Inventory Management using Machine Learning

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Problem Statement:

A requirement for small/medium sized businesses is Inventory Management since a lot of money and resources like labour and time is to be invested to do so. The e-commerce players also use machine learning models to do inventory management. Inventory Management can be extended as a service to small and medium sized businesses to improve sale by helping in inventory management. The problem statement will be:

How much stock of a category or item should a business keep to meet the demand?

- What is Inventory Management?
  - Inventory is defined as a stock of goods that is maintained by a business in anticipation of some future demand.
  - Inventory Management is a critical element of supply chain. It is tracking inventory from manufacturers to warehouses and from these facilities to the point of sale.

Market /Business Need Assessment:

- Inventory Management is a major requirement even for small and medium businesses.
- By leveraging machine learning algorithms businesses can predict demand and optimize inventory levels to ensure that they have the right products in the stock.
- This optimization can help businesses increase sales and reduce wastes.
- Among its many benefits, a predictive forecast is a key enabler for a better customer experience through reduction of out-of-stock situations and for lower costs due to better planned inventory and less write-off items.

Target Specifications:

The target of this service will be mainly micro, small and medium companies and obviously startups because it is a cheaper way to manage the inventory. It will be also used by companies which want to switch from costlier model to cheaper model to save some money.

Alternate Products:

There are many products available in the market to use and big e-commerce companies like Amazon have made their own system or model for inventory management. Some of the names are- manageengine, Odoo, Zoho and many more. The difference between them and our product is we can use for micro and small businesses like general store and all. The main thing is this is way cheaper than other products present.

Applicable Patents:

- Patent of technology
- Patent of app and codes framework used

Business Model:

At first we will provide free trial of one month. Then we can give free service for next two months after they create a account to develop a sense of liking towards our product. And after the free period we will give three plans to subscribe one will be monthly which will cost around Rs. 250 in which we will use data analysis only and second plan will be half-yearly which will cost around Rs. 600 after discount in which we will use machine learning models to predict and third plan will be same as second on yearly basis & will cost Rs. 1000. We can also give extra discounts on booming seasons of specific businesses as they will get a need of managing inventory most at that time.

These cheaper charges and discounts will attract the micro and small businesses as they don’t have the capacity to spend much. The businesses will be taking the yearly subscription as it is cost effective and from that we can build a loyal and strong customer base.

Final Product Protype:

The app/website will work in backend and frontend.

Back-end

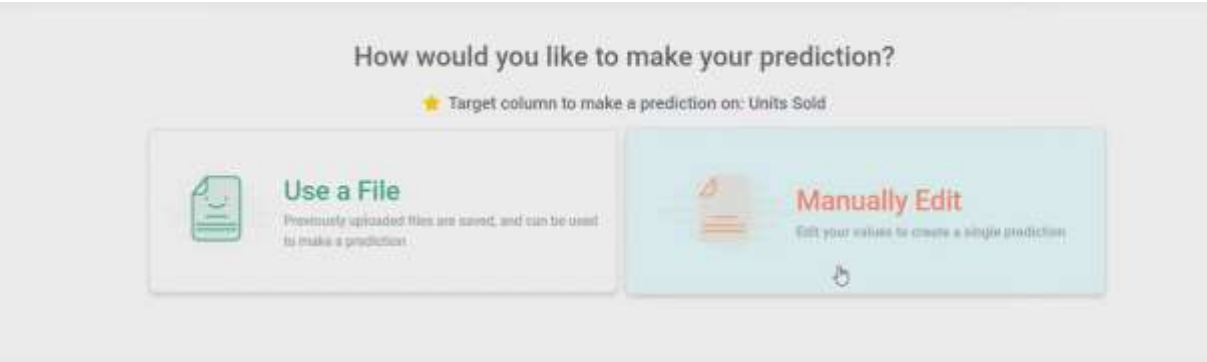
- Perform exploratory data analysis.
- According to plan chose the process of data analysis or machine learning model training will start.
- In monthly plan we will just forecast the demand based on analysis.
- In other plans we will do the prediction of demand after training different machine learning models according to data. Some models used will be linear regression, bagging and boosting techniques like random forest and XGBoost, k-means clustering to first make clusters of same character products and then a supervised machine learning algorithm.

Front-end

- Customer friendly interface to ease the work of customer.
- Interactive and creative visualizations from the given data.
- Feedback system which will help us to know the customer's need and help in model training.

Product Details:

The interface after buying the subscription plan will somewhat look like this-



- How will it work:
  - ❖ After uploading the data file or manually editing a previous file it will be cleaned.
  - ❖ Exploratory data analysis will be performed.
  - ❖ Then feature selection process will be performed.
  - ❖ Training the suitable machine learning model will be done.

