```
#Importing required libraries
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings("ignore")
import seaborn as sns
import matplotlib.pyplot as plt
from scipy.stats import pointbiserialr


import requests
import pandas as pd
import io

url = 'https://raw.githubusercontent.com/PragadishTRS/Customer_segmentation_analysis/main/ifood_df.csv'
response = requests.get(url)

data = pd.read_csv(io.StringIO(response.text))

data.head()
```

	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts	MntGoldProds	...	marit
0	58138.0	0	0	58	635	88	546	172	88	88	...	
1	46344.0	1	1	38	11	1	6	2	1	6	...	
2	71613.0	0	0	26	426	49	127	111	21	42	...	
3	26646.0	1	0	26	11	4	20	10	3	5	...	
4	58293.0	1	0	94	173	43	118	46	27	15	...	

5 rows × 39 columns

```
data.columns
```

```
Index(['Income', 'Kidhome', 'Teenhome', 'Recency', 'MntWines', 'MntFruits',
       'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
       'MntGoldProds', 'NumDealsPurchases', 'NumWebPurchases',
       'NumCatalogPurchases', 'NumStorePurchases', 'NumWebVisitsMonth',
       'AcceptedCmp3', 'AcceptedCmp4', 'AcceptedCmp5', 'AcceptedCmp1',
       'AcceptedCmp2', 'Complain', 'Z_CostContact', 'Z_Revenue', 'Response',
       'Age', 'Customer_Days', 'marital_Divorced', 'marital_Married',
       'marital_Single', 'marital_Together', 'marital_Widow',
       'education_2n Cycle', 'education_Basic', 'education_Graduation',
       'education_Master', 'education_PhD', 'MntTotal', 'MntRegularProds',
       'AcceptedCmpOverall'],
      dtype='object')
```

```
data.isna().sum()
```

```
Income                 0
Kidhome                0
Teenhome               0
Recency                0
MntWines               0
MntFruits              0
MntMeatProducts        0
MntFishProducts        0
MntSweetProducts       0
MntGoldProds           0
NumDealsPurchases      0
NumWebPurchases        0
NumCatalogPurchases    0
NumStorePurchases      0
NumWebVisitsMonth      0
AcceptedCmp3           0
AcceptedCmp4           0
AcceptedCmp5           0
AcceptedCmp1           0
AcceptedCmp2           0
Complain               0
Z_CostContact          0
Z_Revenue              0
Response               0
Age                    0
```

```
Customer_Days           0
marital_Divorced        0
marital_Married         0
marital_Single          0
marital_Together        0
marital_Widow           0
education_2n Cycle      0
education_Basic         0
education_Graduation    0
education_Master        0
education_PhD           0
MntTotal                0
MntRegularProds         0
AcceptedCmpOverall      0
dtype: int64
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2205 entries, 0 to 2204
Data columns (total 39 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   Income                2205 non-null   float64
 1   Kidhome               2205 non-null   int64
 2   Teenhome              2205 non-null   int64
 3   Recency               2205 non-null   int64
 4   MntWines              2205 non-null   int64
 5   MntFruits             2205 non-null   int64
 6   MntMeatProducts       2205 non-null   int64
 7   MntFishProducts       2205 non-null   int64
 8   MntSweetProducts      2205 non-null   int64
 9   MntGoldProds          2205 non-null   int64
 10  NumDealsPurchases     2205 non-null   int64
 11  NumWebPurchases       2205 non-null   int64
 12  NumCatalogPurchases   2205 non-null   int64
 13  NumStorePurchases     2205 non-null   int64
 14  NumWebVisitsMonth     2205 non-null   int64
 15  AcceptedCmp3          2205 non-null   int64
 16  AcceptedCmp4          2205 non-null   int64
 17  AcceptedCmp5          2205 non-null   int64
 18  AcceptedCmp1          2205 non-null   int64
 19  AcceptedCmp2          2205 non-null   int64
 20  Complain              2205 non-null   int64
 21  Z_CostContact         2205 non-null   int64
 22  Z_Revenue             2205 non-null   int64
 23  Response              2205 non-null   int64
 24  Age                   2205 non-null   int64
 25  Customer_Days         2205 non-null   int64
 26  marital_Divorced      2205 non-null   int64
 27  marital_Married       2205 non-null   int64
 28  marital_Single        2205 non-null   int64
 29  marital_Together      2205 non-null   int64
 30  marital_Widow         2205 non-null   int64
 31  education_2n Cycle    2205 non-null   int64
 32  education_Basic       2205 non-null   int64
 33  education_Graduation  2205 non-null   int64
 34  education_Master      2205 non-null   int64
 35  education_PhD         2205 non-null   int64
 36  MntTotal              2205 non-null   int64
 37  MntRegularProds       2205 non-null   int64
 38  AcceptedCmpOverall    2205 non-null   int64
dtypes: float64(1), int64(38)
memory usage: 672.0 KB
```

