Mall Customer Segmentation using K-Means Cluster

Importing Libraries

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
from IPython.display import Image
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
%matplotlib inline

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

```
   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
```

Explore

```
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   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
```

```
mask = df['Spending Score (1-100)'] >50
df_score = df[mask]
df_score.head()
```

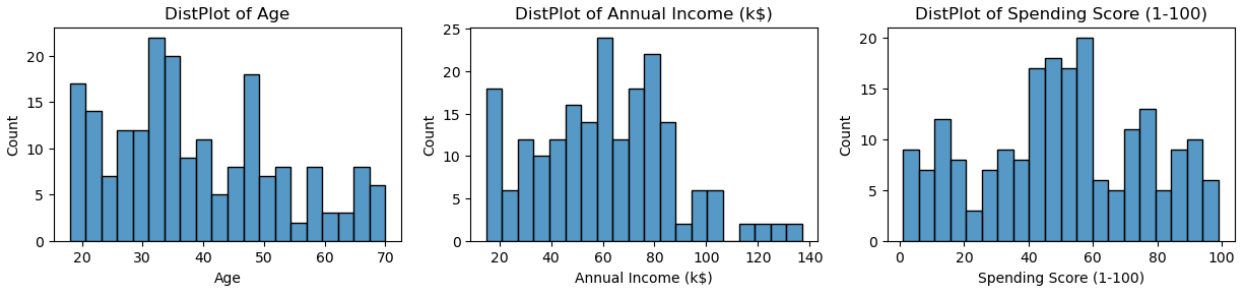
```
   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)
1           2    Male   21                  15                      81
3           4  Female   23                  16                      77
5           6  Female   22                  17                      76
7           8  Female   23                  18                      94
9          10  Female   30                  19                      72
```

```
df_score.describe()
```

```
       CustomerID         Age  Annual Income (k$)  Spending Score (1-
100)
count   97.000000  97.000000           97.000000
97.000000
mean   100.298969  34.597938           60.412371
71.670103
std     59.122783  13.024544           26.756133
14.710910
min      2.000000  18.000000           15.000000
51.000000
25%     51.000000  26.000000           42.000000
57.000000
50%     96.000000  31.000000           60.000000
73.000000
75%    152.000000  38.000000           78.000000
85.000000
max    200.000000  70.000000          137.000000
99.000000
```

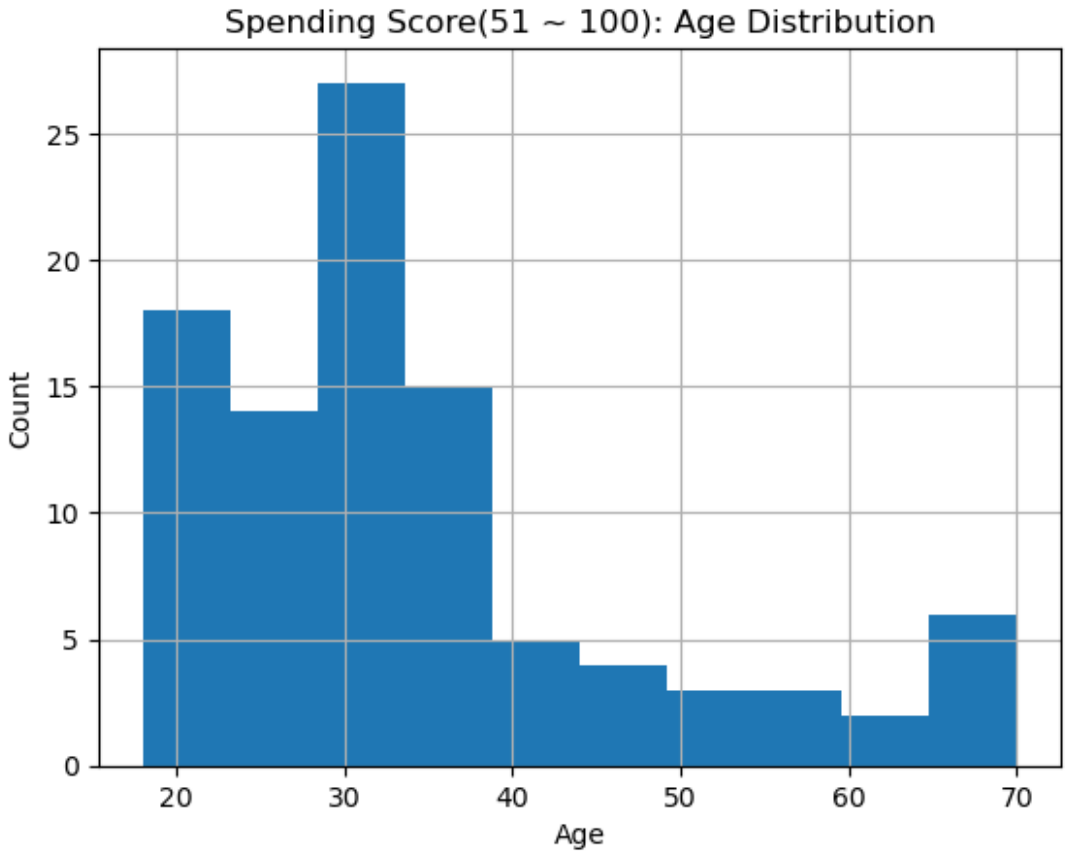
```
plt.figure(figsize = (15,6))
n=0
for x in ['Age','Annual Income (k$)','Spending Score (1-100)']:
    n += 1
```

```
    plt.subplot(2,3,n)
    plt.subplots_adjust(hspace=0.2,wspace = 0.2)
    sns.histplot(df[x],bins = 20)
    plt.title('DistPlot of {}'.format(x))
plt.show();
```



