

Assignment No.6

Utilize the K-Means clustering algorithm to segment customers based on their purchasing

behavior. Apply the Elbow Method to determine the optimal number of clusters that best

represent distinct customer segments for targeted marketing strategies.
Dataset: UCI Machine

Learning Repository - Wholesale Customers Data Set

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```
In [1]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import sklearn as sk
import seaborn as sns
```

```
In [2]: df = pd.read_csv("C:/Users/prath/Downloads/Wholesale customers data.csv")
```

```
In [3]: df
```

```
Out[3]:
```

	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicassen
0	2	3	12669	9656	7561	214	2674	1338
1	2	3	7057	9810	9568	1762	3293	1776
2	2	3	6353	8808	7684	2405	3516	7844
3	1	3	13265	1196	4221	6404	507	1788
4	2	3	22615	5410	7198	3915	1777	5185
...
435	1	3	29703	12051	16027	13135	182	2204
436	1	3	39228	1431	764	4510	93	2346
437	2	3	14531	15488	30243	437	14841	1867
438	1	3	10290	1981	2232	1038	168	2125
439	1	3	2787	1698	2510	65	477	52

440 rows × 8 columns

```
In [4]: df = df.drop(columns=["Channel","Region"],axis=1)
```

```
In [5]: df
```

Out[5]:

	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicassen
0	12669	9656	7561	214	2674	1338
1	7057	9810	9568	1762	3293	1776
2	6353	8808	7684	2405	3516	7844
3	13265	1196	4221	6404	507	1788
4	22615	5410	7198	3915	1777	5185
...
435	29703	12051	16027	13135	182	2204
436	39228	1431	764	4510	93	2346
437	14531	15488	30243	437	14841	1867
438	10290	1981	2232	1038	168	2125
439	2787	1698	2510	65	477	52

440 rows × 6 columns

In [6]: *## Standardization = feature scaling technique*

```
from sklearn.preprocessing import StandardScaler
scalar = StandardScaler()
```

In [7]: *x =df*

Outlier Detection using IQR

In [8]:

```
Q1 = x.quantile(0.25)
Q3 = x.quantile(0.75)
IQR = Q3 - Q1

# Find outlier rows
outlier_condition = ((x < (Q1 - 1.5 * IQR)) | (x > (Q3 + 1.5 * IQR))).any(axis=1)
outliers = df[outlier_condition]

print(f"Number of outliers: {len(outliers)}")
print(outliers)
```

Number of outliers: 108

	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicassen
2	6353	8808	7684	2405	3516	7844
4	22615	5410	7198	3915	1777	5185
17	5876	6157	2933	839	370	4478
22	31276	1917	4469	9408	2381	4334
23	26373	36423	22019	5154	4337	16523
...
427	31012	16687	5429	15082	439	1163
431	8533	5506	5160	13486	1377	1498
435	29703	12051	16027	13135	182	2204
436	39228	1431	764	4510	93	2346
437	14531	15488	30243	437	14841	1867

[108 rows × 6 columns]

In [9]:

```
from sklearn.preprocessing import RobustScaler
scaler = RobustScaler()
x = scaler.fit_transform(x)
```

