"Unveiling Mall Customer Segmentation: A Clustering Analysis Approach."

Importing Libraries

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.cluster import KMeans

import warnings
warnings.filterwarnings("ignore")
```

Reading the Data

Data is available in CSV file

```
df = pd.read_csv('Mall_Customers.csv')

df.columns
```

```
Index(['CustomerID', 'Genre', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

```
# Total rows and columns
df.shape
```

```
(200, 5)
```

```
df.head()
```

```
   CustomerID   Genre  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
```

Variable Identification

```
df.describe()
```

```
       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
```

```
df.info()
```

```
<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   Genre                   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
```

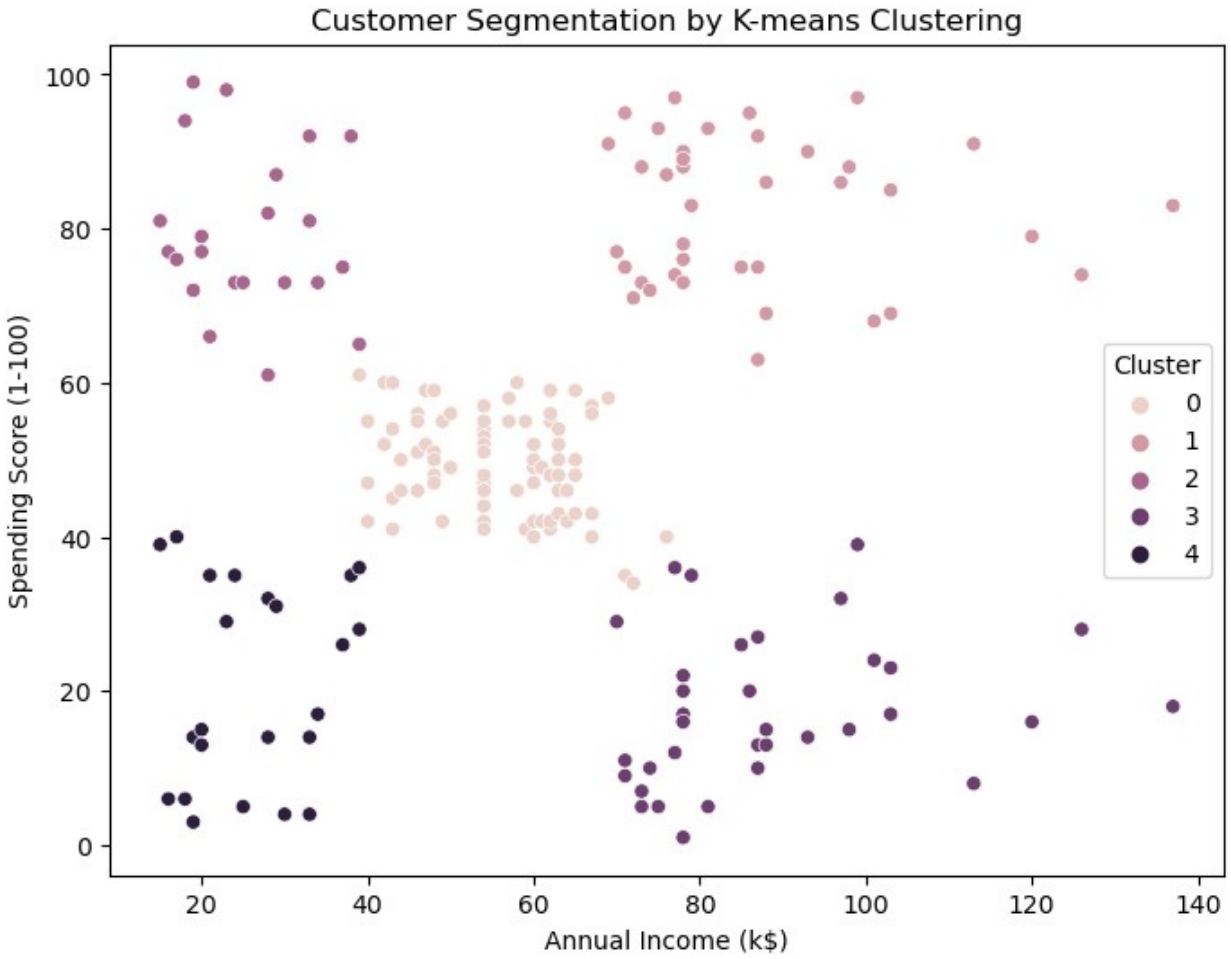
```
# Finding Null Values
print(df.isnull().sum())
```