These features are normally distributed with a little bit of skewness in the first two figures

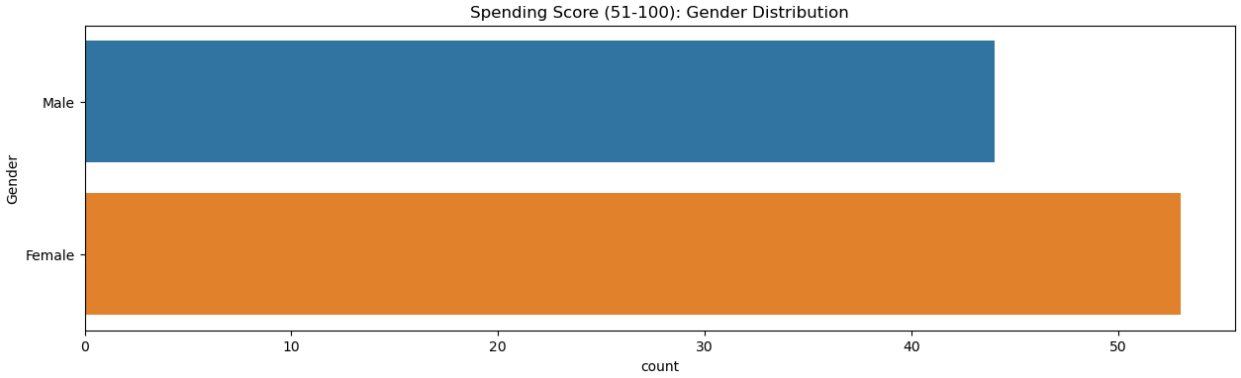
```
df_score['Age'].hist()
plt.xlabel('Age')
plt.ylabel('Count')
plt.title('Spending Score(51 ~ 100): Age Distribution');
```



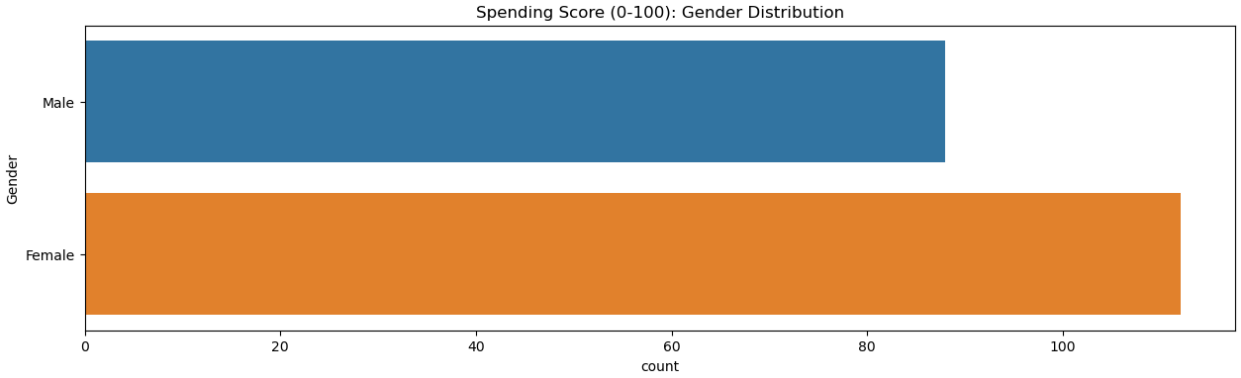
Our histogram is telling us that many of people who have spending score greater than 50 are younger.