```
In [10]: x = scalar.fit_transform(x)
```

```
In [11]: x
```

```
Out[11]: array([[ 0.05293319,  0.52356777, -0.04111489, -0.58936716, -0.04356873,
   -0.06633906],
   [-0.39130197,  0.54445767,  0.17031835, -0.27013618,  0.08640684,
   0.08915105],
   [-0.44702926,  0.40853771, -0.0281571 , -0.13753572,  0.13323164,
   2.24329255],
   ...,
   [ 0.20032554,  1.31467078,  2.34838631, -0.54337975,  2.51121768,
   0.12145607],
   [-0.13538389, -0.51753572, -0.60251388, -0.41944059, -0.56977032,
   0.21304614],
   [-0.72930698, -0.5559243 , -0.57322717, -0.62009417, -0.50488752,
   -0.52286938]])
```

Elbow Method to select K-Value

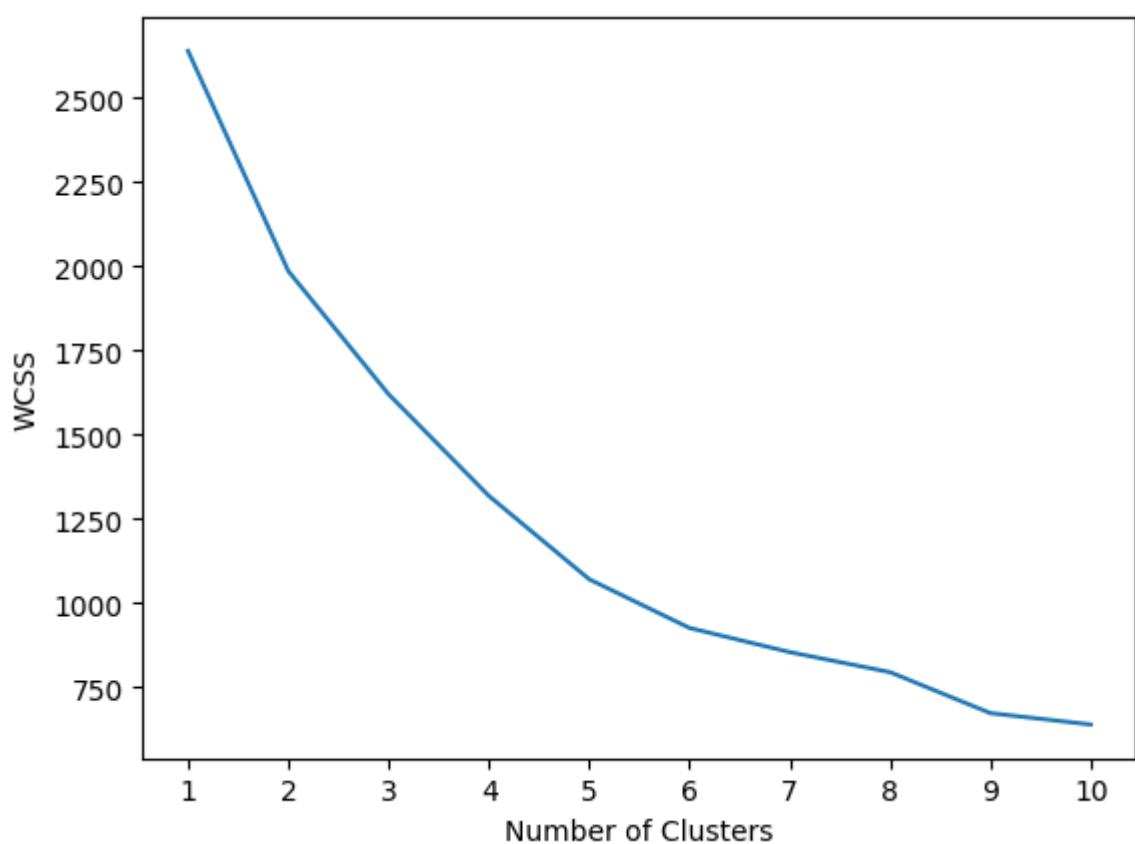
```
In [12]: from sklearn.cluster import KMeans
```

```
In [13]: wcss = []
for k in range(1,11):
    kmeans = KMeans(n_clusters=k, init="k-means++")
    kmeans.fit(x)
    wcss.append(kmeans.inertia_)
```

```
In [14]: wcss
```

```
Out[14]: [2640.0,
 1985.8310672356574,
 1619.952782172456,
 1317.8973573404485,
 1070.2551995135616,
 925.5621320487785,
 853.7550323759655,
 794.1649663000028,
 672.5116366417119,
 638.6802117739219]
```

```
In [15]: ## plot the ELBOW Curve
plt.plot(range(1,11),wcss)
plt.xticks(range(1,11))
plt.xlabel("Number of Clusters")
plt.ylabel("WCSS")
plt.show()
```



