Assignment 5

Market Basket Magic: Extracting Insights for Retail Success

Hritik Kumar --21BCE7815

In [176…

```
# Import necessary libraries
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
```

In [177…

```
# Loading my dataset
df = pd.read_csv('Mall_Customers.csv')
```

In [178…

```
# Display basic information about the dataset
print("Basic Info about the Dataset:")
print(df.info())
```

```
Basic Info about the Dataset:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype 
---  ------                  --------------  ----- 
 0   CustomerID              200 non-null    int64 
 1   Gender                  200 non-null    object
 2   Age                     200 non-null    int64 
 3   Annual Income (k$)      200 non-null    int64 
 4   Spending Score (1-100)  200 non-null    int64 
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
None
```

In [179…

```
print("Shape of the Dataset:")
df.shape
```

```
Shape of the Dataset:
```

Out[179]:

```
(200, 5)
```

In [180…

```
# Display summary statistics of numerical columns
print("\nSummary Statistics:")
print(df.describe())
```

```
Summary Statistics:
       CustomerID         Age  Annual Income (k$)  Spending Score (1-100)
count  200.000000  200.000000          200.000000              200.000000
mean   100.500000   38.850000           60.560000               50.200000
std     57.879185   13.969007           26.264721               25.823522
min      1.000000   18.000000           15.000000                1.000000
25%     50.750000   28.750000           41.500000               34.750000
50%    100.500000   36.000000           61.500000               50.000000
75%    150.250000   49.000000           78.000000               73.000000
max    200.000000   70.000000          137.000000               99.000000
```

In [181…

```
# Display the first few rows of the dataset
print("\nSample Data:")
print(df.head())
```

```
Sample Data:
   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
```

In [182…

```
# Check for missing values
print("\nMissing Values:")
print(df.isnull().sum())
```

```
Missing Values:
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [183…

```
df.isnull().any()
```

Out[183]:

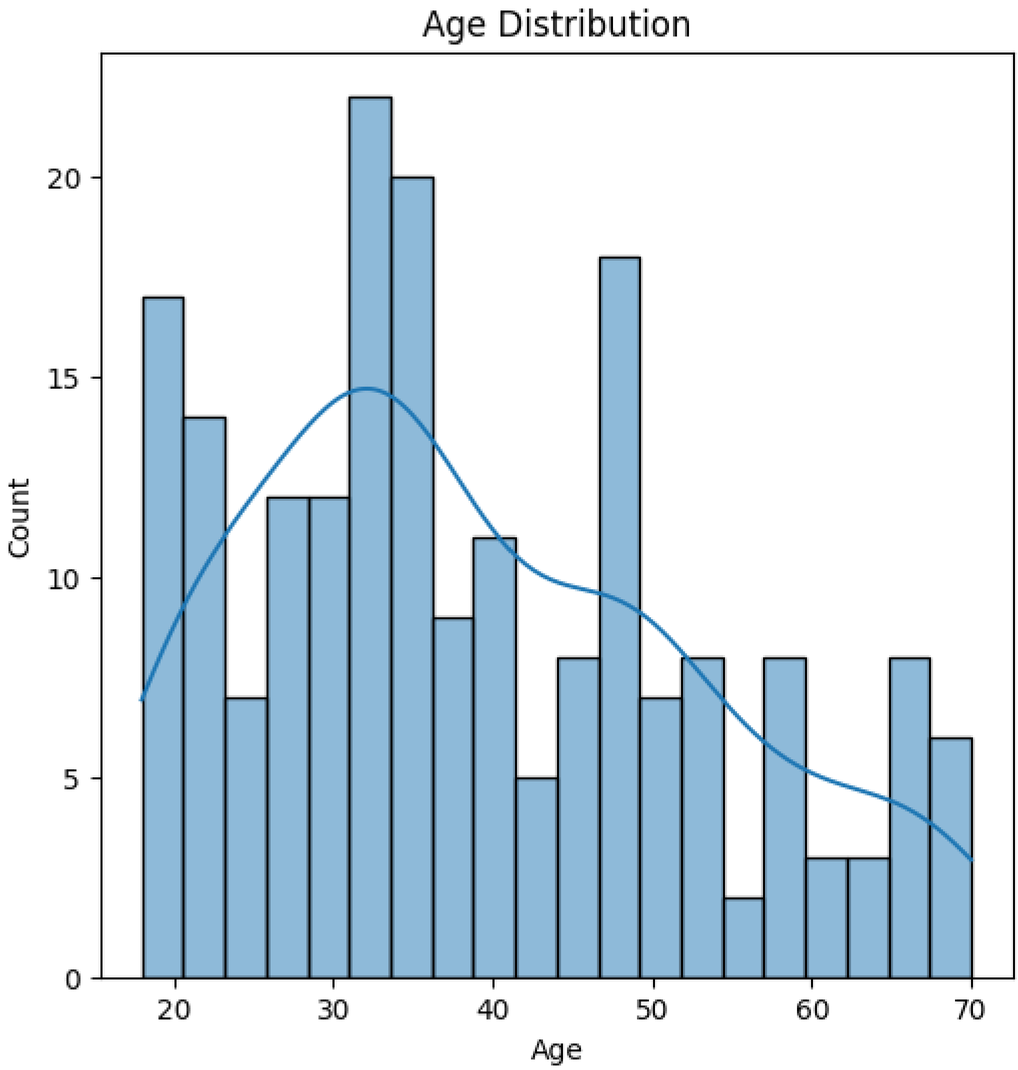
```
CustomerID                False
Gender                    False
Age                       False
Annual Income (k$)        False
Spending Score (1-100)    False
dtype: bool
```

In [184…