Count Plot of Gender

```
plt.figure(figsize = (15,4))
sns.countplot(y='Gender',data = df_score)
plt.title('Spending Score (51-100): Gender Distribution')
plt.show();
```

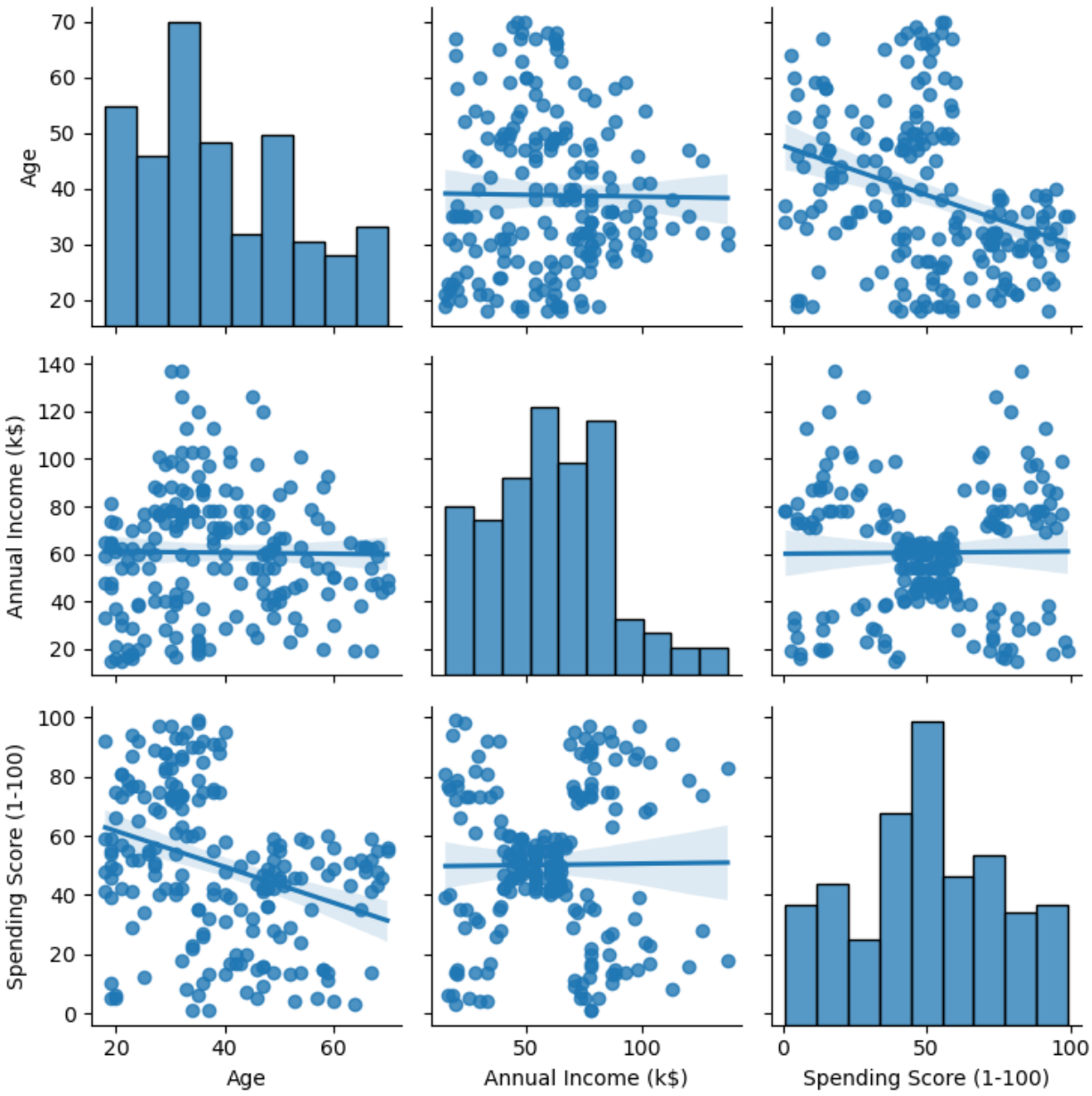



```
plt.figure(figsize = (15,4))
sns.countplot(y='Gender',data = df)
plt.title('Spending Score (0-100): Gender Distribution')
plt.show();
```



