In [1]:
```
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
```

In [2]:
```
df = pd.read_csv('Mall_Customers.csv')
df
```

Out[2]:

	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
...	...	...	...	...	...
195	196	Female	35	120	79
196	197	Female	45	126	28
197	198	Male	32	126	74
198	199	Male	32	137	18
199	200	Male	30	137	83

200 rows × 5 columns

In [3]:
```
df.head()
```

Out[3]:

	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 [4]:
```
df.describe()
```

Out[4]:

	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 [5]:
```
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
```

In [6]:
```
mask = df['Spending Score (1-100)'] >50
df_score = df[mask]
df_score.head()
```

Out[6]:

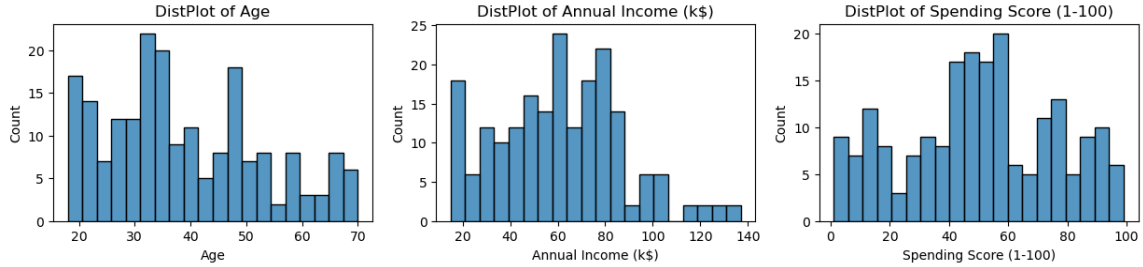
	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
1	2	Male	21	15	81
3	4	Female	23	16	77
5	6	Female	22	17	76
7	8	Female	23	18	94
9	10	Female	30	19	72

In [7]:
```
df_score.describe()
```

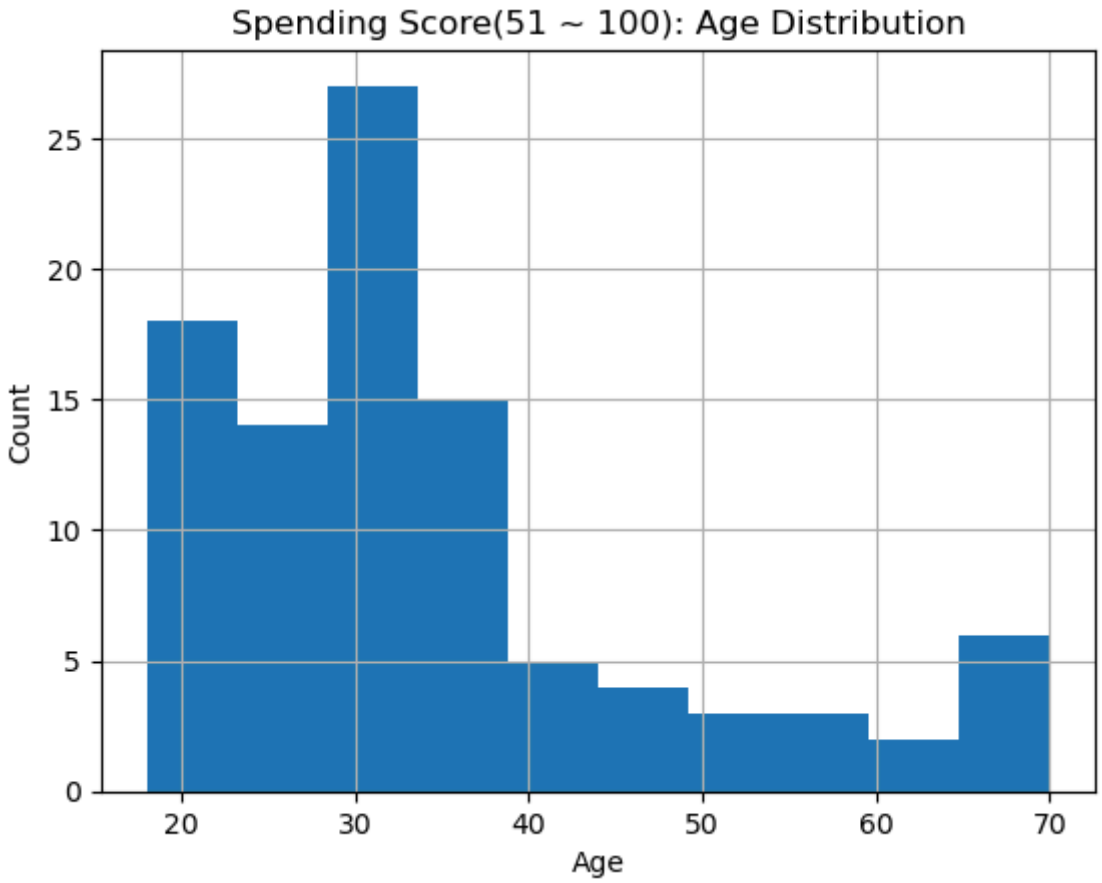
Out[7]:

	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

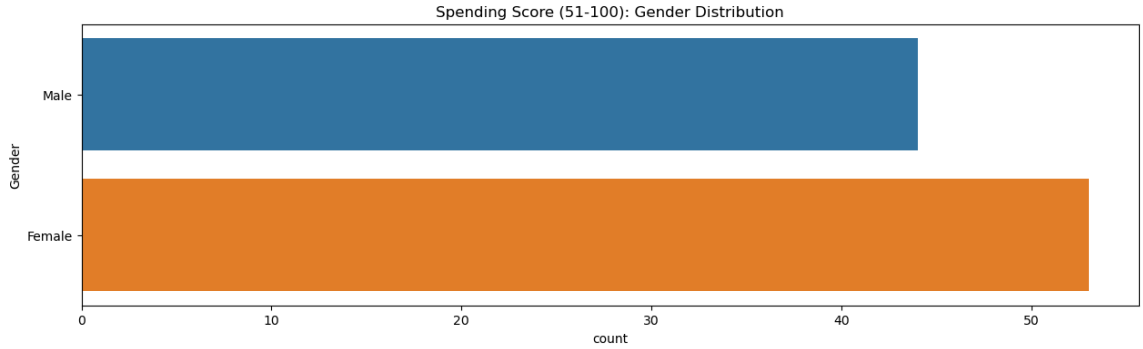
In [8]:
```
plt.figure(figsize = (15,6))
n=0
for x in ['Age','Annual Income (k$)','Spending Score (1-100)']:
    n += 1
    plt.subplot(2,3,n)
    plt.subplots_adjust(hspace=0.2,wspace = 0.2)
    sns.histplot(df[x],bins = 20)
    plt.title('DistPlot of {}'.format(x))
plt.show();
```



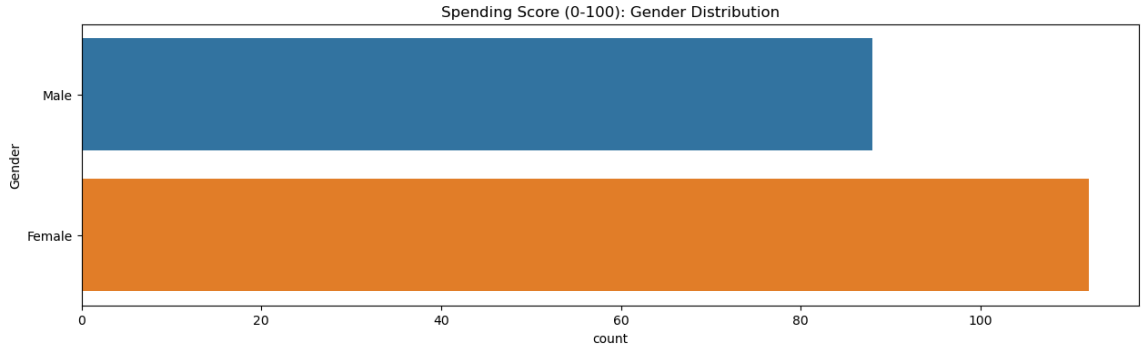
In [9]:
```
df_score['Age'].hist()
plt.xlabel('Age')
plt.ylabel('Count')
plt.title('Spending Score(51 ~ 100): Age Distribution');
```