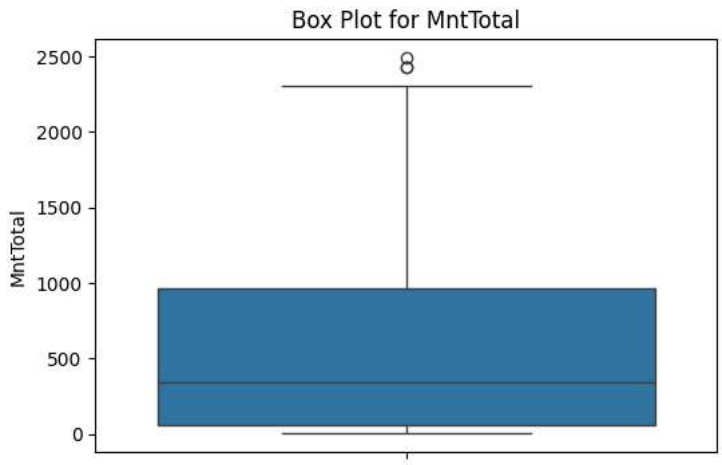
```
data.nunique()
```

```
Income                1963
Kidhome                  3
Teenhome                 3
Recency                100
MntWines               775
MntFruits              158
MntMeatProducts        551
MntFishProducts        182
MntSweetProducts       176
MntGoldProds           212
NumDealsPurchases       15
NumWebPurchases         15
NumCatalogPurchases     13
NumStorePurchases       14
NumWebVisitsMonth       16
```

```
AcceptedCmp3              2
AcceptedCmp4              2
AcceptedCmp5              2
AcceptedCmp1              2
AcceptedCmp2              2
Complain                  2
Z_CostContact             1
Z_Revenue                 1
Response                  2
Age                      56
Customer_Days           662
marital_Divorced          2
marital_Married           2
marital_Single            2
marital_Together          2
marital_Widow             2
education_2n Cycle        2
education_Basic           2
education_Graduation      2
education_Master          2
education_PhD             2
MntTotal                897
MntRegularProds         974
AcceptedCmpOverall        5
dtype: int64
```

```
data.drop(columns=['Z_CostContact','Z_Revenue'],inplace=True)
```

```
plt.figure(figsize=(6, 4))
sns.boxplot(data=data, y='MntTotal')
plt.title('Box Plot for MntTotal')
plt.ylabel('MntTotal')
plt.show()
```




```
Q1 = data['MntTotal'].quantile(0.25)
Q3 = data['MntTotal'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
outliers = data[(data['MntTotal'] < lower_bound) | (data['MntTotal'] > upper_bound)]
outliers.head()
```

	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts	MntGoldProds	...	ma
1159	90638.0	0	0	29	1156	120	915	94	144	96	...	
1467	87679.0	0	0	62	1259	172	815	97	148	33	...	
1547	90638.0	0	0	29	1156	120	915	94	144	96	...	

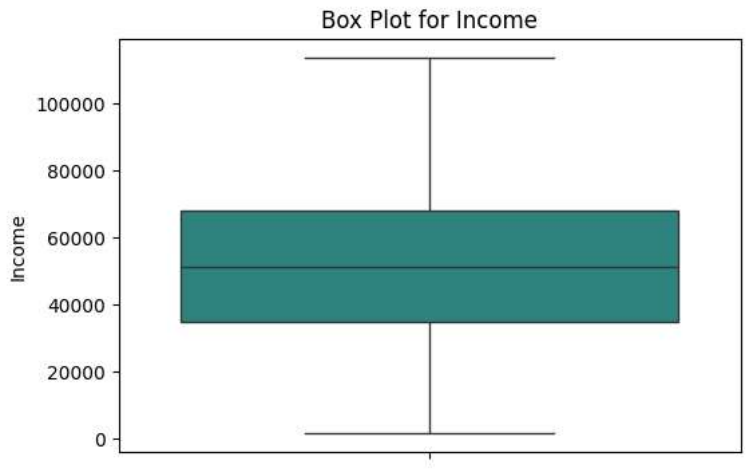
3 rows × 37 columns

```
data = data[(data['MntTotal'] > lower_bound) & (data['MntTotal'] < upper_bound)]
data.describe()
```

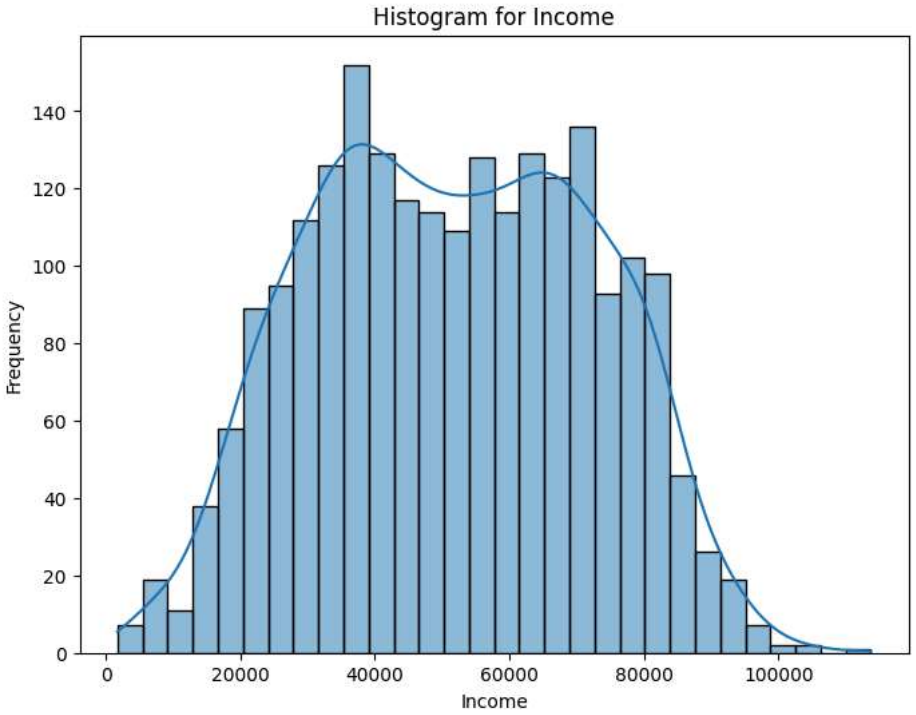
	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts
count	2202.000000	2202.000000	2202.000000	2202.000000	2202.000000	2202.000000	2202.000000	2202.000000	2202.000000
mean	51570.283379	0.442779	0.507266	49.021344	304.960036	26.252044	164.336058	37.678474	26.967302
std	20679.438848	0.537250	0.544429	28.944211	336.135586	39.589747	216.312982	54.821185	40.926101
min	1730.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	35182.500000	0.000000	0.000000	24.000000	24.000000	2.000000	16.000000	3.000000	1.000000
50%	51258.500000	0.000000	0.000000	49.000000	176.500000	8.000000	68.000000	12.000000	8.000000
75%	68146.500000	1.000000	1.000000	74.000000	505.000000	33.000000	230.750000	50.000000	33.000000
max	113734.000000	2.000000	2.000000	99.000000	1493.000000	199.000000	1725.000000	259.000000	262.000000