```
In [31]: model = KMeans(n_clusters=3, random_state=42, n_init=10)
```

```
In [32]: model.fit(x)
```

Out[32]:

▼ KMeans ⓘ ⓘ

► Parameters

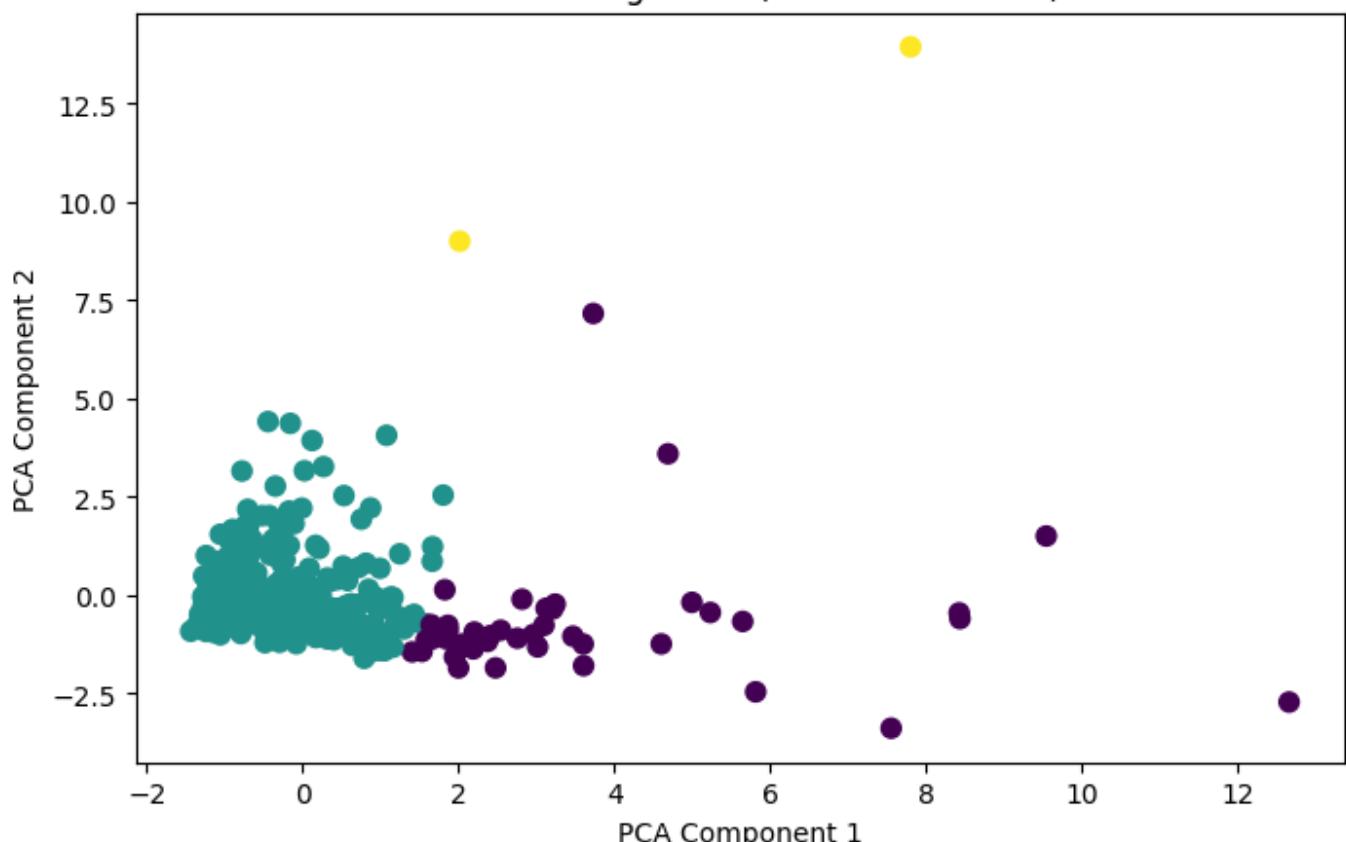
```
In [33]: clusters= model.fit_predict(x)
```

```
In [34]: df['Cluster'] = clusters
```

```
In [36]: from sklearn.decomposition import PCA
pca = PCA(n_components=2)
X_pca = pca.fit_transform(x)
```

```
In [37]: plt.figure(figsize=(8,5))
plt.scatter(X_pca[:,0], X_pca[:,1], c=clusters, cmap='viridis', s=50)
plt.title('Customer Segments (PCA Visualization)')
plt.xlabel('PCA Component 1')
plt.ylabel('PCA Component 2')
plt.show()
```

Customer Segments (PCA Visualization)



Validating k-value diff Method

kneelocator

```
In [38]: from kneed import KneeLocator  
kl = KneeLocator(range(1,11),wcss,curve="convex",direction="decreasing")
```

```
In [39]: kl.elbow
```

```
Out[39]: 5
```

Sillihoute Scoring

```
In [40]: from sklearn.metrics import silhouette_score
```

```
In [41]: sillhoute_coef = []  
for k in range(2,11):  
    kmeans = KMeans(n_clusters=k,init="k-means++")  
    kmeans.fit(x)  
    score = silhouette_score(x,kmeans.labels_)  
    sillhoute_coef.append(score)
```