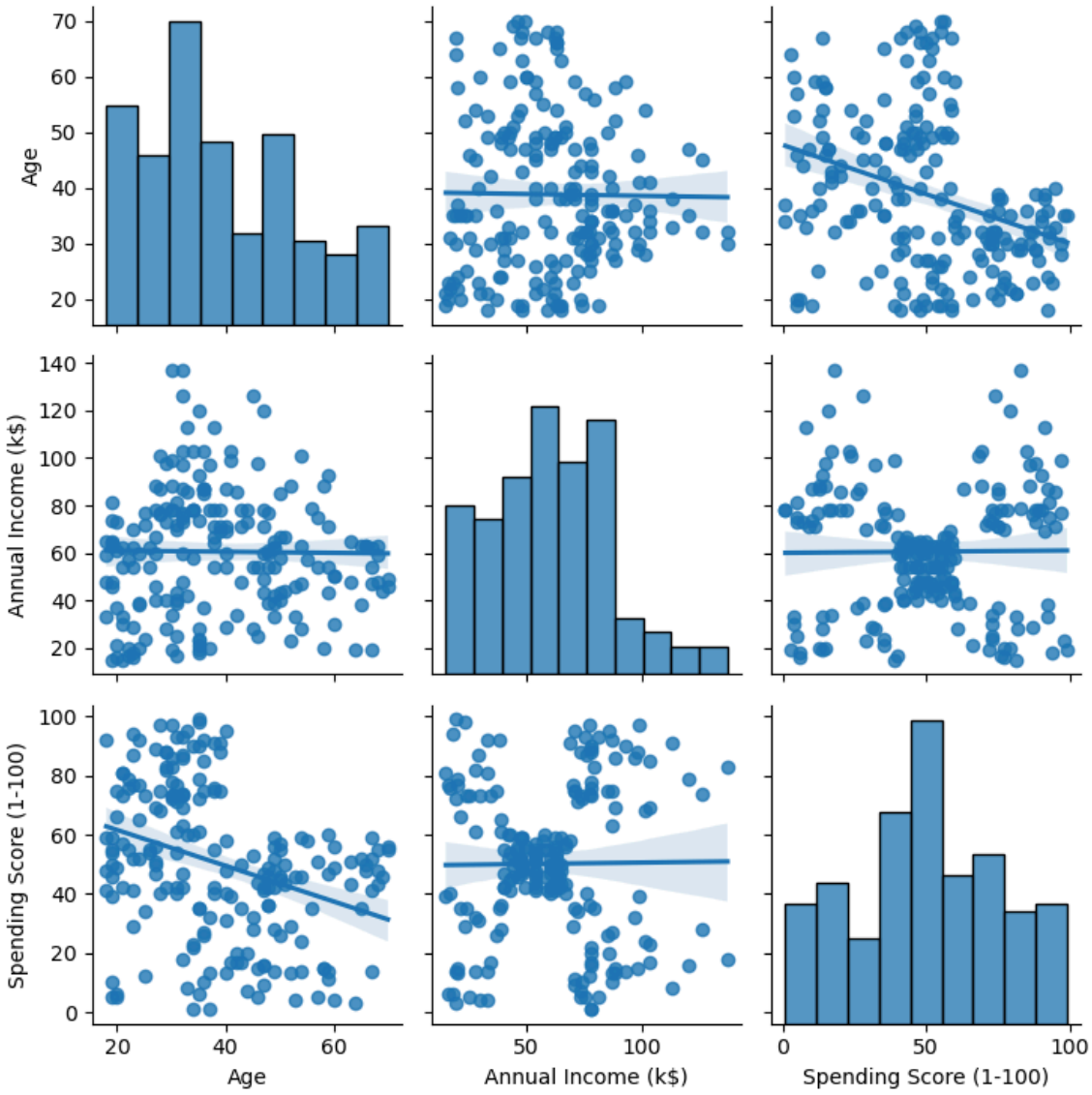
In [10]:
```
plt.figure(figsize = (15,4))
sns.countplot(y='Gender',data = df_score)
plt.title('Spending Score (51-100): Gender Distribution')
plt.show();
```