8 rows × 37 columns

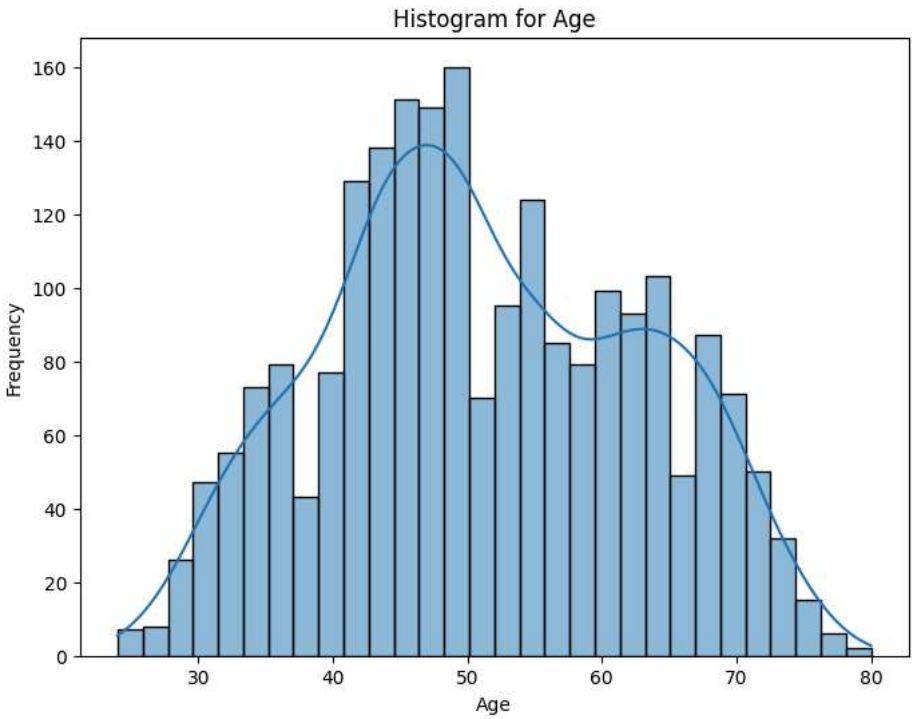
```
#Box plot and histogram for income
plt.figure(figsize=(6, 4))
sns.boxplot(data=data, y='Income', palette='viridis')
plt.title('Box Plot for Income')
plt.ylabel('Income')
plt.show()
```




```
plt.figure(figsize=(8, 6))
sns.histplot(data=data, x='Income', bins=30, kde=True)
plt.title('Histogram for Income')
plt.xlabel('Income')
plt.ylabel('Frequency')
plt.show()
```




```
#Histogram for Age
plt.figure(figsize=(8, 6))
sns.histplot(data=data, x='Age', bins=30, kde=True)
plt.title('Histogram for Age')
plt.xlabel('Age')
plt.ylabel('Frequency')
plt.show()
```

