Customer Segmentation and Analysis

Steps to solve the problem :

1. Importing Libraries.
2. Exploration of data.
3. Data Visualization.
4. Clustering using K-Means.
5. Selection of Clusters.
6. Ploting the Cluster Boundry and Clusters.
7. 3D Plot of Clusters.

Importing Libraries.

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import matplotlib.pyplot as plt
import seaborn as sns
import plotly as py
import plotly.graph_objs as go
from sklearn.cluster import KMeans
import warnings
import os
warnings.filterwarnings("ignore")
py.offline.init_notebook_mode(connected = True)
#print(os.listdir("../input"))
```

Data Exploration

```
df = pd.read_csv('/content/Mall_Customers (1).csv')
```

```
# Remove unnecessary column
df = df.drop(columns=['CustomerID'])  # Remove CustomerID
df.head(3)
```

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	Male	19	15	39
1	Male	21	15	81
2	Female	20	16	6

Next steps: Generate code with df | View recommended plots | New interactive sheet

```
df.shape
```

```
(200, 4)
```

```
df.describe()
```

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

```
df.dtypes
```

	0
Gender	object
Age	int64
Annual Income (k$)	int64
Spending Score (1-100)	int64

dtype: object

```
df.isnull().sum()
```

	0
Gender	0
Age	0
Annual Income (k$)	0
Spending Score (1-100)	0

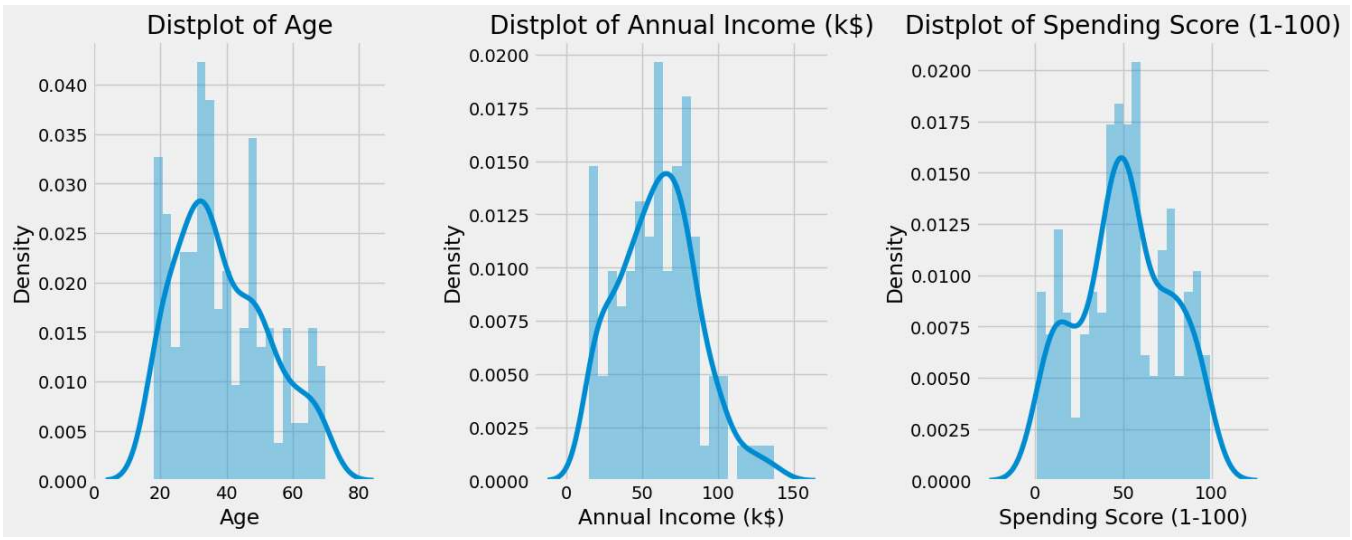
dtype: int64

Data Visualization