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

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

# Choosing the number of clusters
num_clusters = 5

# Creating an instance of the K-means model
kmeans = KMeans(n_clusters=num_clusters, random_state=42)

# Fitting the model to the data
kmeans.fit(features)
```

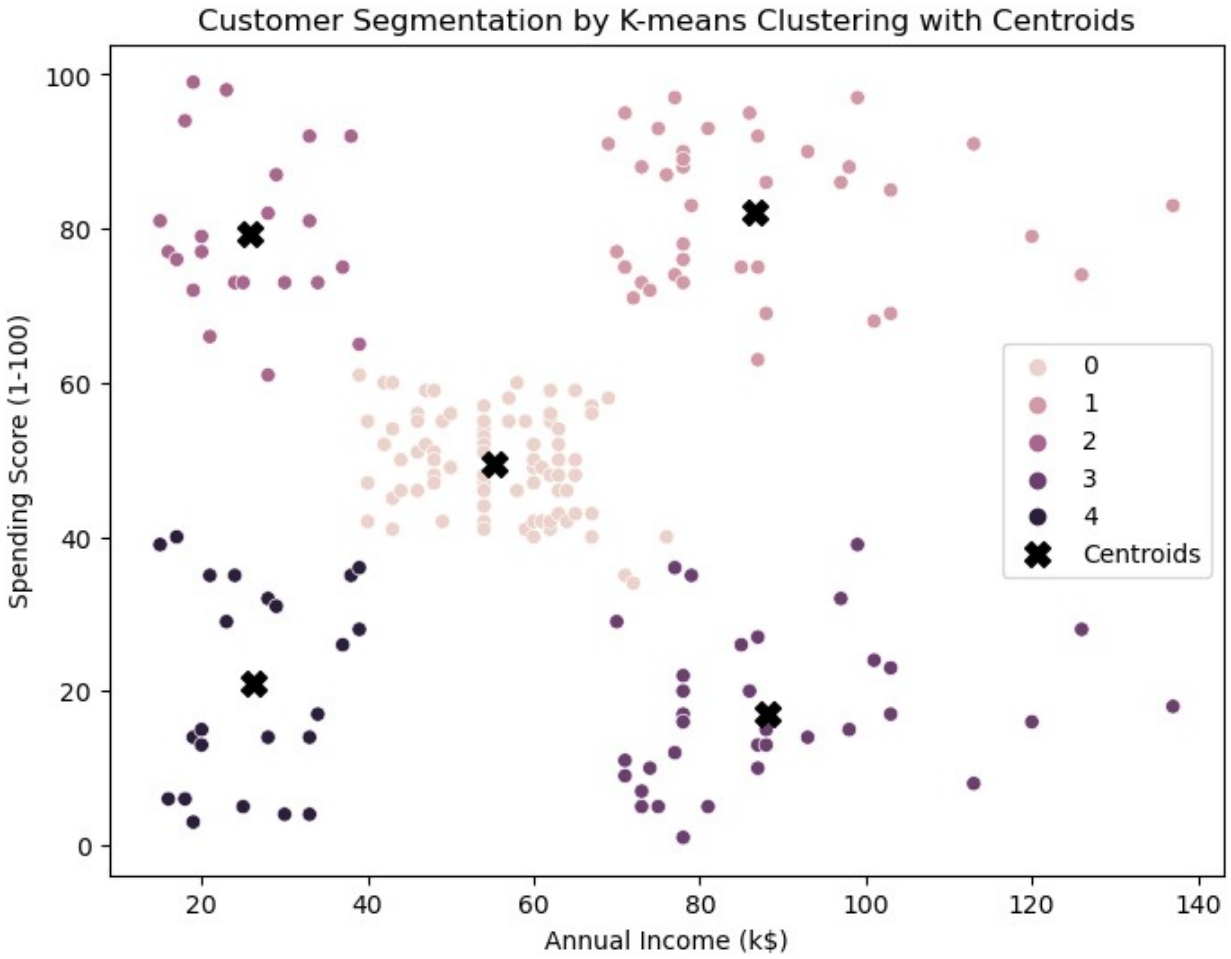
```
KMeans(n_clusters=5, random_state=42)
```

```
# Getting the cluster labels for each data point
cluster_labels = kmeans.labels_

