

**PRODUCT DEMAND PREDICTION**

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**Abstract:**

The problem of predicting demand for a new product based on its characteristics and description is critical for various industrial enterprises, wholesale and retail trade and, especially, for modern highly competitive sector of air transportation, since solving this problem will optimize production, management and logistics in order to maximize profits and minimize costs.

You must have studied that the demand for a product varies with the change in its price. If you take real-world examples, you will see if the product is not a necessity, then its demand decreases with the increase in its price and the demand increases with the decrease in its price. Predictive is the use of data, machine learning algorithms and techniques are used to identify the demand prediction according to the supply based on the historical data. The goal is predict the demand of the products according to the supply to provide a best assessment of what will happen in the future.

**1.Problem statement :**

The company wants to find the price at which its product can be a better deal compared to its competitors. For this task, the company provided a dataset of past changes in sales based on price changes. Here we are training a model that can predict the demand for the product in the market with different price segments.

**2.Market/Customer Need Assessment:**

In order to improve the profits, company needs to examine their product demand in the market which is nothing but demand forecasting. Demand forecasting is used to predict what customer demand will be for a product or service, with varying levels of specificity. Data, software and analytics are increasingly crucial to get demand forecasts.

**3.Target specification:**

Finding demand for the existing /new product in the market and change the price accordingly using machine learning algorithm.

Demand prediction will help companies plan their marketing and can use this model to analyse how they can change their price.

## 4.External search:

The [dataset](#) that we have for this task contains data about:

- The product id
- Store id
- Total price at which product was sold
- Base price at which product was sold
- Units sold (quantity demanded)

