**PRODUCT DEMAND PREDICTION WITH MACHINE LEARNING**

**INTRODUCTION:**

* **In demand forecasting, machine learning algorithms can analyze historical sales patterns and predict future trends.**
* **The first step is collecting data about past sales, such as**
* **product type**
* **quantity purchase frequency**
* **seasonality sold**
* **Discounts and more.**
* **Demand forecasting is the process of using predictive analysis of historical data to estimate and predict customers' future demand for a product or service.**
* **Demand forecasting helps the business make better-informed supply decisions that estimate the total sales and revenue for a future period of time.**

**The limitations of traditional linear regression models in capturing complex relationships.**

** Emphasize the need for advanced regression techniques like Gradient Boosting and**

**XG Boost to enhance prediction accuracy**.

**Content for Project Phase 2:**

**Consider exploring advanced regression techniques like Gradient Boosting or XG Boost for improved Prediction accuracy.**

**Data Source:**

* **A good data source for product demand prediction using machine learning should be**
* **Accurate,**
* **Complete,**
* **Covering the ID,**
* **STORE ID,**
* **TOTAL PRICE and**
* **Unit sold.**

**Dataset Link:**

<https://www.kaggle.com/datasets/chakradharmattapalli/product-demand-prediction-with-machine-learning>

**In above Dataset link given about**

* **Total price**
* **ID**
* **Store Id**
* **Base price**
* **Unit sold**

**Based on product demand prediction with machine learning.**

**Data Collection:**

* **Collect historic sales data and external factors that influence demand, such as marketing campaigns, holidays, economic indicators, etc.**
* **Data collection is the process of gathering and measuring information from countless different sources.**
* **In order to use the data we collect to develop practical artificial intelligence (AI) and machine learning solutions, it must be collected and stored in a way that makes sense for the business problem at hand.**

**Data Preprocessing:**

* **Clean and preprocess the data, handle missing values, and convert categorical features into numerical representations**
* **Data Processing is the task of converting data from a given form to a much more usable and desired form i.e. making it more meaningful and informative. Using Machine Learning algorithms, mathematical modeling, and statistical knowledge, this entire process can be automated.**

**Feature Engineering:**

* **Feature engineering is the pre-processing step of machine learning, which is used to transform raw data into features that can be used for creating a predictive model using Machine learning or statistical Modelling.**
* **Feature engineering in machine learning aims to improve the performance of models.**
* **Create additional features that capture seasonal patterns, trends, and external influences on product demand**

**Advanced Regression Techniques:**

 **Ridge Regression: Introduce L2 regularization to mitigate multi collinear and over fitting.**

** Lasso Regression: Employ L1 regularization to perform feature selection and simplify the model.**

** Elastic Net Regression: Combine both L1 and L2 regularization to benefit from their  Ridge Regression: Introduce L2 regularization to mitigate multi collinear and over fitting.**

** Lasso Regression: Employ L1 regularization to perform feature selection and simplify the model.**

** Elastic Net Regression: Combine both L1 and L2 regularization to benefit from their respective advantages.**

** Random Forest Regression: Implement an ensemble** **technique to handle nonlinearity and capture complex relationships in the data.**

** Random Forest Regression: Implement an ensemble technique to handle nonlinearity and capture complex relationships in the data.**

** Gradient Boosting Regressors (e.g., XG Boost, Light GBM): Utilize gradient boosting algorithms.**

**Model Selection:**

* **Choose suitable regression algorithms (e.g., Linear Regression, Random Forest, XG Boost) for demand forecasting.**
* **Model selection in machine learning is the process of selecting the best algorithm and model architecture for a specific job or dataset.**
* **It entails assessing and contrasting various models to identify the one that best fits the data & produces the best results.**

**LIBRARIES:**

**PANDAS:**

* **Pandas is a Python library used for working with data sets. It has functions for analyzing, cleaning, exploring, and manipulating data.**
* **The name "Pandas" has a reference to both "Panel Data", and "Python Data Analysis" and was created by Wes McKinney in 2008.**

**NUMPY:**

* **NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, transform, and matrices. NumPy was created in 2005 by Travis Oliphant.**

**MATPLOTLIB:**

* **It is a comprehensive library for creating static, animated, and interactive visualizations in Python.**
* **It makes easy things easy and hard things possible. Create publication quality plots.**
* **Make interactive figures that can zoom, pan ,update**

**Model Training:**

* **Model training is the phase in the data science development lifecycle where practitioners try to fit the best combination of weights and bias to a machine learning algorithm to minimize a loss function over the prediction range.**

**PROGRAM:**

**from s k learn import datasets  
from s k learn. model \_selection import train \_ test \_ split  
from s k learn. metrics import accuracy \_ score  
from s k learn .tree import Decision Tree Classifier**

**data = datasets .load \_ wine(as \_ frame = True)  
X = data .data  
y = data . target**

**X \_ train, X \_ test, y \_ train, y \_ test = train \_ test \_ split(X, y, test \_ size = 0.25, random \_ state= 22)**

**D tree = Decision Tree Classifier (random \_ state= 22)  
d tree .fit (X \_ train , y \_ train)**

**OUTPUT:**

**Decision Tree Classifier (random \_ state=22)**

**CONCLUSION:**

**It helps businesses make informed decisions that affect everything from inventory planning to supply chain optimization. With customer expectations changing faster than ever, businesses need a method to forecast demand accurately.**