```
In [42]: sillhoute_coef
```

```
Out[42]: [0.5532526964184259,  
 0.5323210929297174,  
 0.36232371550681225,  
 0.2699786894327585,  
 0.3758033637245776,  
 0.3356008212733988,  
 0.29709019883625454,  
 0.2972001998245971,  
 0.32040877415020924]
```

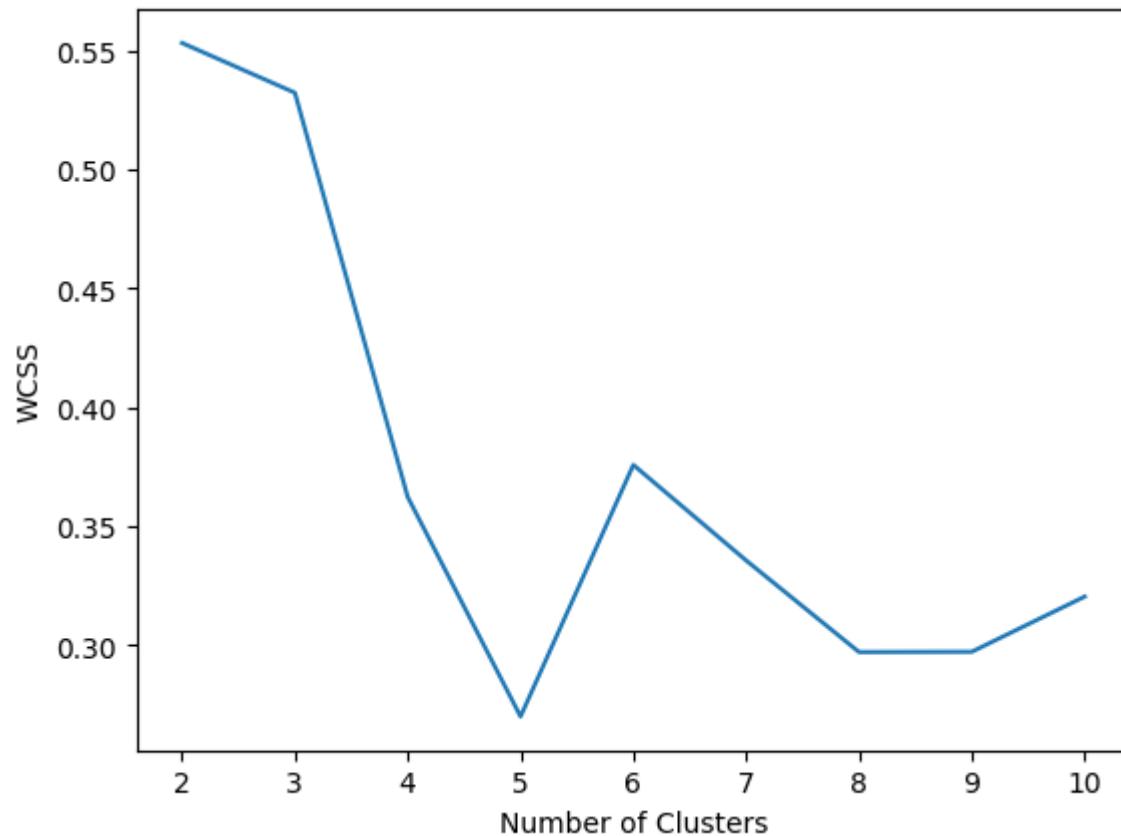
```
In [43]: from sklearn.metrics import silhouette_score
```

```
for k in range(2, 11):
    kmeans = KMeans(n_clusters=k, random_state=42)
    clusters = kmeans.fit_predict(x)
    score = silhouette_score(x, clusters)
    print(f"k = {k}, Silhouette Score = {score:.3f}")
```

```
k = 2, Silhouette Score = 0.400
k = 3, Silhouette Score = 0.458
k = 4, Silhouette Score = 0.349
k = 5, Silhouette Score = 0.369
k = 6, Silhouette Score = 0.276
k = 7, Silhouette Score = 0.277
k = 8, Silhouette Score = 0.324
k = 9, Silhouette Score = 0.295
k = 10, Silhouette Score = 0.229
```

```
In [44]: ## plot the ELBOW Curve
```

```
plt.plot(range(2,11),silhouette_coef)
plt.xticks(range(2,11))
plt.xlabel("Number of Clusters")
plt.ylabel("WCSS")
plt.show()          ## choose the max value in graph      ## i.e. is 5.
```