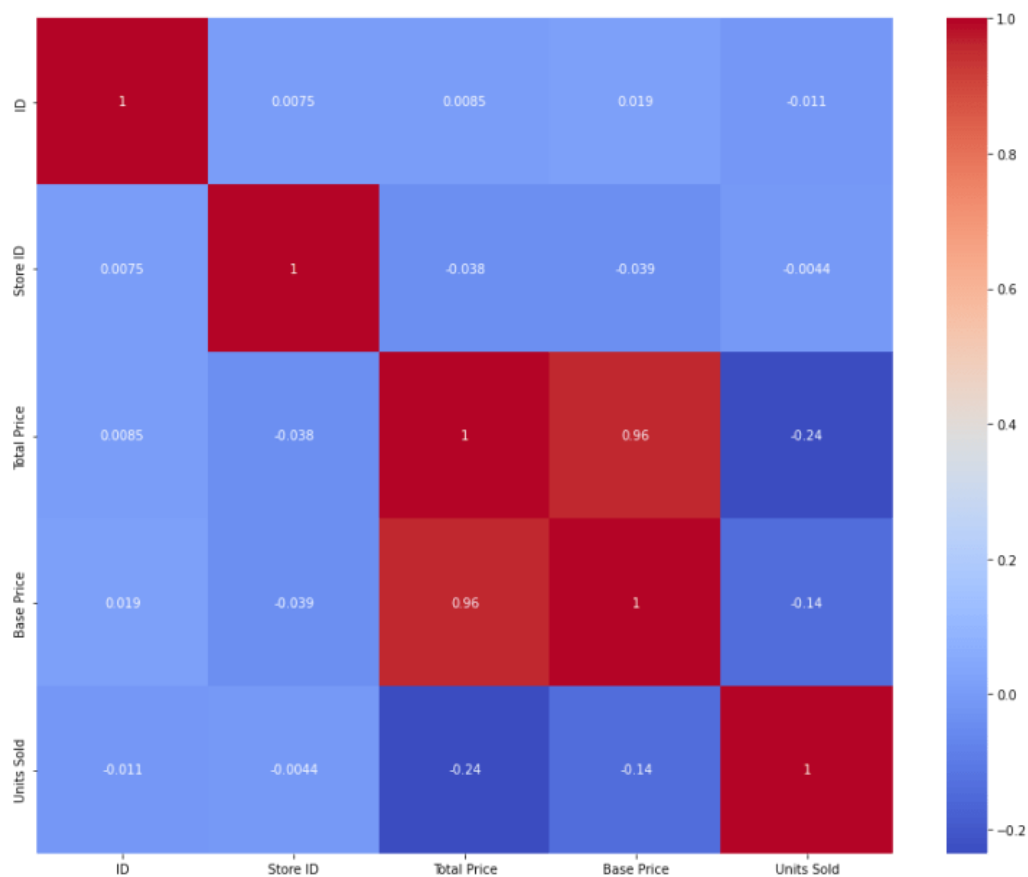
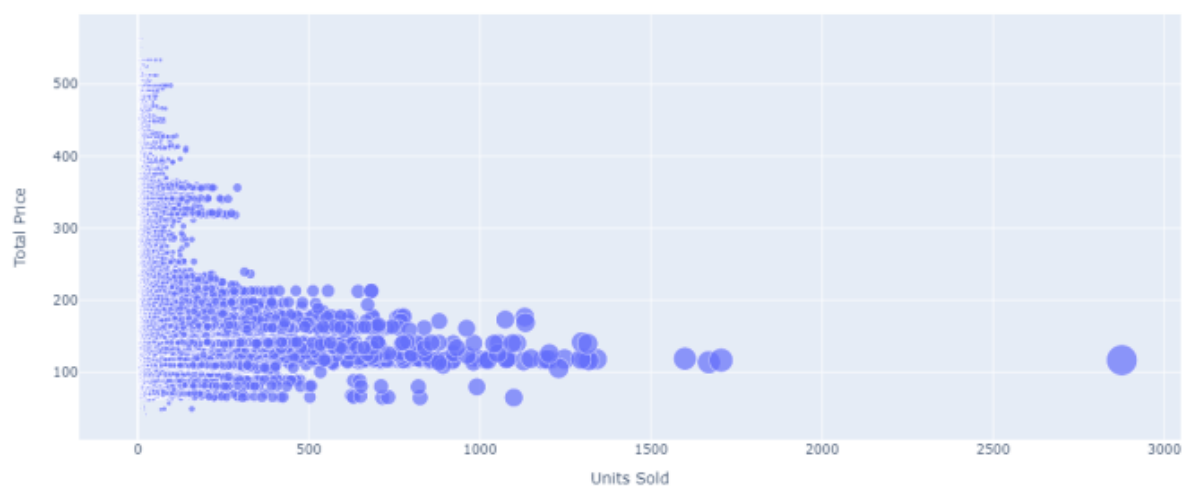
I hope you now understand what kind of problem statements you will get for the product demand prediction task. In the section below, I will walk you through predicting product demand with machine learning using Python.



```
data = pd.read_csv("dataset final.csv")
data.head()
```

	ID	Store ID	Total Price	Base price	Units sold
0	1	8091	99.0375	111.8625	20
1	2	8091	99.0375	99.0375	28
2	3	8091	133.9500	133.9500	19
3	4	8091	133.9500	133.9500	44
4	5	8091	141.0750	141.0750	52

## 5. Bench marking :



In this, above fig., we find the same Correlation of all the columns. I use the matplotlib to resize the output of the image.

## 6.Applicable Constraints :

There are several constraints to consider when using machine learning to predict product demand. These constraints can include:

**Data Availability:** Machine learning models require large amounts of quality data to accurately predict product demand. If data is scarce or incomplete, it can affect the accuracy of the model. Companies should ensure they have access to quality data before developing a demand prediction model.

**Computing Resources:** Machine learning models can be computationally intensive and require significant processing power. Companies should ensure they have the necessary computing resources to train and run the model efficiently.

**Model Complexity:** Highly complex models can be difficult to interpret and understand. Companies should ensure that their demand prediction model is simple enough to be easily understood by decision-makers.

**Time Constraints:** In some industries, demand can change rapidly, requiring real-time demand prediction. Companies should ensure that their model can handle real-time data and provide predictions quickly enough to inform decision-making.

**Cost:** The cost of developing and implementing a machine learning model can be high. Companies should consider the cost-benefit analysis of using a demand prediction model to ensure that the benefits outweigh the costs.

