

# **Project 10: Product demand prediction with machine learnings**

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## **Phase 1: Problem Definition and Design Thinking**

### **Introduction**

The ability to predict product demand is critical for businesses aiming to maintain a competitive edge in today's dynamic market. Accurate demand forecasting allows companies to align their production, inventory, and supply chain management effectively. This project aims to harness the power of machine learning to make precise predictions, ensuring businesses can meet customer needs and demands efficiently.

### **Problem Statement**

The primary challenge revolves around developing a robust machine learning model that predicts product demand based on historical sales data and various external factors. Accurate demand prediction is fundamental for businesses to streamline operations, manage inventory efficiently, and meet customer expectations on time. Leveraging historical sales data along with external factors such as marketing campaigns, economic indicators, and seasonal patterns, this project strives to create a predictive model that enhances business operations and drives growth.

## Design Thinking

Design Thinking is a methodology that provides a solution-based approach to solving problems. It involves understanding human needs, challenging assumptions, re-framing problems, creating innovative solutions, and testing those solutions. For our project, this approach is crucial as it guides us through the problem-solving process, ensuring a well-structured and effective solution.

## Objective and Approach

- **Objective:** The primary objective is to implement a structured design thinking approach, ensuring a comprehensive understanding and solution to the problem.
- **Approach:** We will meticulously follow each step of the design thinking approach, aiming for a deep understanding of the problem and a well-structured solution. Regular evaluations and reviews will be conducted to maintain the integrity and effectiveness of our approach.

## Data Collection

The foundation of building an accurate prediction model lies in the data we collect. Gathering comprehensive historical sales data and external influencing factors is crucial. The dataset needs to be rich and diverse, incorporating various parameters that could influence product demand. External factors such as marketing campaigns, holidays, and economic indicators play a significant role in demand prediction.

## Data Preprocessing

Data preprocessing is a critical step in preparing the collected data for analysis. The main objectives are to handle missing values, convert categorical features into numerical representations, and normalize numerical data to prevent biases during model training. Preprocessing ensures the data is in a suitable format for accurate model training and prediction.

## Objectives and Approach

- **Objective:** To ensure the data is in a suitable format for accurate model training and prediction by preprocessing it effectively.
- **Approach:** We will employ various techniques like imputation for missing values, one-hot encoding for categorical features, and scaling for numerical data. Additionally, we will design features that encapsulate temporal patterns and other relevant information, optimizing the dataset for model training.

## Feature Engineering

Feature engineering is a crucial step to enhance the dataset by creating additional features that capture seasonal patterns, trends, and external influences on product demand. These features enrich the dataset, providing valuable insights for the machine learning model.

## Model Selection

The selection of an appropriate regression algorithm is paramount for demand forecasting. Linear Regression, Random Forest, XGBoost, and other regression algorithms will be evaluated to determine the most suitable model based on the dataset and prediction requirements.

## Objectives and Approach

- **Objective:** To enhance the dataset and choose the most suitable regression algorithm for accurate demand prediction.
- **Approach:** We will employ domain knowledge and experimentation to engineer features that enhance the dataset's predictive power. Subsequently, we will evaluate multiple regression algorithms and select the one that best fits the project's objectives.

## Model Training

This step involves splitting the dataset into training and testing sets. The selected machine learning model is then trained using the training set, allowing it to learn the patterns and relationships within the data.

## Evaluation

Evaluation is critical to measure the model's performance accurately. Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and other regression metrics will be utilized to assess the model's ability to predict product demand.

## Objectives and Approach

- **Objective:** To train the selected machine learning model and evaluate its predictive performance.
- **Approach:** We will use a portion of the dataset to train the model, fine-tuning its parameters to achieve the best results. Subsequently, we will evaluate the model's performance using appropriate regression metrics to ensure its accuracy and effectiveness.

## Conclusion

In this phase, we have extensively examined the problem of predicting product demand using machine learning. The project's foundation lies in leveraging historical sales data and external factors to build an efficient predictive model. The design thinking approach guides us through this journey, ensuring a structured and comprehensive understanding of the problem and a well-thought-out solution.

We began by identifying the significance of accurately predicting product demand, a critical aspect for businesses to streamline their operations and meet customer needs efficiently. The problem statement emphasized the need for a robust machine learning model capable of forecasting demand based on historical sales data and external variables.

Through the design thinking approach, we established a structured framework, delineating essential steps. Data collection and preprocessing are

foundational, involving the gathering and cleaning of data, making it ready for analysis. Feature engineering and model selection are pivotal in enhancing the dataset and choosing the most appropriate regression algorithm for demand forecasting.

Model training and evaluation mark the final steps, ensuring the predictive model is trained effectively and evaluated rigorously using suitable metrics.