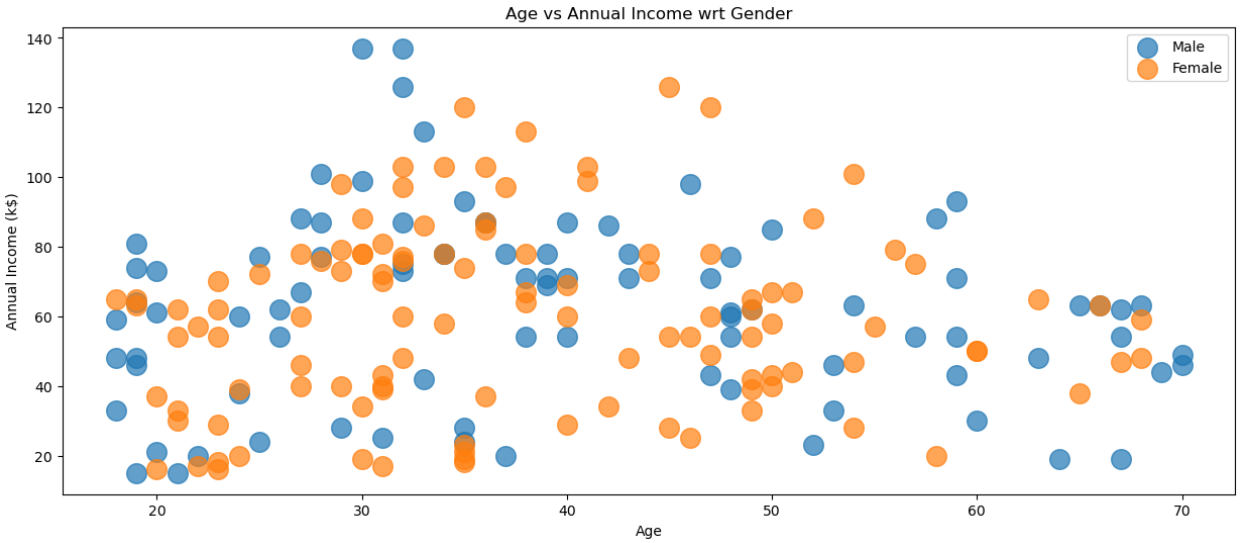
Plotting the Relation between Age,Annual Income and Spending Score

```
import warnings
warnings.filterwarnings("ignore",category =UserWarning)
sns.pairplot(df[['Age','Annual Income (k$)','Spending Score (1-
100)']],kind='reg')
plt.tight_layout()
plt.show();
```



Distribution of values in Age , Annual Income and Spending Score according to Gender

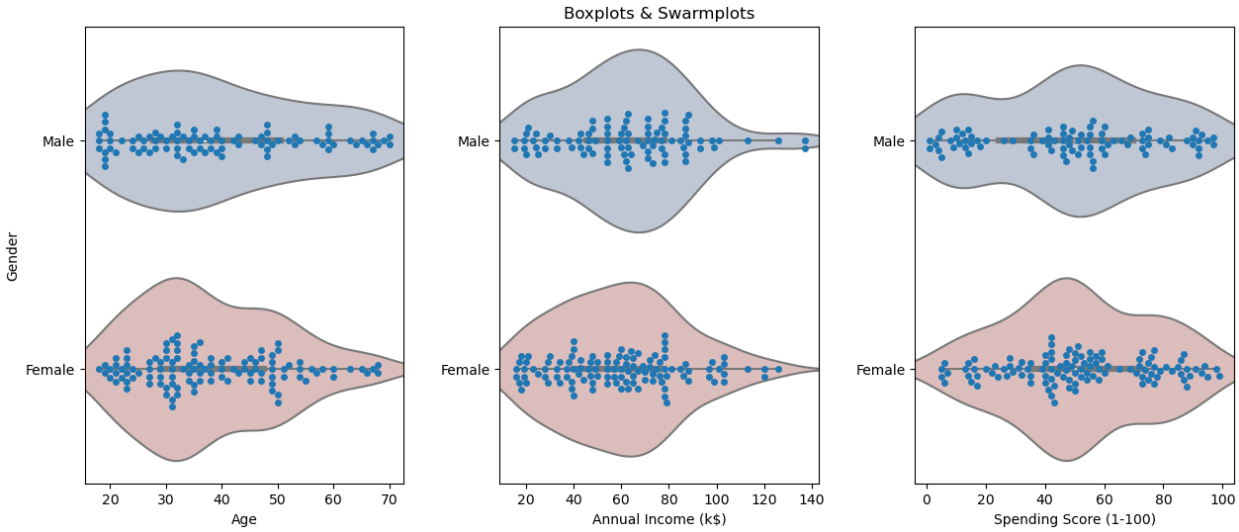
```
plt.figure(1,figsize = (15,6))
for gender in ['Male','Female']:
    plt.scatter(x = 'Age',y = 'Annual Income (k$)',data
=df[df['Gender'] == gender],s = 200,alpha = 0.7,label = gender)
plt.xlabel('Age'),plt.ylabel('Annual Income (k$)')
plt.title('Age vs Annual Income wrt Gender')
plt.legend()
plt.show()
```




```
plt.figure(1,figsize = (15,6))
for gender in ['Male','Female']:
    plt.scatter(x = 'Annual Income (k$)',y = 'Spending Score (1-
100)',data =df[df['Gender'] == gender],s = 200,alpha = 0.7,label =
gender)
plt.xlabel('Annual Income (k$)'),plt.ylabel('Spending Score (1-100)')
plt.title('Annual Income vs Spending Score wrt Gender')
plt.legend()
plt.show()
```


```
plt.figure(1,figsize = (15,6))
n = 0
for cols in ['Age','Annual Income (k$)','Spending Score (1-100)']:
    n += 1
    plt.subplot(1,3,n)
```

```
    plt.subplots_adjust(hspace = 0.3,wspace = 0.3)
    sns.violinplot(x = cols,y = 'Gender',data = df,palette = 'vlag')
    sns.swarmplot(x = cols,y = 'Gender',data = df)
    plt.ylabel('Gender' if n == 1 else '')
    plt.title('Boxplots & Swarmplots' if n == 2 else '')
plt.show();
```



Split

```
X = df.iloc[:,[3,4]]
print(f"X Shape {X.shape}")
X.head()
```

```
X Shape (200, 2)
```

	Annual Income (k$)	Spending Score (1-100)
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40

Clustering using K-Means

Iterate

Use a for loop to build and train a K-Means model where n_clusters ranges from 2 to 12 (inclusive). Each time a model is trained, calculate the inertia and add it to the list inertia_errors, then calculate the silhouette score and add it to the list silhouette_scores.