**Human Expertise:** Machine learning models require expertise in data science and programming. Companies should ensure that they have access to qualified personnel who can develop and implement the model.

## 7.Applicable Regulations:

Predicting product demand with machine learning can be subject to various regulations depending on the industry, location, and data used. Here are some examples of applicable regulations to consider:

**Data Privacy Regulations:** If the data used for demand prediction contains personally identifiable information (PII) such as customer names or addresses, data privacy regulations such as the General Data Protection Regulation (GDPR) in Europe or the California Consumer Privacy Act (CCPA) in the US may apply. Companies should ensure that they comply with these regulations and obtain the necessary consent from customers to use their data.

**Fair Credit Reporting Act (FCRA):** If the demand prediction model uses credit information, the FCRA applies. Companies should ensure that they follow the FCRA's requirements, such as obtaining written consent from the customer before using their credit information.

**Consumer Protection Regulations:** Companies should also consider any consumer protection regulations that may apply, such as the Federal Trade Commission Act (FTC) in the US. The FTC prohibits unfair or deceptive practices in advertising, marketing, and sales.

**Antitrust Regulations:** Companies should be aware of antitrust regulations that prohibit monopolistic behavior, such as price-fixing or market allocation. Companies should ensure that their demand prediction models do not violate these regulations.

## **8.Business opportunity:**

Every business need to predict the demand of a particular product in order to avoid surplus amount of unwanted products in their stores and also to avoid product scarcity to maximize profits. We provide a service that gives an accurate price for a product to sustain well in the market using Machine learning. This will complement their market research team gain better insights on product and pricing design . Business sector can utilize this segmentation report to mark price for a product .

## 9. Concept Generation:

This product requires the tool of machine learning models to be written from scratch in order to suit our needs. Tweaking these models for our use is less daunting than coding it up from scratch. A well trained model can either be repurposed or built. But building a model with the resources and data we have is dilatory but possible. The customer might want to spend the least amount of time giving input data. . This accuracy will take a little effort to nail, because it's imprudent to rely purely on Classic Machine Learning algorithm.

**Procedure followed while designing algorithm for a product:**

**Step-1: Importing the libraries**

```
✓ [22] import pandas as pd
1s      import numpy as np
      import matplotlib.pyplot as plt
      import seaborn as sns
```