- ❖ Then the prediction will be shown with the accuracy of the model trained. In simple words the interface will show which product or item has more demand and which item has to keep more in stock.
- ❖ By doing all this our product will be learning models for various situations or businesses which will be beneficial for future.

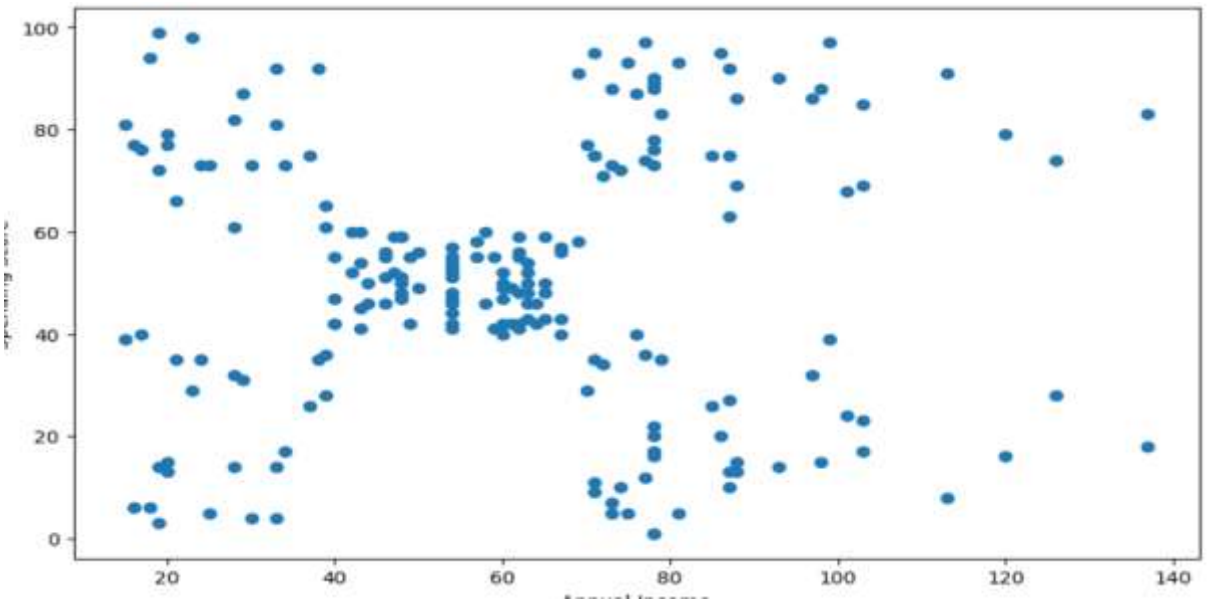
Code Implementation:

This is just an example as I didn't get the perfect data, the codes are also not sequential. It is for reading purpose only.

- If we have to predict according to clusters based on annual income and spending score of customers. So we have to use K-means clustering to make clusters of similar features customers and then predict how much will they buy in future.

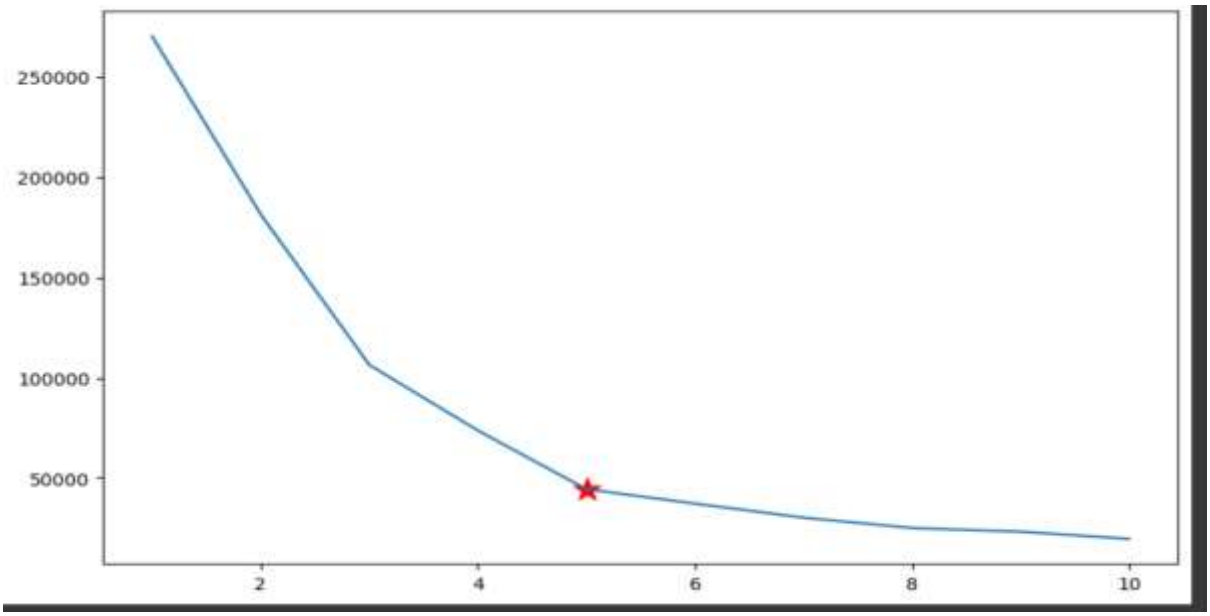
	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