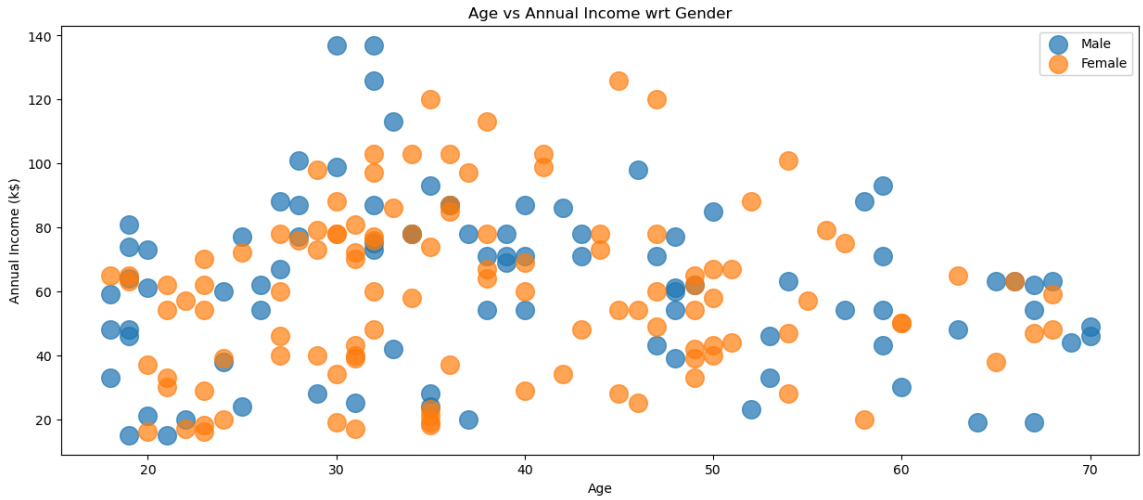
In [11]:
```
plt.figure(figsize = (15,4))
sns.countplot(y='Gender',data = df)
plt.title('Spending Score (0-100): Gender Distribution')
plt.show();
```



In [12]:
```
import warnings
warnings.filterwarnings("ignore",category =UserWarning)
sns.pairplot(df[['Age','Annual Income (k$)','Spending Score (1-100)']],kind
plt.tight_layout()
plt.show();
```