```
plt.style.use('fivethirtyeight')
```

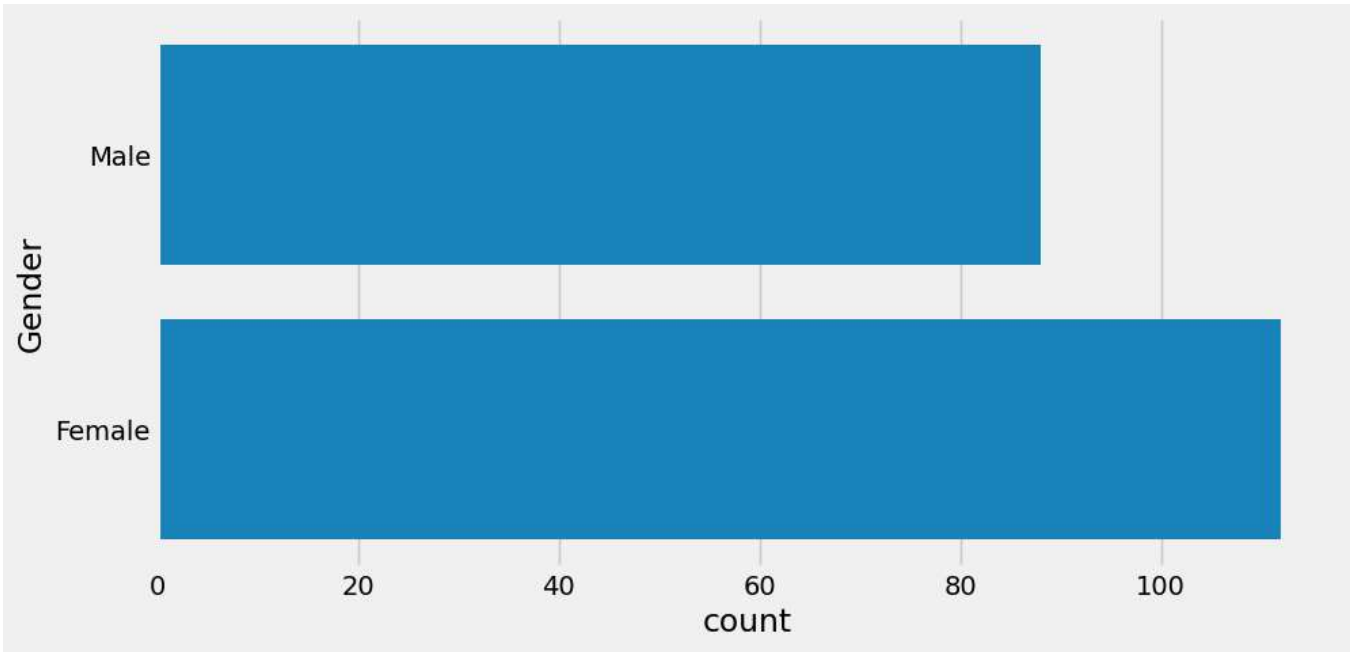
Histograms

```
plt.figure(1 , figsize = (15 , 6))
n = 0
for x in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
    n += 1
    plt.subplot(1 , 3 , n)
    plt.subplots_adjust(hspace =0.5 , wspace = 0.5)
    sns.distplot(df[x] , bins = 20)
    plt.title('Distplot of {}'.format(x))
plt.show()
```



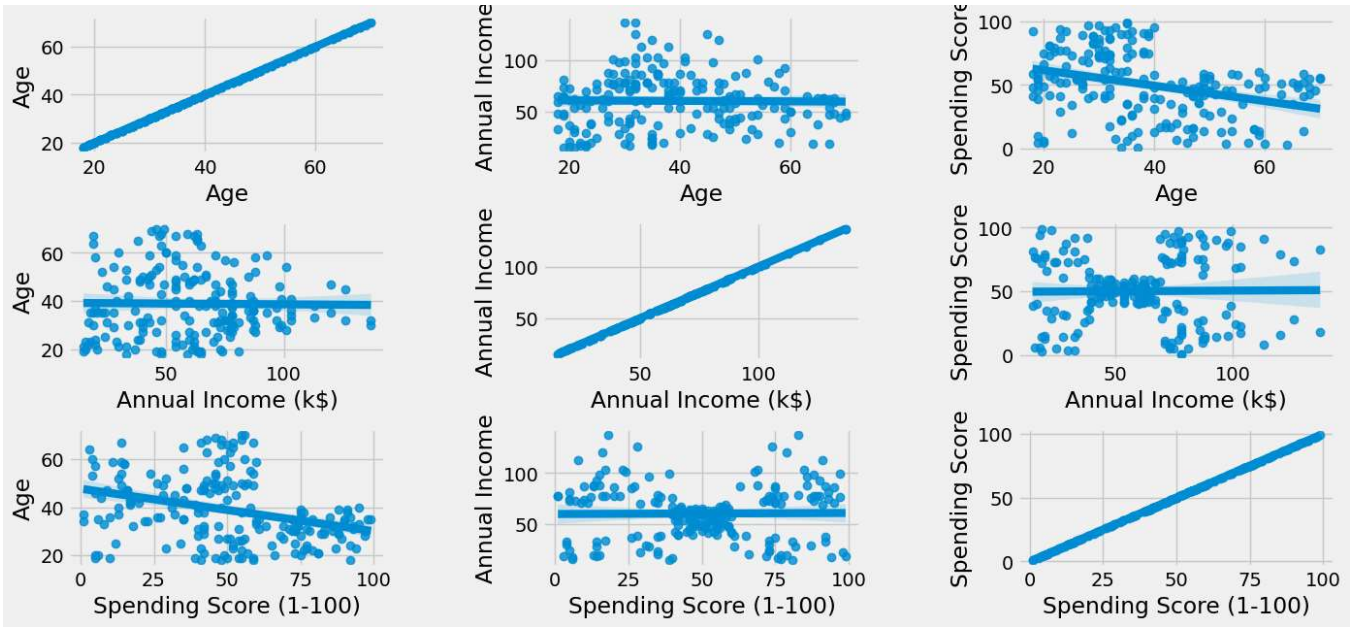
Count Plot of Gender