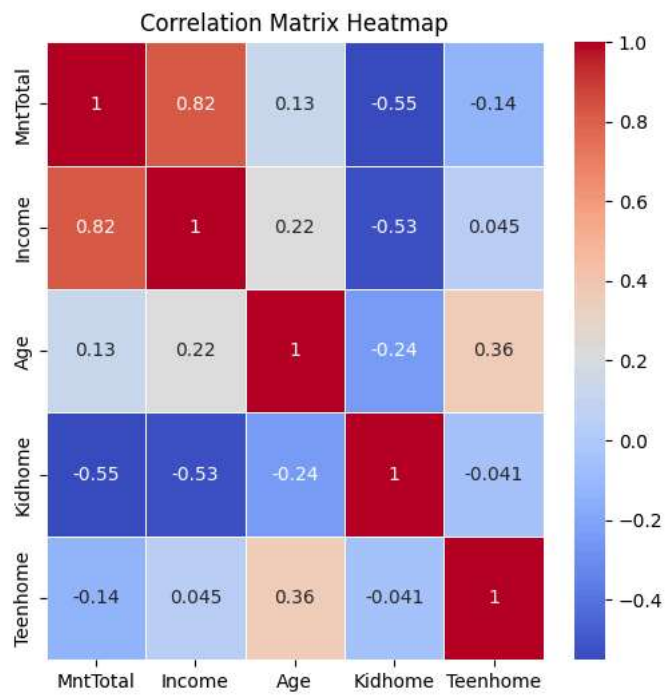



```
print("Skewness: %f" % data['Age'].skew())
print("Kurtosis: %f" % data['Age'].kurt())
```

```
Skewness: 0.091227
Kurtosis: -0.796125
```

```
cols_demographics = ['Income','Age']
cols_children = ['Kidhome', 'Teenhome']
cols_marital = ['marital_Divorced', 'marital_Married','marital_Single', 'marital_Together', 'marital_Widow']
cols_mnt = ['MntTotal', 'MntRegularProds','MntWines', 'MntFruits', 'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts', 'MntGoldProds']
cols_communication = ['Complain', 'Response', 'Customer_Days']
cols_campaigns = ['AcceptedCmpOverall', 'AcceptedCmp1', 'AcceptedCmp2', 'AcceptedCmp3', 'AcceptedCmp4', 'AcceptedCmp5']
cols_source_of_purchase = ['NumDealsPurchases', 'NumWebPurchases','NumCatalogPurchases', 'NumStorePurchases', 'NumWebVisitsMonth']
cols_education = ['education_2n Cycle', 'education_Basic', 'education_Graduation', 'education_Master', 'education_PhD']
```

```
corr_matrix = data[['MntTotal']+cols_demographics+cols_children].corr()
plt.figure(figsize=(6,6))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', linewidths=0.5)
plt.title('Correlation Matrix Heatmap')
plt.show()
```




```
for col in cols_marital:
    correlation, p_value = pointbiserialr(data[col], data['MntTotal'])
    print(f'{correlation:.4f}: Point-Biserial Correlation for {col} with p-value {p_value:.4f}')
```

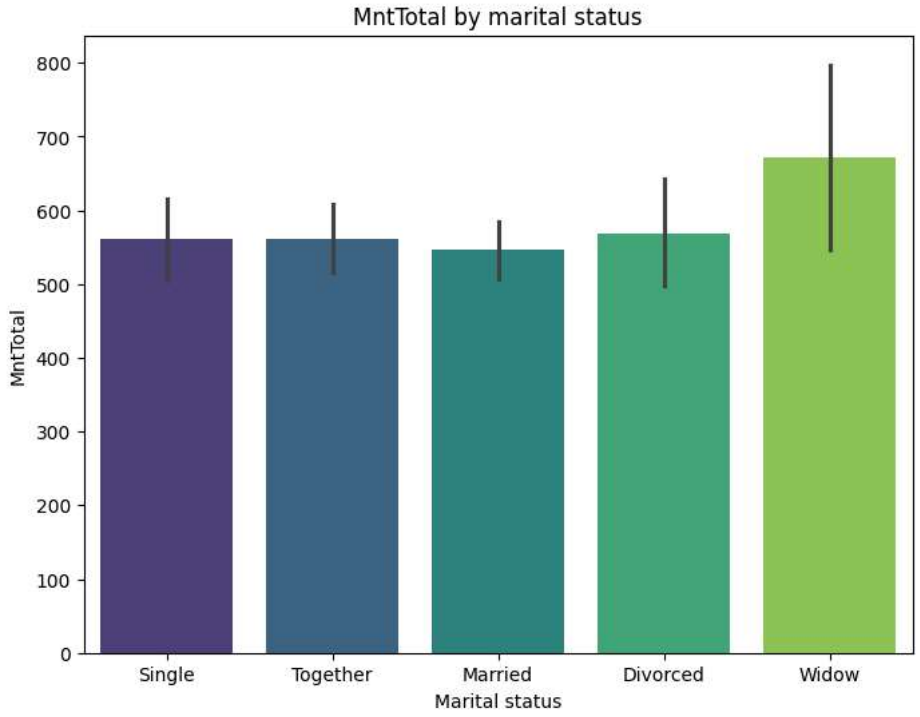
```
 0.0053: Point-Biserial Correlation for marital_Divorced with p-value 0.8041
 -0.0188: Point-Biserial Correlation for marital_Married with p-value 0.3767
 0.0011: Point-Biserial Correlation for marital_Single with p-value 0.9571
 0.0008: Point-Biserial Correlation for marital_Together with p-value 0.9708
 0.0370: Point-Biserial Correlation for marital_Widow with p-value 0.0826
```

```
for col in cols_education:
    correlation, p_value = pointbiserialr(data[col], data['MntTotal'])
    print(f'{correlation:.4f}: Point-Biserial Correlation for {col} with p-value {p_value:.4f}')
```

```
 -0.0593: Point-Biserial Correlation for education_2n Cycle with p-value 0.0054
 -0.1389: Point-Biserial Correlation for education_Basic with p-value 0.0000
 0.0159: Point-Biserial Correlation for education_Graduation with p-value 0.4551
 0.0004: Point-Biserial Correlation for education_Master with p-value 0.9842
 0.0737: Point-Biserial Correlation for education_PhD with p-value 0.0005
```

```
def get_marital_status(row):
    if row['marital_Divorced'] == 1:
        return 'Divorced'
    elif row['marital_Married'] == 1:
        return 'Married'
    elif row['marital_Single'] == 1:
        return 'Single'
    elif row['marital_Together'] == 1:
        return 'Together'
    elif row['marital_Widow'] == 1:
        return 'Widow'
    else:
        return 'Unknown'
data['Marital'] = data.apply(get_marital_status, axis=1)


plt.figure(figsize=(8, 6))
sns.barplot(x='Marital', y='MntTotal', data=data, palette='viridis')
plt.title('MntTotal by marital status')
plt.xlabel('Marital status')
plt.ylabel('MntTotal')
```

```
Text(0, 0.5, 'MntTotal')
```




```
def get_relationship(row):
    if row['marital_Married'] ==1:
        return 1
    elif row['marital_Together'] == 1:
        return 1
    else:
        return 0
data['In_relationship'] = data.apply(get_relationship, axis=1)
data.head()
```