# Adding the cluster labels to the original dataset
df['Cluster'] = cluster_labels

# Visualizing the clusters
plt.figure(figsize=(8, 6))
sns.scatterplot(x='Annual Income (k$)', y='Spending Score (1-100)',
hue='Cluster', data=df)
plt.title('Customer Segmentation by K-means Clustering')
plt.show()
```



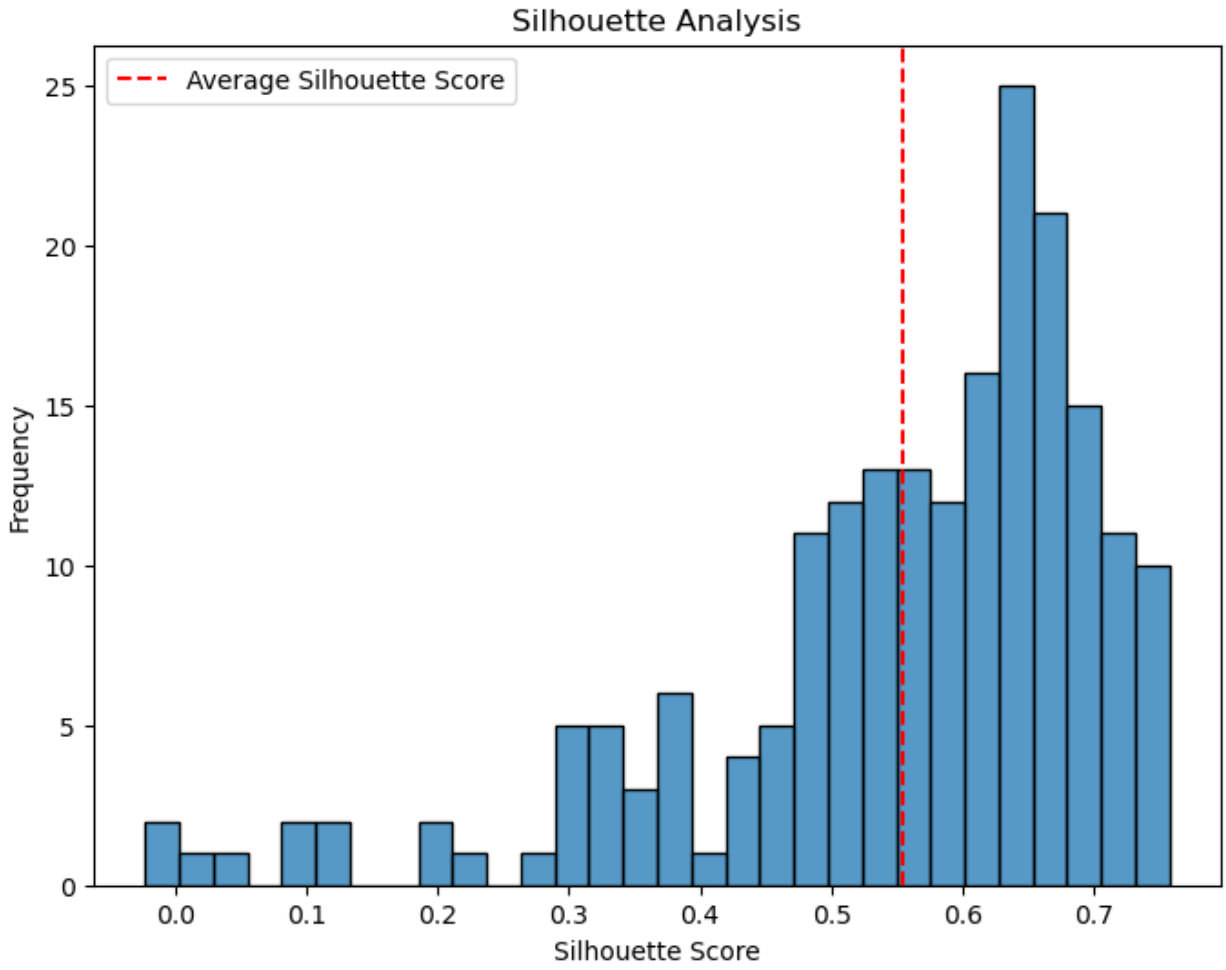
Cluster Centroids:

```
centroids = kmeans.cluster_centers_

plt.figure(figsize=(8, 6))
sns.scatterplot(x='Annual Income (k$)', y='Spending Score (1-100)',
hue='Cluster', data=df)
plt.scatter(centroids[:, 0], centroids[:, 1], marker='X', s=100,
color='black', label='Centroids')
plt.title('Customer Segmentation by K-means Clustering with
Centroids')
plt.legend()
plt.show()
```



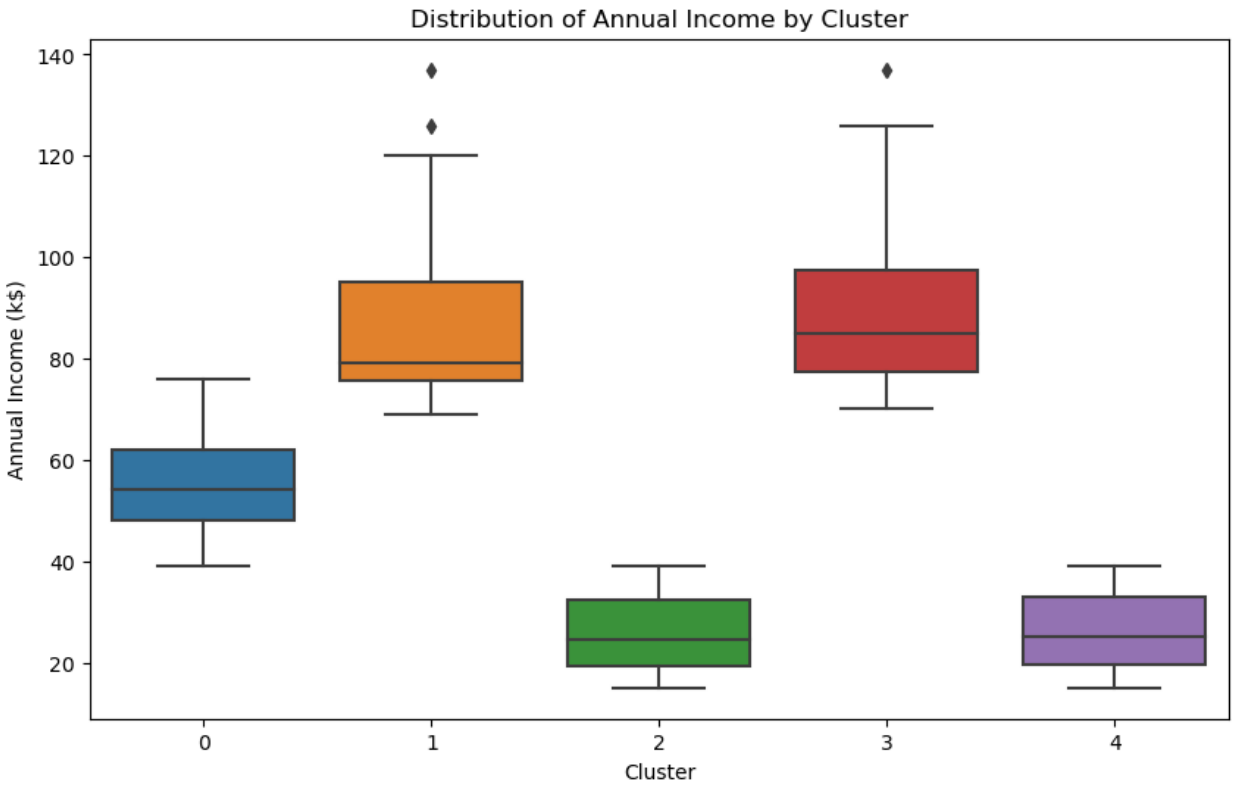
Cluster Silhouette Analysis:

```
from sklearn.metrics import silhouette_samples, silhouette_score

silhouette_vals = silhouette_samples(features, cluster_labels)
silhouette_avg = silhouette_score(features, cluster_labels)