Next steps: View recommended plots



```
clustering_score = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters = i, init = 'random', random_state = 42)
    kmeans.fit(X)
    clustering_score.append(kmeans.inertia_)


plt.figure(figsize=(10,6))
plt.plot(range(1, 11), clustering_score)
plt.scatter(5,clustering_score[4], s = 200, c = 'red', marker='*')
plt.show()
```



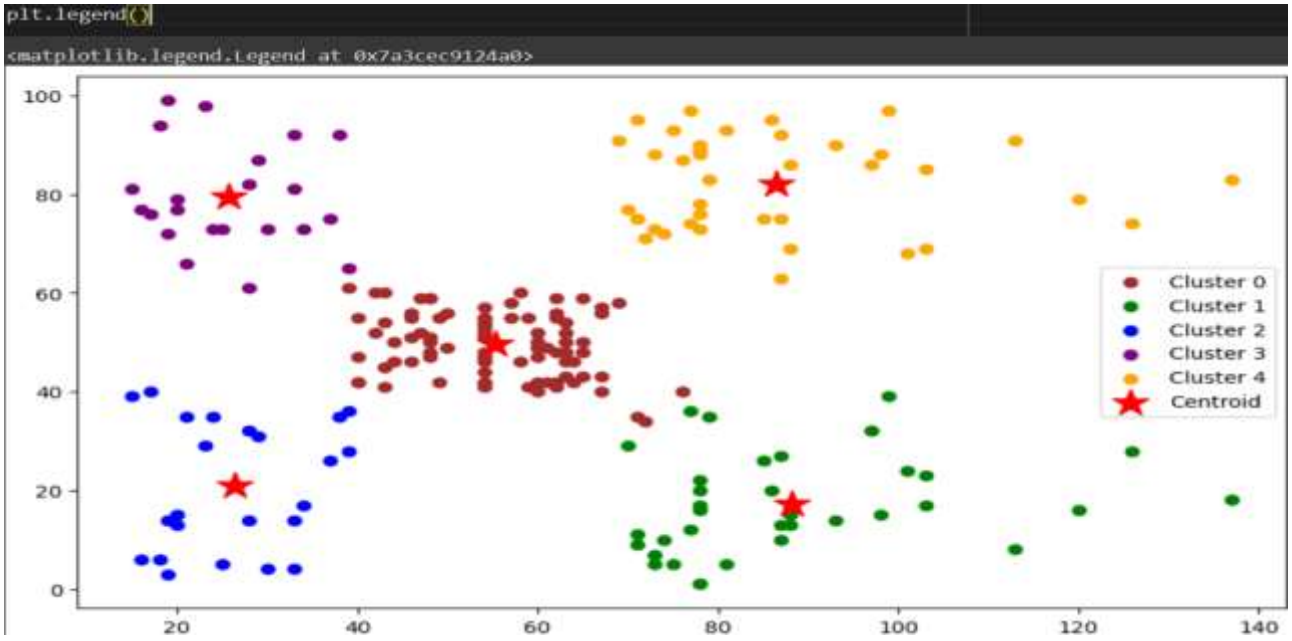

```
kmeans= KMeans(n_clusters = 5, random_state = 42)


kmeans.fit(X)


pred = kmeans.predict(X)

pred
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: Future
  warnings.warn(
array([2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3,
       2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 0,
       2, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 1, 4, 0, 4, 1, 4, 1, 4,
       0, 4, 1, 4, 1, 4, 1, 4, 1, 4, 0, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4,
       1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4,
       1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4,
       1, 4], dtype=int32)
```



- This will predict customer spending that which customer will purchase the costlier and cheaper products. By this we will know how many customers will buy cheaper and how much will buy costlier products and according to that we can predict that which and how much of the inventory we have to keep.

Conclusion:

The different predictions will help micro, small and medium enterprises to maintain inventory and minimize manual labour. It will reduce capital spent and improve profitability. The situations of over-stock and out-of-stock will be decreased. In the future the accuracy can be improved by adding some more features which will affect the prediction.