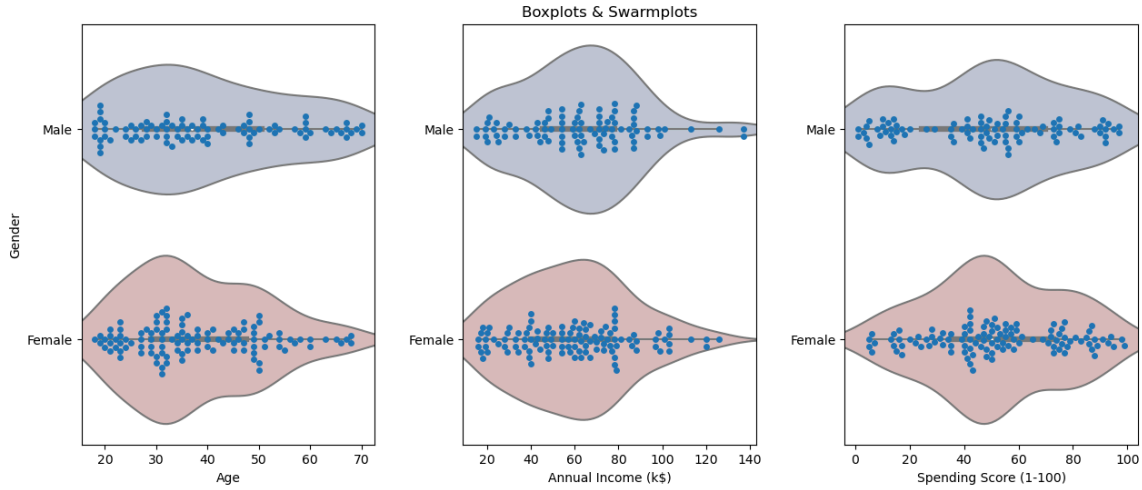


In [13]:
```
plt.figure(1,figsize = (15,6))
for gender in ['Male','Female']:
    plt.scatter(x = 'Age',y = 'Annual Income (k$)',data =df[df['Gender'] ==
plt.xlabel('Age'),plt.ylabel('Annual Income (k$)')
plt.title('Age vs Annual Income wrt Gender')
plt.legend()
plt.show()
```



In [14]:
```
plt.figure(1,figsize = (15,6))
for gender in ['Male','Female']:
    plt.scatter(x = 'Annual Income (k$)',y = 'Spending Score (1-100)',data =
plt.xlabel('Annual Income (k$)'),plt.ylabel('Spending Score (1-100)')
plt.title('Annual Income vs Spending Score wrt Gender')
plt.legend()
plt.show()
```

In [15]:
```
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();
```



In [16]:
```
X = df.iloc[:,[3,4]]
print(f"X Shape {X.shape}")
X.head()
```

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

Out[16]:

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

In [17]:
```
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: [181363.59595959596, 106348.37306211119, 73679.78903948834]

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

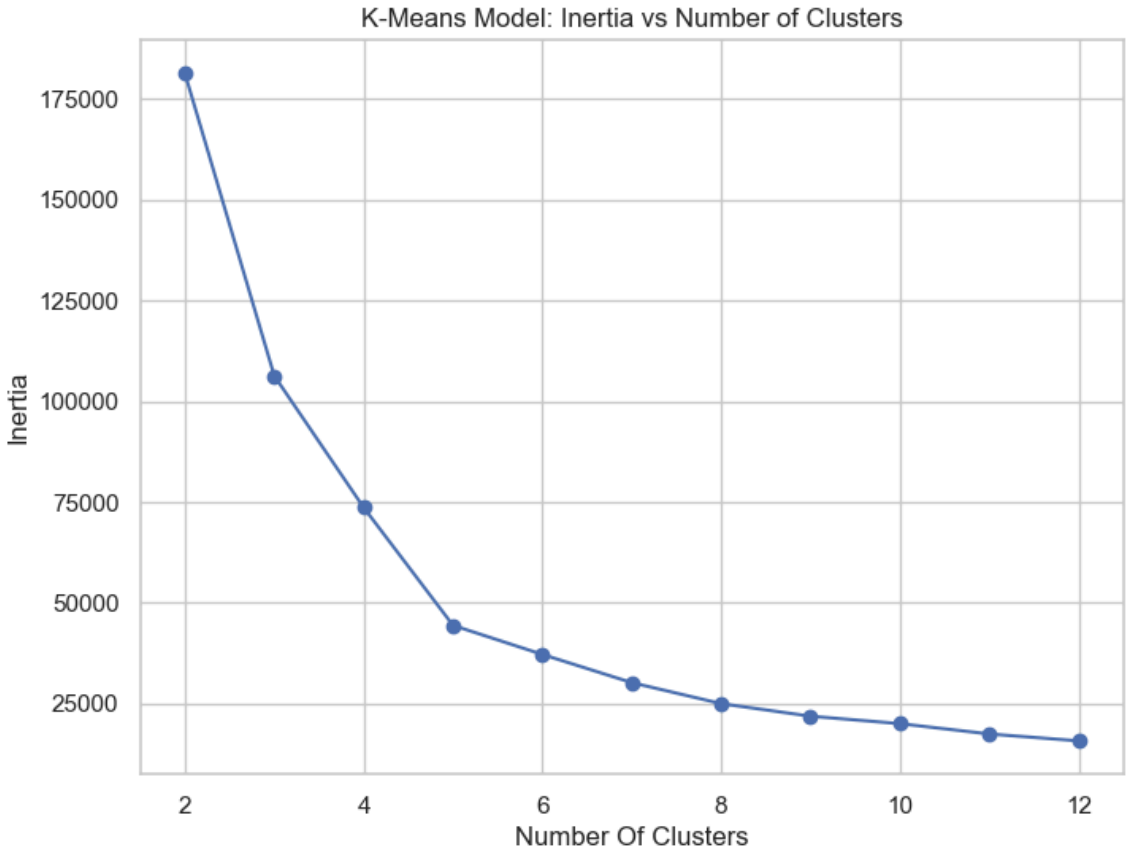
In [18]:
```
#Create a line plot of inertia_errors vs n_clusters
x_values = list(range(2, 13))