```
# Visualize the distribution of numerical columns
plt.figure(figsize=(20, 6))
plt.subplot(1, 3, 1)
sns.histplot(df['Age'], bins=20, kde=True)
plt.title('Age Distribution')
plt.xlabel('Age')
```

Out[184]:

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

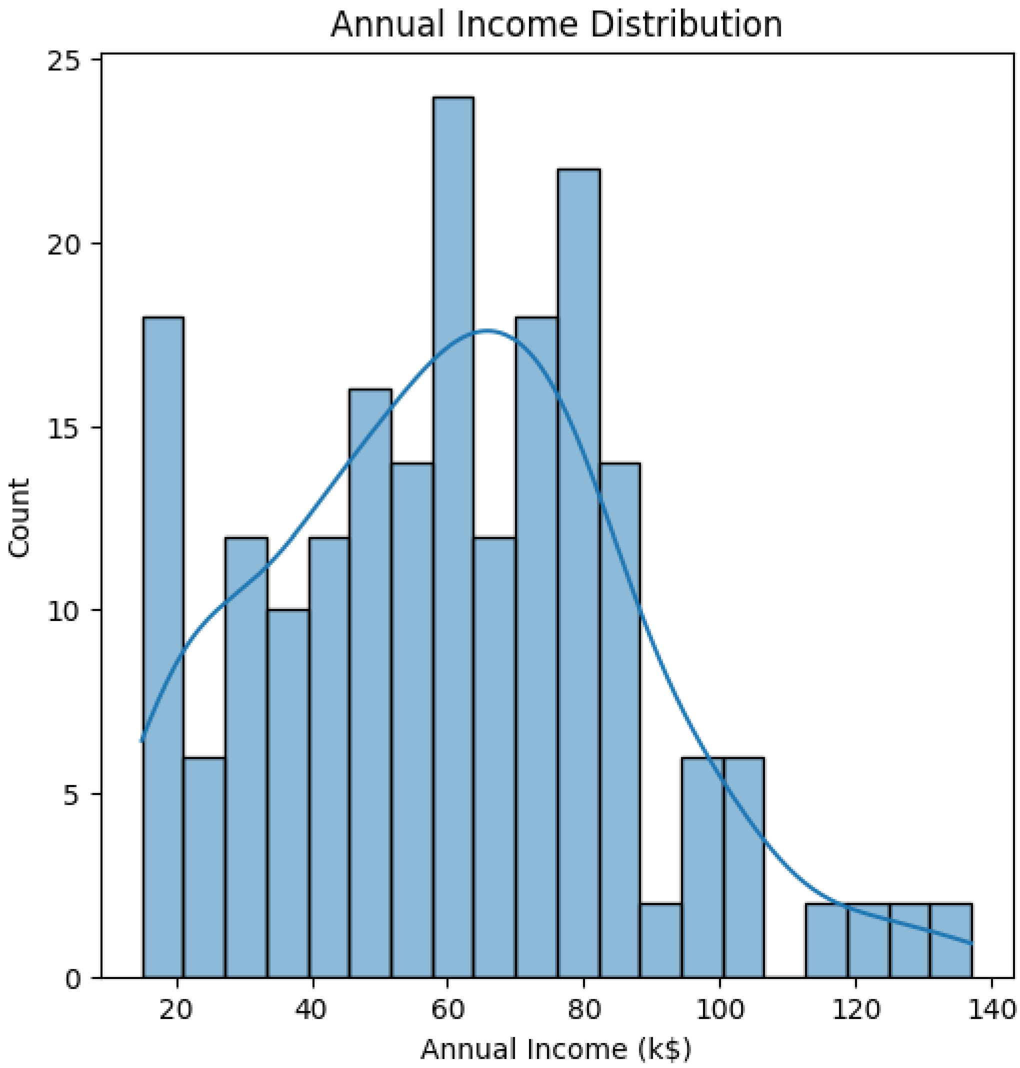


In [185…

