Customer Spending Behavior Analysis Report

1. Load and explore data

In [72]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

In [73]:
```
df = pd.read_csv("D:\Dec'24\DSCourse\data\Mall_Customers.csv")
df.head()
```

Out[73]:

	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 [74]:
```
df.shape
```

Out[74]:
```
(200, 5)
```

In [75]:
```
print(df.info())
print()
print()
print(df.describe())
```

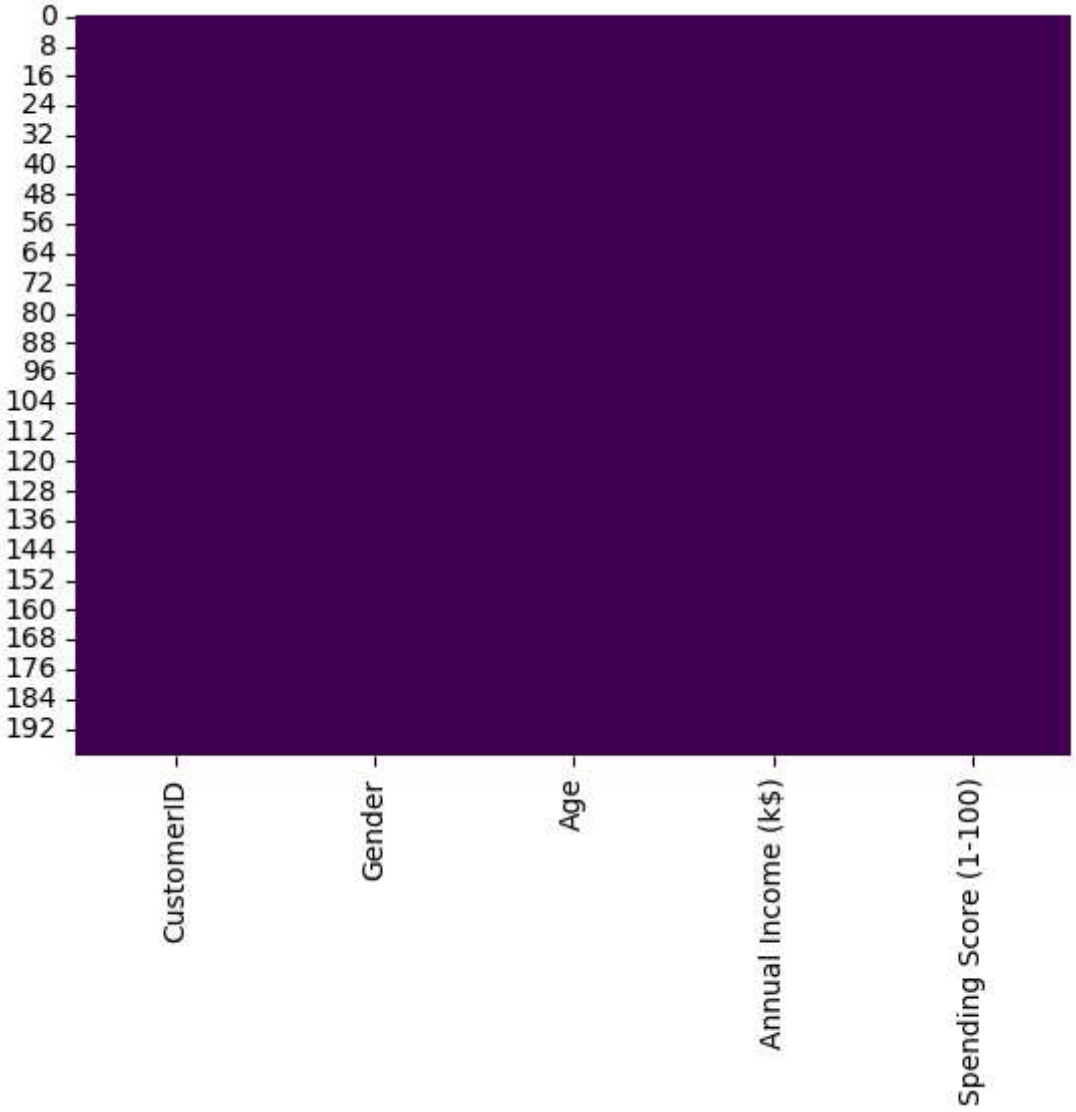
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              200 non-null    int64
 1   Gender                  200 non-null    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
```