plt.figure(figsize=(8, 6))
sns.histplot(silhouette_vals, bins=30)
plt.axvline(x=silhouette_avg, color='red', linestyle='--',
label='Average Silhouette Score')
plt.title('Silhouette Analysis')
plt.xlabel('Silhouette Score')
plt.ylabel('Frequency')
plt.legend()
plt.show()
```



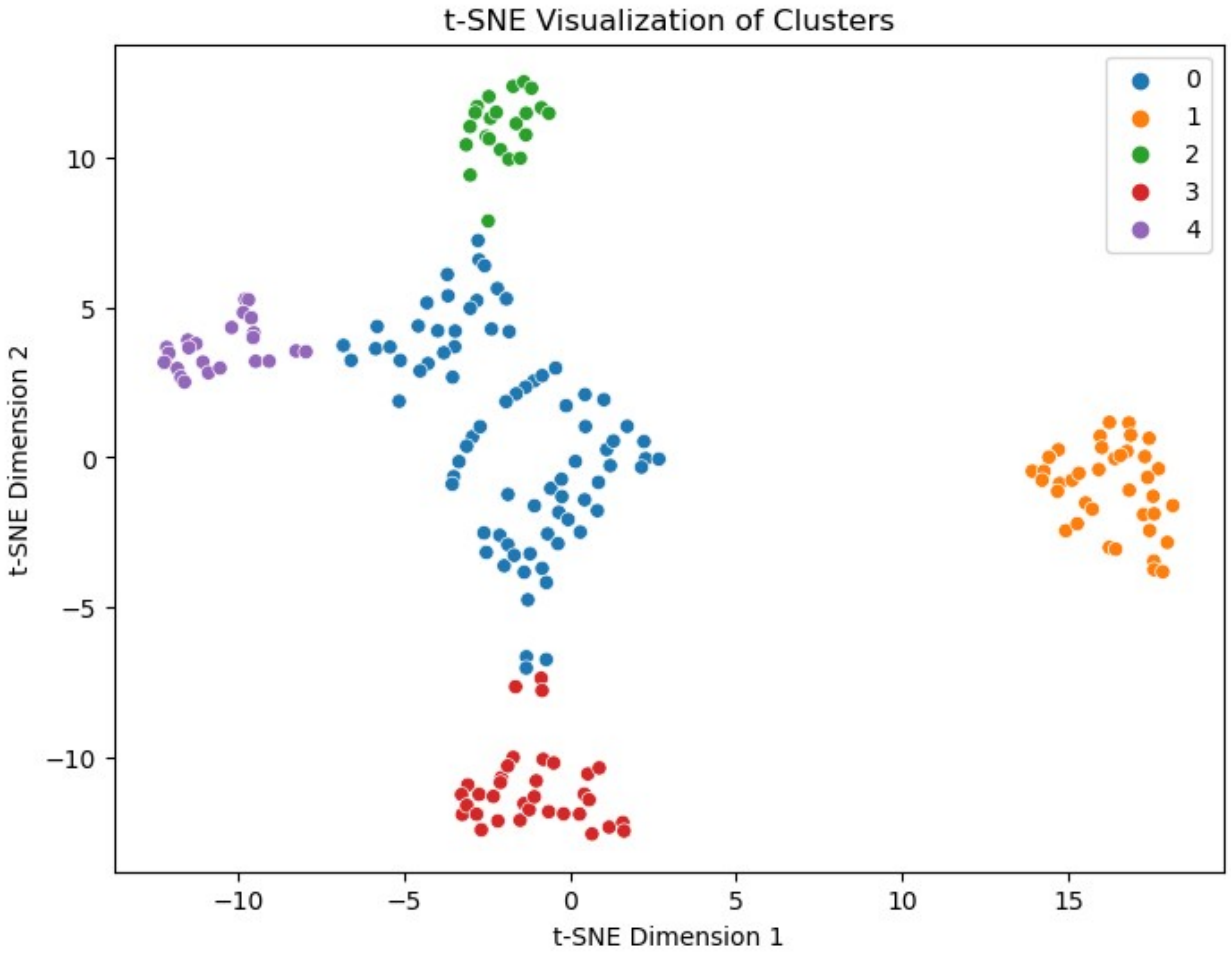
Feature Distribution:

```
plt.figure(figsize=(10, 6))
sns.boxplot(x='Cluster', y='Annual Income (k$)', data=df)
plt.title('Distribution of Annual Income by Cluster')
plt.xlabel('Cluster')
plt.ylabel('Annual Income (k$)')
plt.show()
```



Dimensionality Reduction Visualization (using t-SNE):

```
from sklearn.manifold import TSNE

tsne = TSNE(n_components=2, random_state=42)
tsne_data = tsne.fit_transform(features)

plt.figure(figsize=(8, 6))
sns.scatterplot(x=tsne_data[:, 0], y=tsne_data[:, 1],
hue=cluster_labels, palette='tab10')
plt.title('t-SNE Visualization of Clusters')
plt.xlabel('t-SNE Dimension 1')
plt.ylabel('t-SNE Dimension 2')
plt.legend()
plt.show()
```



"In this project, clustering analysis was performed on the Mall Customers dataset to identify distinct customer segments based on their annual income and spending score. The K-means clustering technique was utilized to visualize the clusters and observe the separation and distribution of customers. The scatter plot with cluster labels showcased the different groups and their boundaries, while the scatter plot with cluster centroids highlighted the central tendencies of each cluster. These insights provide valuable information for targeted marketing strategies, personalized experiences, and business optimization. Overall, this project demonstrates the power of unsupervised learning techniques in customer segmentation and provides actionable insights for data-driven decision-making."