```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
```

```
data = pd.read_csv('/content/Wholesale customers data.csv')
data.head()
```

	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

```
data.describe()
```

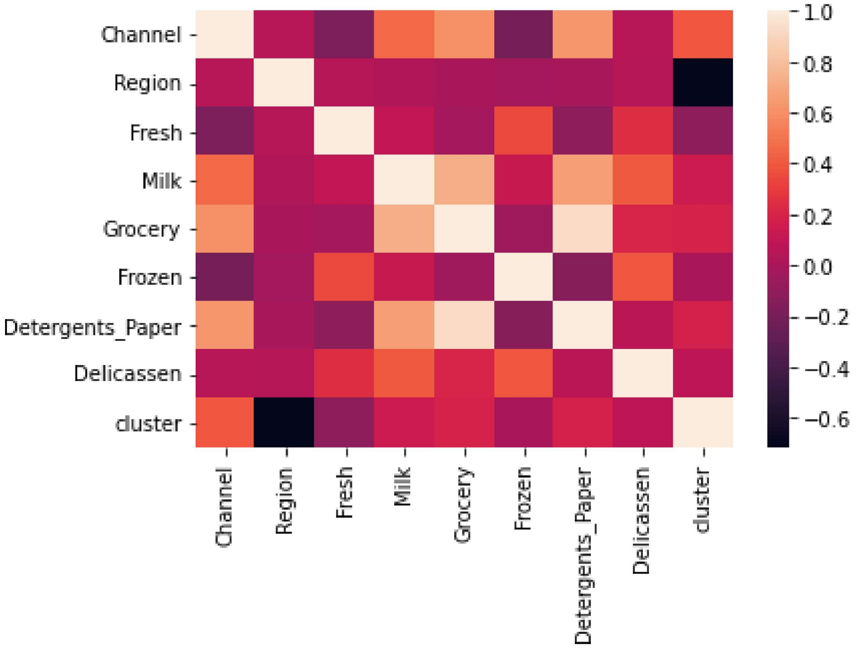
	Channel	Region	Fresh	Milk	Grocery	Frozen
count	440.000000	440.000000	440.000000	440.000000	440.000000	440.000000
mean	1.322727	2.543182	12000.297727	5796.265909	7951.277273	3071.931818
std	0.468052	0.774272	12647.328865	7380.377175	9503.162829	4854.673333
min	1.000000	1.000000	3.000000	55.000000	3.000000	25.000000
25%	1.000000	2.000000	3127.750000	1533.000000	2153.000000	742.250000
50%	1.000000	3.000000	8504.000000	3627.000000	4755.500000	1526.000000
75%	2.000000	3.000000	16933.750000	7190.250000	10655.750000	3554.250000
max	2.000000	3.000000	112151.000000	73498.000000	92780.000000	60869.000000

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 440 entries, 0 to 439
Data columns (total 9 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   Channel           440 non-null    int64
 1   Region            440 non-null    int64
 2   Fresh             440 non-null    int64
 3   Milk              440 non-null    int64
 4   Grocery           440 non-null    int64
 5   Frozen            440 non-null    int64
 6   Detergents_Paper  440 non-null    int64
 7   Delicassen        440 non-null    int64
 8   cluster           440 non-null    int32
dtypes: int32(1), int64(8)
memory usage: 29.3 KB
```

```
sns.heatmap(data.corr())
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8ac3384990>
```

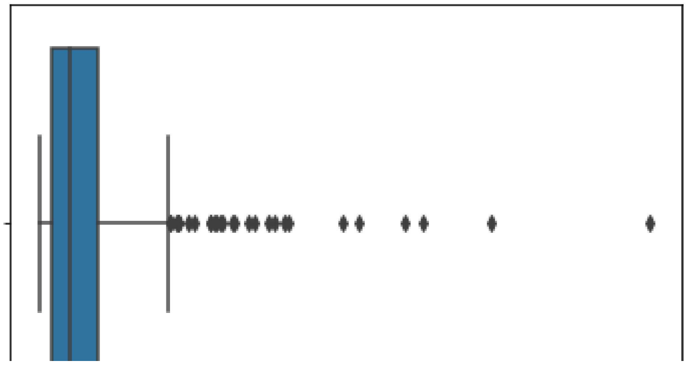


```
data.isnull().sum()
```

```
Channel             0
Region              0
Fresh               0
Milk                0
Grocery             0
Frozen              0
Detergents_Paper    0
Delicassen          0
cluster             0
dtype: int64
```

```
sns.boxplot(data['Milk'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass t
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f8ac30e5590>
```



```
scaler = StandardScaler()
scaled_df = scaler.fit_transform(data)

pd.DataFrame(scaled_df).describe()
```

	0	1	2	3	4	5
count	4.400000e+02	4.400000e+02	4.400000e+02	440.000000	4.400000e+02	4.400000e+02
mean	1.614870e-17	3.552714e-16	-3.431598e-17	0.000000	-4.037175e-17	3.633457e-17
std	1.001138e+00	1.001138e+00	1.001138e+00	1.001138	1.001138e+00	1.001138e+00
min	-6.902971e-01	-1.995342e+00	-9.496831e-01	-0.778795	-8.373344e-01	-6.283430e-01
25%	-6.902971e-01	-7.023369e-01	-7.023339e-01	-0.578306	-6.108364e-01	-4.804306e-01
50%	-6.902971e-01	5.906683e-01	-2.767602e-01	-0.294258	-3.366684e-01	-3.188045e-01
75%	1.448652e+00	5.906683e-01	3.905226e-01	0.189092	2.849105e-01	9.946441e-02
max	1.448652e+00	5.906683e-01	7.927738e+00	9.183650	8.936528e+00	1.191900e+01

Lets take number of clusters as 3 and find the inertia