Segmentation using Annual Income & Spending Score

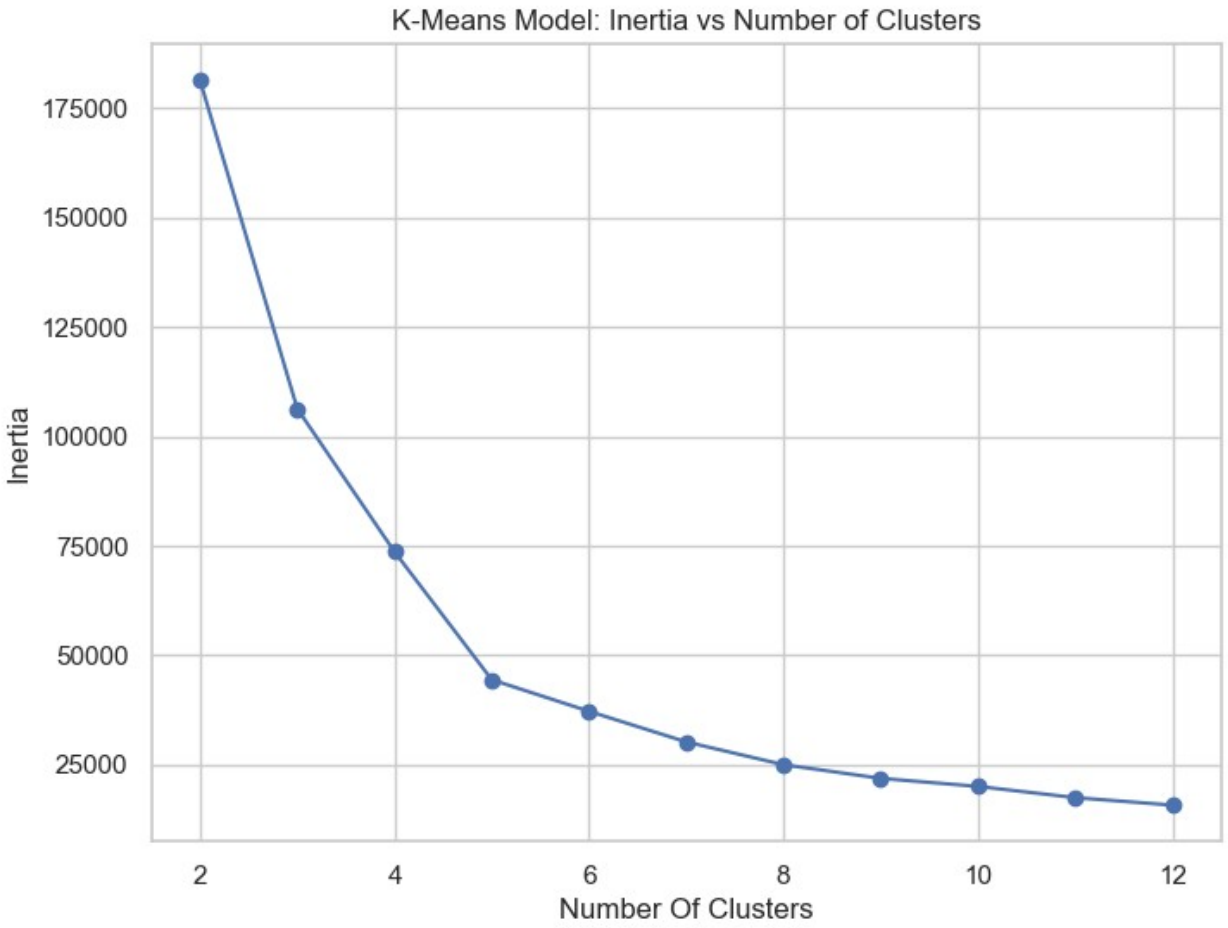
```
n_clusters = range(2,13)
inertia_errors = []
silhouette_scores = []
#Add a for loop to train model and calculate inertia,silhouette score.
for k in n_clusters:
    model = KMeans(n_clusters = k,random_state=42,n_init=10)
    #Train Model
    model.fit(X)
    #Calculate Inertia
    inertia_errors.append(model.inertia_)
    #Calculate Silhouette Score
    silhouette_scores.append(silhouette_score(X,model.labels_))
print("Inertia:",inertia_errors[:3])
print()
print("Silhouette Scores:",silhouette_scores[:3])
```

```
Inertia: [181363.59595959593, 106348.37306211122, 73679.78903948836]

Silhouette Scores: [0.2968969162503008, 0.46761358158775435,
0.4931963109249047]
```