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()
```



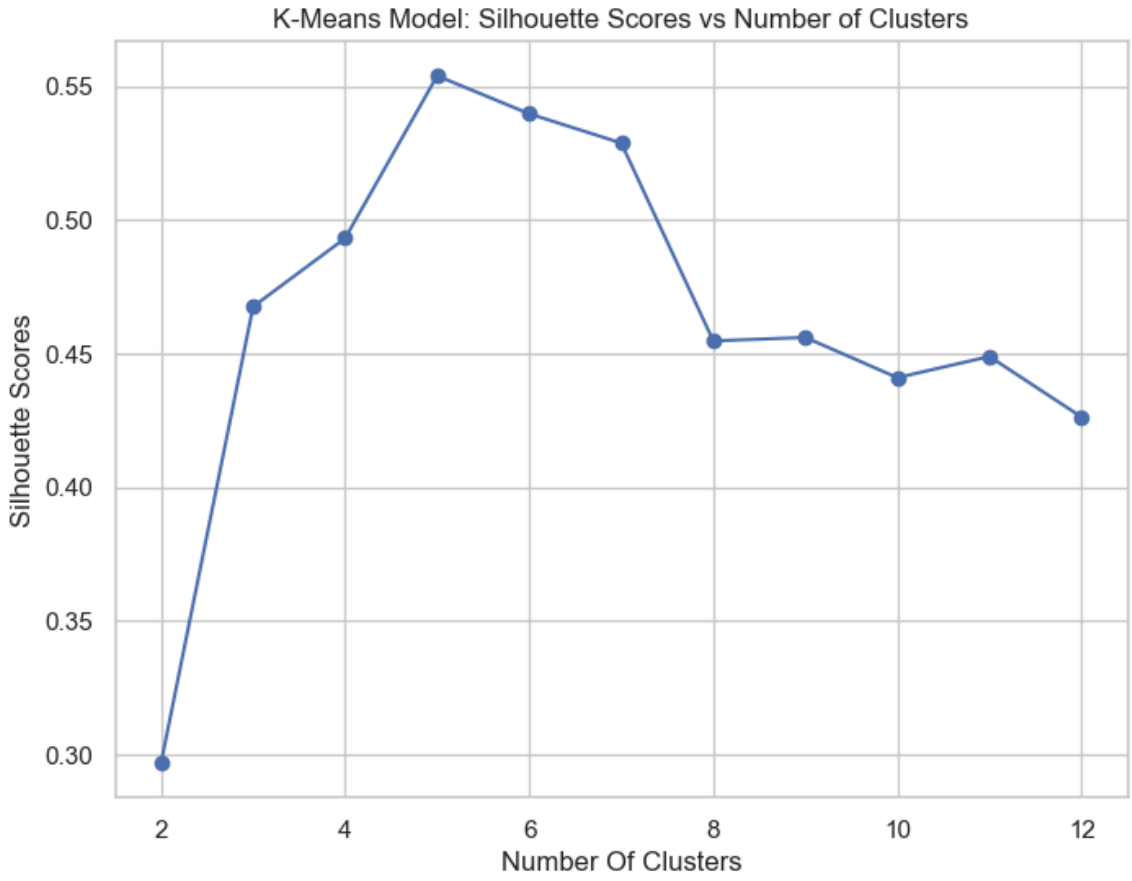
In [19]:
```
#Create a line plot of silhouette scores vs n_clusters
x_values = list(range(2, 13))