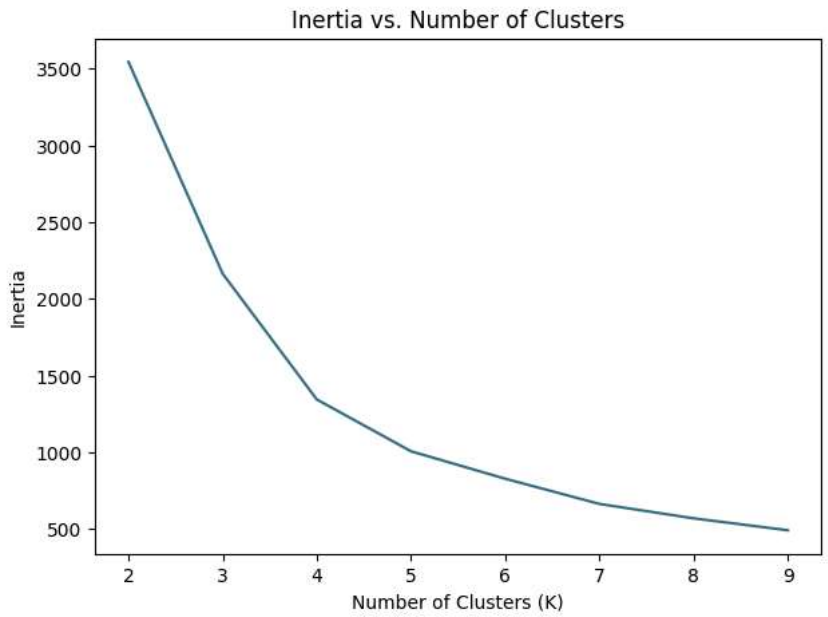
	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts	MntGoldProds	...	educa
0	58138.0	0	0	58	635	88	546	172	88	88	...	
1	46344.0	1	1	38	11	1	6	2	1	6	...	
2	71613.0	0	0	26	426	49	127	111	21	42	...	
3	26646.0	1	0	26	11	4	20	10	3	5	...	
4	58293.0	1	0	94	173	43	118	46	27	15	...	

5 rows × 39 columns

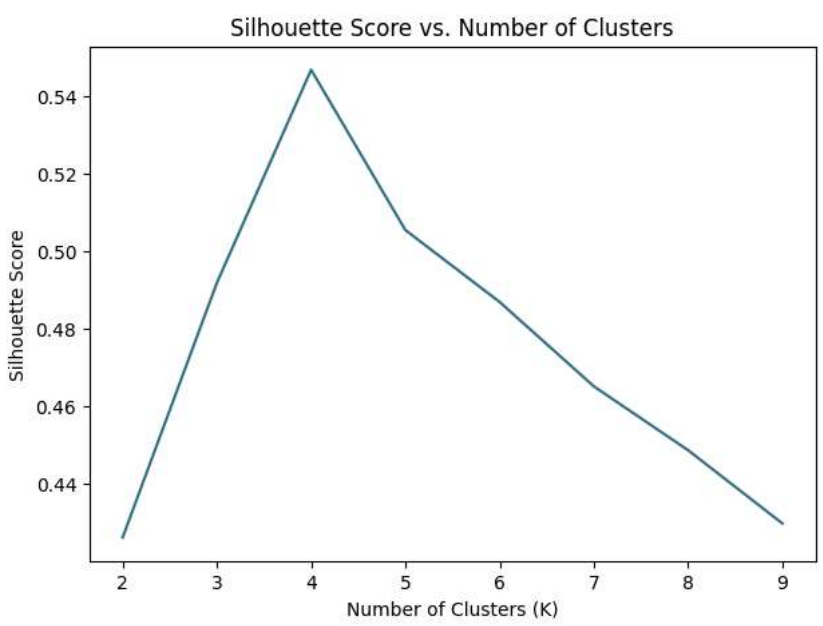
```
from sklearn.cluster import KMeans


from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
cols_for_clustering = ['Income', 'MntTotal', 'In_relationship']
data_scaled = data.copy()
data_scaled[cols_for_clustering] = scaler.fit_transform(data[cols_for_clustering])
data_scaled[cols_for_clustering].describe()
```