```
plt.figure(figsize=(20, 6))

plt.subplot(1, 3, 2)
sns.histplot(df['Annual Income (k$)'], bins=20, kde=True)
plt.title('Annual Income Distribution')
plt.xlabel('Annual Income (k$)')
```

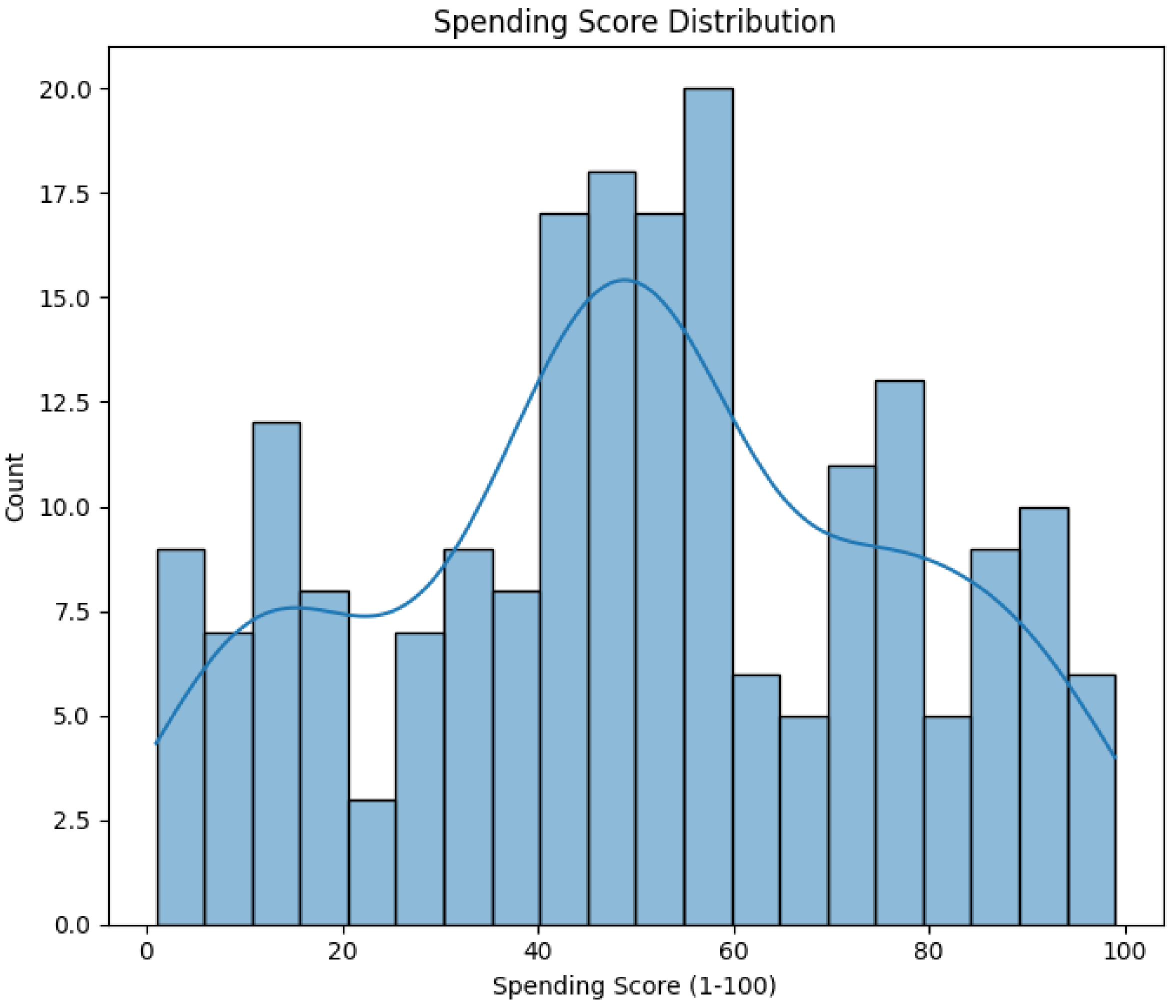
Out[185]:

```
Text(0.5, 0, 'Annual Income (k$)')
```



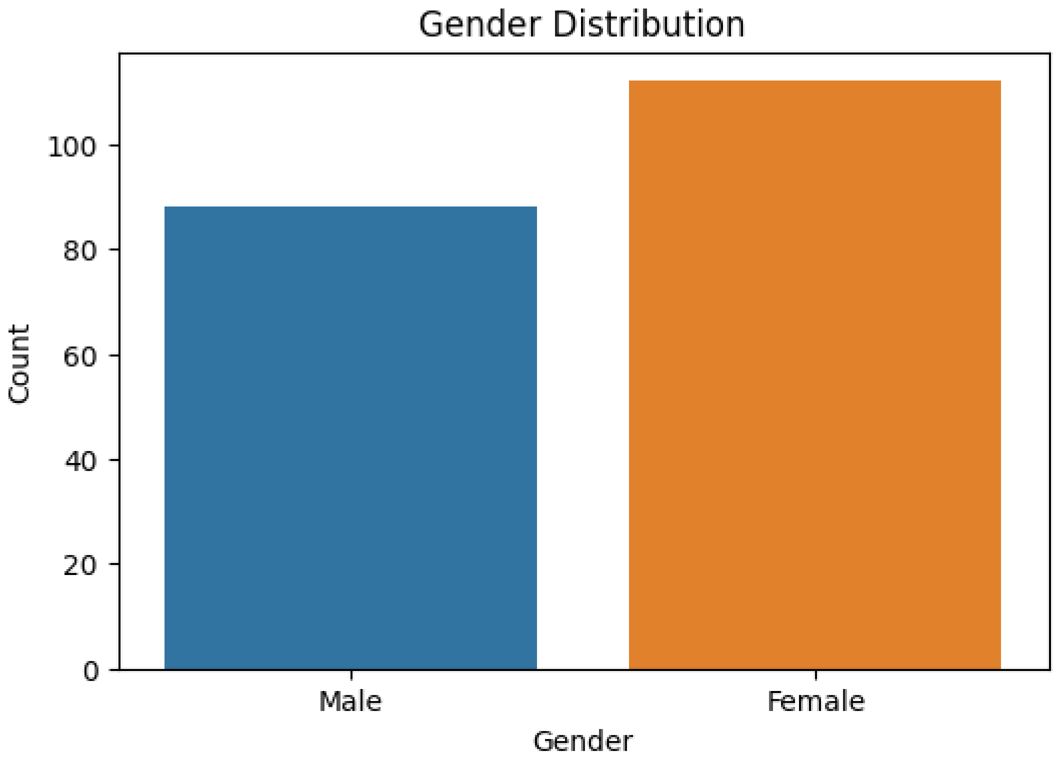
In [186…

```
plt.figure(figsize=(20, 6))

plt.subplot(1, 3, 3)
sns.histplot(df['Spending Score (1-100)'], bins=20, kde=True)
plt.title('Spending Score Distribution')
plt.xlabel('Spending Score (1-100)')

plt.tight_layout()
plt.show()
```



In [187…

```
# Visualize categorical data (e.g., Gender) using a countplot
plt.figure(figsize=(6, 4))
sns.countplot(data=df, x='Gender')
plt.title('Gender Distribution')
plt.xlabel('Gender')
plt.ylabel('Count')
plt.show()
```



In [188…