	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

2. Clean and Preprocess Data

In [76]:
```
sns.heatmap(df.isnull(), cbar=False, cmap="viridis")
```

Out[76]: <Axes: >



In [77]:
```
df['Gender'] = df['Gender'].map({'Male' : 0, 'Female' : 1})          # convert ma
```

In [78]:
```
df.head()
```

Out[78]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	0	19	15	39
1	2	0	21	15	81
2	3	1	20	16	6
3	4	1	23	16	77
4	5	1	31	17	40

In [ ]:
```

```

3. Descriptive Statistics

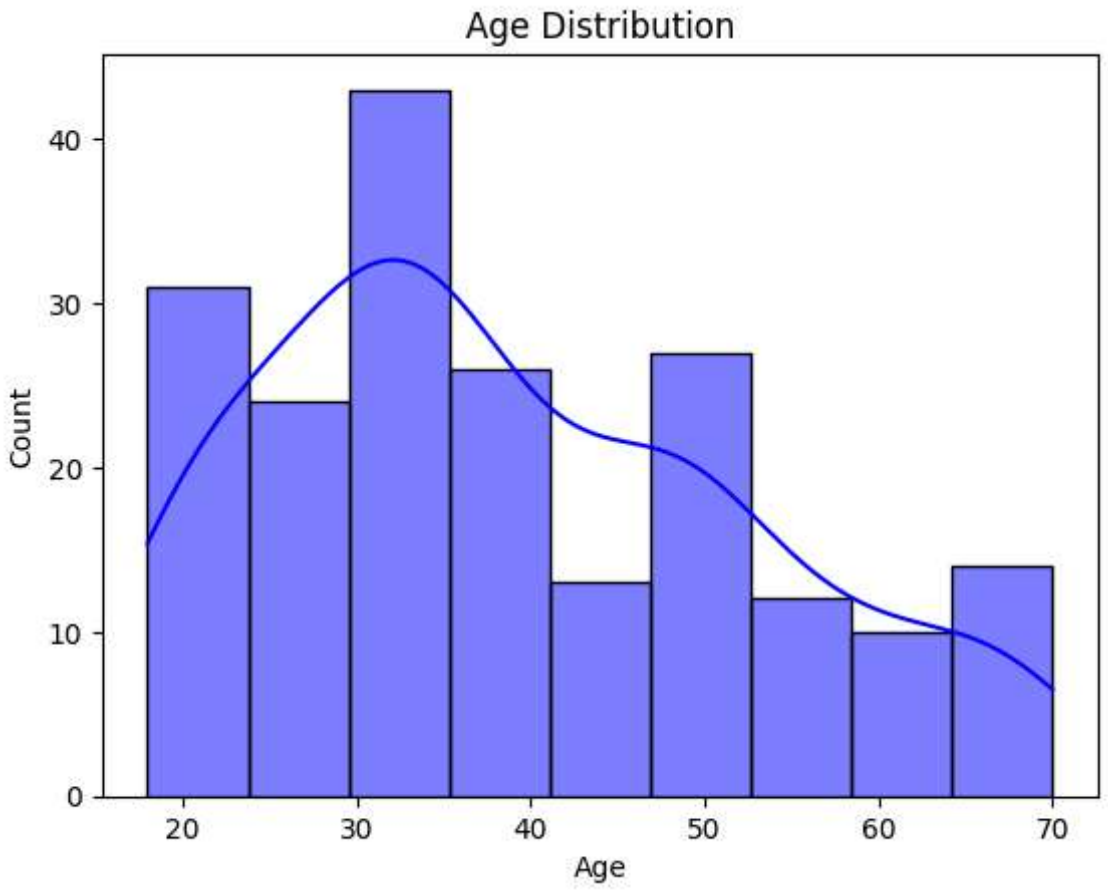
In [79]:
```
# Central Tendency
print('Mean Age: ', df['Age'].mean())
print('Meadian income: ', df['Annual Income (k$)'].median())
```