	Income	MntTotal	In_relationship
count	2.202000e+03	2.202000e+03	2.202000e+03
mean	2.742785e-17	-8.873717e-17	-4.678869e-17
std	1.000227e+00	1.000227e+00	1.000227e+00
min	-2.410685e+00	-9.724232e-01	-1.348874e+00
25%	-7.926475e-01	-8.815089e-01	-1.348874e+00
50%	-1.508040e-02	-3.806058e-01	7.413589e-01
75%	8.017617e-01	7.024988e-01	7.413589e-01
max	3.006747e+00	3.048788e+00	7.413589e-01

```
from sklearn import decomposition
pca = decomposition.PCA(n_components = 2)
pca_res = pca.fit_transform(data_scaled[cols_for_clustering])
data_scaled['pc1'] = pca_res[:,0]
data_scaled['pc2'] = pca_res[:,1]
X = data_scaled[cols_for_clustering]
inertia_list = []
for K in range(2,10):
    inertia = KMeans(n_clusters=K, random_state=7).fit(X).inertia_
    inertia_list.append(inertia)


plt.figure(figsize=[7,5])
plt.plot(range(2,10), inertia_list, color=(54 / 255, 113 / 255, 130 / 255))
plt.title("Inertia vs. Number of Clusters")
plt.xlabel("Number of Clusters (K)")
plt.ylabel("Inertia")
plt.show()
```

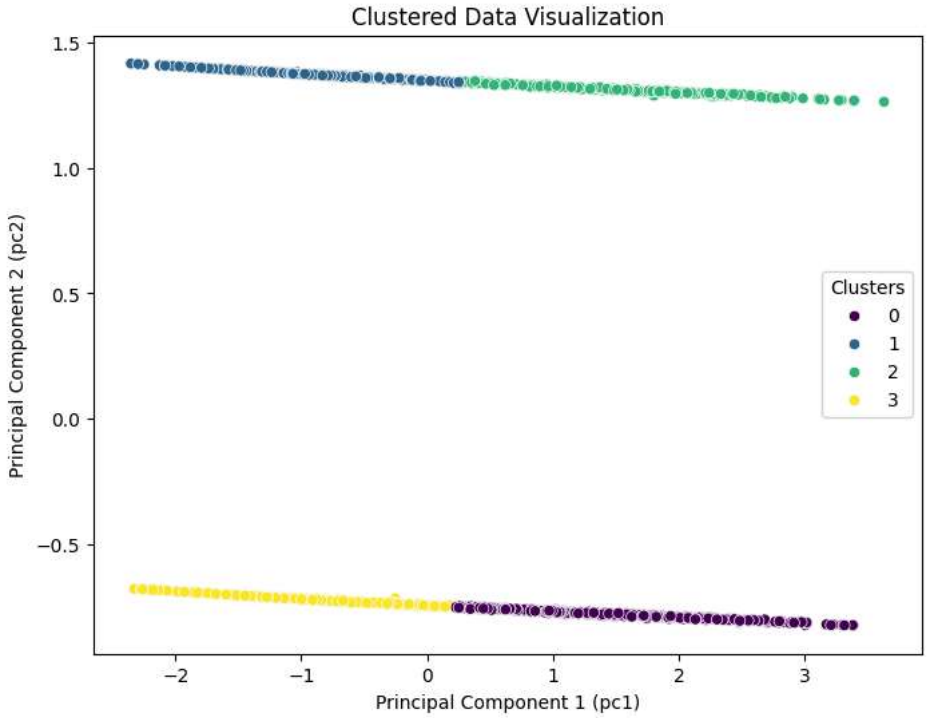


```
from sklearn.metrics import silhouette_score
silhouette_list = []
for K in range(2,10):
    model = KMeans(n_clusters = K, random_state=7)
    clusters = model.fit_predict(X)
    s_avg = silhouette_score(X, clusters)
    silhouette_list.append(s_avg)

plt.figure(figsize=[7,5])
plt.plot(range(2,10), silhouette_list, color=(54 / 255, 113 / 255, 130 / 255))
plt.title("Silhouette Score vs. Number of Clusters")
plt.xlabel("Number of Clusters (K)")
plt.ylabel("Silhouette Score")
plt.show()
```




```
model = KMeans(n_clusters=4, random_state = 7)
model.fit(data_scaled[cols_for_clustering])
data_scaled['Cluster'] = model.predict(data_scaled[cols_for_clustering])

plt.figure(figsize=(8, 6))
sns.scatterplot(x='pc1', y='pc2', data=data_scaled, hue='Cluster', palette='viridis')
plt.title('Clustered Data Visualization')
plt.xlabel('Principal Component 1 (pc1)')
plt.ylabel('Principal Component 2 (pc2)')
plt.legend(title='Clusters')
```

```
<matplotlib.legend.Legend at 0x79fc9b13f490>
```