```
# Encode categorical features (e.g., Gender) using LabelEncoder
le =LabelEncoder()

df.Gender = le.fit_transform(df.Gender)

df.head()

df.describe()
```

Out[188]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000	200.000000
mean	100.500000	0.440000	38.850000	60.560000	50.200000
std	57.879185	0.497633	13.969007	26.264721	25.823522
min	1.000000	0.000000	18.000000	15.000000	1.000000
25%	50.750000	0.000000	28.750000	41.500000	34.750000
50%	100.500000	0.000000	36.000000	61.500000	50.000000
75%	150.250000	1.000000	49.000000	78.000000	73.000000
max	200.000000	1.000000	70.000000	137.000000	99.000000

In [189…

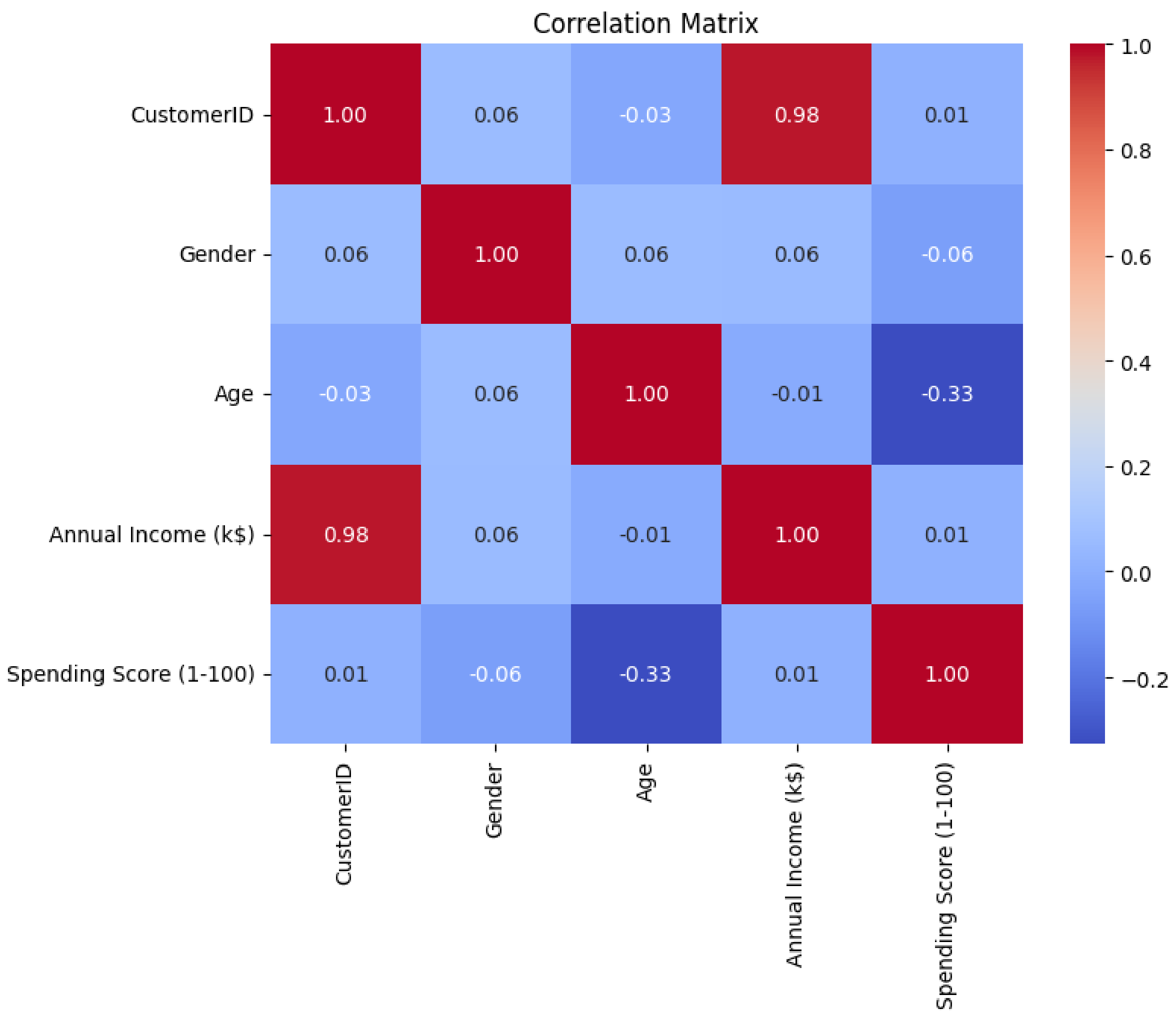
```
# Check unique values and value counts for categorical columns
print("\nUnique Values and Value Counts for Gender:")
print(df['Gender'].value_counts())
```