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()
```



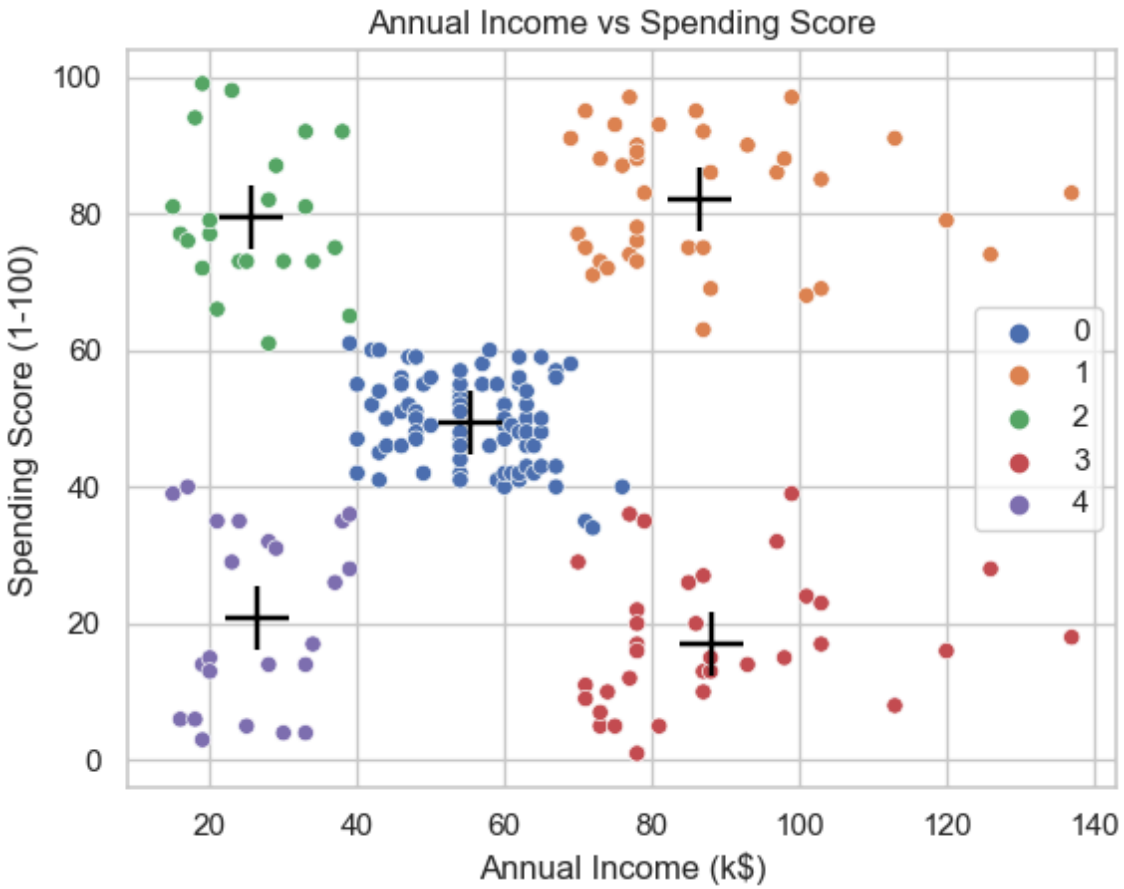
In [20]:
```
final_model = KMeans(n_clusters=5,random_state=42,n_init=10)
final_model.fit(X)
```

Out[20]:
```
KMeans(n_clusters=5, n_init=10, random_state=42)
```

In [21]:
```
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]]
```

In [22]:
```
#Plot "Annual Income" vs "Spending Score" with final_model labels
sns.scatterplot(x=df['Annual Income (k$)'],y=df['Spending Score (1-100)'],h
sns.scatterplot(
    x = centroids[:,0],
    y = centroids[: ,1],