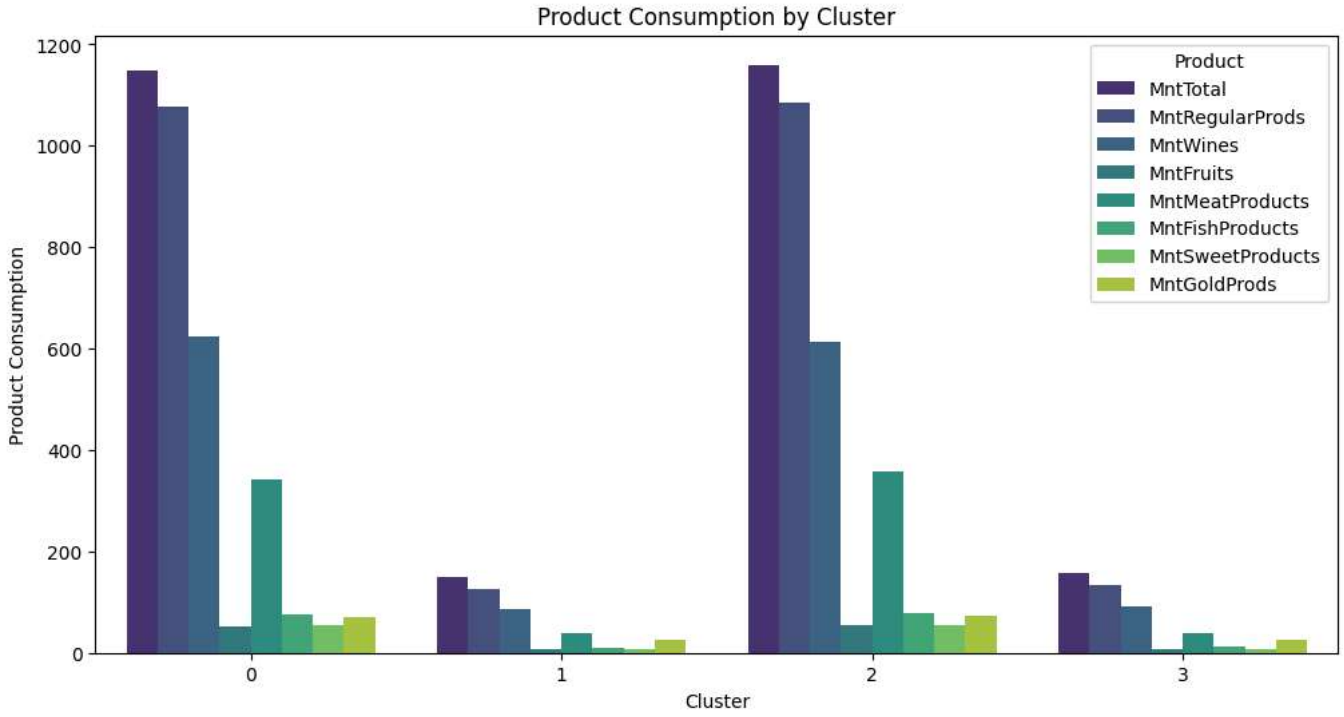

```
data['Cluster'] = data_scaled.Cluster
data.groupby('Cluster')[cols_for_clustering].mean()
```

Cluster	Income	MntTotal	In_relationship
0	71818.929329	1147.372792	1.0
1	37332.339956	150.761589	0.0
2	71946.155488	1159.612805	0.0
3	37892.819883	158.463158	1.0

```
mnt_data = data.groupby('Cluster')[cols_mnt].mean().reset_index()
mnt_data.head()
```

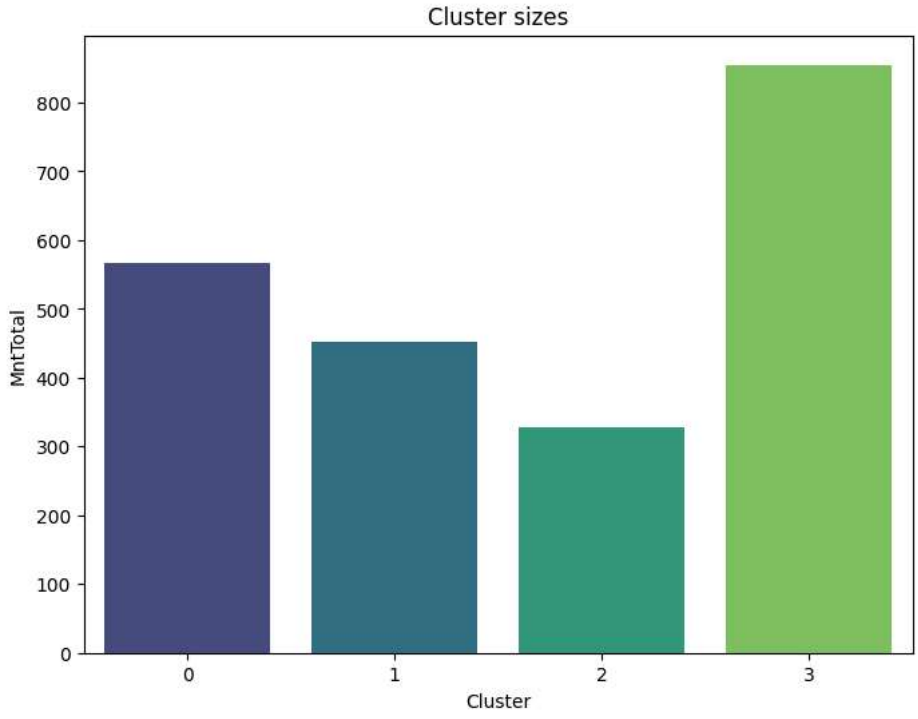
	Cluster	MntTotal	MntRegularProds	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts	MntGoldProds
0	0	1147.372792	1076.279152	623.261484	52.489399	341.326855	75.577739	54.717314	71.093640
1	1	150.761589	125.662252	85.450331	7.832230	38.774834	10.971302	7.732892	25.099338
2	2	1159.612805	1085.332317	613.862805	54.929878	357.902439	77.603659	55.314024	74.280488
3	3	158.463158	133.962573	92.046784	7.640936	39.438596	11.423392	7.913450	24.500585

```
melted_data = pd.melt(mnt_data, id_vars="Cluster", var_name="Product", value_name="Consumption")
plt.figure(figsize=(12, 6))
sns.barplot(x="Cluster", y="Consumption", hue="Product", data=melted_data, ci=None, palette="viridis")
plt.title("Product Consumption by Cluster")
plt.xlabel("Cluster")
plt.ylabel("Product Consumption")
plt.xticks(rotation=0)
plt.legend(title="Product", loc="upper right")

plt.show()
```




```
cluster_sizes = data.groupby('Cluster')[['MntTotal']].count().reset_index()
plt.figure(figsize=(8,6))
sns.barplot(x='Cluster', y='MntTotal', data=cluster_sizes, palette = 'viridis')
plt.title('Cluster sizes')
plt.xlabel('Cluster')
plt.ylabel('MntTotal')
```

```
Text(0, 0.5, 'MntTotal')
```