```
Unique Values and Value Counts for Gender:
0    112
1     88
Name: Gender, dtype: int64
```

In [190…

```
# Explore correlations between numerical features
correlation_matrix = df.corr()
plt.figure(figsize=(8, 6))
```

```
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix')
plt.show()
```



In [191…

```
# Standardize numerical features
scaler = StandardScaler()
df[['Age', 'Annual Income (k$)', 'Spending Score (1-100)']] = scaler.fit_transform(

# Encode categorical features (e.g., Gender) using one-hot encoding
df = pd.get_dummies(df, columns=['Gender'], prefix=['Gender'])

# Check the updated DataFrame
print("\nPreprocessed Data:")
print(df.head())
```

```
Preprocessed Data:
   CustomerID       Age  Annual Income (k$)  Spending Score (1-100)  Gender_0  \
0           1 -1.424569           -1.738999               -0.434801         0
1           2 -1.281035           -1.738999                1.195704         0
2           3 -1.352802           -1.700830               -1.715913         1
3           4 -1.137502           -1.700830                1.040418         1
4           5 -0.563369           -1.662660               -0.395980         1

   Gender_1
0         1
1         1
2         0
3         0
4         0
```

In [192…

```
# Select the features for clustering
X = df[['Age', 'Annual Income (k$)', 'Spending Score (1-100)']]
```

```python
# Choose a range of values for the number of clusters (k)
k_values = range(2, 11)  # Try cluster counts from 2 to 10

# Lists to store silhouette scores and inertia values
silhouette_scores = []
inertia_values = []

# Iterate through different values of k and calculate metrics
for k in k_values:
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(X)

    # Silhouette Score measures cluster separation and cohesion
    silhouette_scores.append(silhouette_score(X, kmeans.labels_))

    # Inertia measures within-cluster sum of squares
    inertia_values.append(kmeans.inertia_)

# Plot Silhouette Score
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(k_values, silhouette_scores, marker='o', linestyle='-')
plt.title('Silhouette Score vs. Number of Clusters')
plt.xlabel('Number of Clusters (k)')
plt.ylabel('Silhouette Score')
plt.grid()

# Plot Inertia
plt.subplot(1, 2, 2)
plt.plot(k_values, inertia_values, marker='o', linestyle='-')
plt.title('Inertia vs. Number of Clusters')
plt.xlabel('Number of Clusters (k)')
plt.ylabel('Inertia')
plt.grid()

plt.tight_layout()
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
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```