```
In [46]: from sklearn.metrics import silhouette_score
```

```
# Calculate silhouette score
score = silhouette_score(x, clusters)
print("Silhouette Score:", score)
```

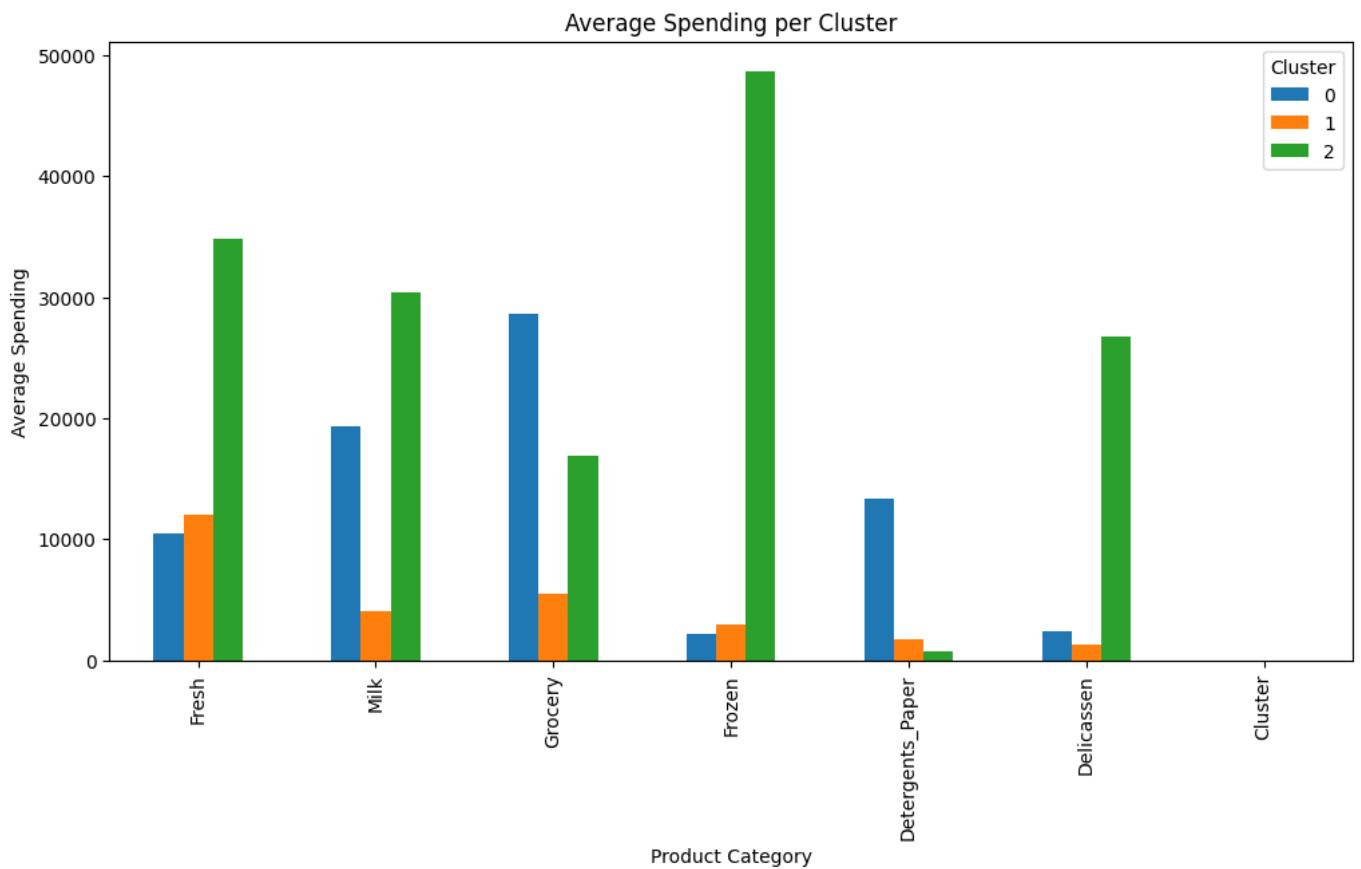
```
Silhouette Score: 0.22876866444760022
```

```
In [47]: cluster_summary = df.groupby('Cluster')[df.columns].mean()
print(cluster_summary)
```

	Fresh	Milk	Grocery	Frozen	\
Cluster					
0	10440.933333	19386.422222	28656.088889	2190.244444	
1	12062.913486	4115.099237	5534.966921	2940.676845	
2	34782.000000	30367.000000	16898.000000	48701.500000	

	Detergents_Paper	Delicassen	Cluster
Cluster			
0	13327.800000	2374.200000	0.0
1	1696.170483	1299.114504	1.0
2	755.500000	26776.000000	2.0

```
In [48]: cluster_summary[df.columns].T.plot(kind='bar', figsize=(12,6))
plt.title("Average Spending per Cluster")
plt.xlabel("Product Category")
plt.ylabel("Average Spending")
plt.show()
```



```
In [ ]:
```

```
In [ ]:
```