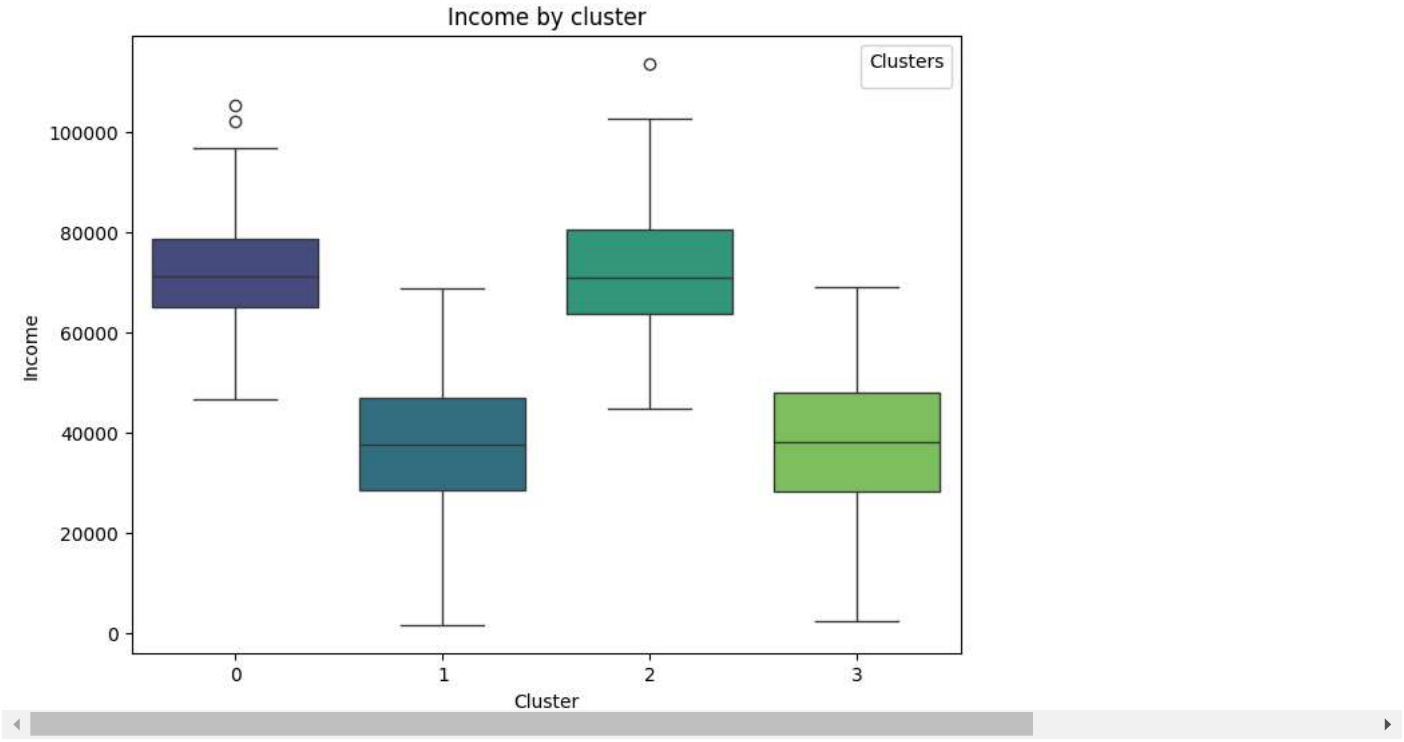



```
total_rows = len(data)
cluster_sizes['Share%'] = round(cluster_sizes['MntTotal'] / total_rows*100,0)
cluster_sizes.head()
```

	Cluster	MntTotal	Share%
0	0	566	26.0
1	1	453	21.0

```
plt.figure(figsize=(8, 6))
sns.boxplot(x='Cluster', y='Income', data=data, palette='viridis')
plt.title('Income by cluster')
plt.xlabel('Cluster')
plt.ylabel('Income')
plt.legend(title='Clusters')
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that artists whose label start with an underscore are igr
<matplotlib.legend.Legend at 0x79fc983a6980>
```




```
plt.figure(figsize=(8, 6))
sns.scatterplot(x='Income', y='MntTotal', data=data, hue = 'Cluster', palette='viridis')
plt.title('Income by cluster')
plt.xlabel('Income')
plt.ylabel('MntTotal')
plt.legend(title='Clusters')
```

```
<matplotlib.legend.Legend at 0x79fc98fdfac0>
```