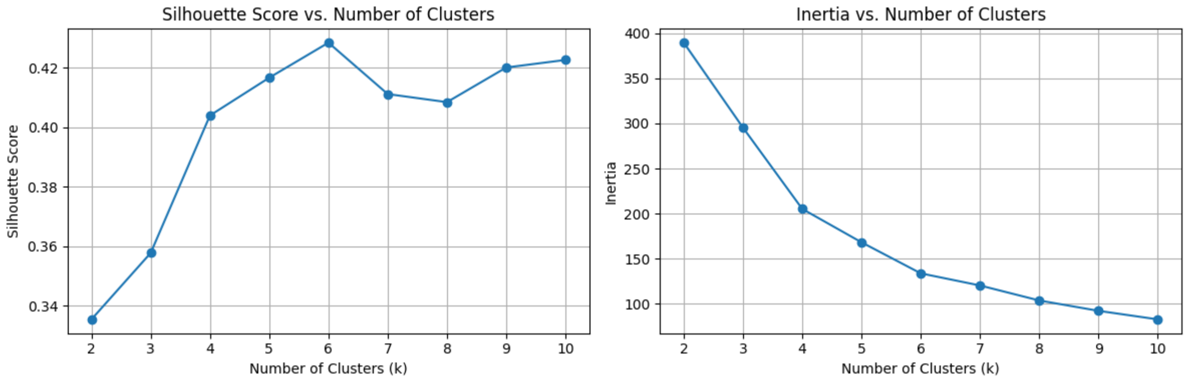

In [193…

```python
# Determine the number of clusters using the Elbow Method
wcss = []  # Within-Cluster-Sum-of-Squares

for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, init='k-means++', random_state=42)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)

# Plot the Elbow Method graph
plt.plot(range(1, 11), wcss)
plt.title('Elbow Method for Optimal Number of Clusters')
plt.xlabel('Number of Clusters')
plt.ylabel('WCSS (Within-Cluster-Sum-of-Squares)')
plt.show()
```

```
# Based on the Elbow Method, choose 5 clusters

# Initialize and fit the K-Means model with 5 clusters
kmeans = KMeans(n_clusters=5, init='k-means++', random_state=42)
df['Cluster'] = kmeans.fit_predict(X)

# Separate data points for each cluster
clusters = []
for cluster_num in range(5):
    clusters.append(df[df['Cluster'] == cluster_num])

# Plot the clusters
plt.figure(figsize=(10, 6))
for i, cluster_df in enumerate(clusters):
    plt.scatter(cluster_df['Annual Income (k$)'], cluster_df['Spending Score (1-10
                label=f'Cluster {i}', s=50)

# Plot cluster centers
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s=300, c
plt.title('Customer Segmentation')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn
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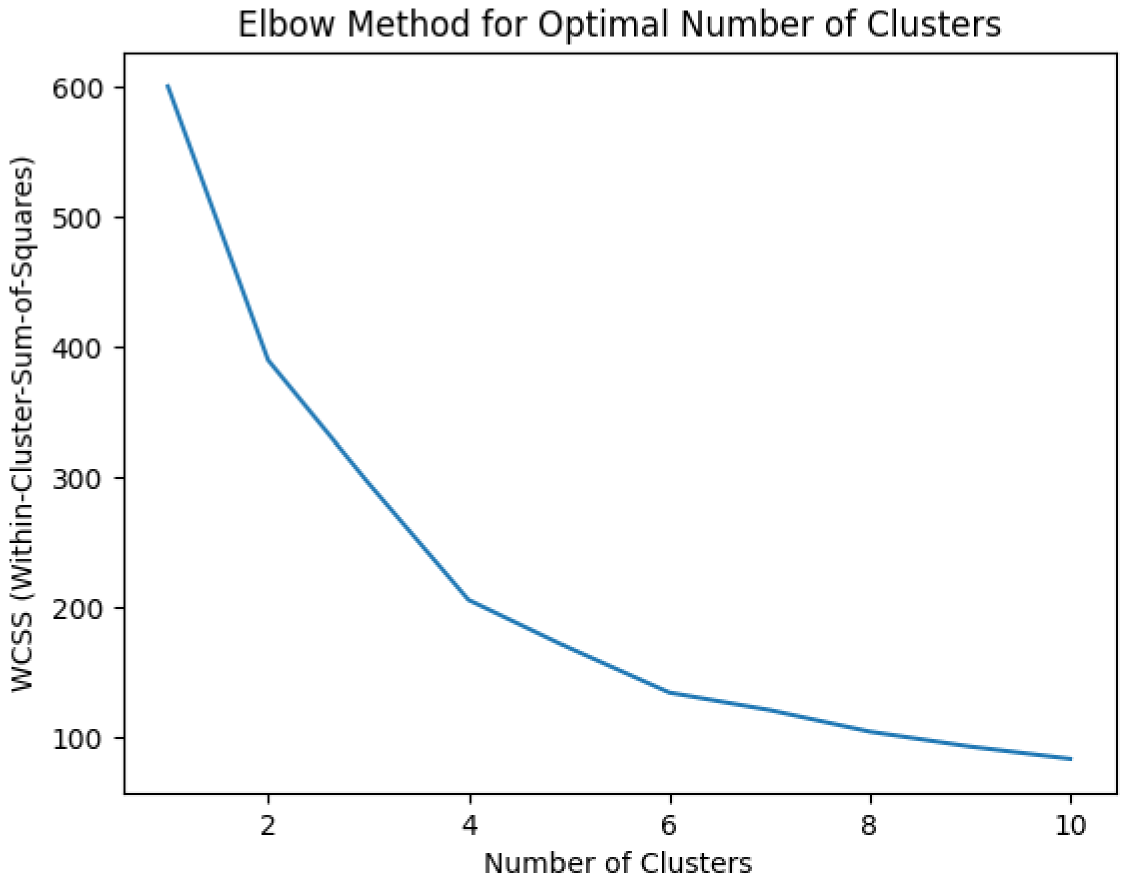


```
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