```
# Dispersion
print('Standard Deviation Spending Score: ', df['Spending Score (1-100)'].std())
```

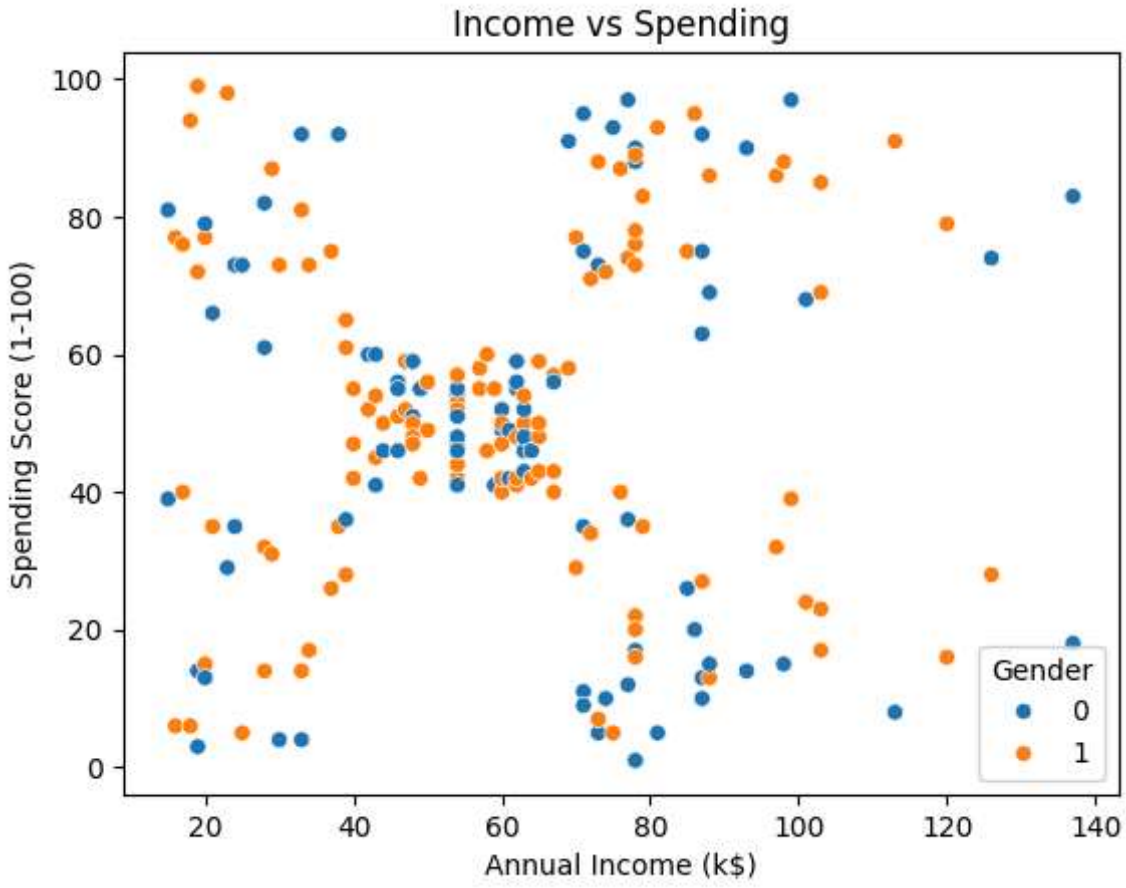
```
Mean Age:  38.85
Meadian income:  61.5
Standard Deviation Spending Score:  25.823521668370173
```

4. Visualizations

In [80]:
```
# Histogram of Age distribution
sns.histplot(df['Age'], kde=True, color='blue')
plt.title('Age Distribution')
plt.show()
```



In [81]:
```
# Scatter plot for Income vs Spending score
sns.scatterplot(x='Annual Income (k$)', y='Spending Score (1-100)',hue='Gender',
plt.title('Income vs Spending')
plt.show()
```



5. Statistical Test

In [82]:
```
# Correlation Matrix
print('Correlation matrix: ', df[['Annual Income (k$)', 'Spending Score (1-100)'
```