    color = 'black',
    marker = '+',
    s = 500)
plt.xlabel("Annual Income (k$)")
plt.ylabel("Spending Score (1-100)")
plt.title("Annual Income vs Spending Score");
```



In [23]:
```
xgb = X.groupby(final_model.labels_).mean()
xgb
```

Out[23]:

	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

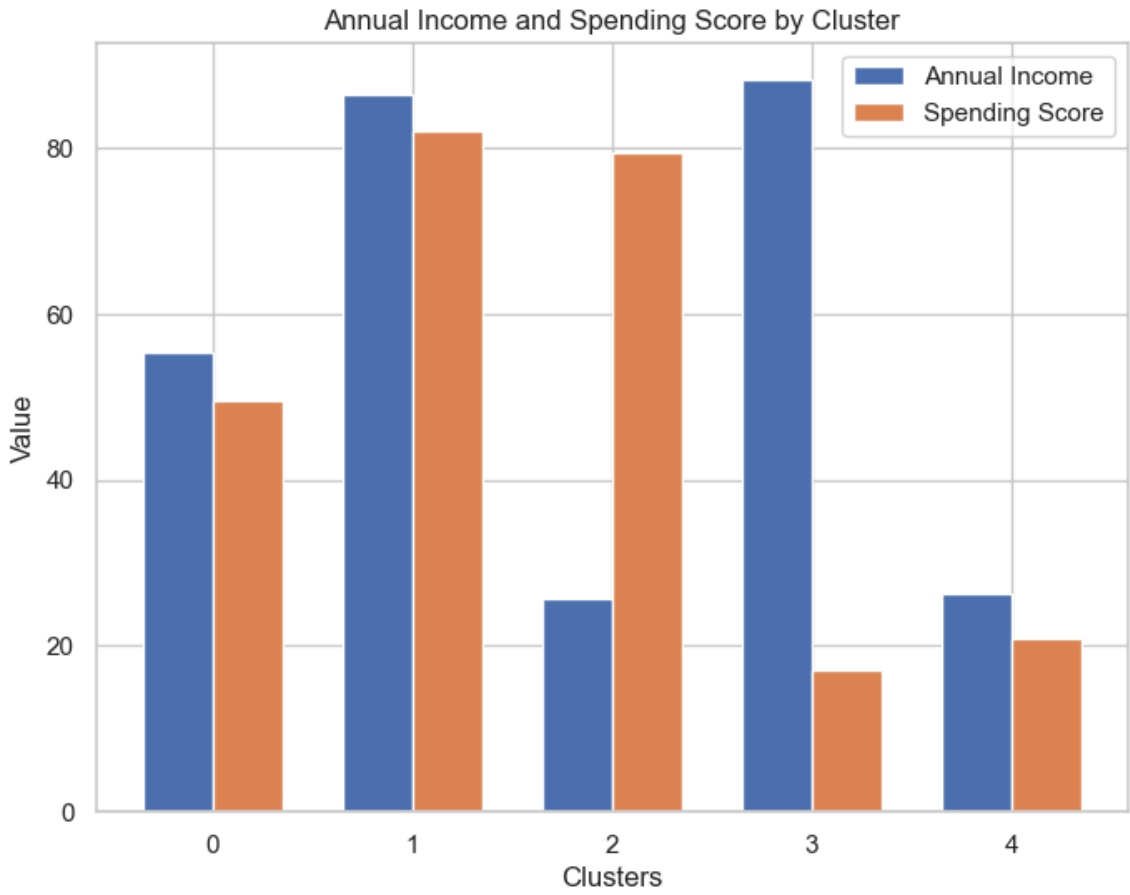
In [24]:
```
# Create side-by-side bar chart of `xgb`
plt.figure(figsize=(8, 6))

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='
# 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()
```



In [ ]: