**Module 5: Multivariate Regression (Dynamic)**

**Sub Module 5.1: Understanding Dynamic Regression & Data Preparation**

- Dynamic Regression is a type of regression that incorporates lagged values of the dependent variable (in this case, sales) and potentially lagged values of your other predictors as well. The idea is that past sales, past clicks, etc., can influence future sales.
- Create lagged variables of sales, Google clicks, and Facebook impressions by shifting them by one or more time periods.
- Consider interactions between predictors if appropriate (e.g., do clicks in high season periods have greater impact).

**Milestone 3: Week 6**

**Module 6: Multivariate Regression (Dynamic)**

**Sub Module 6.1: Model Construction**

- Investigate functions to build dynamic regression models.
- Start with simple models and progressively add complexity or interactions on training data.

**Sub Module 6.2: Model Evaluation**

- Use metrics like Adjusted R-squared, RMSE, MAE to assess model fit.
- Visualize residuals and compare dynamic regression performance to a basic multiple regression model.

**Milestone 4: Week 7**

**Module 7: Model Evaluation & Selection & Forecasting**

- Comparative analysis of model performance (metrics calculated like MAE, RMSE, MAPE) on test data.
- Select the best performing models.
- Generate forecasts for future period.

**Milestone 4: Week 8**

**Module 8: Project Presentation and Documentation**

- Prepare a presentation with following structure:
  - Problem Statement & Objective
  - Methodology (Brief overview of models used)
  - Results & Insights (emphasize on key takeaways)
  - Visualizations of Forecasts
  - Recommendations (business implications, next steps)
  - Q&A Session
- Clear visualizations and minimum overly technical text in presentations.
- Documentation preparation in below mentioned format:
  - Project Overview: Problem statement, goals, expected outcomes
  - Data Sources: Details on where data was acquired
  - Data Preprocessing and Cleaning: Steps taken, techniques used, justification
  - Exploratory Data Analysis: Summary of findings, key visualizations
  - Model Development: Explanation of model choices (time-series techniques, regression approaches), rationale for parameter selection

- Model Evaluation: Performance metrics used, comparison of different models
- Forecasting and Results: Final forecasts, visualizations, insights, and business implications
- Appendix: Code snippets (well-commented), additional visualizations, etc.

**Evaluation Criteria:**

**Milestone 1 Evaluation (Week 1-2):**

- Data completeness
- Cleaning script functionality
- Quality of EDA visualizations
- Clarity of insights

**Milestone 2 Evaluation (Week 3-4):**

- Model implementation
- Code documentation
- Preliminary performance metrics
- Thoroughness of model comparison

**Milestone 3 Evaluation (Week 5-6):**

- Model implementation
- Code documentation
- Preliminary performance metrics
- Thoroughness of model comparison

**Milestone 4 Evaluation (Week 7-8):**

- Justification for model selection
- Accuracy of forecasts
- Approved Final Model.
- Approved Presentation and Project Documentation.