```
model = KMeans(n_clusters=3)

model.fit(scaled_df)
model.inertia_
```

```
2149.283956221758
```

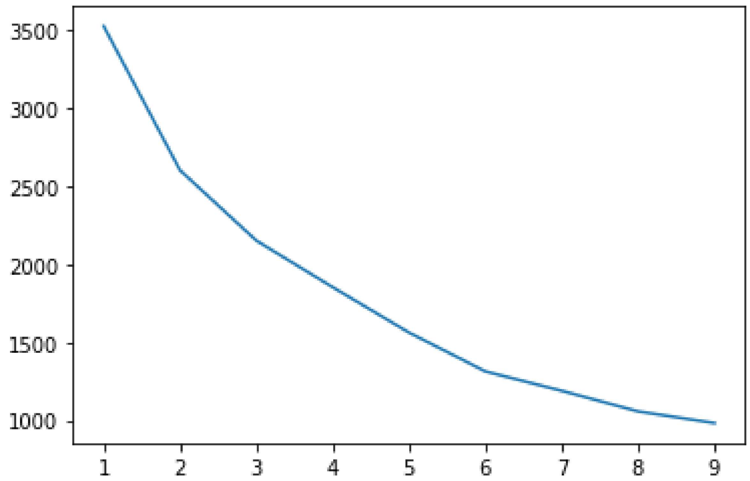
to find the optimal number of clusters

```
clusters = range(1, 10)
inertia =[]
for cluster in clusters:
    model = KMeans(n_clusters=cluster)

    model.fit(scaled_df)
    inertia.append(model.inertia_)

plt.plot(clusters, inertia)
```

```
[<matplotlib.lines.Line2D at 0x7f8ac0cc3190>]
```



from the graph, we can choose the optimum number of clusters as 4

```
model = KMeans(n_clusters=4)

model.fit(scaled_df)
```

```
KMeans(n_clusters=4)
```

```
print("the model has an inertia of ", model.inertia_)
print("the centeroids are", model.cluster_centers_)

pred = model.predict(scaled_df)
data['predicted'] = model.predict(scaled_df)
print('\nCount in each cluster: \n', data['predicted'].value_counts())
```

```
the model has an inertia of  1851.8408722743848
the centeroids are [[-0.57404987 -1.58776439  0.0322041  -0.32480994 -0.39159364  0.208
  -0.42347134 -0.11589632]
 [ 1.1195826   0.09335859  1.09004412  3.98320348  3.58457916  0.77799282
   3.56664129  2.25618179]
 [-0.69029709  0.59066829  0.10271946 -0.35647922 -0.44358724  0.07527901
  -0.44349195 -0.09313733]
 [ 1.44865163  0.1699285  -0.30636283  0.41750021  0.65187952 -0.3572697
   0.67684797  0.00633175]]

Count in each cluster:
 2    209
3    126
```

```
0     92
1     13
Name: predicted, dtype: int64
```

Applying PCA

```
print("the cluster having most number of points is 2")
```

```
the cluster having most number of points is 2
```

```
from sklearn.decomposition import PCA
pca = PCA(n_components=4)
pca_data = pca.fit_transform(scaled_df)
```

```
print(pca_data)
```

```
[[ 0.84393893 -0.51535075 -0.76763222 -0.0442148 ]
 [ 1.06267645 -0.48460126 -0.67297526  0.40137178]
 [ 1.26914052  0.68205455 -0.6640946   1.63495276]
 ...
 [ 3.86514909 -0.47985376 -0.52534452 -0.68713197]
 [-1.09706738 -0.06989568 -0.63012755  0.31182088]
 [-1.16595067 -0.90215675 -0.59770486  0.34265555]]
```

do clustering on transformed data

```
clusters = range(1, 10)
inertia =[]
for cluster in clusters:
    model = KMeans(n_clusters=cluster)

    model.fit(pca_data)
    inertia.append(model.inertia_)

plt.plot(clusters, inertia)
```

```
[<matplotlib.lines.Line2D at 0x7f8ac0b9a790>]
```

by analysing the graph, we can find that the optimal number of centeroids is 5

```
model1 = KMeans(n_clusters=5)
```

```
model1.fit(scaled_df)
```

```
KMeans(n_clusters=5)
```

```
print("the model has an inertia of ", model1.inertia_)
print("the centeroids are", model1.cluster_centers_)

pred2 = model1.predict(scaled_df)
data['predicted2'] = model1.predict(scaled_df)
print('\nCount in each cluster: \n', data['predicted2'].value_counts())
```

```
the model has an inertia of  1541.2223189373358
the centeroids are [[ 1.44865163e+00 -5.58343155e-02  3.13830315e-01  3.92190593e+00
   4.27561037e+00 -3.57419457e-03  4.61816580e+00  5.03365339e-01]
 [-6.80111616e-01  5.90668285e-01  1.12663617e-01 -3.55978165e-01
  -4.42978026e-01  7.32433363e-02 -4.43738312e-01 -9.14933607e-02]
 [-1.55559907e-01  2.67416985e-01  3.16804122e+00  3.51326433e+00
   1.11031138e+00  5.51716255e+00 -3.83193146e-02  6.43664422e+00]
 [ 1.44865163e+00  1.66562579e-01 -3.26341681e-01  4.22850268e-01
   6.59619766e-01 -3.57310160e-01  6.86224579e-01  4.36563167e-03]
 [-5.72772431e-01 -1.59749436e+00  1.45371704e-02 -3.44758082e-01
  -4.02466315e-01  7.96677044e-02 -4.24411072e-01 -1.33102511e-01]]

Count in each cluster: 
 1    210
3    125
4     91
0     10
2      4
Name: predicted2, dtype: int64
```

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