Elbow Plot

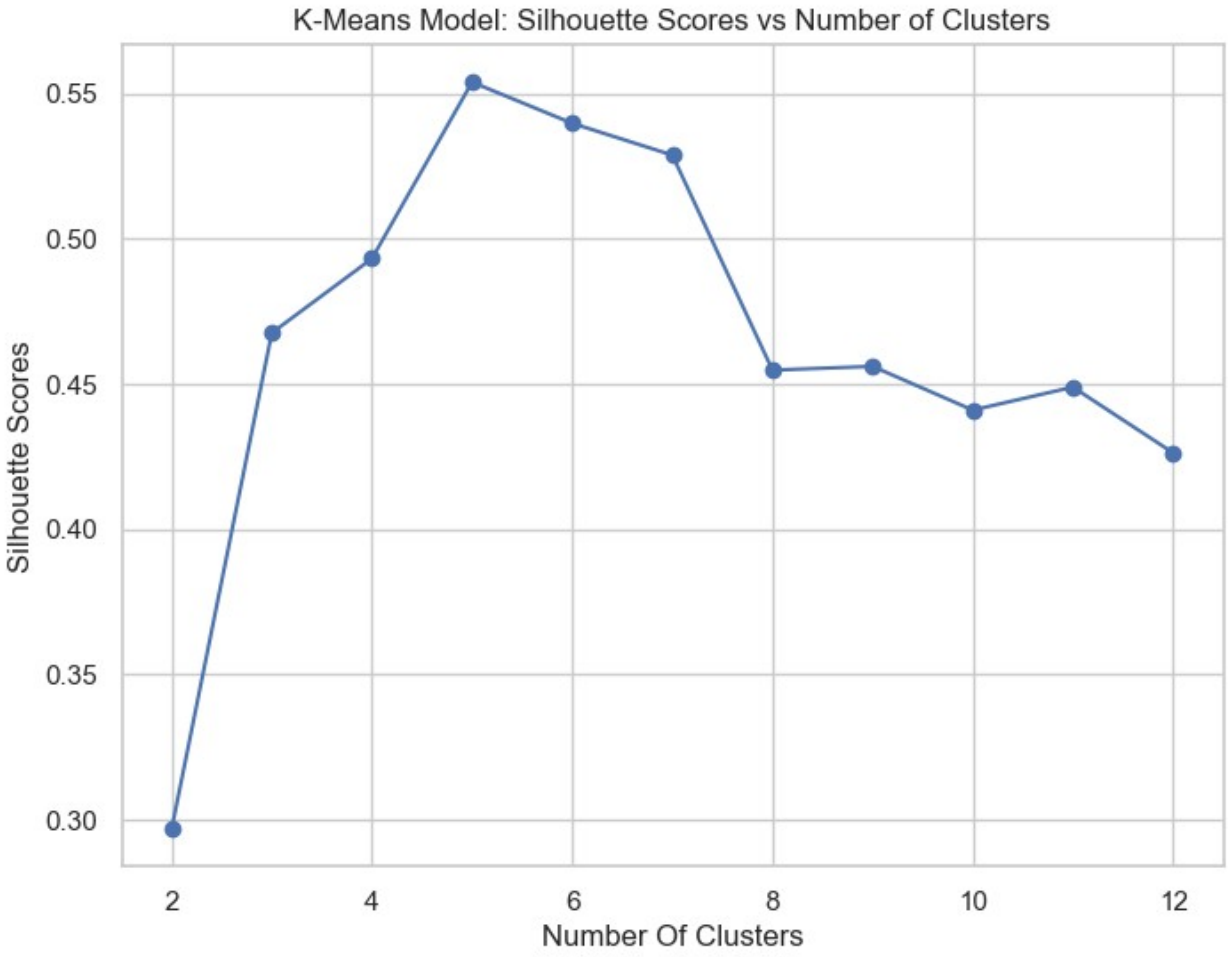
```
#Create a line plot of inertia_errors vs n_clusters
x_values = list(range(2, 13))

plt.figure(figsize=(8, 6))
sns.set(style="whitegrid")  # Set Seaborn style

# Create a line plot using Matplotlib
plt.plot(x_values, inertia_errors, marker='o', linestyle='-',
color='b')

# Add labels and title
plt.title('K-Means Model: Inertia vs Number of Clusters')
plt.xlabel('Number Of Clusters')
plt.ylabel('Inertia')
```

```
# Turn on grid and show plot
plt.grid(True)
plt.show()
```




```
#Create a line plot of silhouette scores vs n_clusters
x_values = list(range(2, 13))

plt.figure(figsize=(8, 6))
sns.set(style="whitegrid")  # Set Seaborn style

# Create a line plot using Matplotlib
plt.plot(x_values, silhouette_scores, marker='o', linestyle='-',
color='b')

# Add labels and title
plt.title('K-Means Model: Silhouette Scores vs Number of Clusters')
plt.xlabel('Number Of Clusters')
plt.ylabel('Silhouette Scores')

# Turn on grid and show plot
```

```
plt.grid(True)
plt.show()
```