```
Correlation matrix:                      Annual Income (k$)  Spending Score
(1-100)
Annual Income (k$)                1.000000            0.009903
Spending Score (1-100)            0.009903            1.000000
```

In [83]:
```
# T-test
from scipy.stats import ttest_ind


# t-test for spending scores by gender
male_scores = df[df['Gender'] == 0]['Spending Score (1-100)']
female_scores = df[df['Gender'] == 1]['Spending Score (1-100)']

t_stat, p_value = ttest_ind(male_scores, female_scores)
print('T-Statistic: ', t_stat)
print('P-Value: ', p_value)
```

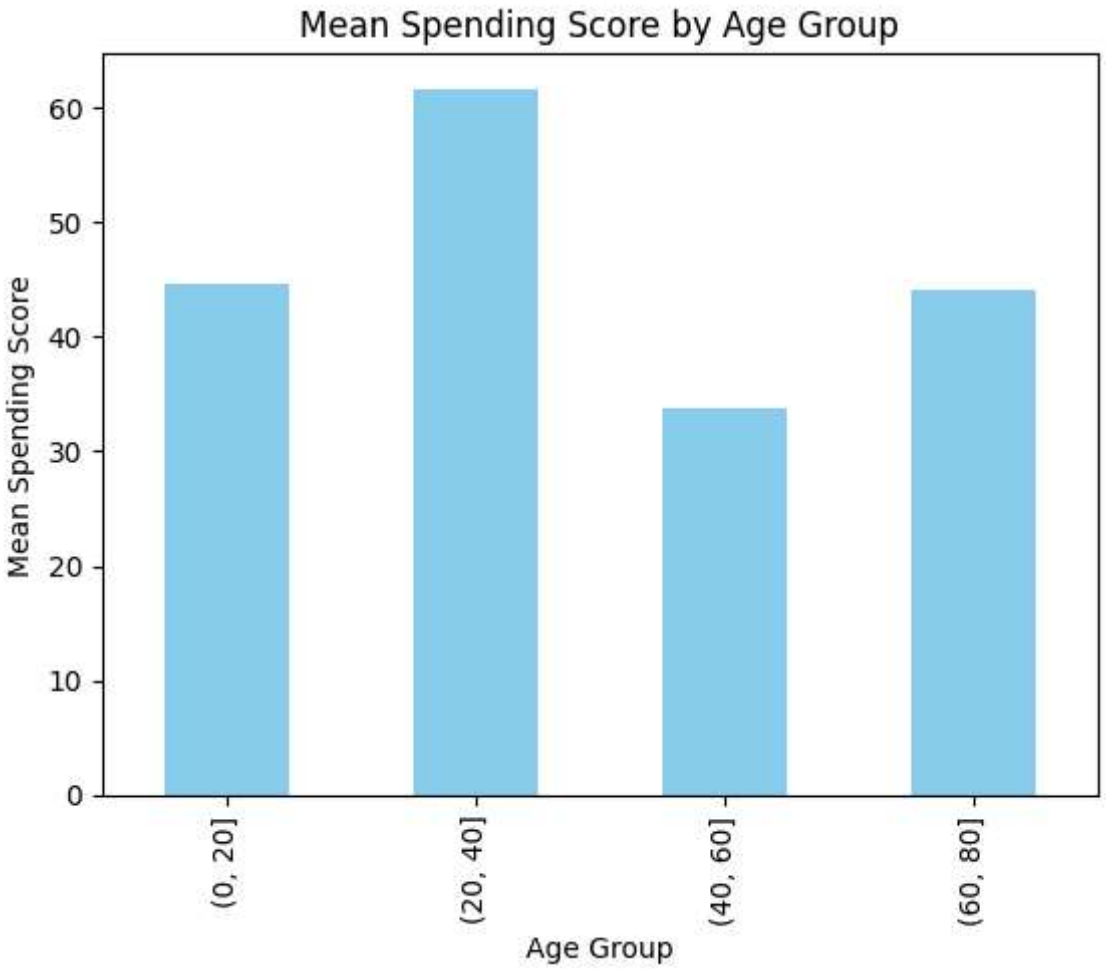
```
T-Statistic:  -0.8190464150660334
P-Value:  0.4137446589852174
```

In [92]:
```
from scipy.stats import f_oneway