```
plt.figure(1 , figsize = (10 , 5))
sns.countplot(y = 'Gender' , data = df)
plt.show()
```

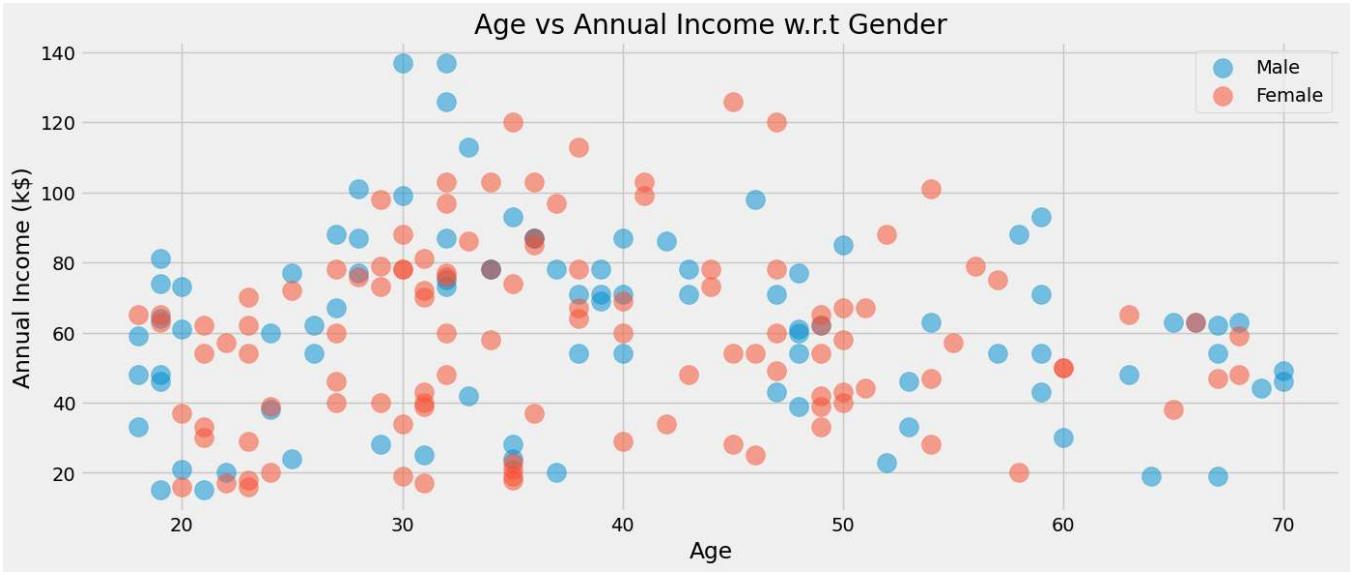


Ploting the Relation between Age , Annual Income and Spending Score

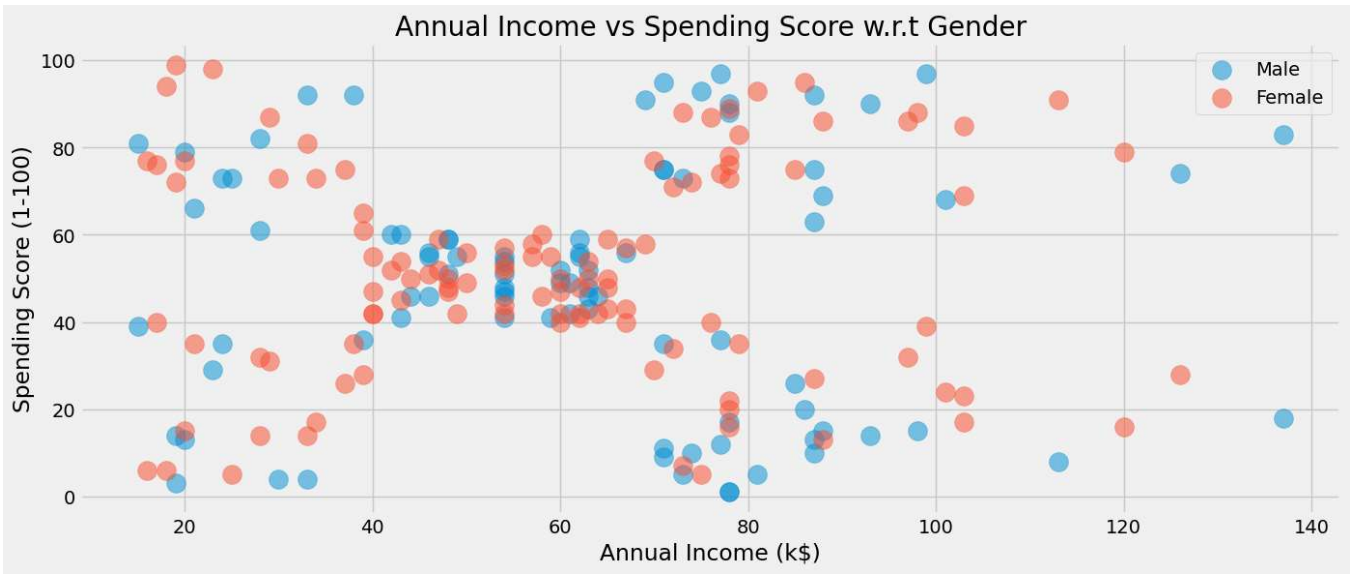
```
plt.figure(1 , figsize = (15 , 7))
n = 0
for x in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
    for y in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
        n += 1
        plt.subplot(3 , 3 , n)
        plt.subplots_adjust(hspace = 0.5 , wspace = 0.5)
        sns.regplot(x = x , y = y , data = df)
        plt.ylabel(y.split()[0]+' '+y.split()[1] if len(y.split()) > 1 else y )
plt.show()
```




```
plt.figure(1 , figsize = (15 , 6))
for gender in ['Male' , 'Female']:
    plt.scatter(x = 'Age' , y = 'Annual Income (k$)' , data = df[df['Gender'] == gender] ,
                s = 200 , alpha = 0.5 , label = gender)
plt.xlabel('Age'), plt.ylabel('Annual Income (k$)')
plt.title('Age vs Annual Income w.r.t Gender')
plt.legend()
plt.show()
```

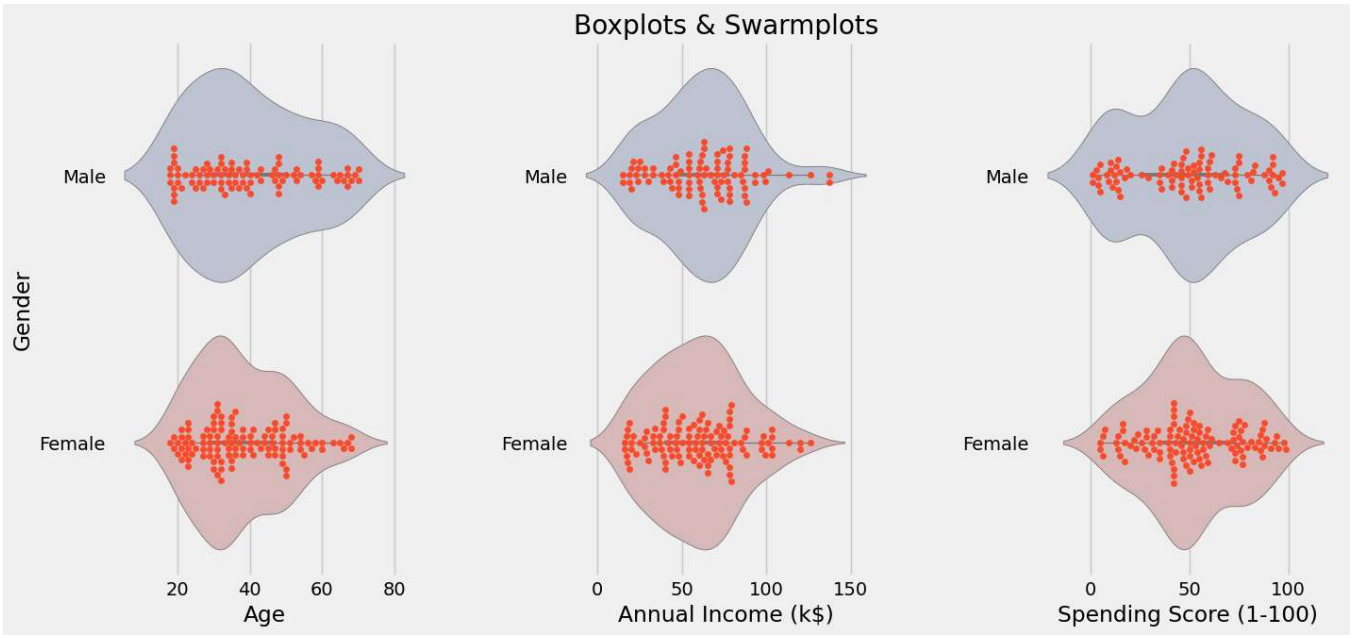



```
plt.figure(1 , figsize = (15 , 6))
for gender in ['Male' , 'Female']:
    plt.scatter(x = 'Annual Income (k$)',y = 'Spending Score (1-100)' ,
                data = df[df['Gender'] == gender] ,s = 200 , alpha = 0.5 , label = gender)
plt.xlabel('Annual Income (k$)'), plt.ylabel('Spending Score (1-100)')
plt.title('Annual Income vs Spending Score w.r.t Gender')
plt.legend()
plt.show()
```



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

```
plt.figure(1 , figsize = (15 , 7))
n = 0
for cols in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
    n += 1
    plt.subplot(1 , 3 , n)
    plt.subplots_adjust(hspace = 0.5 , wspace = 0.5)
    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()
```



Clustering using K- means

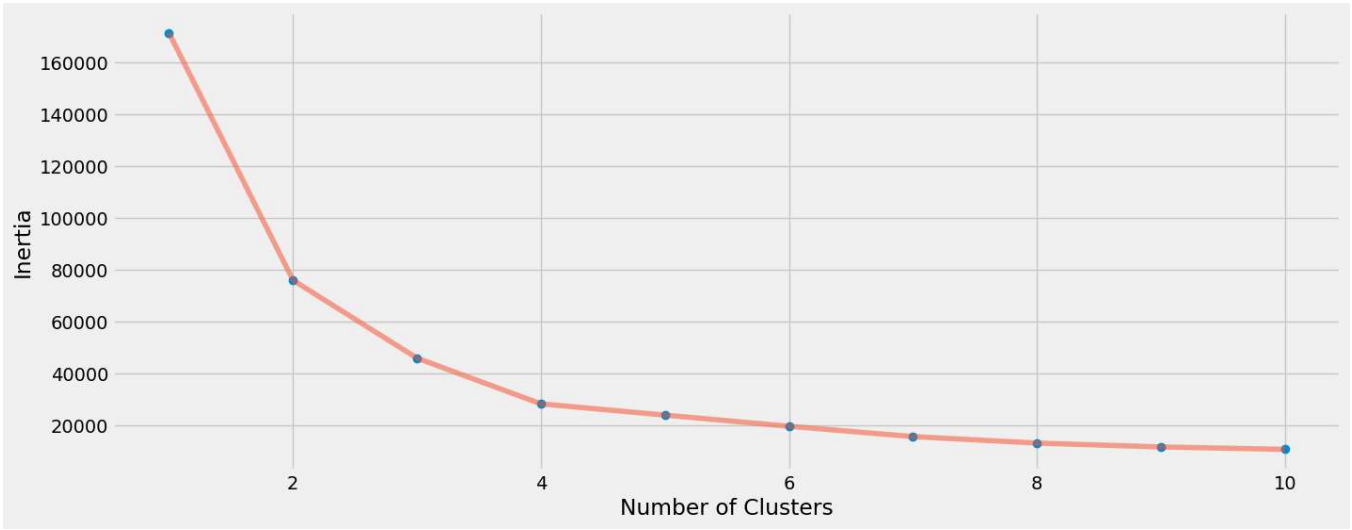
1.Segmentation using Age and Spending Score

```
'''Age and spending Score'''
X1 = df[['Age' , 'Spending Score (1-100)']].iloc[: , :].values
inertia = []
for n in range(1 , 11):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max_iter=300,
```

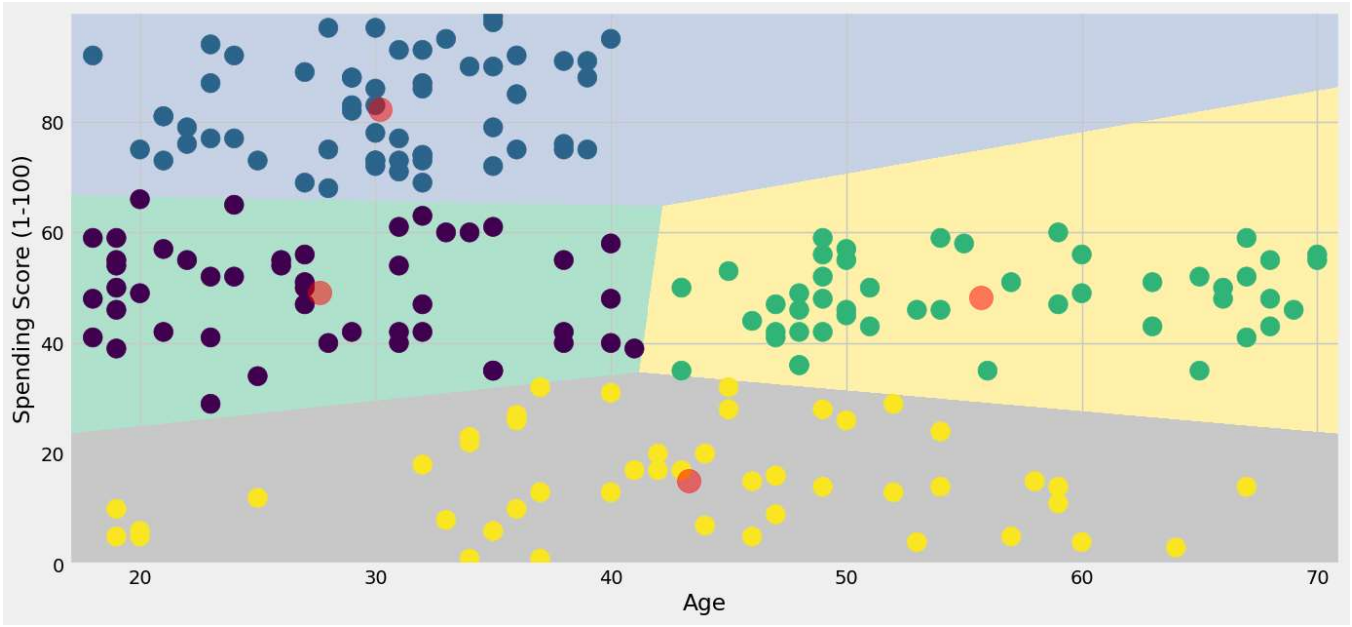
```
                        tol=0.0001,  random_state= 111  , algorithm='elkan') )
    algorithm.fit(X1)
    inertia.append(algorithm.inertia_)
```

Selecting N Clusters based in Inertia (Squared Distance between Centroids and data points, should be less)

```
plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 11) , inertia , 'o')
plt.plot(np.arange(1 , 11) , inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
plt.show()
```

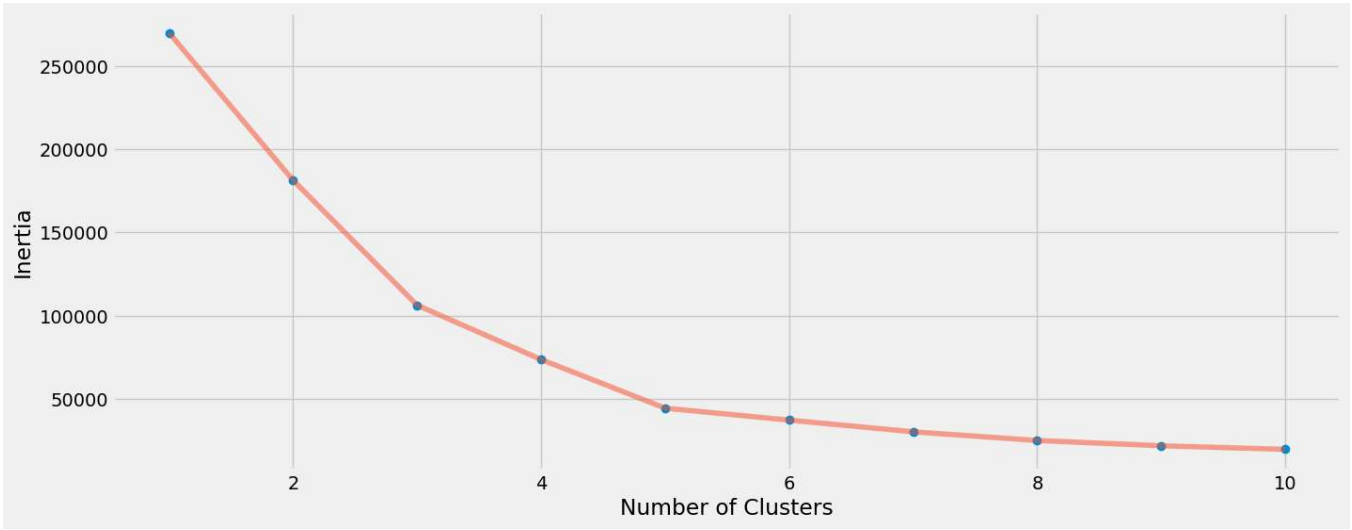



```
algorithm = (KMeans(n_clusters = 4 ,init='k-means++', n_init = 10 ,max_iter=300,
                        tol=0.0001,  random_state= 111  , algorithm='elkan') )
algorithm.fit(X1)
labels1 = algorithm.labels_
centroids1 = algorithm.cluster_centers_


h = 0.02
x_min, x_max = X1[:, 0].min() - 1, X1[:, 0].max() + 1
y_min, y_max = X1[:, 1].min() - 1, X1[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])


plt.figure(1 , figsize = (15 , 7) )
plt.clf()
Z = Z.reshape(xx.shape)
plt.imshow(Z , interpolation='nearest',
           extent=(xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')

plt.scatter( x = 'Age' ,y = 'Spending Score (1-100)' , data = df , c = labels1 ,
            s = 200 )
plt.scatter(x = centroids1[: , 0] , y =  centroids1[: , 1] , s = 300 , c = 'red' , alpha = 0.5)
plt.ylabel('Spending Score (1-100)') , plt.xlabel('Age')
plt.show()
```



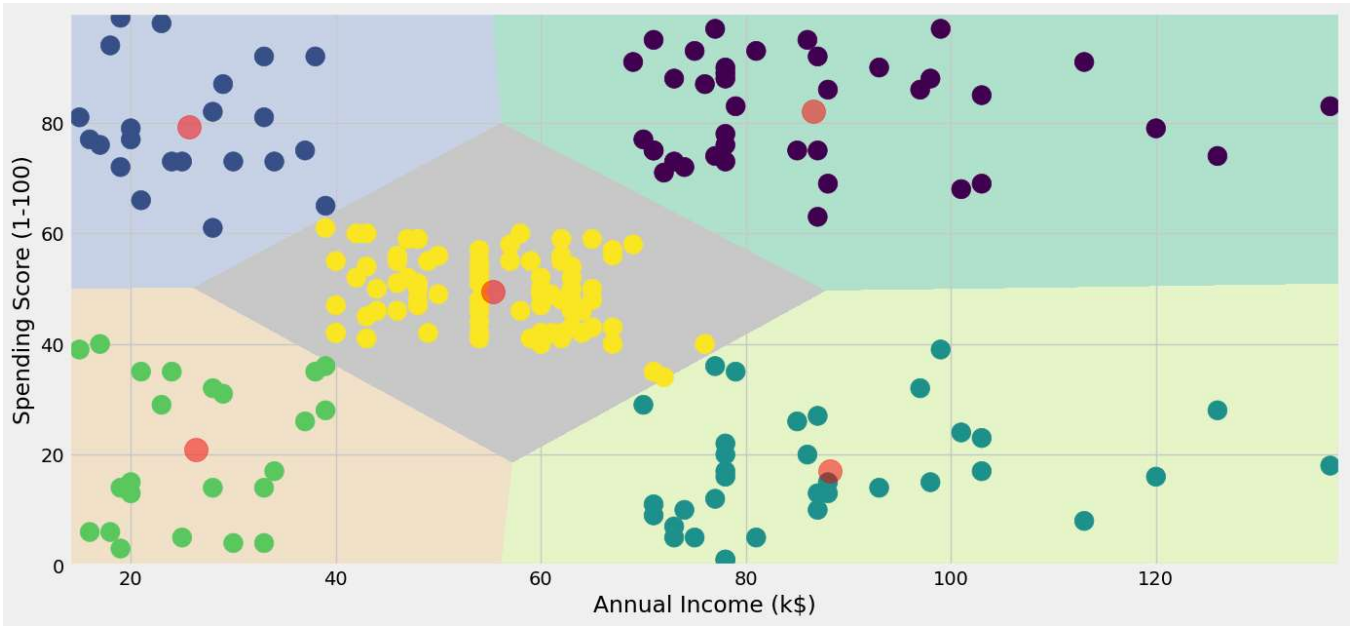
2. Segmentation using Annual Income and Spending Score