**Step-2: Importing the dataset**

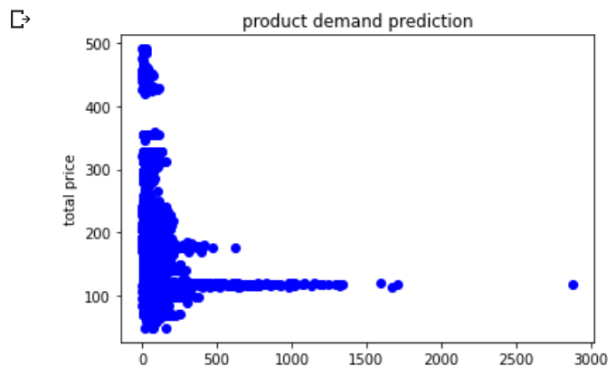


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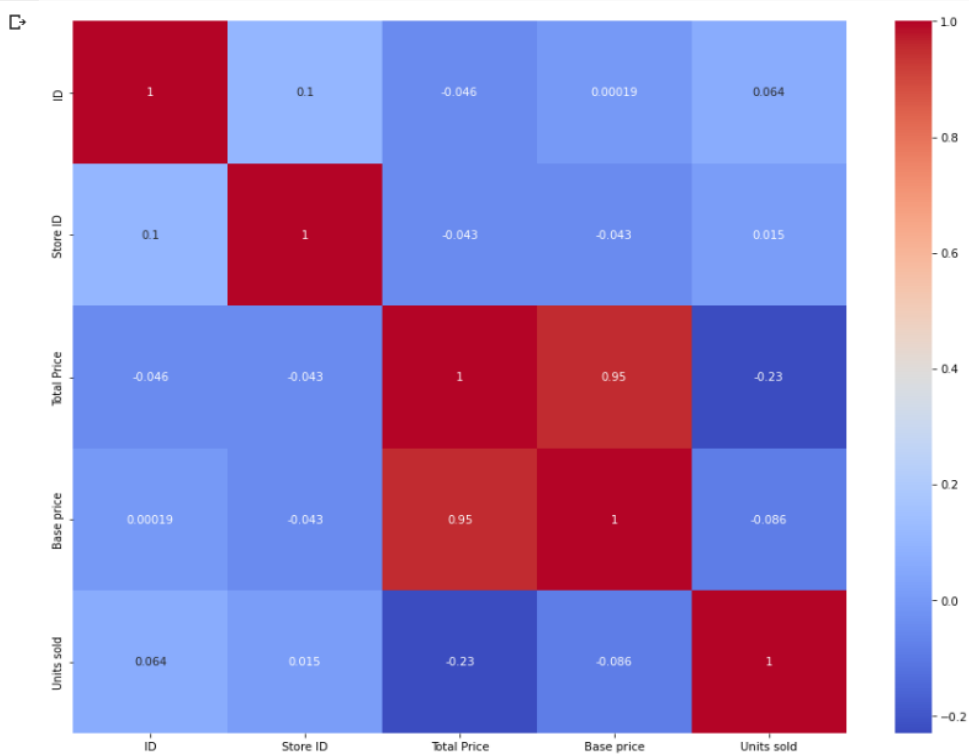
Step-3: Splitting the dataset into the total price and units sold and scatter plot between them.

```
js ▶ X=data.iloc[:, -1].values  
y=data.iloc[:, 2].values  
  
plt.scatter(X, y, color = 'blue')  
plt.title('product demand prediction')  
plt.xlabel('units sold')  
plt.ylabel('total price')  
plt.show()
```



Step-4: Correlation plot between total price and units sold

```
js ▶ correlations = data.corr(method='pearson')  
plt.figure(figsize=(15, 12))  
sns.heatmap(correlations, cmap="coolwarm", annot=True)  
plt.show()
```





## Step-6:Splitting the dataset into the Training set and Test set

```
[29] from sklearn.model_selection import train_test_split
      X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 1/3, random_state = 0)
```

## Step-7:Training the Decision Regression model on the Training set

```
[30] from sklearn.tree import DecisionTreeRegressor
      model = DecisionTreeRegressor()
      model.fit(X_train, y_train)
```

```
▼ DecisionTreeRegressor
DecisionTreeRegressor()
```

## Step-8:Predicting the Test set results

```
[31] features = np.array([[133.00, 140.00]])
      model.predict(features)

array([72.])
```

## 10.Final Report Prototype:

The product takes the following functions to perfect and provide a good result

### Back-end :

Model or Webapp Development : This must be done before releasing the service. A lot of manual supervised machine learning must be performed to optimize the automated tasks

- Performing EDA to realize the dependent and independent features.
- Algorithm training and optimization must be done to minimize overfitting of the model and hyperparameter tuning.

## **Front end:**

To create a front-end for a demand price prediction project using machine learning, you can follow these general steps:

Choose a programming language and web development framework: we choose Python language here. Consider your team's experience and preferences when selecting one.

Design the user interface: Sketch out the user interface (UI) for your front-end.

Consider what data you want to display to the user, how they will interact with the application, and what features you want to include.

Connect the front-end to the machine learning model: Your machine learning model should be running in the back-end, but you'll need to connect it to the front-end so that it can display predictions to the user. You can use an API or a database to facilitate this connection.

Test the application: Once you have a functional front-end connected to your machine learning model, test the application to make sure it's working as expected. You may need to make adjustments to the UI or the back-end to improve performance.

Deploy the application: Finally, deploy your application so that others can use it. Consider using Heroku to make the deployment process easier.

## **11. Conclusion:**

So this is how you can train a machine learning model for the task of product demand prediction using Python. Price is one of the major factors that affect the demand for the product. If a product is not a necessity, only a few people buy the product even if the price increases. I hope you liked this article on product demand prediction with machine learning using Python.