# ANOVA for Spending Score by Age Groups
age_groups = pd.cut(df['Age'], bins=[0, 20, 40, 60, 80])
anova_result = f_oneway(
    *[
```

```
        df.loc[age_groups == interval, 'Spending Score (1-100)']
        for interval in age_groups.cat.categories
    ]
)

print("ANOVA F-Statistic:", anova_result.statistic)
print("P-Value:", anova_result.pvalue)
```

```
ANOVA F-Statistic: 20.40059070488781
P-Value: 1.510354860990344e-11
```

In [93]:
```
import seaborn as sns
import matplotlib.pyplot as plt

# Calculate mean spending scores for each age group
age_group_means = df.groupby(age_groups)['Spending Score (1-100)'].mean()

# Plot
age_group_means.plot(kind='bar', color='skyblue')
plt.title('Mean Spending Score by Age Group')
plt.xlabel('Age Group')
plt.ylabel('Mean Spending Score')
plt.show()
```



Report

Key Sections:

1. **Introduction**:
    - This analysis focuses on customer spending behavior using a dataset containing 200 records of customer demographics and spending patterns.
2. **Methods**:
    - **Data Cleaning:**
        - Encoded `Gender` as numerical values (`Male = 0` , `Female = 1`).
        - Checked for missing values (none were found).
    - **Statistical Techniques:**
        - **Correlation Analysis:** Examined relationships between `Annual Income` and `Spending Score` .
        - **T-Test:** Compared average spending scores between genders.
        - **ANOVA:** Tested if spending scores significantly differ across age groups.
    - **Visualization Tools:**
      Used **Matplotlib** and **Seaborn** for scatter plots, histograms, and bar charts.
3. **Findings**:
    - Correlation insights
        - Correlation matrix revealed:
            - Weak correlation between `Annual Income` and `Spending Score` (correlation coefficient: `0.0099`).
        - Interpretation: Higher income does not necessarily lead to higher spending scores.
    - T-test results
        - **T-Statistic:** `-0.819`
        - **P-Value:** `0.414` (greater than 0.05).
        - Interpretation: There is **no significant difference** in spending scores between males and females.
    - ANOVA results
        - **F-Statistic:** `20.40`
        - **P-Value:** `1.51e-11` (less than 0.05).
        - Interpretation: Spending scores differ significantly across age groups, suggesting that age influences spending behavior.
4. **Visuals**:
    - A. **Scatter Plot:**
        - **Income vs Spending Score:** Showed no strong trend.

      B. **Histogram:**
        - **Age Distribution:** Highlighted a concentration of customers in their 30s and 40s.

      C. **Bar Chart:**
        - **Mean Spending Score by Age Group:** Showed younger customers (e.g., 20-40) had higher spending scores.
5. **Conclusion**:
    - **Key Trends:**

    - Age significantly impacts spending scores, with younger customers showing higher spending tendencies.
    - Gender does not influence spending scores significantly.
    - Income has little to no relationship with spending scores, suggesting other factors might drive spending habits.
- **Actionable Insights:**
    - Businesses should target younger age groups (20-40) with marketing campaigns to maximize spending potential.
    - Further research could analyze additional factors like product categories or time of purchase to uncover deeper trends.