The best number of clusters is 5

```
final_model = KMeans(n_clusters=5,random_state=42,n_init=10)
final_model.fit(X)
```

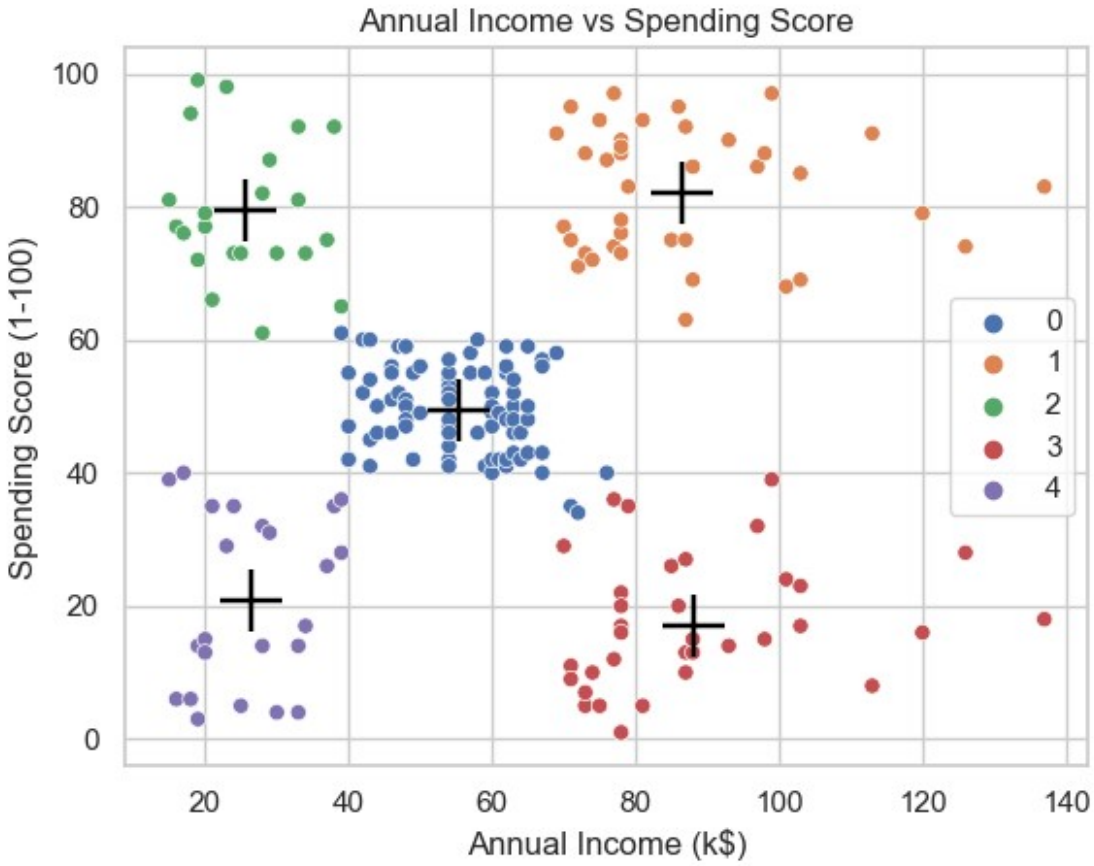
```
KMeans(n_clusters=5, n_init=10, random_state=42)
```

```
labels = final_model.labels_
centroids = final_model.cluster_centers_
print(labels[:5])
print(centroids[:5])
```

```
[4 2 4 2 4]
[[55.2962963  49.51851852]
 [86.53846154 82.12820513]
 [25.72727273 79.36363636]
 [88.2        17.11428571]
 [26.30434783 20.91304348]]
```

Communicate

```
#Plot "Annual Income" vs "Spending Score" with final_model labels
sns.scatterplot(x=df['Annual Income (k$)'],y=df['Spending Score (1-
100)'],hue=labels,palette='deep')
sns.scatterplot(
    x = centroids[:,0],
    y = centroids[: ,1],
    color = 'black',
    marker = '+',
    s = 500)
plt.xlabel("Annual Income (k$)")
plt.ylabel("Spending Score (1-100)")
plt.title("Annual Income vs Spending Score");
```

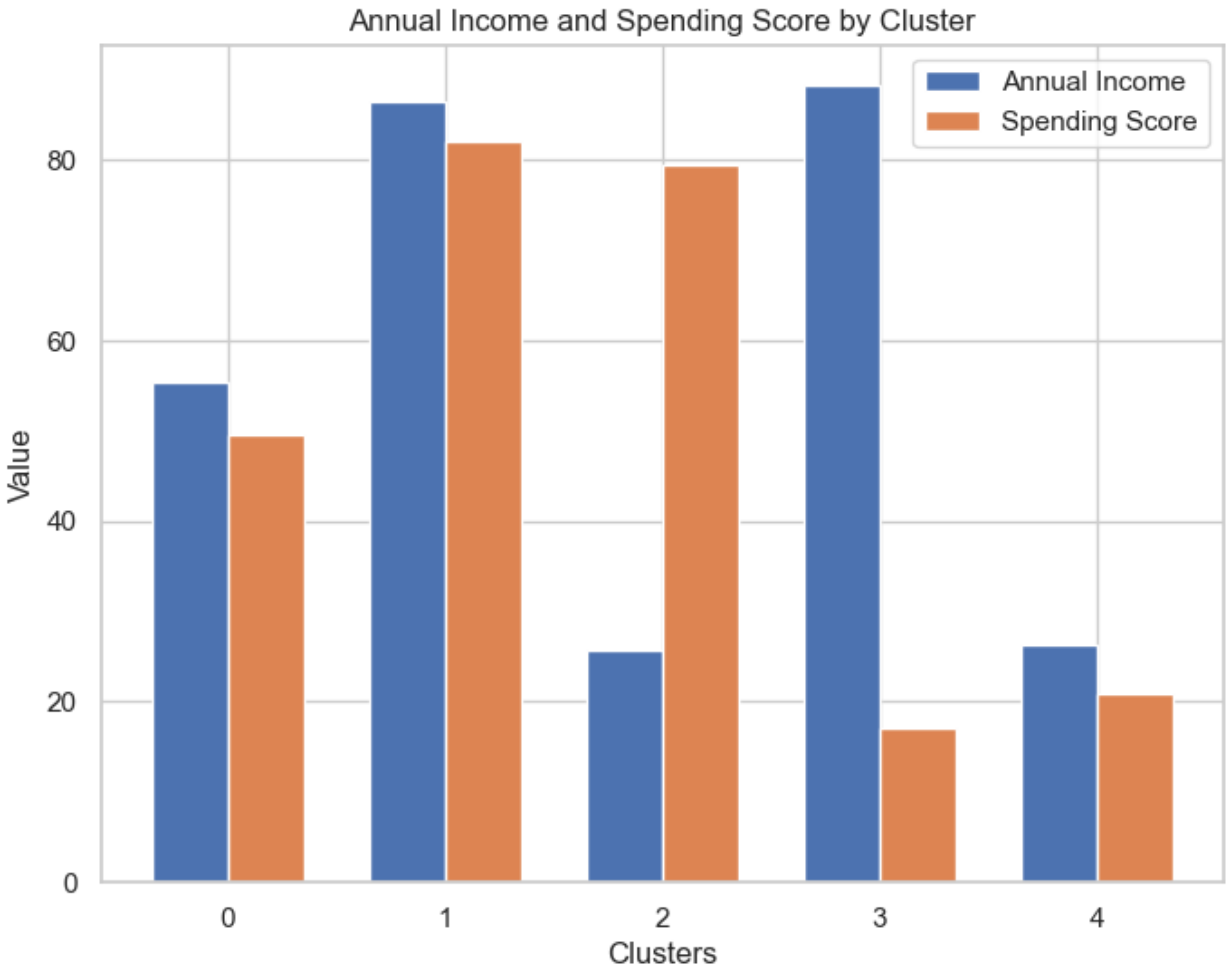



```
xgb = X.groupby(final_model.labels_).mean()

xgb
```

	Annual Income (k$)	Spending Score (1-100)
0	55.296296	49.518519
1	86.538462	82.128205
2	25.727273	79.363636

```
3            88.200000                17.114286
4            26.304348                20.913043
```

```
# Create side-by-side bar chart of `xgb`
plt.figure(figsize=(8, 6))

x = [0,1,2,3,4]
x_labels = labels
income_values = xgb['Annual Income (k$)']
spending_values = xgb['Spending Score (1-100)']

bar_width = 0.35
index = range(len(x))

# Create grouped bar plot using Matplotlib
plt.bar(index, income_values, bar_width, label='Annual Income')
plt.bar([i + bar_width for i in index], spending_values, bar_width,
label='Spending Score')

# Add labels and title
plt.xlabel('Clusters')
plt.ylabel('Value')
plt.title('Annual Income and Spending Score by Cluster')
plt.xticks([i + bar_width / 2 for i in index], x)
plt.legend()

# Show plot
plt.show()
```


Annual Income and Spending Score by Cluster
Annual Income
Spending Score
Value
0
20
40
60
80
0
1
2
3
4
Clusters