```
'''Annual Income and spending Score'''
X2 = df[['Annual Income (k$)' , 'Spending Score (1-100)']].iloc[: , :].values
inertia = []
for n in range(1 , 11):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max_iter=300,
                        tol=0.0001,  random_state= 111  , algorithm='elkan') )
    algorithm.fit(X2)
    inertia.append(algorithm.inertia_)


plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 11) , inertia , 'o')
plt.plot(np.arange(1 , 11) , inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
plt.show()
```



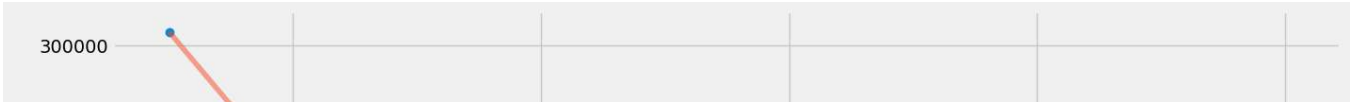

```
algorithm = (KMeans(n_clusters = 5 ,init='k-means++', n_init = 10 ,max_iter=300,
                    tol=0.0001,  random_state= 111  , algorithm='elkan') )
algorithm.fit(X2)
labels2 = algorithm.labels_
centroids2 = algorithm.cluster_centers_


h = 0.02
x_min, x_max = X2[:, 0].min() - 1, X2[:, 0].max() + 1
y_min, y_max = X2[:, 1].min() - 1, X2[:, 1].max() + 1
```

```
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z2 = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])


plt.figure(1 , figsize = (15 , 7) )
plt.clf()
Z2 = Z2.reshape(xx.shape)
plt.imshow(Z2 , interpolation='nearest',
           extent=(xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')

plt.scatter( x = 'Annual Income (k$)' ,y = 'Spending Score (1-100)' , data = df , c = labels2 ,
            s = 200 )
plt.scatter(x = centroids2[: , 0] , y =  centroids2[: , 1] , s = 300 , c = 'red' , alpha = 0.5)
plt.ylabel('Spending Score (1-100)') , plt.xlabel('Annual Income (k$)')
plt.show()
```



3.Segmentation using Age , Annual Income and Spending Score

```
X3 = df[['Age' , 'Annual Income (k$)' ,'Spending Score (1-100)']].iloc[: , :].values
inertia = []
for n in range(1 , 11):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max_iter=300,
                        tol=0.0001,  random_state= 111  , algorithm='elkan') )
    algorithm.fit(X3)
    inertia.append(algorithm.inertia_)


plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 11) , inertia , 'o')
plt.plot(np.arange(1 , 11) , inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
plt.show()
```




```
algorithm = (KMeans(n_clusters = 6 ,init='k-means++', n_init = 10 ,max_iter=300,
                    tol=0.0001,  random_state= 111  , algorithm='elkan') )
algorithm.fit(X3)
labels3 = algorithm.labels_
centroids3 = algorithm.cluster_centers_
```

```
# 📌 Install & Import Libraries
!pip install plotly
import pandas as pd
from sklearn.cluster import KMeans
import plotly.graph_objs as go
import plotly.io as pio

# ✅ Renderer Fix for Colab
pio.renderers.default = 'colab'

# 📌 Load Dataset
df = pd.read_csv("/content/Mall_Customers (1).csv")

# 📌 Select Features for Clustering
X = df[['Age', 'Spending Score (1-100)', 'Annual Income (k$)']]

# 📌 K-Means Clustering (3 Clusters Example)
kmeans = KMeans(n_clusters=3, random_state=42)
labels3 = kmeans.fit_predict(X)
df['label3'] = labels3  # Add cluster labels

# 📌 Create 3D Scatter Plot
trace1 = go.Scatter3d(
    x=df['Age'],
    y=df['Spending Score (1-100)'],
    z=df['Annual Income (k$)'],
    mode='markers',
    marker=dict(
        color=df['label3'],    # Cluster colors
        size=8,                # Marker size
        line=dict(color='black', width=1),
        opacity=0.8
    ),
    text=df[['Age', 'Annual Income (k$)', 'Spending Score (1-100)']],  # Hover info
    hovertemplate=
        'Age: %{x}<br>' +
        'Spending Score: %{y}<br>' +
        'Annual Income: %{z}<extra></extra>'
)

# 📌 Layout for Plot
layout = go.Layout(
    title='Customer Clusters (3D View)',
    scene=dict(
```